



# **UNIVERSITY OF NAIROBI**

**SCHOOL OF COMPUTING AND INFORMATICS (SCI)**

**Strategic Interventions to enhance adoption of Open Source Applications and Creative commons licensed Open Content in the Kenyan Government**

BY

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**P58/61647/2010**

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**OCTOBER 2012**

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*A Research Project presented in partial fulfillment of the requirements governing the award of the Degree of the Master of Science in Computer Science. This report is the product of my own work except where indicated in the text. The report may be copied and distributed freely in part or whole as long as the source is acknowledged.*

**DECLARATION**

I Janet Maranga hereby declare that this project has not been submitted for a degree or any other award in any other university or institution.

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This research project has been submitted as part of fulfillment of requirements for the Master of Science in Computer Science with my approval as the School of Computing and Informatics (UoN) supervisor.

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**ABSTRACT**

Open source software (OSS) is a viable alternative for proprietary software (PS), particularly in the government sector globally for reasons such as lowering software costs, growing local software development industry, and bridging the digital divide. On the other hand CC licensed open content is also very useful and can be effectively used to supplement the content the government has in various thematic areas. However the Kenyan government has not harnessed the benefits that these afford. This research sought to realize the current status of OSS and CC licensed content usage in the Kenyan government by surveying top level ICT management in the e-government directorate, ICT staff as well as availability and skill of OSS software developers and willingness of content creators to share content appropriately licensed with an aim to proposing strategic interventions to enhance the adoption of these in the Kenyan government. The U.S Department of Labor E-Government framework was adopted to inform this research. The results indicate that OSS and CC licensed open content usage within the ministries is not yet extensive and measures need to be put in place to enhance the utilization of these. Various challenges and obstacles are hampering full OSS and CC licensed open content implementation and utilization within the ministries and agencies. These can however be combated and OSS and CC licensed open content adopted once these strategies have been adopted and implemented.

The entire study took a maximum duration of six (6) months.

**DEDICATION**

This research is dedicated to the memory of my late mother Grace, who has inspired me for the best.

## **ACKNOWLEDGEMENT**

First I would like to express my most sincere thanks to God who has been a constant source of strength, direction and inspiration throughout and particularly during the Masters Study programme.

Sincere thanks and gratitude to my supervisor Dr. Wanjiku Ng'ang'a for all her support and encouragement during the course of this study. In spite of the deficiencies of my early proposal at the beginning of the year, she immediately believed in this research project and gave me the motivation I needed. Her professional, quick, and detailed responses have managed to keep my research on track. Quite frankly, the thesis would not have been completed without her support and guidance. The patience and kindness she has shown has amazed me so many times. Thank you Dr. Ng'ang'a, I have been in good hands and fortunate enough to be given the opportunity to be your student.

I like also to express my deepest gratitude to the panelists, Evans Miriti, Andrew Mwaura, Sam Ruhii and Dr. Timothy Waema who provided me valuable comments and constructive criticism for improvement of my research work. I am also greatly thankful to many other researchers for the contributions they have provided to this research area.

There are numerous people in the Kenyan e-Government to whom I am thankful for the support and open-mindedness they have shown. Especially during the early stages of the study, the support shown by the top management of the e-Government was of utmost importance. For the support shown during the period January to July 2012, I am especially grateful to Dr. Katherine Getao whose constructive comments and criticism has managed to sharpen my thinking on the research topic and to improve my study. In addition to that the introduction to e-Government staff who served as a source of relevant and much needed information on the internal working of the e-Government and possible setbacks on the implementation of Open source software applications and suggestions on how these could be averted has been of great usefulness to me.

During the actual research of the Open Source Software applicability to the Kenyan e-Government, numerous staff members and colleagues in the e-Government and its administrative sector have surprised me with their positive attitude and willingness to participate in data collection activities to support the research. I gratefully acknowledge their support.

I am thankful to my Dad, Dr. Maranga for sponsoring my MSc degree studies without whose support this research would not have been possible. I am also grateful to my fiancé Derrick for the patience and support he has shown during the past months. My sisters Nancy, Emily and Naomi have been an inspiration to me through their optimism and practical touch with the complexities of life.

I would also wish to thank George Gitau who offered invaluable advice in many aspects of this research.

Finally, this research is especially dedicated to the memory of my mother Grace who died in May 2011 a few months before this study was commenced. Memories live, keeping the past not quite past.

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## **List of Abbreviations**

**G.o.K** – Government of Kenya

**OSS** – Open Source Software

**CC licensed Open Content** – Creative Commons licensed Open content

**PHP** – Hypertext preprocessor

**GPL** - General Public license

**FOSS** – Free and Open Source Software

**IIS** - Microsoft Internet Information Server

**ICT's** –Information and Communication technologies.

**CRM** - Customer Relationship Management

**SSL** – Secure Socket Layer

**TLS** – Transport Layer Security

**DOL** – Department of Labour

**I.T** – Information Technology

**MIT** – Massachusetts Institute of Technology

**AGIMO** - Australian Government Information Management Office

## **CHAPTER ONE: INTRODUCTION**

### ***1.1 Background***

Governments around the world, over the years are recognizing the need for utilization of Information technology as an enabler in the various day to day tasks and are gradually embracing the various capabilities and efficiencies that these afford. These governments are also making or considering efforts to promote open source software (typically produced by cooperatives of individuals) at the expense of proprietary software (generally sold by for profit software developers).

e-Government is a key instrument for modernization and reform as governments face the continuing pressure of increasing their performance and adapting to the pressure of the new information society (Morven McLean and Tawfik Jelassi, 2003).

The recent trouble is that many government departments in Kenya still have little understanding of the many benefits that open source software can have and how to utilize it effectively in order to get optimal results from its use and subsequently lack a path toward making decisions in keeping with core government responsibilities. Cost savings, the naïve enticement, may not provide good enough motivation in the end. Although proprietary software (the complement to open source software) tends to come with high licensing fees, whereas open source can be downloaded without payment, monetary arguments for deploying open source software might be unsuccessful because of the high cost of conversion, retraining and developing an adequate base for support which can postpone the potential savings of open source software for many years.

E-government is enabling government organizations to provide better services to their constituents. Transactions such as filing taxes online, applying for jobs, renewing driver's licenses and ordering recreational and occupational licenses can now be conducted online, quickly and efficiently (West, 2002).

While some earlier e-government computer issues, such as office automation, may not be highly relevant to research today, many issues are, for example decision making service processes and values (Ake Gronlund, Tom Horan, 2005).

The Kenya government is embracing this change and is more open to adopting and making use of the numerous benefits it can reap from this automation. Over the last few years, efforts to automate most of the government processes have become a core undertaking of the various sectors in the government. The e-Government strategy has set out several best practices for benchmarking in Kenya some of which are coherent and compatible information processing and management policies and business processes, proper and adequate skills, knowledge and attitudes necessary for operationalization and sustainability of Communication within government, networked readiness by exploiting the literate population, innovative private sector and efficient government to stimulate economic growth, the use of Internet to ensure that e-Government services reach every citizen, business and institutions in Kenya, to mention but a few.

Open source software generally means software that is often developed in a public collaborative manner. Therefore the open source applications that will be built from it allow anyone to create modifications of the software, port it to new operating systems and processing architectures and share it with others. This comes with several benefits such as the software will continually be improved and tested by a wide community of software developers in Kenya and even beyond. Bugs will be fixed and knowledge will be drawn from a vast domain of knowledgeable persons.

Open source-software is usually copyrighted and its license may contain restrictions intended to preserve its open source status or to require notice of authorship or to control other developmental factors.

The open-source licensing model as evidenced by the GNU General Public license (GPL) contrasts sharply with licenses of proprietary mainstream software (i.e non-open or closed source equivalent to commercial product.) Examples are Sun Microsystems makes Star Office, alternative to Microsoft office, Apache Web server alternative to Microsoft Internet Information Server (IIS) or Netscape Web Server, GIMP (GNU Image Manipulation Program) alternative to Adobe Photoshop or Corel Photopaint, Postgre SQL relational SQL database alternative to Oracle (Oracle Corporation) or DBZ (IBM).

The Kenya government plays a crucial role with regard to ICT in general and open source and creative commons licensed open content in particular. With the recent launch of open data in Kenya, it is clear that the Kenya government is appreciating and warming up to the spirit of sharing. The Kenya government is in a position to drive strategic change throughout the whole country. According to the FOSS Policy toolkit (2005), the public sector is the biggest consumer of ICT and governments set the economic and regulatory boundaries that allow businesses to develop. Open source software has for a long time been in use among government agencies, and prospects for increased use have been greeted enthusiastically by both knowledgeable government employees and open source communities. A lot of open source software applications exist and continue to come into existence day by day which can be used in many different ways in order enhance service delivery in e-government in a life changing manner. But mobilizing the necessary forces in government to procure open source software has been difficult. This study attempts to explore the reasons so many efforts have stalled, the lessons learnt by the successful efforts as well as measures that can be put in place to facilitate the adoption of open source applications as well as increase the utilization of creative commons licensed open content.

## ***1.2 Outline of the Report***

This report begins with an introduction to open source software and creative commons licenses. It also gives the problem statement, objectives and justification of the study in the first chapter. Chapter two will be the literature review, where various e-governments in the world that are using open source software are reviewed and also highlight the proposed solution to the problem posed in the previous chapter. Chapter three presents the methodology that was used in the research to build the prototype. Chapter four gives the results and findings of the analysis done, while a conclusion and recommendations are highlighted in chapter five.

### ***1.3 Problem Statement***

The purpose of this study is to unearth the constraints that limit widespread adoption of open source software in e-government for some government services and utilize open source software to come up with a solution which will make it easy and enhance the use of Creative commons licensed open content by the government and also make it easy for content creators to channel this content to the relevant authorities in the government so as to increase awareness on its great potential so that it can be used in many life-changing ways.

Licensing can be complex and somewhat tricky. Creative commons was therefore founded in order to help give content creators an easy way to distribute their work while specifying some simple factors such as whether the work could be used commercially or modified.

The problem of closed source software applications is that they are not flexible in the sense that the vendors retain the source code and distribute the software in compiled form thereby preventing the user from understanding how it works or changing how it works and it also does not encourage collaboration on projects as the source code is not availed publicly thereby stifling innovation.

It is this knowledge gap in open source software adoption in government in the Kenyan scenario and the subsequent software development process and utilization that we propose to address in this research.

### ***1.4 Objectives***

The guiding research question in the study is to formulate strategic interventions to be used in the facilitation of the adoption of open source applications and creative commons open licensed content to be used in e-Government in Kenya. This study aims to:

- i) Investigate current e-Government frameworks in use globally in relation to OSS
- ii) Explore the flexibility of the current ICT policies and strategies in as far as adoption of OSS and CC are concerned.
- iii) Determine a model that enables content sharing and utilization of CC licensed open content from the literate population by the Government.
- iv) Determine strategic interventions to enhance adoption of OSS and CC licensed Open content and disseminate them to the Kenyan government.

### ***1.5 Research Questions***

In order to achieve the objectives, the following research question will constitute the domain of investigation:

What are the strategies that need to be formulated to enhance the adoption of Open source applications and creative commons licensed open content in Kenya?

Other research questions that will be considered include:

- What is the potential of OSS as an appropriate relevant alternative to commercial software in Kenyan e-Government?
- To what extent and how adequately does the Kenyan e-Government strategy deal with Open source software and creative commons licensed open content?
- How and under what conditions can CC licensed open content be considered and utilized as a value add in the service delivery of the Kenyan e-Government?
- What new approaches towards content sharing can be implemented to enhance adoption of CC licensed content in the Kenyan e-Government scenario.
- What strategic interventions can be put in place to enhance and facilitate the use of OSS and CC licensed content to aid service delivery in the Kenyan e-Government?

### ***1.6 Justification of the study***

The need for governments to automate their processes and to provide value added services to their citizens and other stakeholders has always been a key undertaking, to keep pace with the current technological changes but also to identify possibilities to reap the benefits that come with these technologies.

Several researches done in the developed and developing countries have revealed that software applications for e-governance cannot and should not be limited to proprietary software applications only. Their counterparts, open-source software can also be utilized to play a vital role in service delivery to citizens. In this regard, effort must be put in devising a way of ensuring these two platforms work well together. (Working Group on e-Government in the Developing World, 2002)

Despite the advancements in technology, many government departments still have little understanding of fundamental goals of open source software let alone its massive capabilities. Although proprietary software (the complement to open source software) tends to come with high licensing fees, whereas open source can be downloaded without payment, monetary arguments for deploying open source software are usually unsuccessful because of the high cost of conversion, retraining and developing an adequate base for support which can postpone the potential savings of open source software for many years. Nevertheless, it is vital to produce locally based goods and services to substitute increasingly expensive imports and lower costs substantially. The weakening of the local currencies against the international major currencies like the dollar or the sterling pound will make the licenses on the imported software (not to mention other imports) prohibitively expensive. Whether or not the Kenyan shilling enjoys an upswing in future, it makes sense to minimize risks through avoidance where possible of dollar based software license fees and through vigorous encouragement of local software development.

The key trait distinguishing open source from proprietary software is not its availability free of cost, but its provision under a license that allows anyone to alter it and redistribute the altered form. Freedom to change, improve, and extend the software is the trait that draws a hard and fast line between software that can be defined as open source and software that remains locked to a particular developer. (Yayehyirad Kitaw, 2006).

Revealing source code to a particular customer or even to the general public is not enough to define a product as open source; it must also have a license that allows unlimited changes and redistribution by anyone.

In the light of these, the advantages of the traits of open source software are the ability to continue support and development if the original developer goes out of business, the capability to extend it in ways that the original developer does not find worth its while, the software developer community involvement in finding and fixing bugs quickly and also extending the functionality of the applications developed and continually enhancing the capabilities of the applications developed to keep in line with the changing needs of the citizens among other benefits. Nevertheless governments are additionally mandated with several responsibilities that make open source software particularly necessary such as:

- Vendor independence
- Access for all
- Archiving
- Special government needs
- Security

The approach that will be used is investigating and finding out how best OSS and CC can be adopted and be used widely and intuitively in the effective service delivery by the Kenyan e-Government. The project findings and recommendations will create awareness in the government on the importance and benefits of open source software as well as creative commons licensed open content and to remove the barriers to future open source development projects. The recommendations of this research will also provide a source for legalization of alternatives to lowering software cost as well as harnessing the myriad of other benefits accrued from adopting an open source software approach in addition to the utilization of the wealth of information and knowledge licensed using the Creative commons licensing model. It also intended to reveal that OSS and CC licensed open content has massive potential that can be successfully exploited and adopted to accelerate the pursuits and mandate of the Kenyan e-Government by utilizing the currently available information resident with the literate population and also offering a platform where updated content can be shared under various CC licenses which can be cleaned and used by the e-Government. The adoption of open source software is likely to make Kenya extremely well placed to compete in global software development market joining South Africa and Ethiopia among others in Africa, that are already participating in the global market for software development. The proposed CC licensed content sharing platform built using OSS will assist in expanding the information infrastructure, facilitate connectivity of all the Kenyan government agencies, initiate other systems geared towards increasing efficiency and non-replication of data as well as involvement of citizens and eliciting citizen participation and develop capacity of e-government I.T staff to monitor progress, maintain and utilize the content that is shared on this platform. It is also likely to provide a catalyst for the Kenyan government to develop national policies to promote the use of open source software in other sectors. The adoption of the open source software and creative commons licensed open content is also likely to provide a useful tool to enable a developing country like Kenya to leapfrog into the information technology age.

### ***1.7 Scope of the Study***

The study will focus on the analysis and evaluation of the existing e-Government frameworks worldwide as well as technology adoption frameworks, select one which can map to the Kenyan scenario and utilize it to come up with recommendations and design a creative commons licensed content sharing model suitable to the Kenyan situation. The flexibility of the proposed strategies can, however, be reproducible in similar settings with a high degree of success for any other exercise that aims to increase adoption using the defined methodology.

### ***1.8 Research Outcomes and their significance to key audiences***

The main outcome of this research process is to furnish concrete strategies that can enhance the adoption of FOSS and CC licensed open content in the Kenyan Government.

This will involve the creation of a content sharing platform where content can be shared using CC licensed open content which will foster interactions of the Government with its citizens, non-profits, businesses, other agencies, communities as well as the government within itself and the departments within it.

Utilization of Open source software will also feature prominently in the research outcome in that it will be used as a tool for building the content sharing platform which will enable and encourage sharing of content which will help in making critical therefore enhancing its value to more people than just the creator and enhance the e-governance process.

#### **1.8.1 Summary of the Major Benefits of Open software and Open standards**

- Reduced costs and less dependency on imported technology and skills
- Affordable software for individuals, enterprise and government
- Universal access through mass software rollout without barrier of proprietary software and data formats.
- Access to government data without barrier of proprietary software and data formats.
- Participation in global network of software development

### ***1.9 Assumptions and Limitations of the research***

The main underlying assumption in this study is that there is availability presence of creative commons licensed content improves e-government. How much it improves e-government depends on how well the availed content is collected and collated on a portal and thereafter implemented in facilitating various government projects.

Determining the availability of the CC licensed open content and having a platform for the publishing of this whilst utilizing open source software in this survey is meant to validate this assumption.

Other assumptions and limitations in this research are as outlined here under:

- i. The local software developer community is abreast with the current trends in open source software technologies.



- ii. The literate population in Kenya understand licensing especially using the Creative commons licensing model.
- iii. Time – All the aspects of E-governance and open source technologies as well as creative commons licensed open content might not be adequately covered due to the limited time allocated for the research. The flexibility of the proposed strategies can however be reproducible in similar settings with a high degree of success.
- iv. The developmental stage of this research area is in its infancy, this might be a limitation in terms of related work that may not be much detailed.

### ***1.10 Definitions of Important Terms***

**E-Government** - E-Government is defined as the use of information and communication technology (ICT) to enable more efficient, cost-effective, and participatory government, facilitate more convenient government services, allow greater public access to information, and make government more accountable to citizens.

**Conceptual Framework** – A set of theories widely accepted enough to serve as the guiding principles of research within a particular discipline.

**Software framework** – A reusable set of libraries or classes for a software system (or software system)

**Application framework** – A software framework used to implement the standard structure of an application for a specific operating system.

**Strategy** – a long term plan or action designed to achieve a particular goal.

**Intervention** – This is the action or process of intervening. An influencing force or act that occurs in order to modify a given state of affairs.

**ICT's** – A general term that stresses the role of unified communications and the integration of telecommunications, computers, middleware as well as necessary software, storage and audio-visual systems, which enable users to create, access, store, transmit and manipulate information.

**FOSS** – Free/open-source software is software that is distributed together with its underlying source code, under a certain kind of copyright. FOSS copyright licenses allow everyone to read, modify, and redistribute the source code, so programmers can improve and adapt the software, and fix bugs.

**CC** – Creative commons licensed open content -Creative commons licensed open content is content that is released under licenses which allow creators to communicate which rights they reserve and which rights they waive for the benefits of recipients or other creators.

**Commercial software** – Software being developed for a business, which aims to make money from the use of software.

**Copylefted software** – Free-software whose distribution terms do not let redistributors add any additional restriction when they redistribute or modify the software.

**Freeware** – Refers to packages distributed free of charge (no license fee) which permit redistribution but not modification (and their source code is not available).

**GNU programs** – Software that is released under the auspices of GNU project

**Non-copylefted free software** – Non-copylefted free software comes from the author with permission to redistribute and modify and also add additional restriction to it.

**Proprietary software** – Software that is not free or semi-free. Its use redistribution or modification is prohibited or requires you to ask for permission, or restricted so much that you effectively cannot do it freely.

**SSL** - SSL is the secure communications protocol of choice for a large part of the Internet community. There are many applications of SSL in existence, since it is capable of securing any transmission over TCP. Secure HTTP, or HTTPS, is a familiar application of SSL in e-commerce or password transaction.

**TLS** - The protocol “allows client/server applications to communicate in a way that is designed to prevent eavesdropping, tampering or message forgery.

## **CHAPTER TWO: LITERATURE REVIEW**

This review focuses on various topical issues that will be covered in this research ranging from the outline of various e-Government frameworks available, countries that have adopted FOSS and their experience, driving forces of FOSS, the benefits and limitations of FOSS as well as creative commons licensed open content among others. Finally it will narrow down the research problem and come up with general principles to support the research question. This section will inform the conceptual frame work to be used in this study.

### ***2.1 Terminology***

#### **Open Source Software**

In the Toolkit for FOSS policy in Africa (2005), FOSS has been defined as follows: “Free/open-source software is distributed together with its underlying source code, under a certain kind of copyright. FOSS copyright licenses allow everyone to read, modify, and redistribute the source code, so programmers can improve and adapt the software, and fix bugs. And the software can be shared with others. The difference between "free" and "open" lies mainly in the fundamental beliefs and aims of the respective proponents. Open source software supporters tend to focus on pragmatic aspects of software development and use, whereas the free software community places the aspect of "freedom" at the centre of their activities. Free-software licenses require software developers to distribute their modifications and additions under a similar free-software license, whereas some open source-software licenses allow the inclusion of open source software in proprietary software.”

#### **Creative Commons Licensed Open Content**

Creative commons licensed open content is content that is released under licenses which allow creators to communicate which rights they reserve and which rights they waive for the benefits of recipients or other creators.

#### **Overview of CC licenses**

Each and every CC license has a short name and description which explains in a simple way what that license allows a person to do. There is also a full legal license in case where a content creator may wish to read it thoroughly.

There are some important things to note in regards to these licenses.

**Attribution** – When this is present the user of the content must attribute and link back to the original item. Attribution typically says something like “Photo by Janet Photographer” with a link to the page or portfolio where the item came from.

**Commercial** – This generally means that the licensed work can be used for commercial purposes. All non-commercial CC licenses explicitly say so.

**Public Domain** – Creative Commons also provides a public domain mark which can be used by content creators. Items put into the public domain can be used in any way (including without attribution). However, the public domain isn't technically a Creative Commons license, but the mark is a convenience which is offered by the organization for content creators.

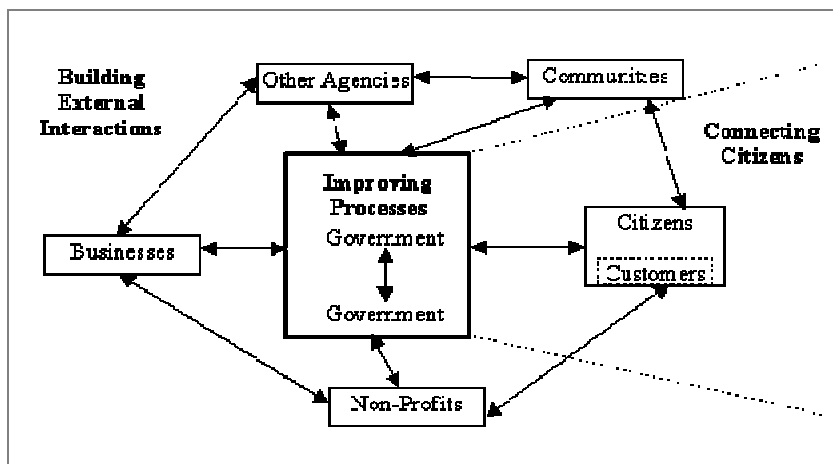
**An Overview of the Definition of E-Government**

According to (Ntiro, 2000), e-Government is the use of information and communication technology (ICT) to enable more efficient, cost-effective, and participatory government, facilitate more convenient government services, allow greater public access to information, and make government more accountable to citizens.

E-Government is the use of Information and Communication Technologies (ICTs) to improve the activities of public sector organizations.

(Ntiro, 2000) goes further to expound that there are three main domains of e-Government, illustrated in *Figure 1.1*.

- Improving government processes: e-Administration
- Connecting citizens: e-Citizens and e-Services
- Building external interactions: e-Society



*Figure 2.1: Focal Domains for e-Government Initiatives*

Ntiro, (2000) further breaks down the different domains of e-Government as follows:

**Improving Government Processes: e-Administration**

Ntiro, (2000) states that “e-Government initiatives within this domain deal mainly with improving the internal workings of the public sector. They include:

- **Cutting process costs:** improving the input: output ratio by cutting financial costs and/or time costs.
- **Managing process performance:** planning, monitoring and controlling the performance of process resources (human, financial and other).
- **Making strategic connections in government:** connecting arms, agencies, levels and data stores of government to strengthen capacity to investigate, develop and implement the strategy and policy that guides government processes.
- **Creating empowerment:** transferring power, authority and resources for processes from their existing locus to new locations.”

### **Connecting Citizens: e-Citizens and e-Services**

The author goes further to elaborate that “such initiatives deal particularly with the relationship between government and citizens: either as voters/stakeholders from whom the public sector should derive its legitimacy, or as customers who consume public services. These initiatives may well incorporate the process improvements identified in e-Administration above. However, they also include a broader remit:

- **Talking to citizens:** providing citizens with details of public sector activities. This mainly relates to certain types of accountability: making public servants more accountable for their decisions and actions.
- **Listening to citizens:** increasing the input of citizens into public sector decisions and actions. This could be flagged as either democratization or participation.
- **Improving public services:** improving the services delivered to members of the public along dimensions such as quality, convenience and cost.”

### **Building External Interactions: e-Society**

In addition to that Ntiro (2000) explains that “such initiatives deal predominantly with the relationship between public agencies and other institutions - other public agencies, private sector companies, non-profit and community organizations. As with citizen connections, these initiatives may well incorporate process improvements. However, they also include a broader remit:

- **Working better with business:** improving the interaction between government and business. This includes digitizing regulation of, procurement from, and services to, business to improve quality, convenience and cost.
- **Developing communities:** building the social and economic capacities and capital of local communities.
- **Building partnerships:** creating organizational groupings to achieve economic and social objectives. The public sector is almost always one of the partners, though occasionally it acts only as a facilitator for others.”

e-Government in the view of Gordon (2002) is the use of ICT to improve the process of government. In a narrow sense it is sometimes defined as citizens 'services, re-engineering with the technology, or procurement over the internet.

Janet Caldwell (1999) on the other hand, defines e-Government as digital information and online transaction services to citizens.

In light of these definitions we move on to examine the various frameworks in place for e-governance.

## ***2.2 Frameworks for E-Government***

A growing body of research indicates that various frameworks for evaluating e-Government are in place. A sample review is provided hereunder:

### **2.2.1 U.S. Department of Labour e-Government Strategic Plan**

The primary components of the Department's e-Government Framework (the Framework) are customer relationship management, organizational capability, enterprise architecture, and security and privacy. (Solis, 2011)

- **Customer Relationship Management (CRM)**

CRM comprises methodologies, technologies, and capabilities that help the Department identify customers, determine what customers want, and learn how to meet and continuously improve customer service. CRM requires developing a dialogue with customers. Advanced CRM is characterized by personalized services that are timely and consistently excellent. Customer relationship management helps Department of Labor prioritize e-Government projects.

- **Organizational Capability.** This component consists of the policies, plans, people, and management processes required to develop, implement, and sustain a high level of digital services in support of the Department's mission. This category includes strategic plans, investment review boards, IT capital planning processes, systems development methodologies, workforce plans, and training. Organizational capability helps Department of Labor select E-Government projects and ensures successful management of the projects and delivery of results.
- **Enterprise Architecture.** Department of Labour's DOL's enterprise architecture includes the explicit description and documentation of the current and the desired relationships among business and management processes and information technology. The enterprise architecture describes the current architecture and the target architecture. It also includes the rules and standards for optimizing and maintaining IT investments and portfolios. DOL's enterprise architecture helps the Department identify E-Government opportunities.
- **Security and Privacy.** This component of the Framework provides an integrated planning framework and a unified approach to developing and implementing security policies, procedures, and plans, including the analysis of threats and vulnerabilities, risk mitigation, and risk management. Security and privacy policies help create a secure and trusted environment for e-Government transactions.

Figure 2.2 depicts the components of the Department's e-Government Framework. As shown in this figure, the organizational capability, enterprise architecture, and security and privacy components, taken together, represent the Department's organizational readiness to meet customer service requirements. The CRM component is an indicator of the Department's customer awareness. The Department will address these components in an integrated manner. In addition, it will chart a forward course that matches organizational readiness to customer requirements.

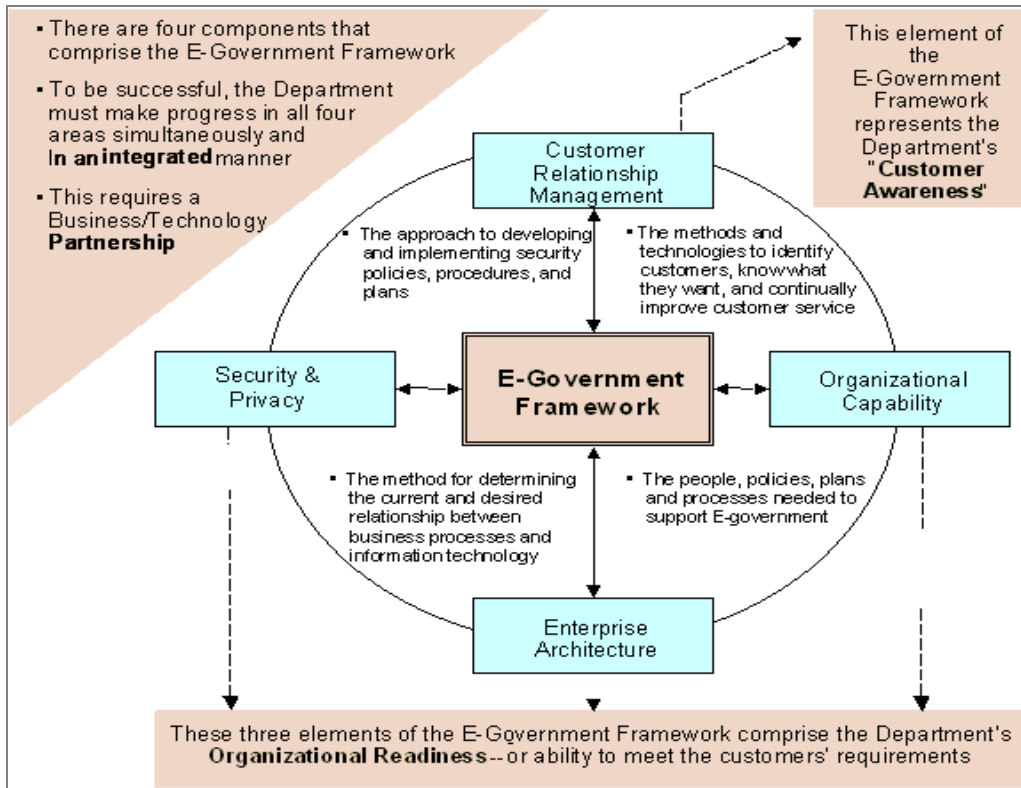


Figure 2.2: Components of U.S Department of Labour's E-Government Framework

### 2.2.2 E-Government Evaluation Framework

Gupta M.P. and Debashish Juma in their paper: E-Government evaluation, have postulated a broad categorization for determining information and servicing value attributable to the several aspects of e-Government benefits.

They go further to say that a range in the classification of methodologies in terms of degree of hardness or softness may be based on the clarity and nature of the influential variables of a problem situation.

Clearly defined problems are structured problems, while poorly articulated or unclear problem situations are categorized as ill structured problems.

They then expound that the methods that match the underlying characteristics of a problem situation are identified and represent an issue that needs to be considered especially in a complex situation.

In line with research done by Mingers and Gill (1997), the typical assumptions made by a hard OR/MS method are that:

- There is a single decision maker (or at least a consensual group) with a clear objective – in a case where there are multiple objectives these are usually reduced to a single metric
- The nature of the problem is agreed upon, even though a good solution may be difficult to find;
- The most important factors can be quantified and reliable data collected;
- A model, often mathematical or computer-based, can be used to generate solutions, and that this does not need to be transparent to the client(s);
- The role of the OR person is one of expert analyst; and
- Future uncertainties can be modeled using probability theory.

In contrast, soft methods can be characterized by generally not making these assumptions. Typically, there might be several decision makers or stakeholders involved, with different opinions and possibly conflicting objectives and definitions of the problematic nature of the situation. In as much as there may be difficulties in quantification of many important factors; transparency and accessibility of the model will be very important, thus often ruling out mathematical models; the OR person's role will often be one of facilitator with a group of participants and uncertainties will not simply be reduced to probabilities.

One important implication of this distinction is that these different types of methods require quite different skills and orientations in their practitioners.

Hard methods would demand a good analytical mind with mathematical and computing skills, while soft methods require people skills and the ability to facilitate often stressful and contentious workshops.

The key measurement criteria for measuring tangible benefits under hard measures are:

Cost Benefit Analysis and benchmarks in E-Government projects.

### **2.2.3 E-Governance framework in the Commonwealth**

Research where an assessment by the Commonwealth Secretariat was done through Governance and Institutional Development Division's Public sector informatics programme reviewed its observations and analyses of ICT case studies gathered in member country workshops and surveys during 2005/06 and came up with an initial e-governance framework which is portrayed in *Figure 2.3*.



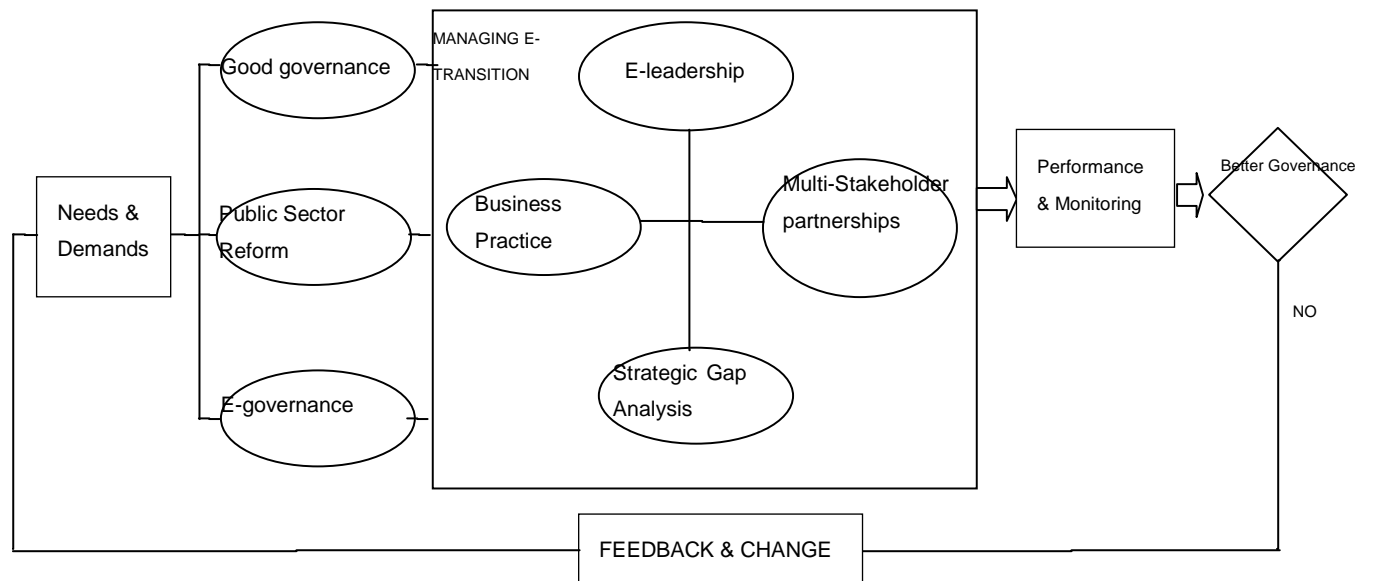


Figure 2.3: e-Governance framework for the Commonwealth

Gessi. *et al.*, (2006), contends that the novelty of this framework stems from its mapping of the confluence of four elements integral to managing e-transitions. First the framework sees e-leadership as the key to making strategic use of ICT's in e-governance initiatives and to assuring local commitment and ownership. Second, it emphasizes good business practice based upon private sector tools for innovation. Third, it focusses on and creates popular pressure for reform through strategic gap analysis. Lastly it features multi-stakeholder partnerships based on mutual trust and interdependence to build capacity.

The framework is about enabling change and redesigning roles and processes to achieve better governance. It responds to good governance principles and practices, public sector reform and ICT innovations. ICTs cross-cut citizens needs for better services and promote improved transparency, accountability and shared decision making. Deploying a set of interrelated planning tools and facilitates strategic responses to intractable problems. The framework also recognizes the need for strong monitoring and evaluation, with a feedback loop for corrective action. Citizens and stakeholders are expected to review governance improvements and to update their changing needs and demands. The combined use of these tools in the public sector increases the chances of successful strategic change management. This framework has been applied in practice as explicated using the four tools which are e-leadership, business practice, strategic gap analysis and multi stakeholder partnerships.

### 2.3 Open Source Software in e-Government

One important research study that demonstrates the need for Open Source Software in e-Government was conducted by the Danish Board of Technology (2002), whereby they cited that the public sector needs to change over to communicating digitally. They discussed that this development makes great demands both on the IT systems on which e-Government is based and on work processes in the public sector. They found out that from the economic point of view, the change-over poses great challenges, as huge investments will have to be made of what forms of Information technology it is anticipated will be used and who controls the ownership of this technology.

They conclude by posing the question: To what extent can open source software supplement or completely replace proprietary software?

#### **2.4 Overview of FOSS Policy in Africa**

The (bridges.org report, 2005) “*Free/open source software (FOSS) policy in Africa: A toolkit for policy makers and practitioners*” which is targeted at governments that are investigating whether and how they can integrate FOSS into their strategies for social and economic development indicates that fifteen African countries show that at least some activity towards the creation of a FOSS policy.

They go further to assert that African governments seem to be hesitant to come out strongly in support of FOSS and that most governments that investigating FOSS are promoting a "level playing field" or favor FOSS where a merit-based comparison shows it is equally suitable to proprietary applications. They conclude that so far no African country has formulated a strategy as strongly in favor of FOSS as countries like Brazil, Peru or Malaysia have.

#### **Example of FOSS policy: South Africa**

One important research study that demonstrates Open source policy was compiled in the report by Government Information Technology Officers' Council in South Africa in which they found out the following.

The South African Government has set out a policy for open source software (OSS):

"Government will implement OSS where analysis shows it to be the appropriate option. The primary criteria for selecting software solutions will remain the improvement of efficiency, effectiveness and economy of service delivery by Government to its citizens.

OSS offers significant indirect advantages. Where the direct advantages and disadvantages of OSS and PS (Proprietary Software) are equally strong and where circumstances in the specific situation do not render it appropriate, opting for OSS will be preferable.” (Using Open Source Software In The South African Government, *A Proposed Strategy Compiled By The Government Information Technology Officers' Council*. 2003)

The following countries have formulated FOSS specific policies or references to FOSS or open standards. Adopted from the (bridges.org report, 2005) “*Free/open source software (FOSS) policy in Africa: A toolkit for policy makers and practitioners*”.

#### **Angola**

The e-strategy recommends the use of 'open systems': computer software and hardware that are based on open standards. Adopted from the bridges.org report, “*Free/open source software (FOSS) policy in Africa: A toolkit for policy makers and practitioners*”.

## **Benin**

The Government has identified the development of free software as a strategy and it sees the promotion of free software and the "free philosophy" as beneficial to software availability and development in Benin. It encourages civil society organizations to engage in the "battle" for wide scale adoption of FOSS, especially at the international level. A free software laboratory project (LABTIC) is being developed, with the support of the Agence de la Francophonie. (ibid)

## **Djibouti**

The government plans to research and test free software, in particular Linux, with a view to reducing the costs of software procurement. There is a plan to build a software laboratory to do this. There is some word of a plan to put Linux networks into schools, and a "Linux team" has been formed to carry this out. (ibid)

## **Kenya**

A FOSS strategy paper is in progress, but nothing has been published. The government has talked about making sure FOSS is always considered in the procurement of software by Government. There are active FOSS supporters in Kenya and a loose network of Kenyan "hackers" that develop FOSS software. (ibid)

## **Senegal**

Senegal has no FOSS policy but it is mentioned here for two reasons. First, Senegal has a notable amount of activity in ICT for development. It has a vocal Linux and free software society: Le Association Senegalaise pour Linux et les Logiciels Libres. The Senegalese chapter of the Internet society also has an interest in FOSS. Secondly, IT managers in Government are experimenting with FOSS solutions and are promoting them internally. (ibid)

## **South Africa**

In 2001, the South African Government began to openly debate the case for using open standards and open source software in government. The Government Information Technology Officers (GITOC) was subsequently tasked with forming an open source software working group to take this to policy level. The working group was provided with research carried out by the National Advisory Council on Innovation (NACI) in 2002, and in January 2003 presented a strategy paper recommending the use of open standards and open source software in government. To date, no official legislature has been passed by the South African Government endorsing these recommendations, but they have been approved by cabinet and are implemented by individual government departments. (ibid)

## **Tanzania**

Tanzanian policy makers have identified the challenges that face the ICT sector in the country, such as total reliance on imports for ICT equipment, no standards guiding the import of hardware and software, very little local software development and software license costs that are unaffordable to many. The National Information and Communications Technologies Policy, March 2003 lists "Development of local and open source software" as a challenge. (ibid)

## **Uganda**

Uganda has no official FOSS policy to date, but there are several organizations active in the field. Uganda Martyrs University began a complete migration of all software to FOSS around 2002. This initiative is being closely watched by the international development community as a case study of issues encountered during a large scale migration to FOSS. In April 2004, the "East African Centre for Open Source Software" (EACOSS) was opened. This is the first specialized FOSS training centre in the region. The Centre has introduced training, certification and access to FOSS. The Women of Uganda network provides a website describing all the FOSS initiatives active in Uganda, and the business sector is known to use FOSS extensively. The recent National ICT policy focusses on the employment of e-Government and there is a brief mention of Linux and Unix as operating systems to consider as alternatives to Microsoft Windows. However, in August 2004, the US Trade and Development Agency gave the Ugandan Government a grant to facilitate their e-Government strategy, and because this agency advances economic development and U.S. commercial interests in developing countries, there will likely be pressure on policy makers to use Microsoft products. (ibid)

## **Zambia**

Zambia makes some mention of Open Standards in its draft National Information and Communications Policy, 2004, in relation to the problems experienced when there is collaboration between institutions with different technology. (ibid)

The following additional countries show some activity that is relevant in the context of FOSS policy:

## **Burkina Faso**

Burkina Faso has no current FOSS policy, and an IICD-commissioned study showed there is only minimal uptake of FOSS. It found that due to the extremely risk-adverse nature of large businesses in Burkina Faso, there was a reluctance to try FOSS. The government may be considering FOSS due to an intention to develop a local software industry. The reason given is: "To reduce considerably the taxes and rights of customs on the importation of the computers, their elements and the basic software." (ibid)

## **Cameroon**

Cameroon has no published policy, but there are active Linux user groups and the Internet Society of Cameroon supports open source software. (ibid)

## **Ethiopia**

Ethiopia has no published policy, but there is an active Linux user group. There is growing evidence of FOSS use in Ghana, but not of local development of FOSS applications. (ibid)

## **Ghana**

Ghana has no published policy, but there is an active user group. There is growing evidence of FOSS use in Ghana but not of local development of FOSS applications. (ibid)

## **Namibia**

The last ICT policy document to be accepted by the Namibian Government was in 2002 and contained no reference to FOSS, despite there being a notable degree of FOSS activism in Namibia. SchoolNet Namibia (SNN) is a key organization that has led a successful, large scale campaign to put open source computer labs into schools. SNN was part of a working group that put a draft ICT policy for education before government in August 2004. (ibid)

## **Nigeria**

Nigeria has no FOSS policy to date, but a small but flourishing ICT industry and it is building ICT capacity. Many in Africa see Nigeria as a contender with South Africa for outsourcing contracts from overseas has a reasonable infrastructure (at least in urban areas) , and a relatively large number of people with relevant education qualifications. Currently, the Nigerian Government is investigating FOSS as an alternative to proprietary systems in Government departments. According to local sources, the situation is complicated by a generous (and as yet undisclosed) Microsoft offer for software.” (ibid)

### **2.4.1 Driving Forces behind the Adoption of Open Source Software**

There are several studies about how free and open source software is developed, who takes part in development, their motives for developing this kind of software and the reasons for their adoption. More and more governments around the world are requiring their agencies to use free or open source software and use proprietary software only as a last resort.

According to Festa (www.egovos.org), *open source and free software represent a budget priced alternative to Microsoft's Windows operating system and applications that can cost thousands of dollars a year to license. In addition, access to underlying source code means governments can fix problems or modify software to work effectively.*

In supporting Festa, Dan Kusnetzky says that one of the overriding drivers behind legislation appears to be a desire to break free of United States lock on global software market. He asserts that it is not just the United States government that they are worried about, but a single vendor exercising so much power over their government operations.

A government would not like to be under so much influence from any supplier. Governments, especially those of poorer nations with less money to spend on information technology are eager to reap the cost savings of using free software. It is a matter of choice for the governments, organizations etc. to opt for open source software over proprietary software.

### **2.4.2 Countries that have adopted the Concept of Open Source software**

It is generally suggested that knowing the current status and progress of OSS within different countries can be useful in improving OSS adoption and implementation in other countries, especially by learning from those countries that have successfully implemented OSS.

The market share of OSS has increased significantly over the past few years, particularly on the server side. (Brink et al. 2007). Several countries such as Brazil and Germany have migrated most of its local governments and state

agencies to OSS over the last decade. (Red Hat, 2006). According to Lewis, in 2007 there were about 286 OSS license initiatives within the government sector globally. Some governments are recommending OSS, some are mandating the adoption and others are merely doing research and development on OSS.

(Red Hat, 2006) reports that over 160 national, provincial and local governments around the world are utilizing OSS one way or the other. From various studies it is also evident that OSS is extensively implemented within the government sector. Formal academic reports on the current status of OSS usage within various governments are very scarce and in most instances only reports about the intended adoption and implementation of OSS are found.

One of the more interesting aspects of open source software movement is the role that governments are beginning to play. Detailed below are some of the countries that have extensively implemented OSS within their various state departments.

### 2.4.2.1 Malaysia

The Malaysian government is one of the governments throughout the world that have articulated comprehensive implementation guidelines for OSS and open standards. (Thomas, 2007). An extensive feasibility study was done to provide proper guidelines for deploying Open Document format within the Malaysian government sector. (Red Hat, 2006). The investigation in to the use of OSS in Malaysian public sector began in 2004 where an encompassing Public Sector Policy on OSS (PSPOSS) implementation was adopted. The Policy is divided into eight areas (See Figure 2.4).

<b>ADOPTION</b>	OSS Adoption should be based on the least disruptive and fit for purpose implementation.
<b>PROCUREMENT</b>	OSS procurement should be based on merits, value for money, transparency, security and interoperability.
<b>OWNERSHIP</b>	OSS ownership should include software licensing that allows rights to use and modify the software.
<b>TECHNOLOGY</b>	OSS technology to be used in the public sector shall comply to worldwide open standards
<b>IMPLEMENTATION</b>	OSS implementation should be based on the guidelines specified in the Malaysian Public Sector OSS Technical Implementation Plan
<b>KNOWLEDGE SHARING</b>	Agencies implementing OSS must register their initiatives in the Knowledge Bank
<b>EDUCATION</b>	OSS education should be introduced through structured programmes in school IT labs for primary, secondary and tertiary education levels.
<b>TRAINING</b>	Agencies must be committed in educating and re-skilling its personnel to ensure their competency in OSS

Figure 2.4: Malaysian government OSS Policy

The eight areas are *adoption, procurement, ownership, technology, implementation, knowledge sharing, education and training*. The strategy for implementing OSS in Malaysia is divided into three (3) phases spanning over a period of five years.

Phase 1 includes the process of laying a foundation such as formulating guidelines and implementing small pilot projects (Thomas, 2007). Phase II focusses on accelerated adoption and Phase III is self-reliance where OSS usage is expected to be significant.

In 2006, the Malaysian government reported on the status of OSS implementation in the public sector (Malaysian Public Sector, 2008). Approximately 61% of IT personnel received training on OSS. In 2008, almost 3,000 government employees had been trained on various OSS products such as OpenOffice.org (The Malaysian Public Sector Open Source Software Master Plan, 2008). OSS is widely used on both the server and the client side in the Malaysian government sector with about 200 state agencies already using OSS (ibid). The OSS applications being used in Malaysia are mainly developed by the OSS community as well as by the Malaysia government open source competency centre (OSCC). Examples include MyWorkSpace (ibid) which was developed to replace MS-Exchange.

By March 2008, an estimated number of about 120 state agencies had migrated desktop users to OSS. The main motivation for adopting OSS in Malaysia is cost savings while lack of technical support is cited as one of the major challenges that affects OSS adoption. (Thomas, 2007).

#### **2.4.2.2 Germany**

According to (Rankin 2006), German government is one of the “visible adopters of OSS”. In 2002, the German federal office moved away from Windows NT to Debian Linux (Nagler, 2005). They further migrated fully from MS Exchange 5.5 to KOLAB, an in-house developed OSS groupware solution (ibid). In 2004, the Munich Municipality migrated 1400 of its Windows Desktop and laptop computers to Linux and OpenOffice.org (Kovacs et al. 2004).

In 2007, the German foreign office converted 10,000 of its desktop machines to OSS across 300 sites (Otter, 2007). What tends to be lacking in many governments that are in the process of adopting and implementing OSS is extensive, diverse and proper implementation guidelines and Germany is one exception. The Federal Ministry in Germany published a comprehensive guide to be used by all government offices when migrating software components on the server and desktop environments.

#### **2.4.2.3 Australia**

##### **2.4.2.3.1 Government Open Source Software Policy Principles**

The Australian government has outlined various principles that guide the procurement and use of open source software in their government and its various agencies. These are briefly highlighted below:

**Principle 1: Australian Government ICT procurement processes must actively and fairly consider all types of available software** (including but not limited to open source software and proprietary software) through their ICT procurement processes. It is recognized there may be areas where open source software is not yet available for consideration. Procurement decisions in such cases have to be made based on ‘value for money’. Procurement decisions should take into account whole-of-life costs, capability, security, scalability, transferability, support and manageability requirements.

**Principle 2: Suppliers must consider all types of available software when dealing with Australian Government agencies** -Australian Government agencies will require suppliers to consider all types of available software (including but not limited to open source software and proprietary software) when responding to the agencies' procurement requests.

**Principle 3: Australian Government agencies will actively participate in open source software communities and contribute back where appropriate** - The Australian Government, through AGIMO (Australian Government Information Management Office), will actively seek to keep up-to-date with international best practice in the open source software arena, through engaging with other countries and organizations. Australian Government agencies should also actively participate in open source software communities and contribute back where appropriate.

These principles go a long way in enhancing the use of Open Source software in Australia.



### 2.4.3 Initiative for Software Choice

To encourage continued software innovation, and promote broad choice, governments are encouraged to consider the following:

- Procure software on its merits not through categorical preferences.
- Promote interoperability through platform neutral standards and maintain a choice of strong intellectual property protection. Stanco (2000) notes that if governments want to create a culture of open source in the country to create an indigenous software industry (a noble goal) they are much better off working on the area of procurement policy.

### 2.5 Technology Adoption and Strategic Planning Frameworks

There are a good number of technology adoption frameworks and strategic analysis tools in place. Johnson and Scholes (1993) proposed a framework for strategic management which has three main elements.

1. Strategic Analysis (environment, culture and stakeholder analysis, and resources and strategic capability) – to understand the strategic situation.
2. Strategic choice (generation of strategic options, evaluation of options and selection of strategy)-to form the strategies.
3. Strategy implementation (planning and allocating resource, organizational structure and design, managing strategic change) – to implement the strategies (tactical)

For the purpose of this study we examine the following:

#### 2.5.1 SWOT Analysis - Strengths, Weaknesses, Opportunities, Threats

SWOT is a simple but powerful framework for assessing internal and external market dynamics. A SWOT analysis must first start with defining a desired end state or objective. A SWOT analysis may be incorporated into the strategic planning model. SWOT is defined as follows:

- **Strengths:** attributes of the person or company that are helpful to achieving the objective.
- **Weaknesses:** attributes of the person or company that are harmful to achieving the objective.
- **Opportunities:** external conditions that are helpful to achieving the objective.
- **Threats:** external conditions which could do damage to the business's performance.

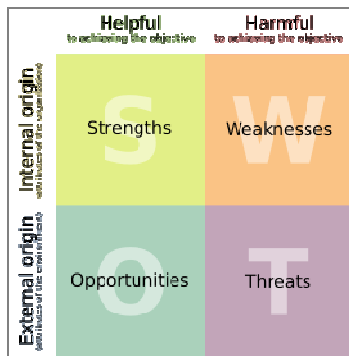


Figure 2.5: SWOT Analysis

### 2.5.2 Cost-Benefit Analysis Framework

Cost Benefit Analysis is typically used by governments to evaluate the desirability of a given intervention. It is used to measure non-monetary as well as monetary costs and benefits to see if the benefits outweigh the costs. The aim is to gauge the efficiency of the intervention relative to the status quo. The costs and benefits of the impacts of an intervention are evaluated in terms of the public's willingness to pay for them (benefits) or willingness to pay to avoid them (costs). Inputs are typically measured in terms of opportunity costs - the value in their best alternative use. The guiding principle is to list all of the parties affected by an intervention, and place a monetary value of the effect it has on their welfare as it would be valued by them. (Gupta and Jana, 2003).

The practice of cost-benefit analysis differs between countries and between sectors (e.g. transport, health) within countries. Some of the main differences include the types of impacts that are included as costs and benefits within appraisals, the extent to which impacts are expressed in monetary terms and differences in discount rate between countries. Agencies across the world rely on a basic set of key cost-benefit indicators, including:

- PVB (present value of benefits);
- PVC (present value of costs);
- NPV (PVB less PVC);
- NPV/k (where k is the level of funds available) and
- BCR (benefit cost ratio, PVB divided by PVC).

The accuracy of the outcome of a cost-benefit analysis is dependent on how accurately costs and benefits have been estimated. Strategies adapted from (Anything Research, 2012).

### 2.5.3 Technology Adoption Curve Framework

The technology adoption curve framework is based on the notion that individuals will adopt an innovation if they perceive that it has the following attributes. First, the innovation must have some relative advantage over an existing innovation or the status quo. Second, the innovation must be compatible with the existing values, past experience, and practices of the potential adopter. Third, the innovation cannot be too complex nor perceived as difficult to

understand. Fourth, the innovation must have trialability; that is, it can be tested for a limited time without adoption. Fifth, the innovation must offer observable results (Rogers, 1995).

(Rogers, 1995) asserts that an adopter's experience with one innovation influences that individual's perception of the next innovation in a technology cluster to diffuse through the individual's system. Thus, if an adopter has a negative first experience with one computer application, he or she may regard all computer applications through this perspective. Diffusion theory provides a framework that helps to understand why IT is adopted by some individuals and not by others. This theory can explain, predict, and account for factors that increase or impede the diffusion of innovations.

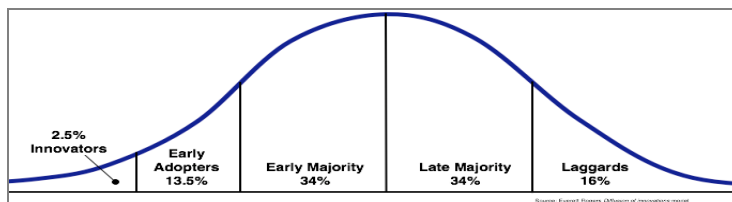


Figure 2.6: Technology Adoption Curve Framework

- **Innovators** tend to be more educated and prosperous, with a greater tolerance for risk
- **Early adopters** are younger, educated, and active in the community
- **Early majority** are more conservative, but open to new ideas and influential within the community
- **Late majority** may be older, less educated, conservative, and less socially active
- **Laggards** are highly conservative, oldest and least educated. They often are less prosperous and more risk averse.

The technology adoption curve is generalizable to any new product or market.

Getao (2004) in citing Sherry identified Rogers (1995) model where an innovation was considered an object with five relative attributes: relative advantage, compatibility, complexity, trialability and observability. The decision by the user to accept or reject the innovation is an event, a point in a linear process where time is the independent variable. The adoption process is made up of a series of choices and action over time based on internal factors within a social system. Getao (2004) contrasted technology adoption models by citing Shih (2004), who pointed out that adoption models concentrate on the diffusion of the technology to different categories of users with use models that concentrate on the different types of use to which the technology is put. *Table 2.1* exemplifies the contrast.

Model	Typology of population	Variable of Interest	Relevant criteria	Element unique to each model	Elements common to both models
Adoption	Adoption	Innovators Early adopters Early majority Late majority Laggards	Timing or rate of adoption	Observability Compatibility Triability	Innovativeness Social Communication Complexity Influence of media Relative Advantage
Use - Diffusion	Use	Intense users Specialized users Non-specialized users Limited users	Rate of use Variety of use	Product experience Competition for use Sophistication of technology Satisfaction	

Table 2.1: Contrast between adoption models and Use diffusion models

## 2.6 Frameworks and Open Source Tools

Frameworks are the base building blocks for most of the current generation applications. This is because of the fact that they help streamline application development, promote adoption of best practices, promote re-use and reduce total cost of ownership by reducing the amount of effort and time. Frameworks are pervasive in most domains of application development and this encompasses object assembly, runtime object management, transaction management, messaging infrastructure, data access, parallel processing, user interaction, service oriented orchestration, event processing, networking and legacy integration. J2EE and .Net which both relate to object oriented technologies are among the most well known and most comprehensive frameworks in the present time.

Nevertheless there are numerous other frameworks, especially those that provide the middleware infrastructure for applications built using Java, C# or the scripting languages like PHP, Python, Perl and Ruby. Java itself has several frameworks like the Apache Struts which implements the MVC pattern and effective user interaction or the Spring framework, that provides an alternative to J2EE and which leverages the dependency injection system. AJAX, Asynchronous JavaScript and XML is also a user interaction methodology or framework.

Many of these frameworks are open source initiatives. After the success of Linux and BSD, the best known open source operating systems, the next thrust to open source adoption has been in the area of middleware infrastructure. Frameworks, application servers, middleware components and shared libraries fall in this place. The debate on application level open source initiatives is still open, whereas the middleware, database and operating system open source options have become real and viable choices. (Rose India Technologies Pvt. Ltd, n.d.)

Some of the Open source frameworks available are:

### Open-source PHP5 web framework

Symfony aims to speed up the creation and maintenance of web applications, and to replace the repetitive coding tasks by power, control and pleasure. Symfony provides these features seamlessly integrated together, such as:

- simple templating and helpers
- cache management
- smart URLs
- scaffolding
- multilingualism and I18N support
- object model and MVC separation
- Ajax support
- enterprise ready

### **Apache Struts**

The Apache Struts web framework is a free open-source solution for creating Java web applications.

Web applications differ from conventional websites in that web applications can create a dynamic response. Many websites deliver only static pages. A web application can interact with databases and business logic engines to customize a response.

Web applications based on Java Server Pages sometimes commingle database code, page design code, and control flow code. In practice, we find that unless these concerns are separated, larger applications become difficult to maintain.

One way to separate concerns in a software application is to use Model-View-Controller (MVC) architecture. The model represents the business or database code, the view represents the page design code, and the controller represents the navigational code. The Struts framework is designed to help developers create web applications that utilize MVC architecture. (Rose India Technologies Pvt. Ltd, n.d.)

The framework provides three key components:

- A "request" handler provided by the application developer that is mapped to a standard URI.
- A "response" handler that transfers control to another resource which completes the response.
- A tag library that helps developers create interactive form-based applications with server pages.

The framework's architecture and tags are catchphrase compliant. Struts works well with conventional REST applications and with nouveau technologies like SOAP and AJAX.

## **Zend Framework Services**

This framework is employed for building performance-oriented, highly secure and modern Web 2.0 Application Development. It is based on OOP, UI design patterns, unit testing, loose coupling, corporate friendly licensing schemes, MVC implementation, and most importantly – a meticulously-tested agile code base. (ibid)

### **Advantages of using Zend Framework for PHP Web Development**

- Faster web development Makes Hybrid Website Development simpler with Rich inbuilt library
- Uncomplicated interfaces and abstract classes
- OOP-based, thus involves lesser coding and rapid development
- Low-cost maintenance
- Scalable over a period of time

### **Code Igniter**

Code Igniter is a powerful PHP framework with a very small footprint, built for PHP coders who need a simple and elegant toolkit to create full-featured web applications. (ibid)

### **Advantages of Code Igniter**

- Has a small footprint
- Exceptional performance
- Broad compatibility with standard hosting accounts that run a variety of PHP versions and configurations
- Requires nearly zero configuration
- Does not require use of the command line.

## ***2.7 Framework to be adopted for the Research***

It is summarized from the above literature that there are several frameworks that are in place to support e-Government as well as open source software applications initiatives. Technology adoption frameworks are also in place to facilitate and give direction to interventions that governments may wish to pursue. The Kenya government can seek the way of stakeholders input, top management support, local skill base in order to enhance the uptake of various open source technologies and encourage the sharing of content.

The Kenyan government will be interrelated with the U.S. Department of Labour e-Government framework which is the e-Government framework of choice for this study because its components map well with the ones intended to be researched on in the Kenyan government to form the research framework that will be adopted.

The User Input will consist of input from all the five categories identified. The users in this context are citizens, as well as officials in the Kenyan government. On creative commons licensed open content, factors such as who owns the data, how useful and relevant digital content can be used to supplement the data that the Kenyan government already has, the factors used in determining relevant content and so on will be researched on.

## **CHAPTER THREE: METHODOLOGY**

### ***3.1 Overview***

The aim of this chapter is to present and justify the research and prototype development methods used in this research.

In carrying out the research, a systematic approach was followed.

Presentation and description of how the data was collected is outlined. The presentation of the chosen methodology includes discussions concerning the research approach, research strategy and research methods.

### ***3.2 Research Purpose and Design***

All research approaches can be classified into one of three general categories of research:

Exploratory, descriptive and casual. These categories differ significantly in terms of research purpose, research questions, the precision of the hypothesis that are formed and the data collection methods that are used. (Aaker et al, 1998).

The methodology employed was exploratory Research as this research is used when one is seeking insights into the general nature of a problem, the possible decision alternatives and the relevant variables that need to be considered. The research methods in this category are highly flexible, unstructured and qualitative, as the researcher begins without firm preconception as to what will be found. The absence of structure permits a thorough pursuit of interesting ideas and clues about the problem situations. (ibid)

### ***3.3 Research Strategy***

The first step to take when conducting research is to evaluate the research strategies.

Depending on the type of research, there are advantages and disadvantages to all the research strategies. The most important criterion for deciding what strategy to use is to look at the research questions/ objectives Davey (1991), Yin (1981).

In the literature review section, several frameworks were reviewed for e-Government, open source as well as technology adoption. In reference to these frameworks, for e-Government, the U.S Department of Labor e-government framework was adopted. This was mainly due to the fact that most of the elements could be married to the Kenyan context and form a good basis to evaluate the Kenyan scenario.

In addition to the above mentioned frameworks, the Code Igniter PHP development framework was the framework of choice as it has a small footprint, exceptional performance and has a broad compatibility with standard hosting accounts that run a variety of PHP versions and configurations.

### ***3.4 Sample Selection***

Choosing a study sample is an important step in any research project since it is rarely practical, efficient or ethical to study whole populations. Martin N Marshall, (1996).

The major emphasis in this study is on the discovery of ideas and insights into the factors that influence the open source software technology adoption in e-Government in Kenya and aims to come up with ways to facilitate the adoption.

#### **3.4.1 Sampling Issues**

For the exercise to be effective and hence produce as meaningful results as possible, it was important that the various stakeholders be classified into different categories.

This put into perspective the various attributes that needed to be investigated. Each of the five categories was given an overview of the aim of the research and adequate understanding developed through discussions and feedback from the participating teams.

#### **3.4.2 Filtration of sampling**

For the purpose of this study, it was observed that the semi-illiterate and illiterate population would be inappropriate as most of them might not have been exposed to open source software nor CC licensed open content. Even though they were part of the customers of the Kenyan government and possible beneficiaries of the outcome of the findings, the research was more focused on Kenyans in the urban areas who were more literate and had some basic understanding of OSS and CC licensed open content. Members of the rural population as well as the semi-illiterate can be included as part of future research work.

#### **3.4.3 Sampling Design**

Due to the prevailing budgetary constraints the sampling procedure that was adopted was random sampling and the type of random sample that was drawn was a stratified sample as the parameters of interest in our research context were the literate populace who had some basic knowledge on open source software as well as content. As the population was homogenous sample bias was overcome by taking a stratified sample so that the stratified population structure was reflected in the sample structure and the criterion that was used was literacy levels.

The informants that were selected were those that had IT literacy and some knowledge about open source applications in addition to various licensing models. The focused population contained both students as well as professionals. The age group was from 21-40 because these age groups people are more interested about new services and have strong opinions about innovations and technology. They also constitute a large part of those involved in the operations of the e-Government and have relevant experience in open source technologies. Our problem is related to the government and its use of various classes of software, so it was necessary to ask them what they expected from software, what they currently had and what they would wish to get out of the software that they had invested in currently and would wish to in the future as well as their expectations as far as CC licensed open content was concerned. The open source software developers were also interviewed on more or less the same issues. This is why the data that was collected was from a sample population as they represented the requirements of their same target group. This helped to abstract the perception and awareness of the required open source applications and creative commons licensed open content from the relevant parties.



### 3.4.4 Sample Size and Sample Selection

The allocation of the sample was made on the basis of the size and population of the various target groups that were relevant to this research.

Different population sizes were used for the various target groups. Using a confidence level of 95% and confidence intervals of 23.77, 17.32, 4.62, 8.84, 9.8 respectively, the sample size for the various groups for ICT Heads, ICT Staff, Citizens, Open Source software developers and Content Creators was estimated at 17, 32, 450, 123 and 100 in that order. This was done by use of an online sample size calculator for statistics available at <http://www.surveysystem.com/sscalc.htm>, accessed on 1<sup>st</sup> April 2012.

#### 3.4.4.1 ICT Heads Sample

**Determine Sample Size**  
Confidence Level:  95%  99%  
Confidence Interval: 23.77  
Population:   
Calculate Clear  
Sample size needed: 17

**Find Confidence Interval**  
Confidence Level:  95%  99%  
Sample Size: 17  
Population:   
Percentage: 50  
Calculate Clear  
Confidence Interval: 23.77

Figure 3.1 ICT Heads Sample

### 3.4.4.2 ICT Staff Sample

**Determine Sample Size**

Confidence Level:  95%  99%

Confidence Interval:

Population:

Sample size needed:

**Find Confidence Interval**

Confidence Level:  95%  99%

Sample Size:

Population:

Percentage:

Confidence Interval:

Figure 3.2 ICT Staff Sample

### 3.4.4.3 Citizens Sample

**Determine Sample Size**

Confidence Level:  95%  99%

Confidence Interval:

Population:

Sample size needed:

**Find Confidence Interval**

Confidence Level:  95%  99%

Sample Size:

Population:

Percentage:

Confidence Interval:

Figure 3.3 Citizens Sample

#### 3.4.4.4 OSS Software Developers Sample

**Determine Sample Size**

Confidence Level:  95%  99%

Confidence Interval:

Population:

Sample size needed:

**Find Confidence Interval**

Confidence Level:  95%  99%

Sample Size:

Population:

Percentage:

Confidence Interval:

Figure 3.4 OSS Software Developers Sample

### 3.4.4.5 Content Creators Sample

**Determine Sample Size**

Confidence Level:  95%  99%

Confidence Interval:

Population:

Sample size needed:

**Find Confidence Interval**

Confidence Level:  95%  99%

Sample Size:

Population:

Percentage:

Confidence Interval:

Figure 3.5 OSS Content Creators Sample

Population	Target	Respondents
ICT Heads	17	12
ICT Staff	32	28
Citizens	450	312
Open Source Software Developers	123	100
Content Creators	100	76

Table 3.1: Sample selection

### **3.5 Framework**

The framework that was adopted to guide this study (the Framework) had these components: Customer relationship management, organizational capability, enterprise architecture, and security and privacy. (Solis, 2011)

- **Customer Relationship Management (CRM).**

This comprised the methodologies, technologies, and capabilities that would help the Government of Kenya identify its customers (citizens), determine what customers want, and learn how to meet and continuously improve customer service. CRM required developing a dialogue with customers. Advanced CRM was characterized by personalized services that are timely and consistently excellent. Customer relationship management would help the Government of Kenya prioritize projects. In our case, projects related to Open source software and CC licensed open content.

- **Organizational Capability.** This component consisted of the policies, plans, people, and management processes which were required to develop, implement, and sustain a high level of open source software digital services and generation of CC licensed content in support of the Government's mission. This category included strategic plans, investment review boards, I.T. capital planning processes, systems development methodologies, workforce plans, and training. Organizational capability will help the Government of Kenya select Open source projects and ensure successful management of the projects and delivery of results.
- **Enterprise Architecture.** This included the explicit description and documentation of the current and the desired relationships among business and management processes and information technology. The enterprise architecture described the current architecture and the target architecture. It also included the rules and standards for optimizing and maintaining IT investments and portfolios. The GoK's enterprise architecture helped the Department identify E- Government opportunities.
- **Security and Privacy.** This component of the Framework provided an integrated planning framework and a unified approach to developing and implementing security policies, procedures, and plans, including the analysis of threats and vulnerabilities, risk mitigation, and risk management. Security and privacy policies help create a secure and trusted environment for e-Government transactions.

### **3.6 Requirement Determination**

The use of exploratory research was employed as from the literature review and research questions it was more relevant to use this. This entailed a fact finding exercise in which information/ facts about the various content needs of the Kenyan Government as well as software needs was discovered. The major emphasis in exploratory studies is on the discovery of ideas and insights. As such the research design appropriate for this study had to be flexible enough to provide opportunity for considering different aspects of the problem under study. Inbuilt flexibility in research design was needed because the research problem, broadly defined initially, was transformed into one with

more precise meaning in exploratory studies, which fact necessitated changes in the research procedure for gathering relevant data.

### **3.7 Data Collection**

#### **3.7.1 Field Data Collection**

Data collection was done immediately after the data collection tools had been prepared. The collection of data lasted for a period of 2 months. The supervisor oversaw the exercise and ensured the correct questions were asked to elicit the most relevant responses in the survey.

#### ***Tools, Procedures and Methods for Data Collection***

The choice of data collection method is a critical point in the research process. The decision was not easy and many factors were considered and generally, the following three methods in the context of research design for this study were explored for establishing the information requirements of the prototype to be developed.

- Interviews
- Questionnaires
- Documentary Review

#### **3.7.2 Interviews**

Experience Survey means the survey of people who have had practical experience with the problem to be studied. The object of such a survey is to obtain insight into the relationships between variables and new ideas relating to the research problem. For such a survey people who are competent and can contribute new ideas may be carefully selected as respondents to ensure a representation of different types of experience. (Kothari, C.R., 2004).

This entailed a direct conversation with the sampled respondents with a specific purpose of obtaining information regarding the open source skills, proficiency levels, the availability of creative commons licensed open content etc.

An interview schedule was prepared for the systematic questioning of the informants. The interview was conducted in such a way as to ensure flexibility in the sense that the respondents were allowed to raise issues and questions which I might not have previously considered.

Different people in the various selected categories were surveyed about their experiences and expectations on open source technologies and creative commons licensed open content. The citizens who had basic IT knowledge and insight concerning the research question were surveyed rather than any sample group of citizens. This research type was more helpful in acquiring the results due to its flexible nature.

#### **3.7.3 Questionnaires**

In order to investigate the workability and applicability of Open source software and CC licensed open content, questionnaires were mainly used from the sampled population. Samples of the questionnaires are attached in the *Appendix*.

The questionnaires were initially piloted to test for ambiguity and ease of response using a few respondents. The validity of the questionnaire was tested by subjecting it to a few respondents. Content validity and relevance was analyzed through peer review and also supervision from my Academic supervisor and the e-Government liaison.

This involved the use of standardized, structured and unstructured questions that were designed to be used to supplement the interviews. Questionnaires were used because of their ability to reach geographically scattered correspondents conveniently and at a lower cost especially with the advent of emails.

The Primary data source was the feedback from the open source software developers on their familiarity of open source software and applications and their expectations in terms of working with the Government of Kenya to build applications and also content creators and the feasibility of sharing their content under creative commons licensed open content. Also sourced were the goings on at the Government with regards to the extent of usage of Open source software applications and systems and the extent to which the current IT strategy and various policies catered for the issue of usage of Open source software and CC licensed Open content in the Kenyan government.

In this case, open source software applications in e-Government were discussed from different aspects like what were the software needs for the government that could be serviced using open source technology. How these services could be made beneficial, effective or efficient by adopting an open source approach.

The questionnaires targeted the five main categories of respondents who helped disseminate useful information on various aspects of interest.

**E-Government decision/ policy makers** – This was to find out about the organizational capability of the government in terms of the policies, plans strategies and management processes required to mandate the development of Open source software applications as well as actualize the content sharing for content licensed under the creative commons licensed open content.

**E-Government I.T Staff** – This was to get feedback on the enterprise architecture of the Government in terms of the desired relationships among business management processes and information technology. They will also shed light on the rules and standards for optimizing and maintaining IT investments which in this case are open source software applications and portfolios and content sharing enablers.

**Citizens** – This was for customer relationship Management to enable us find out what the citizens who were the customers in our case needed and learned how to meet and continuously improve customer service in relation to CC licensed open content delivery.

**Open source software developers** – As this was the skill base that was going to be utilized going forward various aspects such as their skillset in Open source software, their perception of the various features and functionalities and robustness of various Open source software among others were explored.

**Creators of Content** – This was to find out from the literate population their willingness to share any useful content they may have created over the years or had access to under various CC licenses and which way their participation could be elicited in the most optimal way.

Utmost care was taken in order to present the collected expectations in their original way. This would provide strong basis for the Kenya government to find solutions and strategies for facilitating the uptake of open source applications as well as creative commons licensed open content in the light of collected data.

### **3.7.4 Documentary Review**

The survey of relevant literature - Previous work will be thoroughly reviewed. Research questions stated by earlier workers may be reviewed and their usefulness be evaluated as a basis for further research. (Kothari, 2004).

This involved the inspection of existing literature on the OSS adoption concept. It assisted in providing facts on the governments in the world that have implemented OSS applications in their e-governance, their experiences and a critique of the OSS concept.

The documents that were reviewed included professional I.T journals, conference proceedings, newspapers, dissertations and other scholarly research literature. Documentary review formed the core fact finding technique as most of the information regarding the OSS concept, development and its implementation was found in secondary literature.

### **3.8 Data processing**

The uniqueness of the survey required appropriate arrangements to be put in place so that it would be possible to make available the results within the shortest time possible once the data collection was complete.

Using Google Forms, an online survey tool proved requisite as it resulted in faster completion of the survey report. Also it would enable detection of any problems early during the data collection. The Data editing, processing and analysis took six days. Data was processed using the SPSS tool. Descriptive statistics was used mainly for analysis of the data. Frequency tables and charts were used for the presentation of the results.

### **3.9 Data Cleaning and Validation**

The cleaning and validation processes were done during the data entry process. While data cleaning was a continuous exercise even during report writing, efforts were made to identify any invalid values within the data so that they would be sorted out early enough.

### **3.10 Constraints**

When designing this survey, two major constraints were encountered. The first and most important was the financial resources available to undertake the survey. This constraint limited how many people could be surveyed and how much time the interviewer could spend with the respondents.



The second constraint was the willingness and ability of respondents to provide desired information. Majority of the participants were not very willing to provide the interviewer with the desired information and the few who were willing to give information couldn't disclose too much in as much as anonymity was guaranteed.

### ***3.11 Validity and Reliability***

In this research, validity and reliability was achieved by focusing on key stakeholders in the government that were in charge of various matters related to various technologies among them open source and use of the creative commons licensed open content and various relevant categories of respondents. The validity was ensured throughout research by using relevant literature and the questionnaire was formulated to be as unambiguous as possible and to collect the expected information. Although in qualitative and partially quantitative research approaches, it is hard to maintain the reliability, but utmost care was taken in order to try to attain it by managing the contents, sequence and physical layout of questionnaires.

### ***3.12 Prototype Development Tools***

PHP 5.3, MySQL 5 and Apache Web server were used.

### ***3.13 Application Development Methodology***

The Waterfall model methodology was adopted as the prototype development methodology of choice as it was straightforward and let one know exactly what stage they were in the process. The steps that were followed in the development of the prototypes sequentially were outlined in these phases:

- Requirements Analysis Phase
- Design Phase
- Implementation Phase
- Integration and Test Phase
- Maintenance Phase

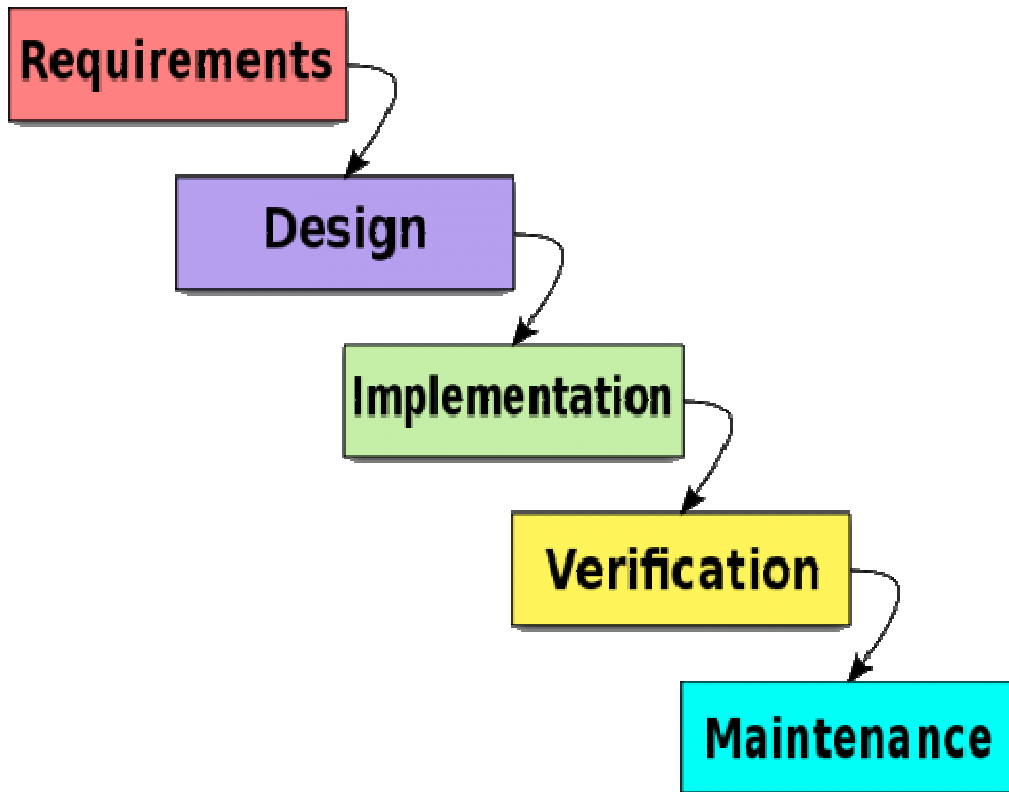


Figure 3.6: Waterfall Methodology

**Requirements Analysis Phase** – Here the various requirements were gathered, for example the actual process flow of the content sharing identified for a prototype to be developed.

**Design Phase** – E-R diagrams were drawn in order to define the various entities and their attributes as well as their relationships.

**Implementation Phase** – A prototype in the form of a platform for content sharing was developed for content sharing purposes using Code Igniter which is a PHP open source software framework.

**Testing Phase** – The tests shall be done by having various users upload content to the portal and check whether all the components function as required.

**Maintenance Phase** – This is where bugs that will have been identified will be fixed

### 3.13.1 Limitations of Methodology and how they are overcome

- You cannot go back a step; if the design phase has gone wrong, things can get very complicated in the implementation phase.
- Often, the client is not very clear of what he exactly wants from the software. Any changes that he mentions in between may cause a lot of confusion.
- Small changes or errors that arise in the completed software may cause a lot of problems.

- Another major disadvantage of the waterfall model is that, until the final stage of the development cycle is complete, a working model of the software does not lie in the hands of the client. Thus, he is hardly in a position to inform the developers, if what has been designed is exactly what he had asked for  
These disadvantages were overcome by ensuring the design stage was very thorough and enough time was allocated to it so that during the implementation stage everything was quite clear.  
All the angles and requirements of the system and processes for which the prototype was developed were thoroughly researched on and documented in order to mitigate against many unanticipated changes during the implementation phase.

### ***3.14 Type of Security***

It is imperative to define the security threats and attacks that exist in a system to be able to develop mechanisms to avert them.

**Authentication** – The system implements mutual authentication. The authentication entails acknowledgement that the user who gains access to the system is who they say they are. This is enabled by the auth.jsp which compares the username and pass keys from users table in the database. The users' passwords are stored in the database in encrypted format so that even if one is able to gain access to database content, they will not be able to access user passwords. The pass key is encrypted using the Message Digest 5 (MD5) one way hash function.

#### **Access Control**

The content sharing system has user levels:

Registered user- Anyone can apply for membership as a registered user. A registered user can upload and edit his/her own content (videos/files/audio/applications among others).

All user transactions are logged by the system in such a way that all processes can be easily tracked.

The system performs automated daily backups in order to allow for quick recovery in the event of failure.

### ***3.15 Implementation of the Content Portal using Open Source Software Frameworks***

Code Igniter (which is an Open Source software) framework for PHP was used to develop the Creative commons licensed Open content portal.

After development, the next stage will be beta testing with a few users in order to evaluate various aspects of the system and also in order to evaluate if we have achieved our research objectives. Before then, a clear test plan will be developed, outline the test objectives, the test items/features, the pass and fail criteria for the tests, the expected and actual outcome etc. The outcome of the tests will be used to review the system and trigger enhancements consistent with the research objectives. Thus the development process will follow the waterfall software development methodology.

The flexibility of the proposed solution can however be reproducible in similar settings with a high degree of success for any other exercise that aims to enhance adoption rates of Creative commons licensed open content using the above defined methodology.

## CHAPTER FOUR: DATA ANALYSIS AND INTERPRETATIONS

### 4.1 Introduction

The purpose of collecting data for this project was to carry out a viability and applicability assessment of enhancing the adoption of Open source applications and CC licensed open content. This chapter presents the research findings and the researchers' interpretation from data collected from the respondents.

In addition, data collected through a closed online survey is descriptively and statistically analysed. Main survey questions, including results received are also discussed and interpreted. It is important to note that respondents, ICT heads, top level management are used interchangeably to refer to the participants who completed the survey. Dynamic online questionnaires were used to provide an adaptive set of questions to the respondents. Questionnaires were administered to five sets of people so as to get various responses on vital aspects that were of concern in this research. The questionnaires consisted mainly of closed type questions, where respondents were compelled to choose between alternatives. Most questions used in the questionnaires had predefined alternatives (answers) with an option to type in other unavailable selections.

Detailed below is the breakdown of the Questionnaire distribution.

- i) **E-Government decision/ policy makers** – This was so as to find out about the organizational capability of the government in terms of the policies, plans strategies and management processes required to mandate the development of Open source software applications as well as actualize the content sharing for content licensed under the creative commons licensed open content.
- ii) **E-Government I.T Staff** – This was to get feedback on the enterprise architecture of the Government in terms of the desired relationships among business management processes and information technology. They also aimed at finding out the literacy levels in as far as Open source applications and software were concerned of the ICT Staff of the government so as to gauge whether they could successfully maintain and support Open Source software.
- iii) **Citizens/ Content Creators** – This was for Customer relationship Management purposes. It was aimed at the literate population and was to find out their willingness to share any useful content they may have come across or were in possession of under various CC licenses and which way they felt would be most beneficial to them to share this content.
- iv) **Open source software developers** – This was aimed at discovering the skill base of Open source software developers that would be utilized going forward as well as various aspects such as their skillset in Open source software, their perception of the various features and functionalities and robustness of various Open source software among others.

- v) **Creators of Content** – This is to find out from the literate population their willingness to share any useful content they may have created over the years under various CC licenses and which way their participation can be elicited in the most optimal way.

Out of 17 ICT heads in the various ministries in the Government of Kenya who were given the questionnaire for decision/ policy makers, only 12 responded.

Out of the 32 Government ICT Staff who the questionnaire was distributed to, 28 responded.

Out of the 450 citizens to whom the questionnaire for citizens was administered to, only 312 responded. Out of the 312 who responded, 64 questionnaires had errors hence could not be used for statistical analysis. This brought down the sample size to 248.

100 open source software developers responded to the questionnaires from total of 123 that were sent out.

For the content creators, 100 questionnaires were sent out and 73 responded.

## **4.2 Data Processing and Analysis**

Data processing involved editing and tabulation of the collected raw data while analysis involved evaluation of some parameters from the data in order to get patterns or relationship among data items.

### **4.2.1 Coding the responses**

In order to analyze the data using SPSS statistical software, as most of the questions were open-ended, similar ideas were identified, and grouped for ease of analyzing.

### **4.2.2 Reliability and Validity Testing**

Before the data analysis was done, reliability and validity tests were carried out on the data collection instruments.

In this case, the techniques used were:

- Face Validity through peer review and experts judgment
- Content Validity using Factor Analysis

#### **4.2.2.1 Reliability Test**

Reliability is the consistency of measurement, or the degree to which an instrument measures the same way each time it is used under the same condition with the same subjects. There are two ways that reliability is usually estimated namely *test/retest* and internal consistency. The idea behind test/retest is that you should get the same on several tests. On the other hand, *internal consistency* estimates reliability by grouping questions in a questionnaire that measure the *same concept*.

#### **4.2.2.2 Validity Test**

Validity refers to the best available approximation to the truth or falsity of a given inference, proposition or conclusion. Three commonly used validity testing techniques are construct, content and face validity.

*Construct Validity* refers to the totality of evidence about whether a particular operationalization of a construct adequately represents what is intended by theoretical account of the construct being measured. Such lines of evidence include statistical analyses of the internal structure of the test including the relationships between responses to different test items.

*Content validity* – is a non-statistical type of validity that involves the systematic examination of the test content to determine whether it covers a representative sample of the behavior domain. Such validity testing is done by a panel of experts who review the specifications of selected items. Through their recommendation, the content validity of a test can be improved.

*Face Validity* is also a non-statistical validation method used to get opinions on whether an instrument “looks like” it is going to measure what it is supposed to measure. While content validity requires more rigorous analysis by subject experts, face validity only requires an intuitive judgment.

#### **4.2.3 Reliability Analysis of the collected data**

#### **4.2.4 Face Validation**

In order to investigate the face validity of the research instruments, the questionnaire was given out to technical and no-technical people to check on whether the questions were clear and in line with the research questions. Changes were made before the questionnaires were administered as recommended by the reviewers.

### ***4.3 Detailed Analysis of Data Collected***

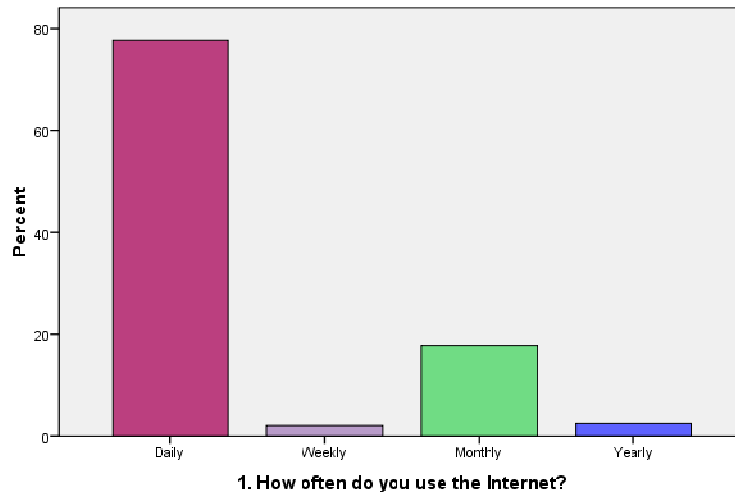
In this section, a detailed analysis and discussion of the valid data obtained from the preliminary investigations using 12, 28, 100, 248 and 73 for e-government top level management, e-government ICT staff, open source software developers, citizens and content creators respectively is presented.

#### **4.3.1 Availability of CC licensed open content among the citizens**

Siebel (2005), in his study indicates that most of the governments and government agencies offer e-government services through the Internet. Therefore the Internet was established to be a good medium for the government to use to reach its citizens and get CC licensed open content from them via a Content sharing portal made available on the Internet.

Figure 4.1 clearly depicts that on average 77.7% of our citizen sample access the Internet on a daily basis, 2% on a weekly basis and only 17.8% and 2.4% access the Internet on a Monthly or Yearly basis.

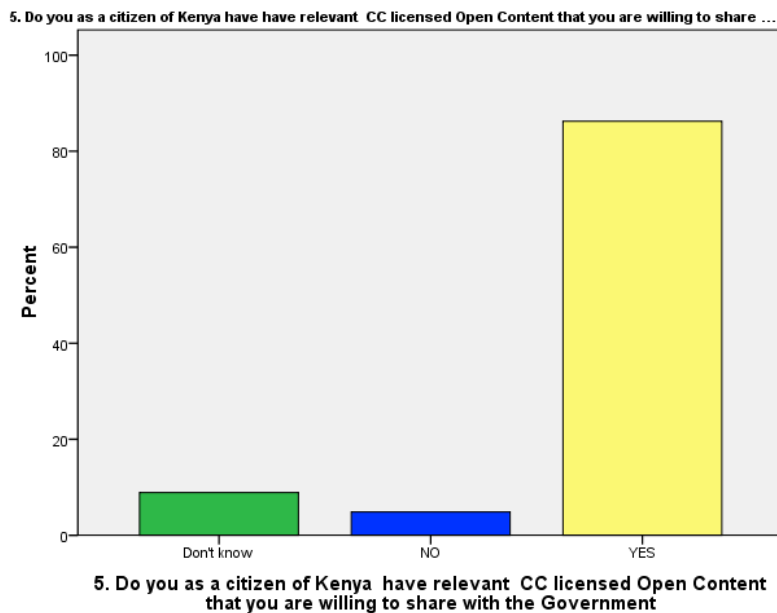
**1. How often do you use the Internet?**



*Figure 4.1 Frequency of Internet Usage*

Figure 4.1 above shows that accessibility to an online content sharing portal is feasible and accessible to a large number of citizens as regularly as daily.

Figure 4.2 below shows that a good percentage (83%) of CC licensed open content is available amongst the citizens of Kenya.



*Figure 4.2: Availability of CC licensed Open content among the citizens of Kenya*

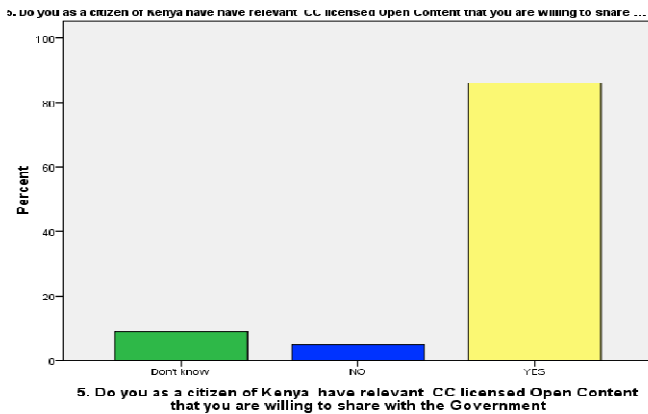


**If you were requested to contribute any open digital content that is  
CC licensed you may be willing to share to the Government to enhance  
service delivery in the GoK would you do it?**

	Frequency	Percent	Valid Percent	Cumulative Percent
NO	27	10.9	10.9	10.9
YES	221	89.1	89.1	100.0
Total	248	100.0	100.0	

*Table 4.1: Willingness to share Open content*

The study established that majority of the respondents were willing to share Open content which they may be having or are able to access to the government. This was evidenced by 89.1% of the respondents who indicated their willingness to share content with the government. However, 10.9% indicated that they were not willing to share the content they may be having with the Government of Kenya. See *Table 4.1* above. This was an indication that the merits of sharing open content were yet to be fully understood by the citizens of Kenya.



*Figure 4.3: Ownership of CC licensed open content*

From the 73 respondents in the content creators category, 68 respondents who constitute 94.4% of our respondents in this category answered in the affirmative as being in a position to create content that they would share. This is depicted in *Figure 4.3* above.

4. Are you willing to share this content after having licensed it accordingly with the government?

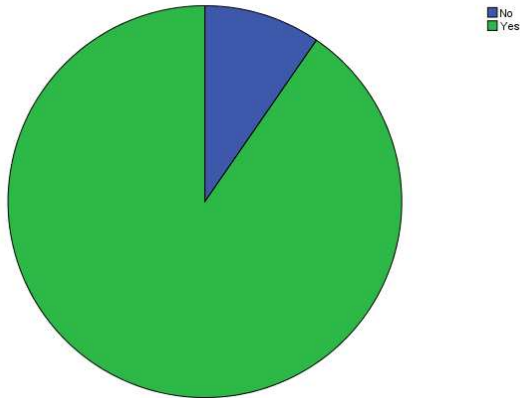


Figure 4.4: Content Creators Willingness to share content

The findings above clearly demonstrate that Kenyan citizens who could also double up as content creators have access to CC licensed open content in one way or other. The research further established that 90.4% were willing to share this content with the Kenyan Government after having licensed it accordingly to enhance service delivery.

**Factors to elicit Content Sharing**

The study also sought to establish the factors that would encourage content sharing from the literate population.

The study found that countrywide attribution and awareness of the benefits of content sharing were the widely cited motivations. A cumulative percentage of 75% of the respondents cited these. Only 25% cited monetary incentives. This indicated that money was not the only motivation for people to share open content but on the contrary, information on the benefits of the content shared as well as attribution and recognition would indeed encourage sharing of open content.

**What do you think can motivate people (citizens and non-citizens of Kenya) to supply content they have licensed under CC licenses to the GoK to allow the government to scale it up to be used countrywide?**

	Frequency	Percent
If they are given countrywide attribution and recognition	27	37.5
If they are informed on the benefits of content sharing	27	37.5
If they are paid in cash	18	25.0
Total	72	100.0

Table 4.2: Factors to elicit CC licensed open Content sharing

Concerning factors that would elicit more participation from the content creators in terms of incentives to share the content they had created or owned, 37.5% of the respondents said if they were given countrywide attribution and recognition, 12.5% cited being informed of the benefits of content sharing and 25% cited monetary rewards.

10. Have you ever used CC licensed content e.g MIT Open Courseware?	No	Count	45
	Yes	Count	27

Table 4.3: Usage/ Awareness of CC licensed content

Out of the 72 valid responses from the content creators, only 27 had used CC licensed content before and 45 had not used any CC licensed content. This is a mere 37.5% of the total respondents. This showed that there was a need to raise awareness of the CC licensed content in Kenya so as to boost its usage to supplement the content that was already available to the government.

#### 4.3.2 Open Source Software Evaluation

For the purpose of evaluating open source application software, questionnaires were sent out to 123 software developers. Out of the 123, there were 100 respondents.

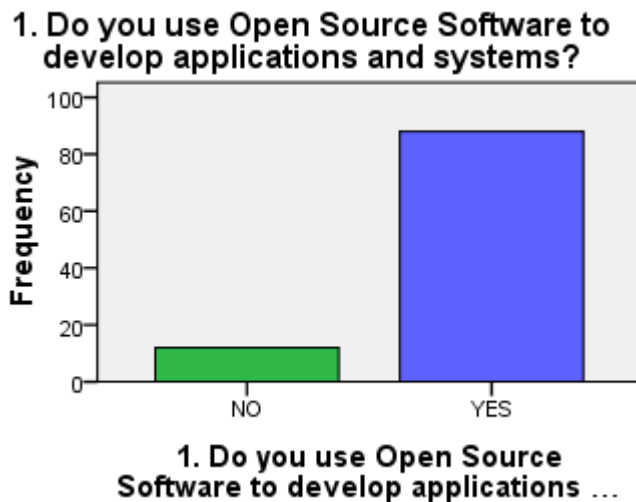


Figure 4.5: Usage of OSS in application/ system development

Figure 4.5 above shows that 88% of our sample respondents build applications and software using open source software of various kinds. From this we can infer that the skill base for open source software is available.

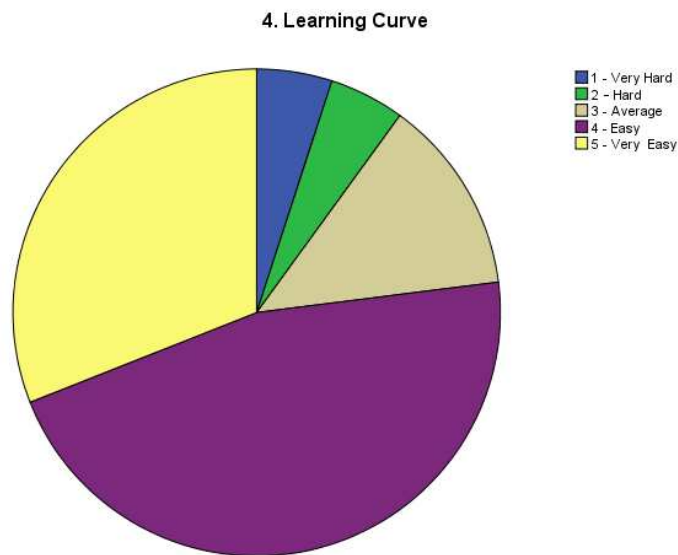
The level of expertise of the developers however varied all the way from beginners to experts according to the frequency table below. See *Table 4.4*. However, it can be deduced from this finding that most (89%) of the developers ranged from intermediate to experts.

Level of Expertise				
	Frequency	Percent	Valid Percent	Cumulative Percent
1 – Beginner	6	6.0	6.0	6.0
2 – Novice	5	5.0	5.0	11.0
3 – Intermediate	22	22.0	22.0	33.0
4 – Skilled	42	42.0	42.0	75.0
5 – Expert	25	25.0	25.0	100.0
Total	100	100.0	100.0	

*Table 4.4: Proficiency Levels of OSS developers*

The various Open source software, specifically PHP which is one of the most commonly used languages for open source development was evaluated using several criteria and the findings were as outlined below.

#### 4.3.2.1 Learning curve



*Figure 4.6: Learning Curve*

The study also sought to establish the ease of learnability of open source software (PHP) as a software development language. 77% of the respondents cited the PHP language as being very easy or easy to learn so that it can be used to build applications and systems.

#### 4.3.2.2 Stability

In terms of stability during development, the developers' responses were as outlined below.

<b>Stability</b>				
	Frequency	Percent	Valid Percent	Cumulative Percent
1 – Very Unstable	5	5.0	5.0	5.0
2 – Unstable	28	28.0	28.0	33.0
3 – Stable	26	26.0	26.0	59.0
4 – Very Stable	41	41.0	41.0	100.0
Total	100	100.0	100.0	

*Table 4.5: Stability*

It can clearly be established from these responses (67% of the respondents) that in terms of stability open source software (PHP) is seen to be fairly stable and thus can be used to build applications that can be used by the government.

#### 4.3.2.3 Performance

Open source software was also analyzed for performance and the outcome was as illustrated in the frequency table below.

<b>Performance</b>			
	Frequency	Percent	Valid Percent
1 – Slow	21	21.0	21.0
2 – Average	27	27.0	27.0
3 – Fast	52	52.0	52.0
Total	100	100.0	100.0

*Table 4.6: Performance*

52% of the respondents affirmed the performance of Open source software, citing it as fast in development. From this we can conclude that with the right resources, open source software can effectively be used to build applications that can be utilized meritoriously in various government departments.

#### 4.3.2.4 Scalability

Open source software was also evaluated in terms of scalability and the findings from our sample respondents are displayed in the table below.

<b>Scalability</b>				
	Frequency	Percent	Valid Percent	Cumulative Percent
1 – Poor	10	10.0	10.0	10.0
2 – Fair	10	10.0	10.0	20.0
4 – Good	24	24.0	24.0	44.0
5 – Excellent	56	56.0	56.0	100.0
Total	100	100.0	100.0	

*Table 4.7: Scalability*

56% of our sample developers were of the inclination that the scalability of the applications developed using open source software applications were scalable and 24% cited that the applications were fairly scalable. This shows that open source software applications can be scaled up accordingly based on the current needs and used at a larger scale than they were initially developed for and can also evolve as needed.

#### 4.3.2.5 Interoperability

In terms of interoperability with other applications built using different platforms, open source software was evaluated and the results are tabulated below.

<b>Interoperability</b>				
	Frequency	Percent	Valid Percent	Cumulative Percent
1 – Very Hard	10	10.0	10.0	10.0
2 – Hard	20	20.0	20.0	30.0
3 – Easy	33	33.0	33.0	63.0
4 – Very Easy	37	37.0	37.0	100.0
Total	100	100.0	100.0	

*Table 4.8: Interoperability of Open source software*

37% of the OSS developers were of the disposition that interoperability of OSS applications with programs built using other kinds of software was very easy, which is very useful as it is vital that the applications that are built using OSS are interoperable with other programs for seamless integration.

#### 4.3.2.6 Extensibility

**9. Extensibility**

	Frequency	Percent	Valid Percent	Cumulative Percent
1 - VeryHard	5	5.0	5.0	5.0
2 - Hard	5	5.0	5.0	10.0
3 - Intermediate	15	15.0	15.0	25.0
4 - Easy	38	38.0	38.0	63.0
5 – Very Easy	37	37.0	37.0	100.0
Total	100	100.0	100.0	

*Table 4.9: Extensibility*

Extensibility in terms of the ease of adapting open source software products to changes of specification was evaluated. It was found that open source software was soft, and indeed is in principle as nothing can be easier than to change a program if you have access to its source code. This is the case with open source software and the responses above affirm this. 75% of the respondents attested to the fact that open source software applications are extendible to changes in specifications which is a very useful quality especially in government applications as needs change and they need to be continually addressed.

#### 5.3.2.7 Standards

**Standards**

	Frequency	Percent	Valid Percent	Cumulative Percent
1 - Poor	5	5.0	5.0	5.0
2 - Good	18	18.0	18.0	23.0
3 – Very Good	41	41.0	41.0	64.0
4 - Excellent	36	36.0	36.0	100.0
Total	100	100.0	100.0	

*Table 4.10: Standards*

Open source software standards were also assessed and 41% of the respondents responded that they were very good and 36% cited that they were excellent. This goes to show that open source software standards were relatively high and could be used to build applications that could be used in the government. The findings here indicated that open source software, and in this the example of PHP possessed most of the qualities of good software.

### 5.3.2.8 Documentation

**Documentation**

	Frequency	Percent	Valid Percent	Cumulative Percent
1 - Scanty	6	6.0	6.0	6.0
2 - Moderate	26	26.0	26.0	32.0
3 - Adequate	32	32.0	32.0	64.0
4 - Excellent	36	36.0	36.0	100.0
Total	100	100.0	100.0	

*Table 4.11: Documentation*

The survey also queried on the state of documentation of Open source software. The responses were generalized to all open source software. But the assumption was that other open source software would only defer minimally and that this would represent most of them adequately. 6% cited open source software as not being well documented whereas 36% which is slightly more than a third of our sample respondents recognized open source software as being more than adequately documented. A cumulative percent of 68 indicated that open source software was well documented.

### 4.3.2.9 Community Support

**Community Support**

	Frequency	Percent	Valid Percent	Cumulative Percent
1 - Poor	5	5.0	5.0	5.0
2 – Good	36	36.0	36.0	41.0
3 – Very Good	18	18.0	18.0	59.0
4 - Excellent	41	41.0	41.0	100.0
Total	100	100.0	100.0	

*Table 4.12: Community Support*

*Table 4.12* above summarizes the community support available for open source software. This was in terms of mailing lists, forums and so on that could provide support to open source software developers.



#### 4.3.2.10 Frequency of Updates

Frequency of Updates				
	Frequency	Percent	Valid Percent	Cumulative Percent
1 - Very Infrequent	5	5.0	5.0	5.0
2 – Fairly frequent	32	32.0	32.0	37.0
3 - Frequent	22	22.0	22.0	59.0
4 – Very Frequent	41	41.0	41.0	100.0
Total	100	100.0	100.0	

*Table 4.13: Frequency of Updates*

The frequency of updates was also investigated. This was also a generalization as it was not easy to single out all the Open source software and thus they were evaluated in general. 41% alluded to very frequent updates of the software. Only 5% were of the opinion that the frequency of updates was not very high.

	Frequency	Percent	Valid Percent	Cumulative Percent
	90	90.0	90.0	90.0
Backtrack g++ Ubuntu metasploit	1	1.0	1.0	91.0
Codeigniter,Joomla,SMS Lib	1	1.0	1.0	92.0
PHP, Android	1	1.0	1.0	93.0
Linux Apache MySQL PHP	1	1.0	1.0	94.0
Linux OS, PHP, Python	1	1.0	1.0	95.0
Mysql Postgre sql Android				
Notepad++ Eclipse Netbeans	1	1.0	1.0	96.0
Php	1	1.0	1.0	97.0
PHP, MySql Linux	1	1.0	1.0	98.0
OS(Ubuntu) Subversion				
PHP/MYSSQL LINUX	1	1.0	1.0	99.0
CARTODB TILEMILL				
UNIX, Linux, Haiku (O.S), Python, JAVA, PHP, Shell (Programming and scripting languages), MySQL and Postgres (database management systems), django and JAVA server Faces (Web development frameworks).	1	1.0	1.0	100.0
Total	100	100.0	100.0	

Table 4.14: FOSS Environments

The study also sought to determine which open source software environment the open source software developers were familiar with and a wide array of open source software platforms were floated which goes a long way to show that the local skill base is varied and capacity for building OSS applications of various kinds and with various functionalities for many useful government applications was indeed in place and what was needed was a link between the two disparate parties (the government and open source developers) for there to be meaningful utilization of the talent and also enhance operations in the various arms of the government.

### 4.3.2 Applicability of Open Source Software in Government

A questionnaire was also administered to top level management and policy makers in the Kenyan government as well as the I.T staff who were questioned about the applicability of open source software in the government among other things. Their responses were as summarized below.

#### 4.3.2.1 OSS Policies in Government

##### 2. Is there an OSS policy in place in your Ministry, Agency or Department?

	Frequency	Percent	Valid Percent	Cumulative Percent
No	12	100.0	100.0	100.0

Table 4.15: Presence of OSS Policies

The ICT heads were questioned on the availability of Open source policies in their ministries. The responses clearly show that there is no Open Source software policy in place in the government as 100% of the respondents answered in the negative.

The question of whether Open source software systems were applicable for the government was also asked and the responses are as exemplified below.

##### 4. Are Open Source systems or applications suitable for Government?

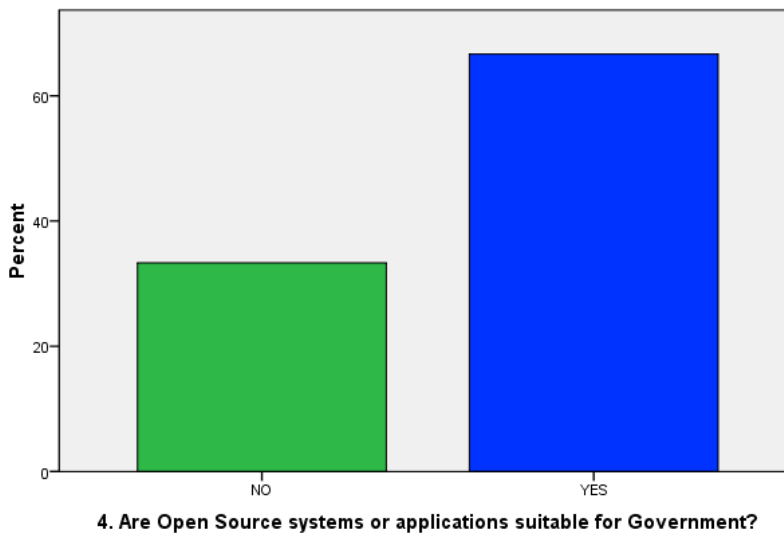


Figure 4.7: Applicability of Open Source Software in Government.

66.7% of our sample respondents answered in the affirmative while 33.3% answered in the negative.

Those who answered in the negative were asked to elaborate on their response. This is detailed below.

**5. If your answer to #4 above is No, kindly state why not.**

	Frequency	Percent	Valid Percent
Support - No central point of support for Open Source Software, Learning Curve - Training and learning time required for familiarity with Open Source Software is high	4	33.3	33.3
Total	4	100.0	100.0

*Table 4.16: Why OSS is not suitable for Government*

As this was a question where only those who answered in the negative were to answer, the percentage of those who answered it was those who had answered in the negative and thus were 33.3%.

**4.3.3.2 e-Government Strategy and OSS current Status in the Kenyan Government**

The research also sought to investigate whether the current e-Government strategy dealt appropriately with the issue of Open source software. The responses are detailed below.

**1. Do you feel that the e-Government strategy deals adequately with the matter of Open source software use in Government?**

	Frequency	Percent	Valid Percent	Cumulative Percent
NO	12	100.0	100.0	100.0

*Table 4.17: e-Government Strategy and OSS*

All of the 12 ICT Heads who responded which is 100% of our sample indicated that the e-Government strategy did not deal adequately with the matter of Open Source Software.

#### 4.3.3.3 Usage of Open Source Operating Systems in the Government

Unix and/or Linux have been listed in the e-government strategy as some of the popular Operating systems for which standards will be developed. To what extent so far have these been deployed as part of the government's Operating systems?

	Frequency	Percent	Valid Percent	Cumulative Percent
>10%	12	100.0	100.0	100.0

Table 4.18: Usage of Linux as an OS in government

The percentage of usage of Open Source OS's in the government was also investigated and the responses showed that they had been deployed on a scale of less than 10% of the Total Operating systems. This showed that proprietary systems were still the Operating systems of choice in the government.

#### 5.3.3.4 Usage of Open Content Licensing in e-Government

**3. Is Open Content licensing used in your Ministry, Agency or Department?**

	Frequency	Percent	Valid Percent	Cumulative Percent
NO	6	50.0	50.0	50.0
YES	6	50.0	50.0	100.0
Total	12	100.0	100.0	

Table 4.19: Usage of Open Content licensing in e-Government

From the responses above, open content licensing was being utilized in the government and the level of usage was at 50%. This showed that there was room for improved usage of creative commons licensed open content for the government.

#### 4.3.3.5 Pilot Projects

**7. Does the e-government strategy and/ or related policies have the flexibility to allow for pilot projects to be undertaken in order to test, monitor and review selected OSS choices that might be considered for implementation in Government?**

	Frequency	Percent	Valid Percent
NO	3	25.0	25.0
YES	9	75.0	75.0
Total	12	100.0	100.0

*Table 4.20: Flexibility to allow for OSS Pilot projects*

The ICT Heads were also questioned on whether the current e-government strategy or related policies had the flexibility to allow for pilot projects to be undertaken to test, monitor and review selected OSS choices that might be considered for implementation by the e-government. 75% cited the flexibility was there but 25% mentioned inflexibility in as far as pilot projects were concerned. This reflects that there will be a need of an awareness campaign in order to win those in top level management who were opposed to having pilot projects to enable OSS usage.

#### 4.3.3.6 Operating System

**8. What is the most commonly used software in your Ministry, Government or Department on the desktop side?**

	Frequency	Percent	Valid Percent	Cumulative Percent
Microsoft Windows	12	100.0	100.0	100.0

*Table 4.21: Operating system*

**4. What is the most commonly used software in your Ministry, Agency or Department on the desktop side?**

	Frequency	Percent	Valid Percent	Cumulative Percent
	12	88.7	88.7	88.7
Mac OS	1	.9	.9	89.6
Microsoft Windows	11	10.4	10.4	100.0
Total	12	100.0	100.0	

*Table 4.22: Desktop Operating System*

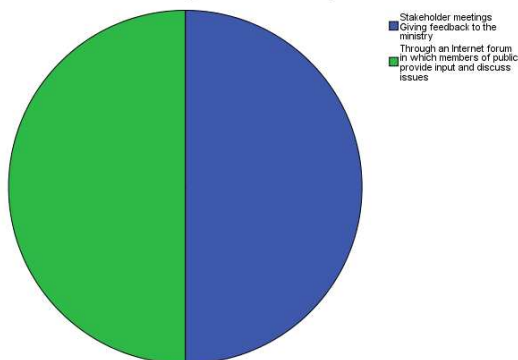
The study discovered that the operating system that was the most common on the desktop side was Windows. This showed that no Open source operating system was currently being used on the desktop. The first set of responses *Table 4.21* was from the ICT heads while the responses in *Table 4.22* were from ICT staff.

In general, most of the government departments indicated that they were using Open content licensing in one way or another but very few were actually using Open source applications. However, the study discovered that on the desktop side, proprietary software is still widely used. In particular Microsoft Windows operating systems. Other operating systems that are being used minimally on the desktop side are Mac OS.

**5.3.3.7 Citizen feedback to the Government**

One of the medium term goals of the e-Government strategy was to increase the input of the citizens into public sector decisions. The ICT heads were asked on how this was currently being addressed. 50% said through stakeholder meetings where they gave feedback to the ministry while 50% of the respondents said it was through an Internet forum in which members of the public provided input and discussed issues. This showed that the government was very willing to accept input that would better influence decisions and supplement service delivery from the citizens.

10. One of the medium term goals of the e-Government strategy is to increase the input of citizens into public sector decisions and actions. How is this being addressed currently?



*Figure 4.8: Input of Citizens into Public sector decisions and actions*

#### 4.3.3.8 In-house OSS Skill base in the Government

They were also questioned on whether there was capability in-house to initiate OSS projects. The responses were as below.

#### 12. Is there capacity in terms of skilled personnel who can be able to initiate in-house OSS development and customization projects?

	Frequency	Percent	Valid Percent	Cumulative Percent
YES, But it can be supplemented when required.	12	100.0	100.0	100.0

Table 4.23: In house OSS capability

The responses in Table 4.23 above showed that as much as there was capability in-house, that is within the government to initiate OSS development and customization of projects, it could be supplemented as often as it was required especially when there was little in-house capacity.

#### 4.3.3.9 Incentives for Content provision

They were also probed on whether their Ministries would be willing to offer incentives to citizens who participated in useful content creation. Their responses were varied as illustrated below.

#### 17. Would your Ministry, Agency or Department be willing to offer some form of incentives to citizens who participate in useful content creation which can enhance service delivery?

	Frequency	Percent	Valid Percent	Cumulative Percent
NO	6	50.0	50.0	50.0
YES	6	50.0	50.0	100.0
Total	12	100.0	100.0	

Table 4.24: Incentive provision

50% of the respondents answered that their ministries were willing to provide incentives to citizens who participated in sharing useful open content, see Table 4.24.



**18. If the answer to #17 above is YES, what form might these incentives most likely take?**

	Frequency	Percent	Valid Percent	Cumulative Percent
Monetary	6	50.0	50.0	50.0
Non-Monetary (NMR)	6	50.0	50.0	100.0
Total	12	100.0	100.0	

*Table 4.25: Monetary vs. Non-Monetary Incentives*

Half the respondents thought the incentives would take a Monetary form whereas 50% cited Non –Monetary incentives for useful content sharing. This confirms that either monetary or non-monetary incentives could be issued to those citizens and content creators who were willing to share their creative commons licensed open content with the government. See *Table 4.25*.

**4.3.3.10 Factors to enhance usage of OSS in Government**

**13. In your opinion, what do you think can be done to enable more use of Open source software and all its benefits in e-Government?**

	Frequency	Percent	Valid Percent	Cumulative Percent
Open source software training should be implemented and have the officers thoroughly trained on how to use it.	6	50.0	50.0	50.0
There should be a policy in place dictating ratios of proprietary and OSS usage in government	6	50.0	50.0	100.0
Total	12	100.0	100.0	

*Table 4.26: Open source s/w usage enhancement*

50% of the respondents cited that if a policy was put in place to dictate ratios of proprietary and OSS software usage in the government then OSS would have a better chance of being adopted and used in government. As this was an optional question, 50% of the respondents did not answer it.

#### 4.3.3.11 Citizen Participation in Content Sharing

In general it can be observed that half of the top level management and policy makers envisioned some participation from the citizens in terms of generation of open content for utilization by the government.

#### 15. Do you envision participation of citizens in generation of useful content properly licensed for use in Government?

	Frequency	Percent	Valid Percent	Cumulative Percent
NO	6	50.0	50.0	50.0
YES	6	50.0	50.0	100.0
Total	12	100.0	100.0	

Table 4.27: Citizen input in Content Generation

The ICT heads also had a section in the questionnaire where they were allowed to add any comments or suggestions they had about the topic. Most of them added that OSS required some sort of support agreement. They cited that this becomes complicated to governments annual budgeting cycles. As no ICT Officer would want to be chasing procurement to renew these agreements every financial year that is why most had a preference for proprietary software.

#### 4.4 Capacity to Support and Maintain Open Source Software Application in Government

From the 32 ICT staff in the government who the questionnaire was administered to, 28 responded. They were being asked about their proficiencies in open source software, deployment of open source applications among others things.

Their responses were as detailed below.

#### 11. What is your proficiency in terms of capability to troubleshoot and provide support and effective maintenance for Open Source Applications being used by your Ministry, Agency or Department?

	Frequency	Percent	Valid Percent	Cumulative Percent
Excellent	16	88.7	88.7	88.7
Good	3	2.8	2.8	91.5
Average	7	6.6	6.6	98.1
Poor	2	1.9	1.9	100.0
Total	28	100.0	100.0	

Table 4.28: Proficiency to support OSS Applications

Most of the respondents (88.7%) graded themselves as excellent in terms of ability to troubleshoot and provide support for OSS applications.

#### 4.4.4.1 Content Availability

The question of Open content applicability was also asked. The responses showed that the majority of the ICT staff deemed it useful if they could be able to access data from a shared pool.

**15. Do you think it would be helpful if you could be able to access data from a shared pool of digital content to supplement the content your Ministry, Agency or Department has to improve services that you provide?**

	Frequency	Percent	Valid Percent	Cumulative Percent
NO	4	12.9	12.9	12.9
YES	24	87.1	87.1	100.0
Total	28	100.0	100.0	

*Table 4.29: Content Availability*

It is based on this literature and the responses obtained from this study that an open source Content sharing portal was designed and prototyped. This involved designing the process narrative, flowchart and then writing PHP scripts for actualizing the functionality. Tests of uploading and downloading data were carried out to ascertain the functionality and reliability of the system. This can be implemented at the Customer relationship management and enterprise architecture of the e-government framework to improve the interaction and contribution of citizens to CC licensed Open Content using open source software applications for efficient and reliable service delivery.

## **CHAPTER FIVE: SYSTEM ANALYSIS AND DESIGN**

### ***5.0 Introduction***

The purpose of collecting data for this project was to carry out a current situation assessment of open source software usage and awareness as well as creative commons open licensed content in the government and also in the literate population with a view to enhancing the adoption and utilization of these in the Kenyan government. This chapter presents the research findings and the researcher's interpretation from data collected from respondents.

### ***5.1 System Analysis (Requirement Definition)***

The first part of this section will deal with the specification of the requirements. Before deciding how the interface is going to work, one should always consider what kind of users will eventually be working with it, and what exactly is expected of the system. Therefore an analysis of User Classes is detailed below which enabled correct and intuitive system design in a manner befitting the users.

The second section of this chapter will focus on the analysis of the data that the desired system will have to manage. Which tasks will it be used for, how to structure all data in the scope of the system so that it's easy to manage, and what overall "look-and-feel" should be obtained. It also takes into consideration the expectations of the users who will be using the system.

#### **5.1.1 User Requirements**

- Consys should be usable countrywide
- The system should be web-based
- The system should allow registration of multiple users
- Consys should allow moderation of content
- Consys should be able to present data in a clear format
- Consys should have capability of filtering information

### 5.1.2 User Classes

#### Administrator

Type of user:	Support.
Experience with the system:	Expert.
Frequency of use:	When they need to check on the content that can be utilized and is resident on the portal. When they need to authorize I.T user staff.
Computer experience:	Advanced general computer skills.
Education/intellectual abilities:	A computer scientist or equal by experience.
Number of users:	1 (could be more)
Motivation for using the system	Keeping the system running, making everything possible. The administrator could be a selected personnel from e-Government
Tasks performed	Checking for new content

Table 5.1: Administrator User Class

#### Moderator

Type of user:	Direct.
Experience with the system:	Intermediate
Frequency of use:	Depending on the amount of content to be reviewed.
Computer experience:	Basic general computer skills
Education/intellectual abilities:	Expert in the subjects of the content assigned to them for review. Mostly people from the e-Government environment.
Number of users:	1
Motivation for using the system	Natural interest for the particular content they are assigned to review.
Tasks performed	Reviewing content for the various ministries.

Table 5.2: Moderator User Class

### **Author/ Content Creator**

Type of user:	Direct.
Experience with the system:	Novice – Expert
Frequency of use:	As often as they have new or revised content to upload.
Computer experience:	Basic general computer skills
Education/intellectual abilities:	Creative mind
Number of users:	No limit, every person is allowed to submit content.
Motivation for using the system	Presenting his research, artwork, content etc, exchanging knowledge.
Tasks performed	Submitting content in various formats

*Table 5.3: Author User Class*

### **5.1.3 System Use Case Diagram**

The system prototype development began with specifying, visualizing, constructing and documenting the components of the systems. A System Use Case diagram was drawn to describe the set of scenarios of interaction between a user and the system. The actors and Use cases of the system were identified and represented as shown in *Figure 5.1*.

#### **i) Actors**

User

Administrator

Moderator/ Reviewer

#### **ii) Use Cases**

Logging in

Uploading content

Managing users

Moderating conten

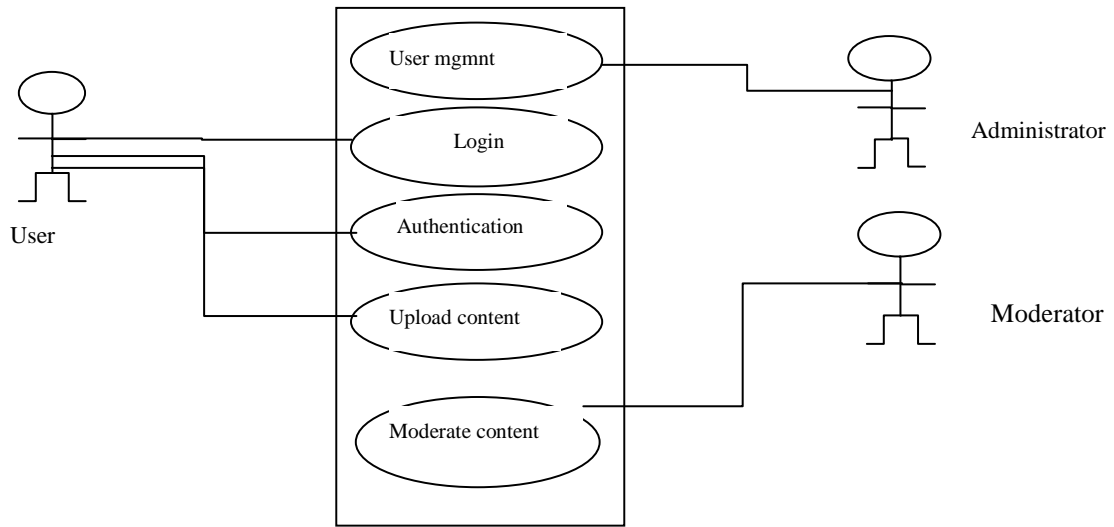


Figure 5.1: System Use Case

## 5.2 System Design Flow Chart

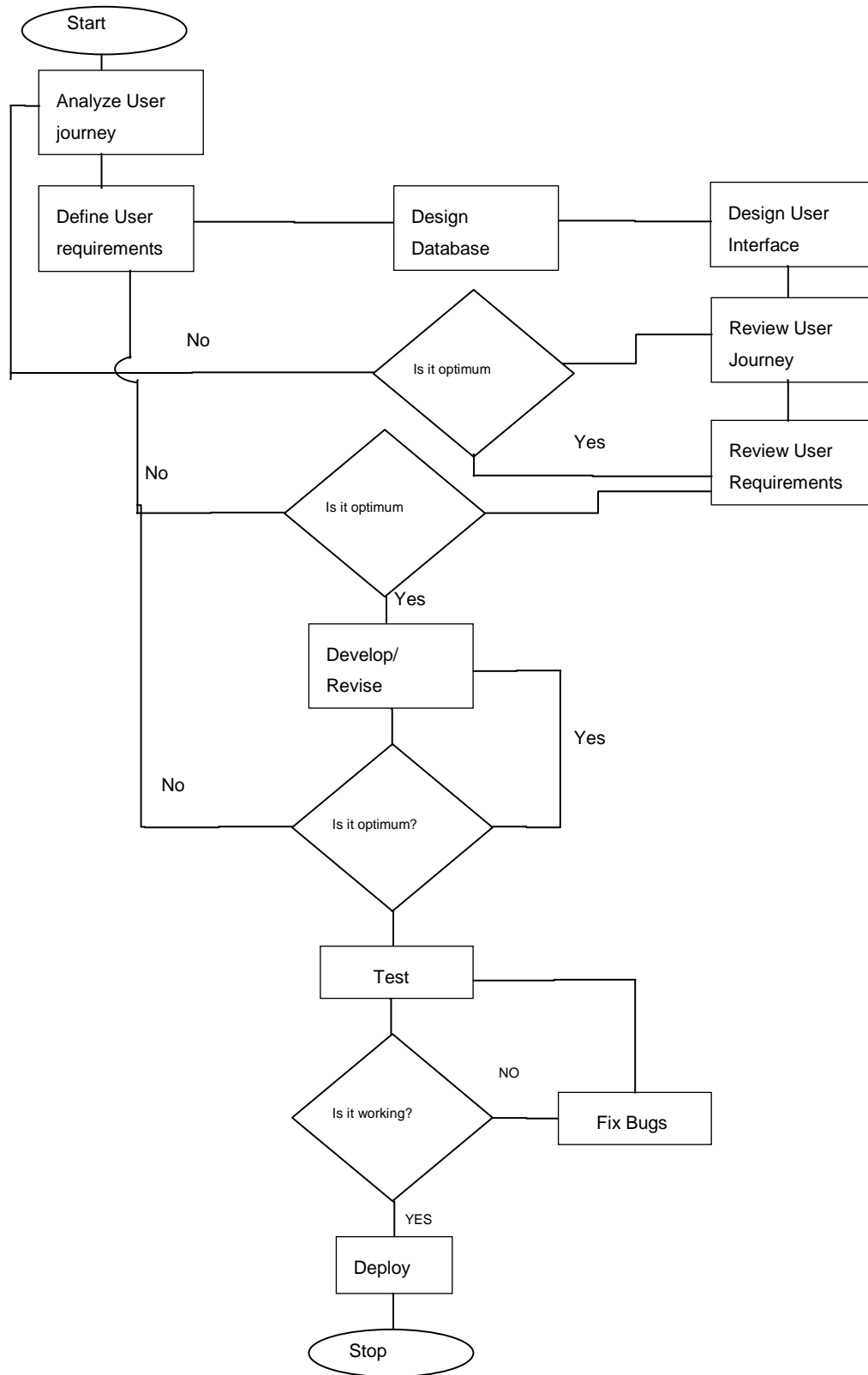


Figure 5.2: System Design Flowchart



### 5.3 Database Design - E-R Diagram

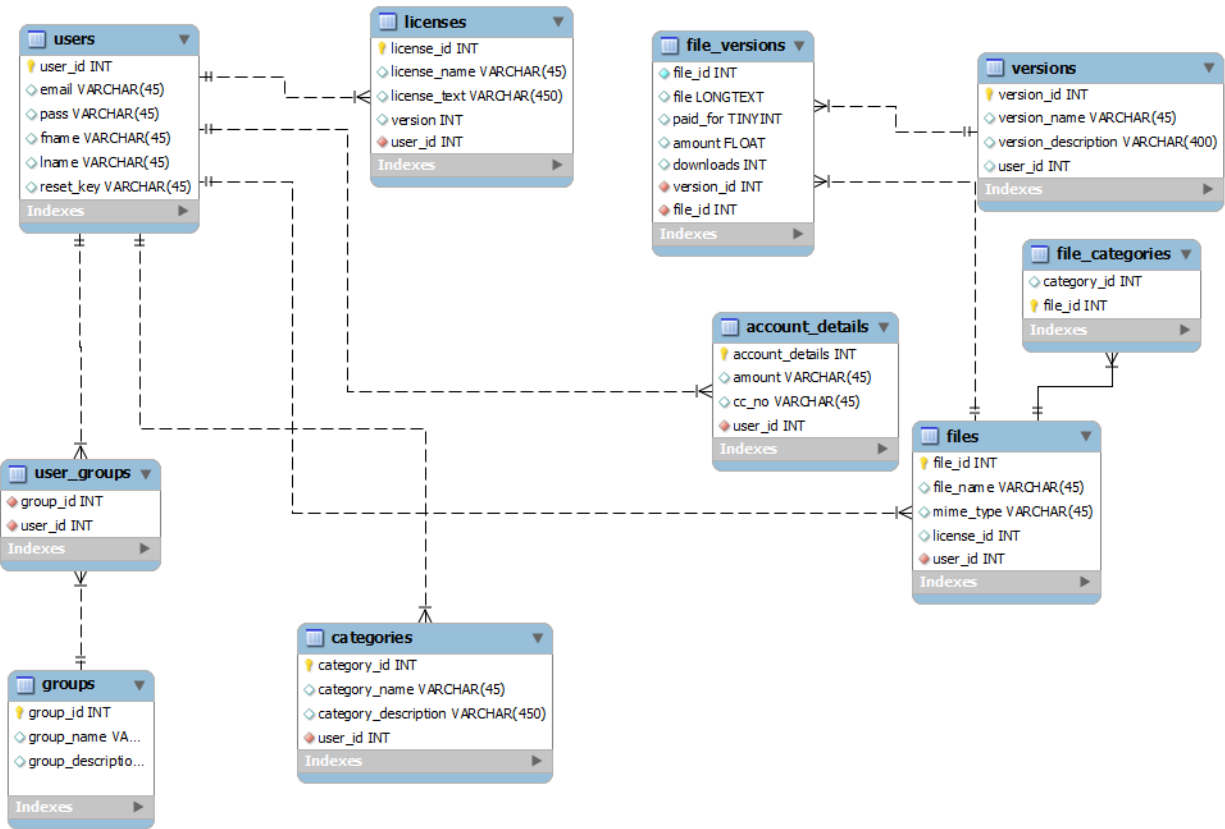


Figure 5.3: E-R Diagram

A database for storing the various system entities was designed. The database will hold categories, licenses, versions, user account details as well as files. The entity relationship diagram developed is as shown above.

#### ***5.4 Process Narrative***

P1: When users land on the page for the first time, they will be able to view content marked as public.

P2: Users will be required to register online in order to upload their own content.

P3: User interaction with the system will be through HTTP and HTTPS.

P4: Information entered by the user will be routed over the internet and stored on the server.

P5: Users will be allowed to change their information except for their email addresses, which will be uniquely used to identify individual users.

P6: Once a user is registered and his/her email address has been confirmed by the system, the user will be allowed to login using his/her new credentials.

P7: When a user logs in, he/she will be presented with a dashboard with a summary of his/her activities.

P8: The user can now upload his own content under an appropriate license.

P9: Uploaded content will be approved by the reviewer/ system administrator before it can be made public.

P10: Content uploaded on the site can now be moderated by the designated government ICT staff whose role will be to find useful content and have it utilized by the Government of Kenya. They will be using the reviewer's comments and quality of work and relevance to subject matter.

P11: The system will attempt to ease the work of the designated government ICT staff by allowing general users to rate content. Highly rated content will be assumed to be of high quality and the most relevant three will be displayed on the home page.

P12: The rating will eventually contribute to winning of prizes and winners will be picked on the 1<sup>st</sup> of every month.

## 5.5 Software Requirements and Configuration

Open source software was used to build this system. The web server and PHP Code editor were installed on the same computer. The software used included:

### 5.5.1 XAMPP Server

Xampp is software that has a combination of apache (Web Server), PHP (Scripting Language) and MySQL (Database) on it. This is a webserver and was installed for local web administration using MySQL database and Apache. The version of XAMPP used for this project is XAMPP 2.5. A database named Consys was created.

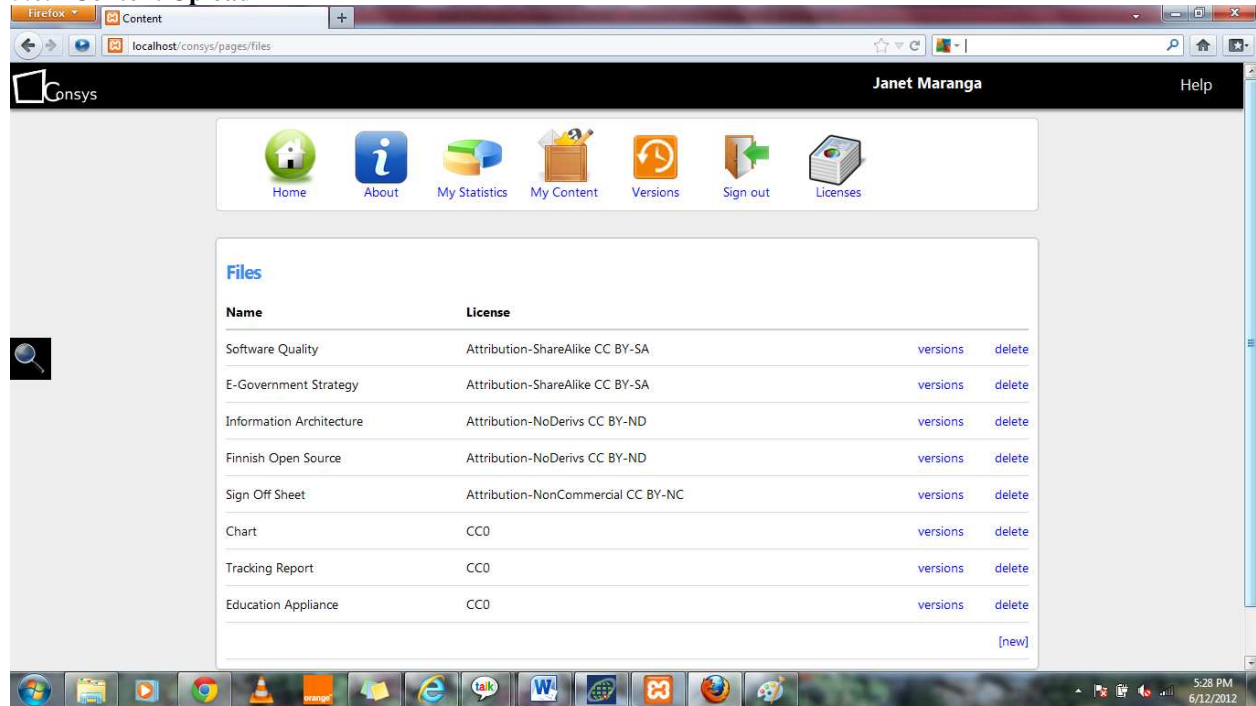
### 5.5.2 Code Igniter

Code igniter which is a powerful PHP framework with a very small footprint was used for coding and testing PHP scripts.

## 5.6 System Testing

Testing the functionality of the system was done to ascertain whether the system could upload files under various licenses and have them downloadable to facilitate sharing of CC licensed Open content. Various users signed up and shared content that could be moderated and then shown publicly to the government and to the world.

### 5.6.1 Content Upload



The screenshot shows a web browser window displaying a web application interface. The browser address bar shows the URL `localhost/consys/pages/files`. The application header includes the logo "Consys", the user name "Janet Maranga", and a "Help" link. A navigation menu contains icons for Home, About, My Statistics, My Content, Versions, Sign out, and Licenses. The main content area is titled "Files" and contains a table with the following data:

Name	License	actions
Software Quality	Attribution-ShareAlike CC BY-SA	versions delete
E-Government Strategy	Attribution-ShareAlike CC BY-SA	versions delete
Information Architecture	Attribution-NoDerivs CC BY-ND	versions delete
Finnish Open Source	Attribution-NoDerivs CC BY-ND	versions delete
Sign Off Sheet	Attribution-NonCommercial CC BY-NC	versions delete
Chart	CC0	versions delete
Tracking Report	CC0	versions delete
Education Appliance	CC0	versions delete

At the bottom right of the table, there is a "[new]" link. The Windows taskbar at the bottom shows the system clock as 5:28 PM on 6/12/2012.

Figure 5.4: Sample Test Data Output

## 5.6.2 Moderation Testing

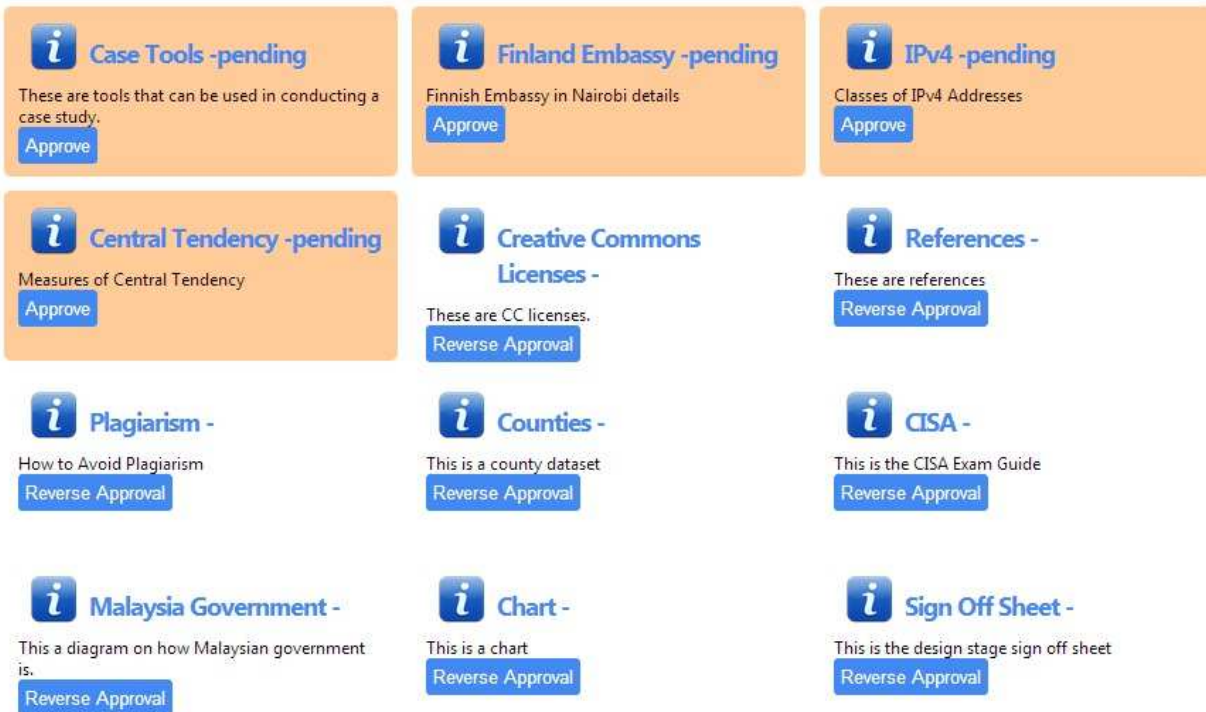


Figure 5.5 Moderation of Content

The moderation feature was tested to find out whether content that was put up could be moderated before being made publicly available to all the users of the system. All approved content would appear to the public but unapproved content would not be publicly visible to the public until the moderator approved it.

This study found that open content sharing with the appropriate licensing tools was feasible in the Kenyan context and there was a good match between the content creators/ citizens and content the government might need.

## 5.6.3 Validation Testing

### 5.6.3.1 Login Test

The validation of the log in was tested in the following way:

- entering invalid data into the fields
- pressing the login button
- checking that the login page is shown again
- entering valid data into the fields

- pressing the login button again
- checking that now the index page is shown

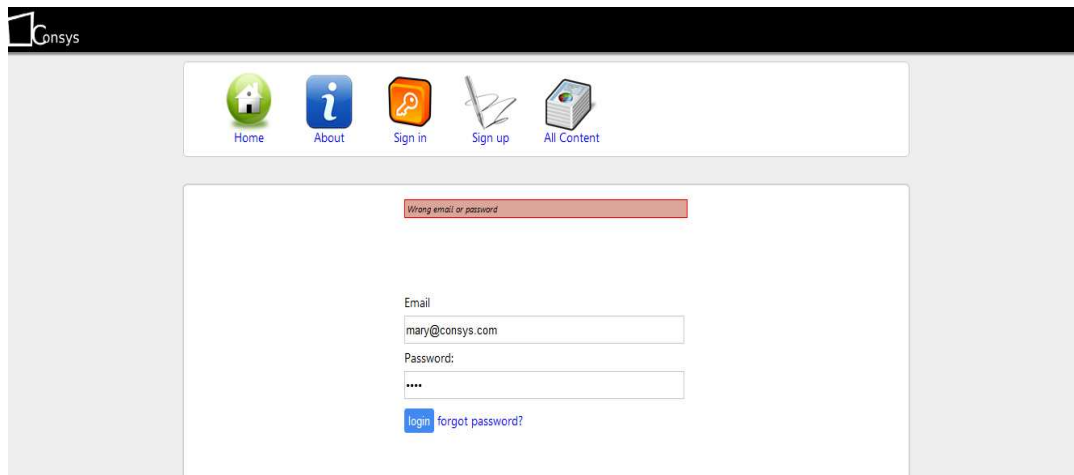


Figure 5.6: Login Test

## **CHAPTER SIX: DISCUSSION**

This section will discuss the implication of the results and the findings in relation to the research objectives, research framework and the methodology adopted in the study. This section is important in developing an understanding of the practical and theoretical implications of the results and findings.

### **6.1 Objectives**

This study has four objectives that collectively play a role in attaining the main aim. The first objective is to investigate current e-Government frameworks in use globally in relation to OSS. The findings reveal a number of governments in the world both developed and developing which have various formalized guidelines that govern both procurement and usage of OSS in government and its agencies. These guidelines take various forms such as mandating the adoption of OSS, undertaking research and development on OSS, developing comprehensive OSS policies among others. All these require input from different stakeholders.

The second objective of the study was to explore the flexibility of the current ICT policies and strategies in as far as adoption of OSS and CC licensed open content were concerned. Pursuant to this objective, top level e-government officials and decision makers were questioned in regard to the current status of these. The same questionnaire was presented to the officials. The questionnaire was informed by the research framework which had the aspect of organizational capability which partly consisted of the plans and policies required to support and maintain a high level of digital services in support of the e-government's mission. The findings reveal that most of the e-Government ICT heads felt that the e-Government strategy did not adequately deal with the matter of OSS use in e-Government. Furthermore, the findings reveal that the ICT heads strongly felt that if clear policy guidance on OSS procurement and usage was developed for the Kenyan e-Government, and further train officers on open source products, it would go a long way in enhancing the uptake of OSS software and the subsequent applications that could be built from it. These findings suggest that the e-Government officials needed to reconvene and work on some detailed guidelines on OSS procurement and policy which would inform the usage of OSS in e-Government and its various agencies. It is however noteworthy that it was indicated that there was a FOSS strategy paper which had been indicated to be in progress, but nothing had as yet been published.

The third objective was to determine a model that enables content sharing and utilization of CC licensed open content. For a system to attain this objective, it should be able to accept information and offer mechanisms for licensing it under various CC licenses, store this information in a systematic and easily retrievable way so as to be usable and provide information that is relevant to various users. An examination of summary statistics reveals that the system developed allowed users to log in to the system, upload content under any of the various CC licenses, input the version of their document as well as view their statistics in terms of downloads. The uploaded content did not automatically go public so as to avoid offensive and misleading content being shared on the site. To mitigate against this a moderator role was created on the system which allowed for all the content to be approved/ moderated

before being viewable on the site. This will go a long way in ensuring the content on the portal reflects well on e-Government and remains continually useful and relevant. The model incorporated a provision where users would be able to rate content that had been made public so that the top three apps and open content were displayed on the home (landing) page. A competition was also launched which would serve to encourage contributors of apps based on open source software as well as contributors of open content. It worked using the rating of the apps and content where the contributors of the top three most highly rated apps and open content would be awarded with various prizes on the first of every month. The portal also has filtering capabilities which make information uploaded on the portal be able to be filtered by Ministry (i.e the ministry they had been uploaded under) thereby making retrieving information easy and intuitive.

The fourth objective was to determine strategic interventions to enhance the adoption of OSS and CC licensed open content and disseminate them to the Kenyan government. This had to be initiated with finding out the current OSS situation in the government so as not to duplicate efforts in areas which had already been previously covered. In our survey, we investigated the extent of the deployment of OSS technologies in government departments and state agencies. Our investigation indicated that there was some indication of usage of Open Source OS's in the government as there was a deployment of Linux as an operating system on a scale of less than 10% of the Total Operating systems. Regarding open source software in general, the respondents from the e-Government cited that open source software were good only if the officers were trained on how to use them. This led to the realization that training on OSS technologies was vital in enhancing the uptake of OSS in the government as the users will already be having the skills necessary to run these kinds of systems. It also came out clearly from the research study that there was need for top level management support in open source spearheading so that it could be used to catalyze strategic change throughout the country.

## **6.2. Research Framework**

The research framework that informed this study had four major aspects which together enabled the researcher follow a systematic and scientific way in this research.

The questionnaires that were used for data collection were also informed by our research framework of choice.

**E-Government decision/ policy makers** – This was to find out about the organizational capability of the government in terms of the policies, plans strategies and management processes required to mandate the development of Open source software applications as well as actualize the content sharing for content licensed under the creative commons licensed open content.

**E-Government I.T Staff** – This was to get feedback on the enterprise architecture of the Government in terms of the desired relationships among business management processes and information technology. They will also shed light on the rules and standards for optimizing and maintaining IT investments which in this case are open source software applications and portfolios and content sharing enablers.

**Citizens** – This was for customer relationship Management to enable us find out what the citizens who were the customers in our case needed and learned how to meet and continuously improve customer service in relation to CC licensed open content delivery.

**Open source software developers** – As this was the skill base that was going to be utilized going forward various aspects such as their skillset in Open source software, their perception of the various features and functionalities and robustness of various Open source software among others were explored.

**Creators of Content** – This was to find out from the literate population their willingness to share any useful content they may have created over the years or had access to under various CC licenses and which way their participation could be elicited in the most optimal way.

A critical examination of the design of the system shows that the components included in the system have targeted the four main sections namely customer relationship management, organizational capability, enterprise architecture and security and privacy.

Utmost care was taken in order to present the collected expectations in their original way. This would provide strong basis for the Kenya government to find solutions and strategies for facilitating the uptake of open source applications as well as creative commons licensed open content in the light of collected data.

### ***6.3. Methodology***

In relation to the methodology, there are a number of limitations highlighted in the findings. First, the conclusion that the Content sharing portal enhances OSS and CC licensed open content is reached subject to a number of assumptions. This is largely a result of the use of prototyping rather than coming up with a full-fledged system design. Further studies should look into the possibility of including treatment, control groups and blinding to accurately determining the implication of such a system on OSS and CC licensed open content adoption in the government. The inclusion of these measures would reduce the need for subjecting the findings to a myriad of assumptions. Another factor is that there is need for increase in the users of the system to even semi-illiterate persons and those who might not be I.T literate. In the current study, the participants were exposed (or used the system) for a one week period. It is not clear if this period is enough for the respondents that were drawn from the literate population. Making the system simple and easily understandable would enable all the users with different skills to be fully aware of the functionalities of the system so that they can help ensure they enjoy the full benefits of the system and its limitations. These methodological issues have to be addressed by future studies.

### ***6.4 Strategic Interventions to enhance adoption of OSS and CC licensed content in the Kenyan***

#### ***Government***

It is evident from the results of this research that OSS and CC licensed content usage within the Kenyan government departments is not yet extensive. This has been occasioned by various challenges such as lack of OSS policies in Kenya to govern OSS procurement and use, lack of awareness of OSS software products and benefits, no central



point of support for OSS applications and so on. The proposed interventions are necessitated by the results of the survey suggesting that despite OSS having several good attributes and qualities and being very relevant in usage in the government both from an applications point of view as well as operating system; the uptake has been very poor.

Governments such as those in Germany, Malaysia and Australia have developed comprehensive guidelines (models) that are used by their departments to proliferate OSS usage within ministries.

However there are some interventions that could be put in place to be utilized as a possible solution in overcoming the challenges and obstacles encountered currently by various government departments, thus improve and proliferate OSS usage within ministries and departments of the government.

- i) **Proper planning** – The first intervention in improving OSS usage within the Kenyan government should be proper planning. It is vital that all OSS implementation information be developed where there is a lack of these as is the situation currently. Come up with OSS policies, strategies and benefits of OSS and share them with all relevant stakeholders such as top level management, ICT personnel (support and development staff), external ICT service providers, software vendors, end users and business partners. This is also essential in minimizing resistance and negative influence. An element that would be of valuable importance is awareness campaigns. Within this part, we suggest that different awareness campaigns be initiated in order to ensure that every stakeholder, particularly end users who are the customers of the government are directly and indirectly involved in the implementation process. This will help in minimizing user resistance. Delegate the tasks of OSS implementation to certain ICT personnel rather than to all staff in order to not disrupt support for proprietary systems.
- ii) **Target environment** - Commence OSS implementation on the server side as there will be fewer users involved when servers are being migrated to new systems.
- iii) **Open Standards** – Select OSS alternatives which will enable interoperability with other solutions but ease future systems migrations.
- iv) **Re-skill** – ICT personnel and end users in the government should be trained thoroughly on open source software policies so as to enable them be better placed in maintaining the new software.
- v) **Pilot projects** – To ensure smooth implementation, pilot projects should be undertaken in order to test, monitor and review selected OSS choices. From the research findings the Kenyan government is flexible in as far as piloting is concerned so this can enable trialing of OSS applications and systems within a small environment. These will prove less disruptive but should be performed in a live user environment.
- vi) **Initiating in-house OSS development** and customization projects and supplementing with the OSS developers – This would enhance the skills of these developers.
- vii) Ensure some of the personnel are responsible for upgrading to newly released versions and customizing

where applicable as these are not done automatically.

viii) Encourage developers to participate in various OSS activities such as in OSS forums, and global OSS projects which would in turn spill over to be utilized in government with some form of incentives.

ix) Provide a forum for citizens' participation in Government activities e.g. scale up the Content sharing Prototype and incorporate more features that will aid citizen participation.

x) Hold competitions on the content sharing portal in order to encourage software developers to compete to design and upload apps based on open source software to the portal for a chance to win fabulous prizes and CC licensed open content contributors to upload their content to the site and award prizes to the contributors of highly rated apps and content. Have a leader board which displays the names of the contributors of the best rated apps and content whereby earning a spot on the Leader Board will be a great achievement. This will motivate the contributors and engage citizens and ensure that they always strive to upload well thought out apps and content that will be useful in the Kenyan Government. This will encourage collaboration as well as visibility of the portal to more citizens and sharing as well as provide tangible and sustainable results which will reach a larger audience and can be used to facilitate the running of various sectors of e-government.

## **CHAPTER 7: CONCLUSION AND RECOMMENDATIONS**

### **7.1 CONCLUSION**

The motivation of this project was to come up with strategic interventions that would assist the Kenyan government adopt the use of Open source software applications and Creative commons licensed open content. Improving the content delivery method and awareness on the value of Open content for the Government and Government agencies as well as citizens and also linking open source software developers to the government would ensure full interaction between all these actors.

We believe the Kenyan government should be more proactive in drafting an open source policy and following the international developments in more detail. The government has an important function in signaling to software vendors what sort of standards and software are being needed in the public sector. Thus, we propose that the governments in the rich countries at large should in fact learn from the developing countries. More detailed and active open source policies for the different parts of the public sector can help in filling the current gaps in the software supply and demand. Both the local software companies and the public sector can potentially benefit.

This study found that it is possible for the citizens to provide open content to the government and also the developers would build various applications for the government under different agreements. This would greatly improve on information turn-around time within the government, its agencies and clients/ citizens.

### **7.2 FURTHER WORKS**

In the future, this work can be extended in the following directions:

#### **7.1.1. Knowledge management**

As Open Source Projects produce enormous amounts of data on mailing lists, web sites, repositories, in online communications, and other media and this data is very often dispersed across multiple sites and no one maintains it. Future efforts can be focused on extending the content sharing platform to have a knowledge bank where all this relevant information can be stored centrally. Also have staff in charge of maintaining this knowledge bank.

#### **7.1.2 Skill Matrices**

A central skill matrix can be included on the content sharing portal so that open source application developers and even contributors of CC licensed open content can classify themselves on a wide range of skills, the level they are at and their experience. This will make it easy to assess and plan resources as well as assign tasks on new open source projects and open content generation projects that the government may wish to undertake.

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Available at :< [http://people.itu.int/~kitaw/egov/paper/E-Government\\_in\\_Africa.pdf](http://people.itu.int/~kitaw/egov/paper/E-Government_in_Africa.pdf)>  
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## APPENDICES

### APPENDIX A: Questionnaires

#### **Strategic Interventions to enhance Open Source Adoption and Creative Commons licensed Open content in the Kenyan Government Questionnaire**

##### **Introduction**

Dear respondent,

This is a survey I am conducting in order to find out Strategic Interventions that can be used to enhance adoption of Open Source Software applications and Creative Commons licensed Open Content in the Kenyan Government . However, the research requires you as a participant to have some basic understanding on software, both open source and proprietary software. Your responses are very important in enabling me to gain a better understanding about this topic.

I am a student at University of Nairobi. School of Computing and Informatics. This is in partial fulfillment of my course. You have been selected to take part in this study. I would be grateful if you would assist me by responding to all the attached questions in the questionnaire. The questionnaire should take you about 20 minutes to complete.

You will be asked a few questions about your opinion on factors affecting open source software applications adoption and creative commons licensed open content in the Kenyan government. Participation in this study is fully voluntary and you have the right to withdraw at any time with no penalty. I treat your participation as anonymously as practically possible. All data is treated as confidential and will be used for academic research purposes only. Your responses and others will be used as the main data set for my research project for my Master's degree in Computer Science at the University of Nairobi. The results of the study will be made available to the Directorate of e-Government after I have completed the data analysis. I hope that you will find completing this questionnaire a pleasurable experience. If you have any question or would like further information, please do not hesitate to email me at [janetmaranga@gmail.com](mailto:janetmaranga@gmail.com). Thank you very much for your time.



**Questionnaire for E-Government ICT Heads**

1. Do you feel that the e-Government strategy deals adequately with the role of Open Source Software and CC licensed open content use in e-Government?

\*Government in this case refers to your Ministry, Agency or Department.

- YES
- NO
- I don't know
- Other:

2. Is there an OSS policy in place in your Ministry, Agency or Department? \*

- Yes
- No

3. Is Open Content licensing used in your Ministry, Agency or Department? \*

- YES
- NO
- Other:

4. Are Open Source systems or applications suitable for Government?

\*Government in this case refers to your Ministry, Agency or Department.

- YES
- NO
- I don't know

5. If your answer to #4 above is No, kindly state why not.

Select all that apply

- Support - No central point of support for Open Source Software
- Learning Curve - Training and learning time required for familiarity with Open Source Software is high
- Unique requirements already catered for by Proprietary Software
- No guarantee of Regular Updates
- Other:

6. Unix and/or Linux have been listed in the e-government strategy as some of the popular Operating systems for which standards will be developed. To what extent so far have these been deployed as part of the government's Operating systems? \*Government in this case refers to your particular Ministry, Agency or Department

- >10%
- 11-25%

26-50%

51-75%

<75%

7. Does the e-government strategy and/ or related policies have the flexibility to allow for pilot projects to be undertaken in order to test, monitor and review selected OSS choices that might be considered for implementation in Government?

\*The Government in this case refers to your Ministry, Agency or Department

YES

NO

8. What is the most commonly used software in your Ministry, Government or Department on the desktop side? \*Select all that apply.

Linux/ Unix

Microsoft Windows

Sun Solaris

Mac OS

I don't know

9. Which of these applications are currently being used in the Government? \*Government in this case refers to your Ministry, Agency or Department. Select all that apply

OpenOffice.org

KDE office

Microsoft Office

Squirrel Mail

Mozilla Thunderbird

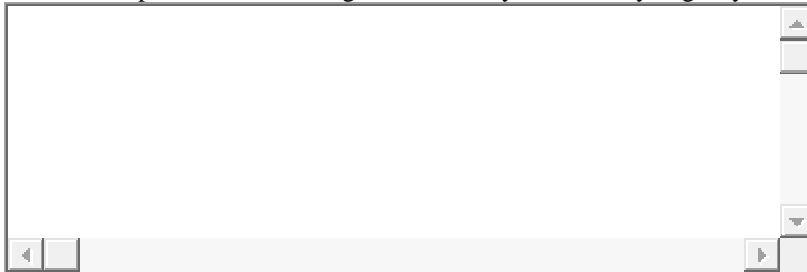
Mozilla Firefox

Internet Explorer

Other:

10. One of the medium term goals of the e-Government strategy is to increase the input of citizens into public sector decisions and actions. How is this being addressed currently?

\*You can explain how it is being addressed in your Ministry, Agency or Department.



11. Does the I.T training strategy currently in place in the e-Government for training Government personnel cover use of open source technologies?

\*You can explain how this is covered in your Ministry, Agency or Department

YES

NO

I don't know

12. Is there capacity in terms of skilled personnel who can be able to initiate in-house OSS development and customization projects? \*This is in your Ministry, Agency or Department

YES

NO

YES, But it can be supplemented when required.

13. In your opinion, what do you think can be done to enable more use of Open source software and all its benefits in e-Government?

14. Providing a forum for citizens' participation in Government activities is one of the specific objectives of the e-government. How is this being addressed currently in your Ministry, Agency or Department?

15. Do you envision participation of citizens in generation of useful content properly licensed for use in Government? \*

YES

NO

16. If yes to #15 above, please mention some categories of content that can be useful to your Ministry, Agency or Department. Kindly indicate your Ministry, Agency or Department in your answer.

17. Would your Ministry, Agency or Department be willing to offer some form of incentives to citizens who participate in useful content creation which can enhance service delivery? \*

YES

NO

18. If the answer to #17 above is YES, what form might these incentives most likely take? \*

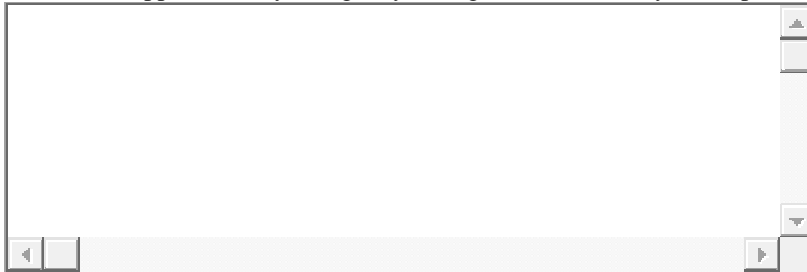
Monetary

Non-Monetary (NMR)

Other:

19. Please give your comments or suggestions about other ways citizens can take a more participatory role in enhancing the quantity and quality of services and material offered by Government. \*Government in this case refers to your Ministry, Agency or Department.

20. I would appreciate any thoughts you might like to add to your responses or to the topic in general.



21. Email (Optional)

Note:

Your personal detail will be kept confidential and will not be used for any other purpose apart from Academic Research purposes. Thank you for your kind cooperation.

### Questionnaire for E-Government I.T. Staff

1. In your opinion are Open Source Software Systems suitable for Government? \*Government in this case means your Ministry, Agency or Department

- YES
- NO
- Don't know

2. If your answer to 1 above is No, kindly state why not. \*Select all that apply

- Support - No central point of support for Open Source Software
- Learning Curve - Training and learning time for familiarity with Open source software is high
- Unique Requirements already catered for by proprietary software
- No guarantee of regular updates
- Other:

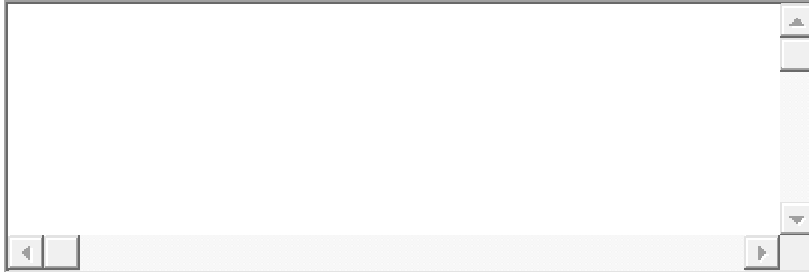
3. To what extent have Open Source Operating systems e.g Linux been deployed as part of your Ministry, Agency or Department's operating systems? \*

- >10%
- 11-25%
- 26-50%
- 51-75%
- >75%
- I don't know

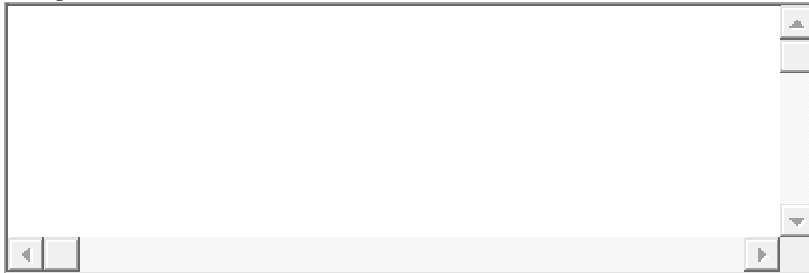
4. What is the most commonly used software in your Ministry, Agency or Department on the desktop side? \*Select all that apply.

- Linux/ Unix
- Microsoft Windows
- Sun Solaris
- Mac OS
- Don't know

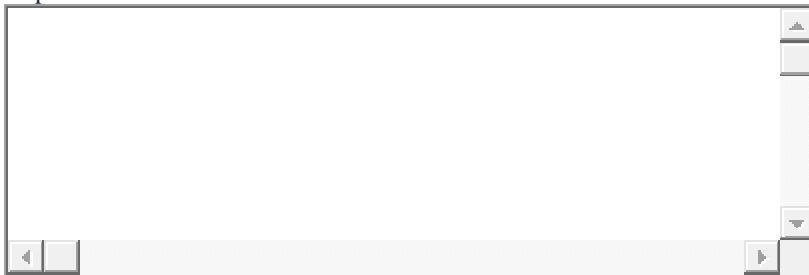
5. What is the most commonly used Operating System installed on the Servers in your Ministry, Agency or Department? \*e.g. Linux, Windows 2003 Server, Windows 2008 Server



6. What is the Web Server of choice in use in most of the servers in your Ministry, Agency or Department? e.g. Apache, Tomcat etc.



7. What are some of the considerations of Software choice to be deployed in your Ministry, Agency or Department?



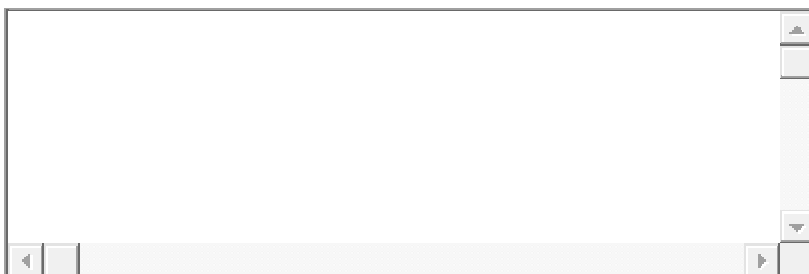
8. Have you faced any challenges in maintenance of I.T infrastructure in your Ministry, Agency or Department's services using any kind of Open Source technologies ?\*

YES

NO

Other:

9. If the answer to Question 5 above is YES, kindly mention what kind of challenges these were.



10. Why do you think the Government of Kenya might not be utilizing a lot of Open Source Software?

\*OSS - Open source software

- Lack of Awareness of OSS
- Absence of skilled manpower to train and support OSS
- Lack of capacity of OSS user support network
- Lack of OSS applications that are relevant for use by e-Government
- Other:

11. What is your proficiency in terms of capability to troubleshoot and provide support and effective maintenance for Open Source Applications being used by your Ministry, Agency or Department? \*

- Excellent
- Good
- Average
- Limited
- None

12. Would training/ seminars on Open Source Software use and benefits increase your proficiency? \*

- YES
- NO

13. In your opinion, what do you think can be done to enable more use of Open source software and all its benefits in your Ministry, Agency or Department?

14. Do you experience any drawbacks (in terms of availability of content or lack thereof) in the course of delivery of e-Government services provided by your Ministry, Agency or Department?

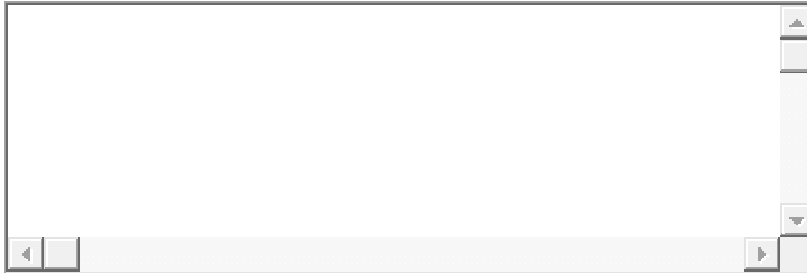
- YES
- NO

15. Do you think it would be helpful if you could be able to access data from a shared pool of digital content to supplement the content your Ministry, Agency or Department has to improve services that you provide? \*

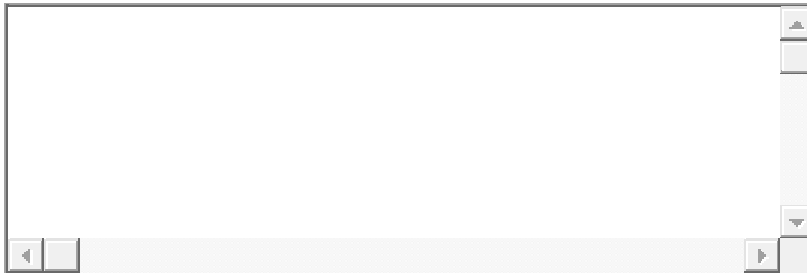
- YES

NO

16. If yes to #15 above, please mention some categories of content that can be useful to your Ministry, Agency or Department? Kindly also indicate the name of your Ministry, Agency or Department in your answer.



17. Give some brief measures that you think the Government of Kenya can take to create a culture of sharing useful digital content by content creators to be used in enhancing the Government services?

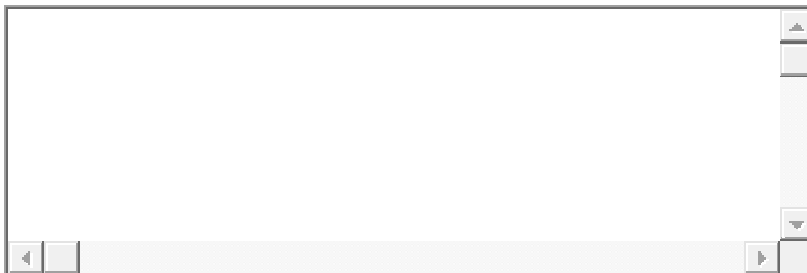


18. Has any of the training you have gone through at the Government covered the use of Open source technologies? \*

YES

NO

19. Please give your comments or suggestions about other ways in which citizens can take a more participatory role in enhancing the quantity and quality of material offered by e-Government in your Ministry, Agency or Department.



20. I would appreciate any thoughts you might like to add related to your responses or to the topic in general. (Kindly add below, if the space above is too limited)



21. Email (Optional)

Note: Your personal detail will be kept confidential and will not be used for any other purpose apart from Academic Research purposes. Thank you for your kind cooperation.

## Questionnaire for Citizens

### Brief explanation of Creative Commons licenses

CC licensed open content stands for Creative Commons licensed open content and it helps you share your knowledge and creativity with the world. CC licenses that work can be published under include:

Attribution alone (by)

Attribution + NoDerivatives (by-nd)

Attribution + ShareAlike (by-sa) Attribution + Noncommercial (by-nc)

Attribution + Noncommercial + NoDerivatives (by-nc-nd)

Attribution + Noncommercial + ShareAlike (by-nc-sa)

CC0 - a legal tool for waiving as many rights as legally possible, worldwide when releasing material into the public domain.

1. How often do you use the Internet? \*

Daily

Weekly

Monthly

Yearly

Other:

2. Do you create/ own content that you can share? \*Articles, Photos, Research material, Books etc

Yes

No

Not sure

3. If answer to 2 above is YES, what kind of content is it? \*Select all that apply

Articles

Photos

Books

Research Material

Educational content e.g Exam questions

Music

Other:

4. Are you willing to share this content after having licensed it accordingly with the government? \*

Yes

No

5. If yes in 4 above, how would you like to be compensated?

- Payment in Cash
- Payment by use of electronic means e.g MPESA
- Payment in kind e.g getting recognition countrywide as the creator of some content
- If my content sharing can assist in one way or other in advancing knowledge in Kenya
- If the research findings/ outcomes can be shared with me
- If the content sharing objectives are explained to me
- I am willing to share content free of charge
- Other:

6. If No in 4 above, kindly explain why

7. What do you think can motivate people (citizens and non-citizens of Kenya) to supply content they have licensed under CC licences to the GoK to allow the government to scale it up to be used countrywide? \*Select all that apply

- If they are paid in cash
- If they are given countrywide attribution and recognition
- If they are informed on the benefits of content sharing
- I don't know
- Other:

8. Are you concerned about security of content you may have licensed using CC licenses and shared with the government? \*

- Yes
- No

9. If appropriate security measures were put in place to secure your content (the one you've shared) you were assured that you would be attributed as per your license, would you share the content? \*

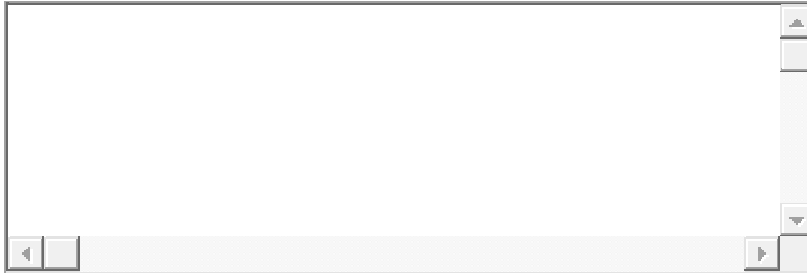
- Yes
- No

10. Have you ever used CC licensed content e.g MIT Open Courseware? \*

Yes

No

11. If yes, to 10 above, did you find it useful?



12. Do you envision more interaction and positive change in the government services once you share your CC licensed Open content with the GoK? \*

Yes

No

13. Do you use Social Media? \*

Yes

No

14. If yes to 13 above, please tick the ones you use

Facebook

Twitter

Google+

LinkedIn

MySpace

Flickr

Tagged

Other:

15. Have you ever shared any content (photos, notes etc) on any of these social media platforms?

Yes

No

16. If yes to 15 above, then to some extent you were sharing content. Did you realize this at the time?

Yes

No

17. Email

I would appreciate any thoughts you might like to add related to your responses or to the topic in general.

Note:

Your personal detail will be kept confidential and will not be used for any other purpose apart from academic research purposes. Thank you for your cooperation.

## Questionnaire for Open Source Software Developers

For the purpose of this survey, the particular focus is on PHP software.

1. Do you use Open Source Software to develop applications and systems? \*

YES

NO

2. Which FOSS environments do you have experience in? \*Please list all of them below.



3. Level of Expertise \*What is your personal experience level with this software?

No answer

1 - Beginner

2 - Novice

3 - Intermediate

4 - Skilled

5 - Expert

4. Learning Curve \*Do you think it is easy or hard to learn how to use Open Source Software as a developer?

1 - Very Hard

2 - Hard

3 - Average

4 - Easy

5 - Very Easy

5. Stability \*Do you think Open Source Software is stable and reliable for production use? (e.g few critical bugs)

1 - Very Unstable

2 - Unstable

3 - Fairly stable

4 - Stable

5 – Very Stable

6. Performance \*In your experience, how would you define the performance of Open Source Software?

1 – Very Fast

2 - Fast

3 – Fairly fast

4 - Slow

5 – Very Slow

7. Scalability \* In your experience, how would you define the scalability of Open Source Software?

1 – Very Poor

2 - Poor

3 - Average

4 - Good

5 – Very Good

8. Interoperability \*How would you define the integration of Open Source Software with other technologies?

1 – Very Hard

2 - Hard

3 - Average

4 - Easy

5 – Very Easy

9. Extensibility \*Is it easy to extend Open Source Software functionalities with external plugins/ add-ons?

1 – Very Hard

2 - Hard

3 - Average

4 - Easy

5 – Very Easy

10. Standards \*How would you define the Open Source Software support for widely adopted standards?

1 – Very Poor

2 - Poor

3 - Average

4 - Good

5 - Excellent

11. Documentation \*What do you think of the documentation of the Open Source Software? (e.g readability, completeness, quality, useful examples, etc)?

1 – Very Poor

2 - Poor

3 - Fair

4 – Good

5 – Very Good

12. Community Support \*How would you define the technical support for Open Source Software offered on the technical forums/ mailing lists?

1 – Very Poor

2 – Poor

3 - Fair

4 - Good

5 – Very Good

13. Frequency of Updates \*How would you define the new releases containing new features, improvements and bug fixes?

1 – Very Rare

2 - Rare

3 - Average

4 - Frequent

5 – Very Frequent

14. Why do you think the Government of Kenya is not using a lot of Open Source Software? \*

Lack of Awareness of Open Source Software

Absence of skilled manpower to build Open Source Software Applications

Lack of capacity of Open Source Software applications that are relevant

Other:

15. Do you think the Kenyan government should embrace and use more OSS applications? \*OSS - Open Source Software

YES

NO



16. What is your highest level of completed education? \*

17. Was FOSS part of this education?

Yes

No

18. Given a chance, would you build OSS applications to be used by the Kenyan e-Government? \*

YES

NO

19. If your answer to Question 15 above is YES, how would you like to be compensated?

20. If your answer to Question 15 above is NO, why wouldn't

you?

Comments

I would appreciate any thoughts you might like to add to your responses or to the topic in general

Email: (Optional)

Note:

Your personal detail will be kept confidential and will not be used for any other purpose apart from Academic Research purposes

**APPENDIX B: User Manual**



**Consys USER MANUAL**

## Introduction

This section will detail:

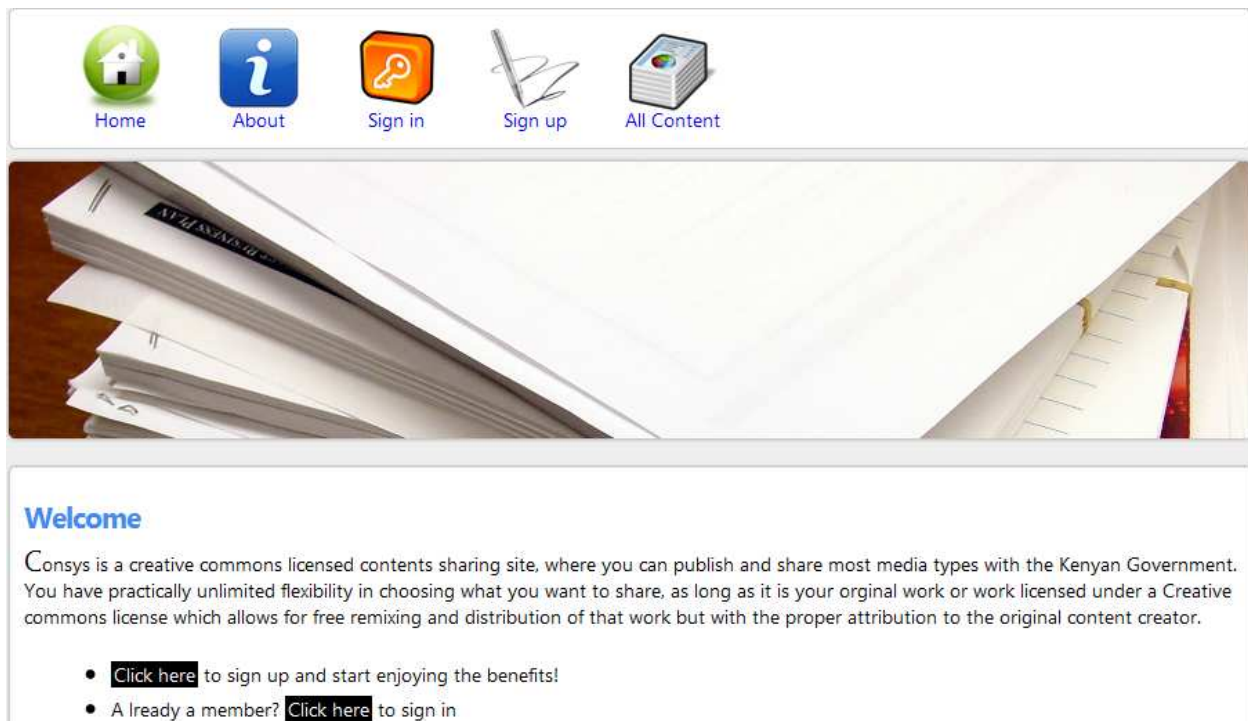
- How Users, Moderators and Administrators log in to the content sharing platform.
- An overview of the default buttons Consys uses.
- How to perform various tasks on Consys.

### How to Access the Home Page

In order to access the Consys Content sharing portal, type in the URL.

### How to Access the Portal as an Administrator

Input your Username and Password in their respective fields and click the Login button. The Control Panel (Home page) is displayed.



Home About Sign in Sign up All Content

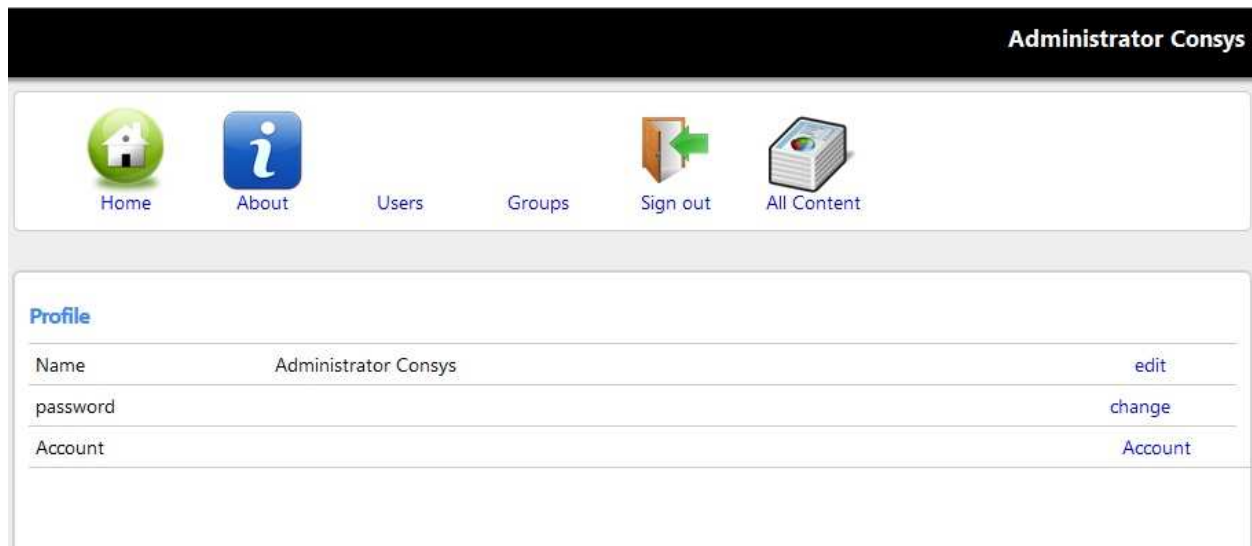
**Welcome**

Consys is a creative commons licensed contents sharing site, where you can publish and share most media types with the Kenyan Government. You have practically unlimited flexibility in choosing what you want to share, as long as it is your original work or work licensed under a Creative commons license which allows for free remixing and distribution of that work but with the proper attribution to the original content creator.

- [Click here](#) to sign up and start enjoying the benefits!
- A ready a member? [Click here](#) to sign in

As an administrator, log in with your credentials. Input your username and password.

This will be the landing page.






You can edit your profile by clicking on the 'edit' link.

To create and manage users and groups and perform other functional activities you click on one of the links as shown in the following screenshot and this will give you access to various sections of the administration interface.

## Users

The Users link does just what you might guess by its title. It manages users. You can create new users; delete existing ones, change passwords and so on. Lastly, but perhaps most importantly, you can change the user's user group, giving the user different access levels and different abilities in the portal.

Click on the 'Users' link and it will take you to the page illustrated below.

 Home	 About	Users	Groups	 Sign out	 All Content
---	--	-------	--------	---	---

users				
Email	First name	Last name		
mary@consys.com	Mary	Anne	Account	Delete
mod@consys.com	Consys	Moderator	Account	Delete
				[new]

To add a new user, click on the 'new' link and the page shown below will be displayed which will allow you to enter the credentials of the new user and assign them to the appropriate group.

#### User details and parameters

You will see different fields where you can fill in or edit information of the user. These are:

**E-Mail:** The e-mail address from the user is displayed here. When a user wants to log in, he has to fill in this email.

**Password:** Fill in a (new) password.

**Confirm password:** Fill in the password from the field above again, to verify it. This field is required when you filled in the Password field.

**Role:** The user's Group. The following Groups are available:

- **User:** Normal visitors who register at the site. Can view Menu Items and can submit articles.
- **Moderator:** Can review and approve articles to be published on the content sharing platform.



Home



About

Users

Groups



Sign out



All Content

### New government user

Email

Password:

Confirm password

Role:

Moderator

First name

Last name

save

### Adding New Groups

As an Administrator, you can be able to add groups with different rights and assign new users to new groups which you create. You can also be able to edit existing groups as is necessary.

[Home](#)[About](#)[Users](#)[Groups](#)[Sign out](#)[All Content](#)

## Groups

Group name	Group description		
User	Application user	<a href="#">edit</a>	<a href="#">delete</a>
Administrator	Application Administrators	<a href="#">edit</a>	<a href="#">delete</a>
Mod	Moderator	<a href="#">edit</a>	<a href="#">delete</a>
I.T. Staff	Application Maintainers	<a href="#">edit</a>	<a href="#">delete</a>
			<a href="#">[new]</a>

To add new groups, click on the new link and the page shown below will appear.

[Home](#)[About](#)[Users](#)[Groups](#)[Sign out](#)[All Content](#)

## New group

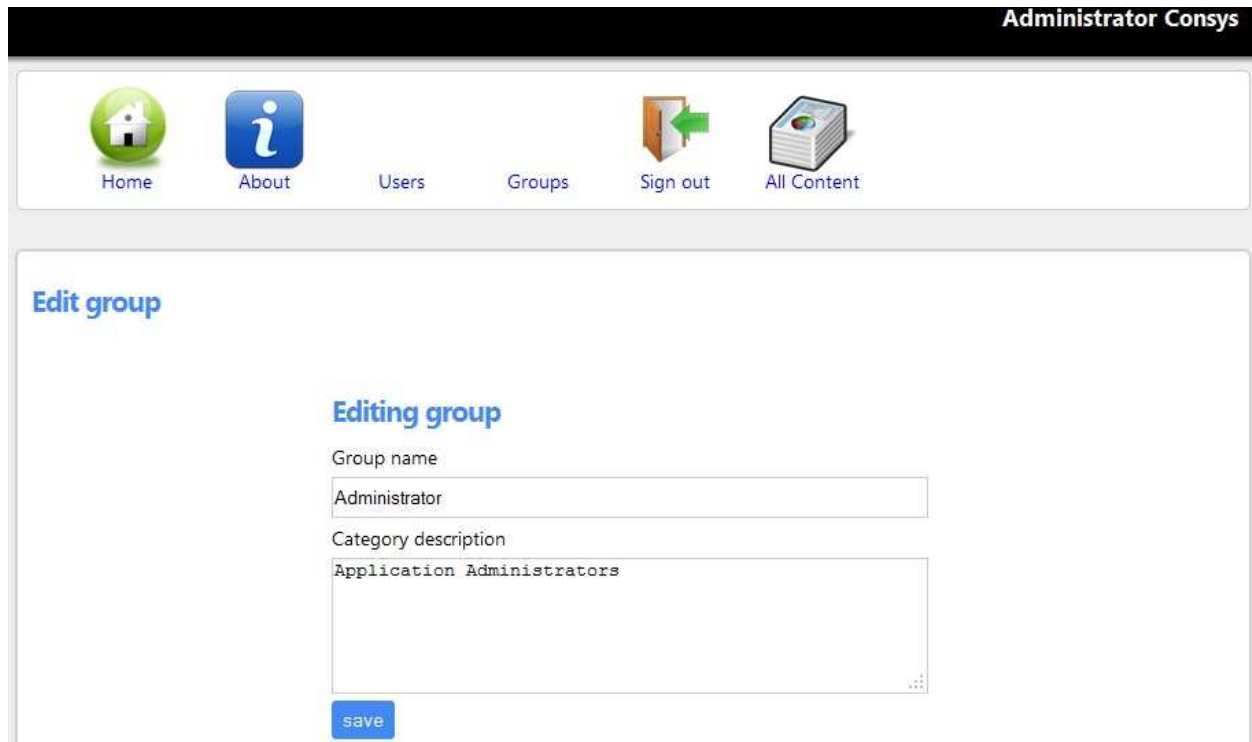
Group name

Category description

Enter the details of the new group which you wish to add and then click on Save.



To edit an existing group, click on the 'edit' link next to the group which you wish to change.



The screenshot displays the 'Administrator Consys' interface. At the top, a black header contains the text 'Administrator Consys'. Below this is a navigation bar with six icons and labels: 'Home' (house icon), 'About' (person icon), 'Users' (users icon), 'Groups' (groups icon), 'Sign out' (door with arrow icon), and 'All Content' (stack of papers icon). The main content area is titled 'Edit group' in blue. Underneath, there is a section titled 'Editing group' with two input fields: 'Group name' containing the text 'Administrator' and 'Category description' containing the text 'Application Administrators'. A blue 'save' button is located at the bottom of the form.

### Viewing Content

As an administrator, you can also be able to view all the content that has been uploaded on the portal by clicking on the 'All Content' link.



Home



About

Users

Groups



Sign out



All Content

Filter: search

Pick a Ministry

Filter



**Creative Commons Licenses -**

These are CC licenses.



**Malaysia Government -**

This a diagram on how Malaysian government is.



**Sign Off Sheet -**

This is the design stage sign off sheet



**E-Government Strategy -**

This is the Kenyan e-Government Strategy



**MSc Guidelines -**

These are the MSc guidelines.



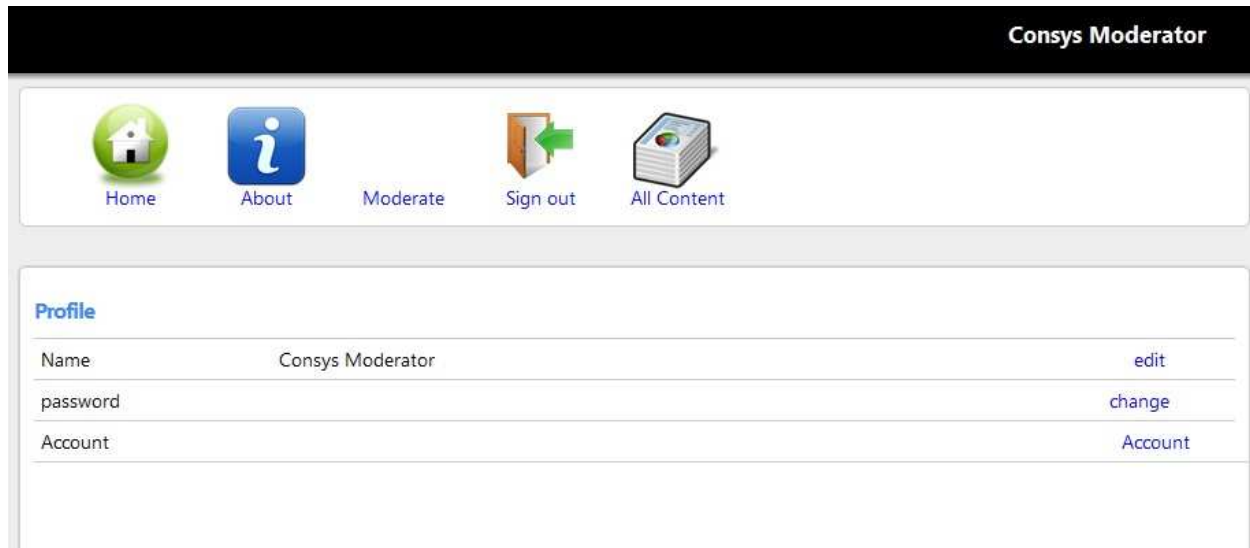
**Transmission Media -**

Different transmission media

You can also be able to filter the content which has been uploaded by a specific Ministry or search for specific content.

## How to Access the Portal as a Moderator

Input your Username and Password in their respective fields and click the Login button. The Home page is displayed.



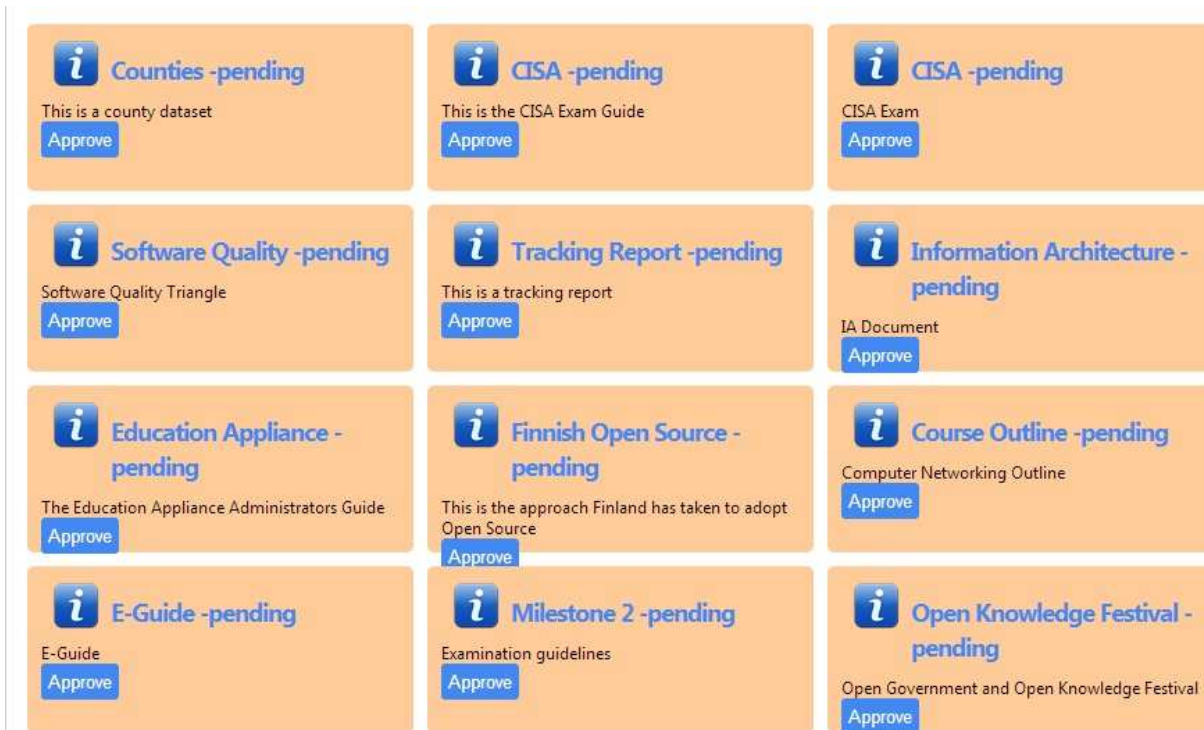
You can edit your profile or change your password from here.

## Moderation

The role of the moderator is to review all the content that has been uploaded on the content sharing portal and approve it for general viewing on the portal.

In order to moderate the content on the portal, click on the 'Moderate' link.

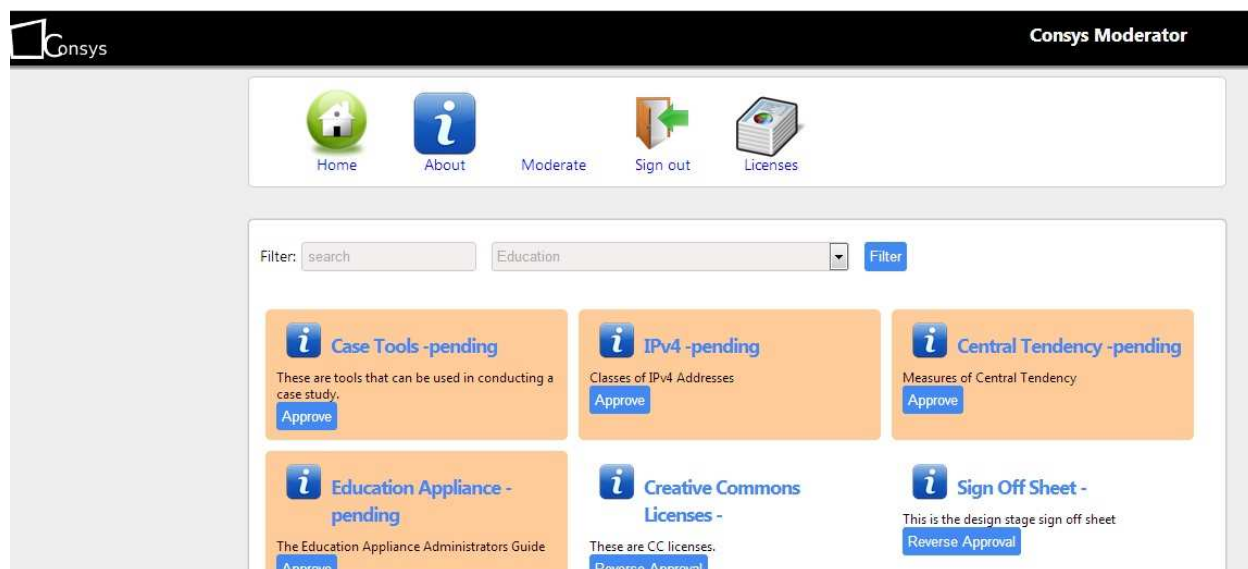
Once you click on the link, the following screen will appear.



To moderate content, click on the 'Approve' link on the specific content that you would wish to approve for general viewing on the site. You can be able to reverse the approval at any time by clicking on the 'Reverse Approval' link for any content.

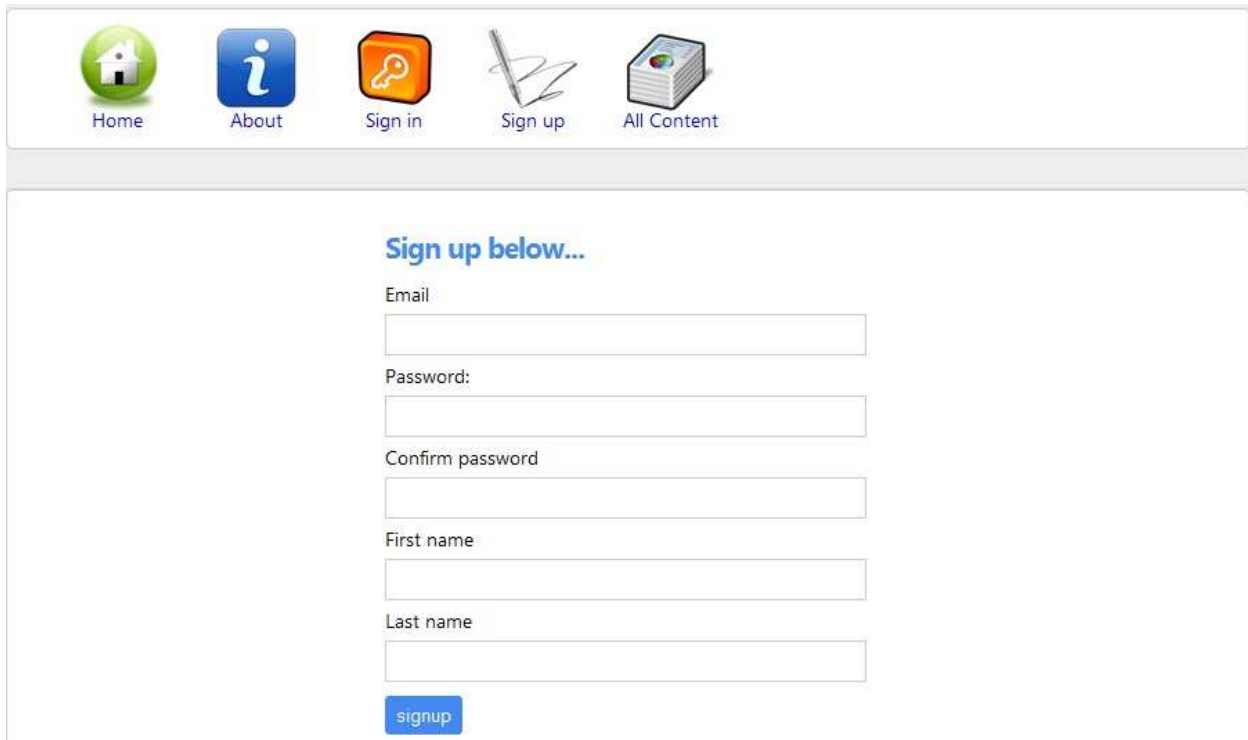
Approved content will not be highlighted but all Unapproved content will be highlighted as depicted above.

You can also be able to filter the content per ministry as shown below for moderation



## How to Access the Portal as a User

In order to upload your content as a user, Sign up on the content sharing platform as shown below by filling in your details.



**Sign up below...**

Email

Password:

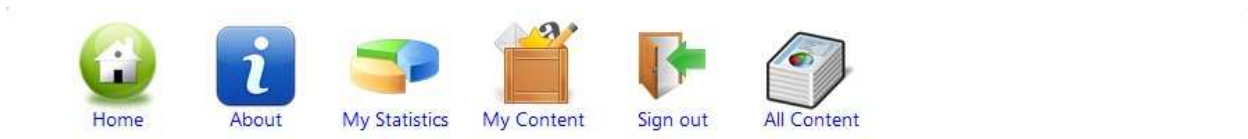
Confirm password

First name

Last name

## Getting around the Portal

Navigating the portal interface from anywhere within the content sharing site is accomplished by a global menu bar to guide you through the various areas of the portal. Located at the top of every screen (which is why we refer to it as global) the links are named according to the areas they lead to. The global menu bar is as shown in the following screenshot:



## Home

This takes you back to the Home page which contains links to all of the key site areas, which include the following:

- Top Rated Content
- Versioning information
- Licensing details among others.

## About

This links takes you to the section where you can get information on what Consys is all about and what to expect from it.







## My Statistics

This takes you to a page where you can see a list of all the content that you have uploaded on the Consys content sharing portal, the license with which you licensed your work as well as the number of times your content has been downloaded.

Files			
Name	License	Downloads	
CISA	Attribution-NonCommercial-ShareAlike CC BY-NC-SA	0	<a href="#">versions</a>
Malaysia Government	Attribution-NonCommercial CC BY-NC	1	<a href="#">versions</a>

## My Content

All the information that you have uploaded on the site and has been approved by the moderator can be viewed through here.

[Home](#) [About](#) [My Statistics](#) [My Content](#) [Sign out](#) [All Content](#)

### Files

Name	License		
Peeling back the Mask	Attribution-ShareAlike CC BY-SA	<a href="#">versions</a>	<a href="#">delete</a>
Sality Reg Keys	Attribution-ShareAlike CC BY-SA	<a href="#">versions</a>	<a href="#">delete</a>
Sality Killer	Attribution-NoDerivs CC BY-ND	<a href="#">versions</a>	<a href="#">delete</a>
Malaysia Government	Attribution-NonCommercial CC BY-NC	<a href="#">versions</a>	<a href="#">delete</a>
			<a href="#">[new]</a>

## All Content

This is the link via which you can see all the content that has been published on the portal, not just by you but by other users as well. It will appear as shown below.

Filter:

Pick a Ministry

[Filter](#)

 **Creative Commons Licenses -**

These are CC licenses.

 **CISA -**

This is the CISA Exam Guide

 **Malaysia Government -**

This a diagram on how Malaysian government is.

 **Sign Off Sheet -**

This is the design stage sign off sheet

 **E-Government Strategy -**

This is the Kenyan e-Government Strategy

 **MSc Guidelines -**

These are the MSc guidelines.

 **Transmission Media -**

Different transmission media

 **E-Govt Strategy -**

Kenyan E-Gov Strategy

 **Peeling back the Mask -**

Peeling back the Mask by Miguna Miguna

 **Salinity Killer -**

Salinity Killer

 **Salinity Reg Keys -**






Salinity Reg Keys



## Help

A comprehensive list of terms and key phrases are contained within a database of information. This is the site-wide Help database and contains broad information for all areas of the site. It is available on most of the pages on the content sharing portal.

Close

	<b>Content</b> Here you are offered the facility of submitting your high quality original articles and content licensed using any one of the various Creative Commons licenses for use by the Kenyan government which will increase exposure of your work as well as have your work have a greater impact in the society at large.
	<b>Statistics</b> Here you can monitor download statistics generated by your files and content that you have uploaded on the portal.
	<b>Versions</b> This is where the provision for adding versions to your work is permitted. Therefore you can use an incrementing value to indicate various versions of the same file you might want to upload on the portal. An old copy of your file will still be maintained in the portal. You also have the flexibility of deleting any of your files in case you deem it obsolete or have a revised version which supersedes the older one.
	<b>Categories</b> These are the various categories under which you can publish your work on the portal. In case a category that you wish to publish your work under is not listed here, you can suggest it to the Portal Administrator who will review it and then add it.
	<b>Licences</b> The Creative Commons copyright licenses and tools forge a balance inside the traditional "all rights reserved" setting that copyright law creates. These tools give everyone from individual creators to large companies and institutions a simple, standardized way to grant copyright permissions to their creative work. The combination of these tools and our users is a vast and growing digital commons, a pool of content that can be copied, distributed, edited, remixed, and built upon, all within the boundaries of copyright law. For more information, <a href="#">Click Here</a>

Click on close once you finish and you will be taken back to the page you were on before you clicked on 'help'.

## Uploading New Content

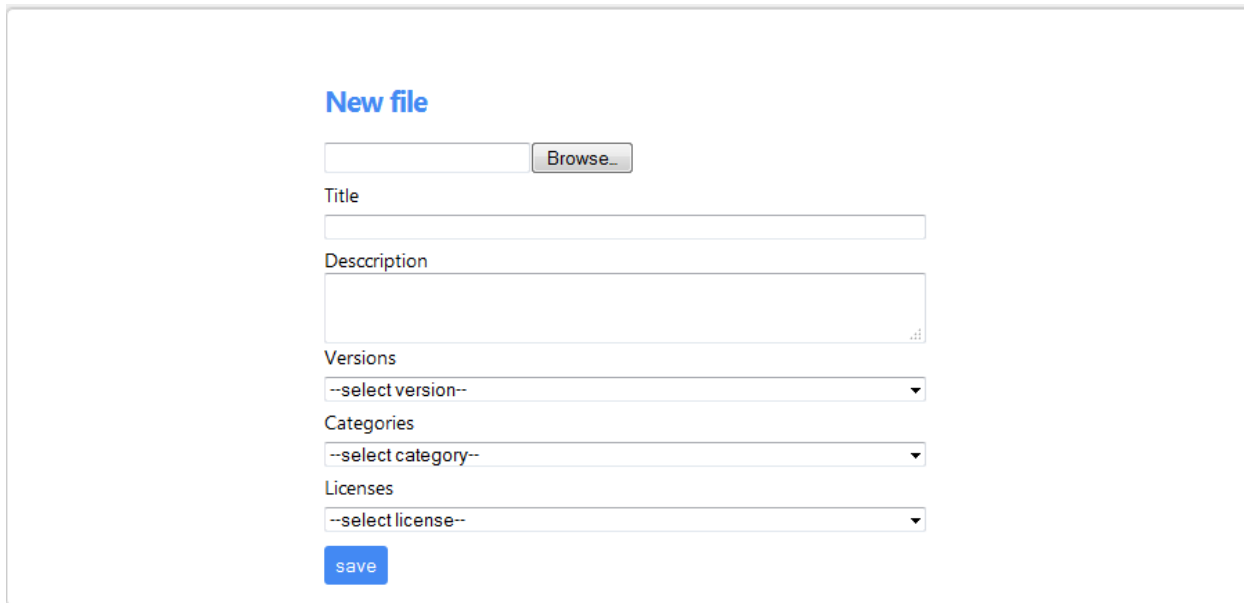
To upload new content on the portal, click on the 'My content' link. Then click on the 'New link' as shown below.

### Files

Name	License		
Peeling back the Mask	Attribution-ShareAlike CC BY-SA	<a href="#">versions</a>	<a href="#">delete</a>
Sality Reg Keys	Attribution-ShareAlike CC BY-SA	<a href="#">versions</a>	<a href="#">delete</a>
Sality Killer	Attribution-NoDerivs CC BY-ND	<a href="#">versions</a>	<a href="#">delete</a>
Malaysia Government	Attribution-NonCommercial CC BY-NC	<a href="#">versions</a>	<a href="#">delete</a>

[\[new\]](#)

This will open the page shown below. Select the file or zipped folder containing your content or application from your computer, fill in the title in the title field, type in a short description of your article or application. Select the Version, category (ministry) and last but not least the CC license with which you are sharing your work. Then click on save.



**New file**

Title

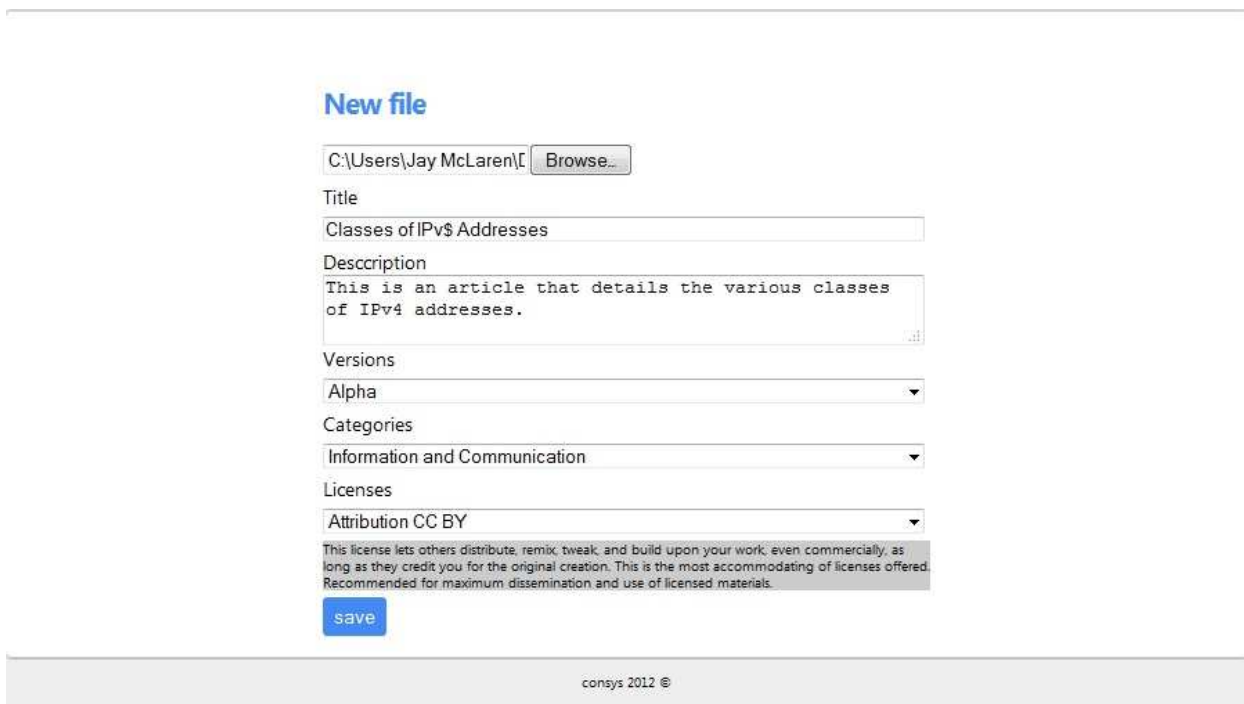
Description

Versions  
--select version--

Categories  
--select category--

Licenses  
--select license--

A filled in upload section would look as follows.



**New file**

C:\Users\Jay McLaren\ [  ]

Title  
Classes of IPv4 Addresses

Description  
This is an article that details the various classes of IPv4 addresses.

Versions  
Alpha

Categories  
Information and Communication

Licenses  
Attribution CC BY

This license lets others distribute, remix, tweak, and build upon your work, even commercially, as long as they credit you for the original creation. This is the most accommodating of licenses offered. Recommended for maximum dissemination and use of licensed materials.

consys 2012 ©

Once you click on Save, your content will be saved in the database. But it can only be visible on the website once the moderator has reviewed and approved it.

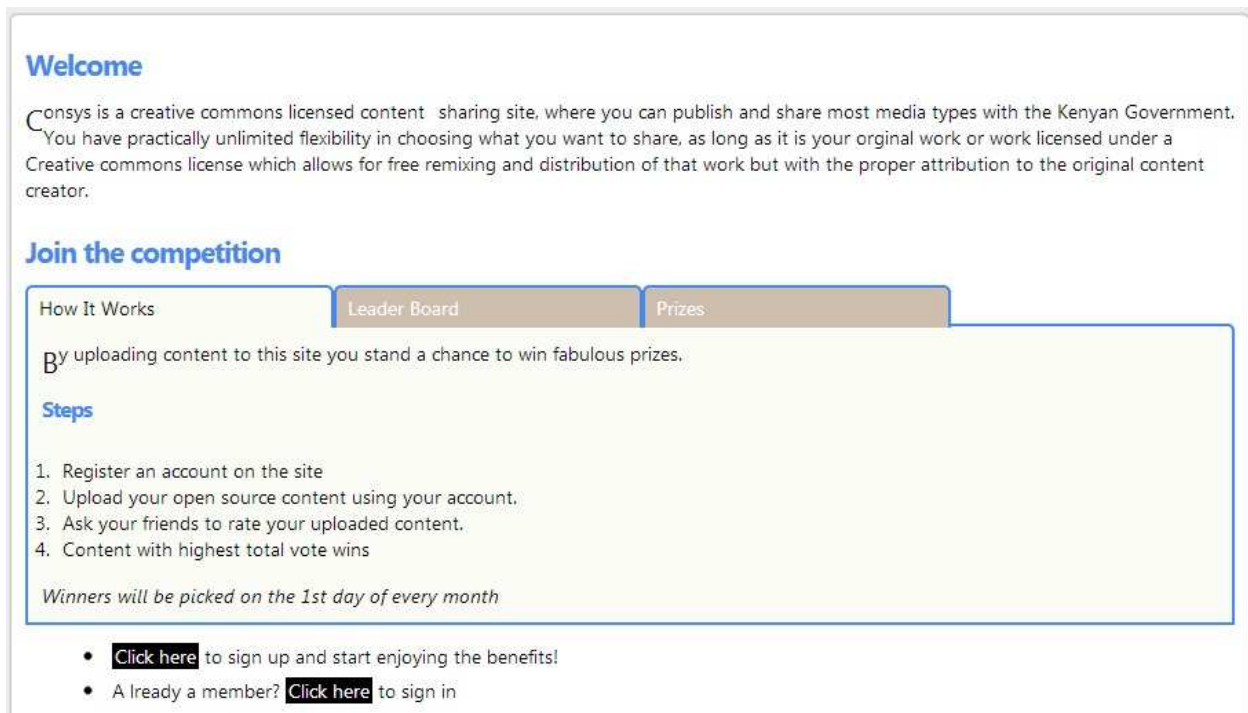
But you can keep track of your uploaded content by using the Statistics section where you can be able to view all the content that you have uploaded on the site and how many times your work has been downloaded.

<b>Files</b>			
<b>Name</b>	<b>License</b>	<b>Downloads</b>	
CISA	Attribution-NonCommercial-ShareAlike CC BY-NC-SA	0	<a href="#">versions</a>
Malaysia Government	Attribution-NonCommercial CC BY-NC	1	<a href="#">versions</a>
Open Knowledge Festival	Attribution CC BY	0	<a href="#">versions</a>
Sality Killer	Attribution-NoDerivs CC BY-ND	1	<a href="#">versions</a>
Sality Reg Keys	Attribution-ShareAlike CC BY-SA	0	<a href="#">versions</a>

## Competition

### How to enter the competition

The content sharing platform also offers you a chance to win fabulous prizes by participating in uploading open content as well as apps based on OSS. All you need to do is follow the instructions on the home page as highlighted below.



The screenshot shows a webpage section titled "Join the competition". At the top, there is a "Welcome" heading followed by a paragraph explaining that Consys is a Creative Commons licensed content sharing site. Below this, there is a "Join the competition" heading. Underneath, there are three tabs: "How It Works", "Leader Board", and "Prizes". The "How It Works" tab is active, showing a paragraph stating that by uploading content, users stand a chance to win prizes. Below this is a "Steps" heading followed by a numbered list of four steps: 1. Register an account on the site, 2. Upload your open source content using your account, 3. Ask your friends to rate your uploaded content, and 4. Content with highest total vote wins. A note states "Winners will be picked on the 1st day of every month". At the bottom, there are two bullet points: "Click here" to sign up and start enjoying the benefits! and "A ready a member? Click here" to sign in.

**Welcome**

Consys is a creative commons licensed content sharing site, where you can publish and share most media types with the Kenyan Government. You have practically unlimited flexibility in choosing what you want to share, as long as it is your original work or work licensed under a Creative commons license which allows for free remixing and distribution of that work but with the proper attribution to the original content creator.

**Join the competition**

How It Works | **Leader Board** | Prizes

By uploading content to this site you stand a chance to win fabulous prizes.

**Steps**

1. Register an account on the site
2. Upload your open source content using your account.
3. Ask your friends to rate your uploaded content.
4. Content with highest total vote wins

*Winners will be picked on the 1st day of every month*

- [Click here](#) to sign up and start enjoying the benefits!
- A ready a member? [Click here](#) to sign in

### Leaderboard

The Leader Board displays the top six rankings of the leading content contributors to the portal. Ranks are based on the points that users achieve in each of their uploaded items that have been rated. That is, the highest position on the Leader Board at any particular time is given to the user whose app or content has achieved the highest points. The Leader Board only keeps track of the six highest scores. Therefore, earning a spot on the Leader Board is a great achievement, and the top three users are awarded for doing so on the 1st of every month.

## Welcome

Consys is a creative commons licensed content sharing site, where you can publish and share most media types with the Kenyan Government. You have practically unlimited flexibility in choosing what you want to share, as long as it is your original work or work licensed under a Creative commons license which allows for free remixing and distribution of that work but with the proper attribution to the original content creator.

## Join the competition

Name	File Title	File Description	Total Points
1 Ann Consys	MSc Guidelines	These are the MSc guidelines.	40
2 Janet Maranga	Creative Commons Licenses	These are CC licenses.	38
3 Well Ness	CISA	This is the CISA Exam Guide	36
4 Janet King	Malaysia Government	This a diagram on how Malaysian government is.	30
5 Anna Lora	Transmission Media	Different transmission media	25
6 Janet Maranga	Chart	This is a chart	23

## Prizes

The prizes that users will compete for are:

**Top prize:** A Samsung S3 phone, **Runners up:** A Samsung Galaxy Tab 2, **Third Prize:** A Samsung Galaxy Young phone. These are great prizes, so the more your friends rate your app or content, the higher your chances of winning.

The prizes are as shown below.

How It Works	Leader Board	Prizes
		<p><b>1st Prize</b></p>  <p><b>Key Features</b></p> <ol style="list-style-type: none"><li>1. HD Super AMOLED, 4.8" , 1280 x 720, 306 PPI with Gorilla Glass 2.0</li><li>2. Android Ice Cream Sandwich 4.0</li><li>3. 8 megapixels with LED, autofocus, records video</li><li>4. 3G, HSPA+, 4G LTE (and WiFi)</li></ol>
		<p><b>2nd Prize</b></p>  <p><b>Key Features</b></p> <ol style="list-style-type: none"><li>1. 1GB (RAM), 16/32GB (ROM) + microSD (up to 32GB)</li><li>2. 1.2GHz dual-core processor</li><li>3. Built-in 4,000mAh battery</li><li>4. Back camera : HD(720p) Video recording, 3MP auto-focus camera with LED flash)</li></ol>
		<p><b>3rd Prize</b></p>  <p><b>Key Features</b></p> <ol style="list-style-type: none"><li>1. Android v2.3.5 (Gingerbread)</li><li>2. 832MHz Processor</li><li>3. TOUCHWIZ v3.0 User Interface (up to 7 pages widget desktop)</li><li>4. User Memory: 160MB</li></ol>