

DESIGN AND DEVELOPMENT OF A WEB-BASED COLLECTIONS MANAGEMENT SYSTEM

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Author: Sam Chilapu

Dept. of Information and Communication Technology
School of Engineering
Information and Communications University
Lusaka, Zambia
Email: samchilapu@gmail.com

Co-author: Dr. John Mupala

Dept. of Information and Communication Technology
School of Engineering
Information and Communications University
Lusaka, Zambia

ABSTRACT

The use of ICTs by way of developing a Web-based Museum Collections management System can go long way in improving the management of museum collections as well as provision of services to clients. Museum Collections Management System is a system that can be used by museum and any art gallery, private or public to manage their collections. The system is ideal because being a web-based it entails that users can use the system while in the field or comfort of their homes. The system can contribute to cost reduction that arises from stationery usage in terms of printing information. Users can access information provided they are online. A survey was carried out at Lusaka National Museum where employees were targeted. Questionnaires were distributed in order to help gather data. It was found out that 75% of respondents were not aware of the Museum Collections Management System while 25% were aware and these were mainly from management. The system that was available was a manual collections management system. The risks of not having a web-based collections management system were observed from the survey that was carried out. The system was developed using agile

development model because it allows for input from customers as the system is being development thus avoiding rejection of the system at the end. The tools that were used to develop the system included HTML 5, MySQL, JAVASCRIPT and PHP. It is envisaged that this system will help the institution in minimizing the cost of managing collections (objects) together with its related information. The costs incurred on stationery will be reduced as well as deployment of several human resource as the case is with manual system will be reduced.

Keyword: Collections, Museum, Museum Collections Management System, Modules, Database

CHAPTER 1 INTRODUCTION

1.0 Introduction

This chapter gives a perspective of the background of the study, statement of the problem, objectives of the study, and significance of the study.

Museums now have a new identity in 21st century. According to Setlhabi (2008), states that the coming of technology has made museums change their face and are now being referred to as digital museum, virtual museums, hybrid or museums without walls. The use of technology has not only changed the perception of museums but also has also transformed information storage and retrieval procedures. Further, the use of technology has helped to improve internal management of collections and the related information. This therefore hastens to mention that technology has allowed members of staff carryout office duties away from office. Museum specialists have emphasized the need to adopt and implement electronic systems that are in line with the collections management mandate of their museums because the rationale is not for change but for enhancement.

Cultural heritage collections require uttermost care and protection in order to ensure safety from loss or damage. Thus, museums shifted from traditional approaches which were designed on the premise of manual communication system to electronic communication approach. (Ambrose and Paine (2012) asserts that it can be argued that Information and Communication Technology (ICT) application in museums has contributed significantly towards wide accessibility and presentation of cultural information by museums in different formats as a result this has enhanced the general appreciation of the role of the museum in the societies.

Museums in Zambia mainly use manual collections management system. The research therefore aimed at assessing the efficiency of Museum Collections Management System (MCMS) towards the retrieval of objects and information.

1.1 Motivation and significance of study

The research aimed at designing and development of a Museum Collections Management System. The finding of the research was used to design a Web-based Collections Management System that would be able to overcome the change of the manual system being used.

Furthermore, the research findings may also be a source of reference by other researchers intending to study and understand the relevance of Museum Collections Management Systems. Museums being research institutions such a system could be of help in quick retrieval of the needed information. Furthermore, it is envisaged that the study will also persuade museum management to consider formulating and implementation an in-house ICT policy. The research is also a partial requirement towards academic fulfillment for an award of a Master's degree in Information Communication and Technology.

1.2 Scope

The research was conducted from Lusaka national museum in Lusaka, the capital City of Zambia. Lusaka National Museum is situated in Kamwala at Government complex. It is about three (3) kilometers away from the central business district of the capital, Lusaka, Zambia. The baseline study was as well carried out from Lusaka national Museum. The finding of the research were used to design and develop the Web-based Museum Collections management System. The system is meant to help museum employees locate and retrieve objects and

related information in a timely manner in order to serve clients efficiently and effectively. Under the loaning system, the system is designed to send a reminder to institutions that borrow objects. The Web-based Collections management System is user friendly and will allow users to interface with the system easily.

1.3 Statement of the problem

International Council of Museums (2007) defines museums as organizations that hold cultural materials and information which researchers and the general public access for reading and referencing purposes. National Museum Board (2016) also indicates that the challenge members of staff experience is that of quick location and retrieval of objects and information sources in their custody. Although museums have collection registers and cards designed to help mitigate the problem of locating and quick retrieval of information, the problem still remains obvious. It is envisaged that the use of Web-Based Collections Management System could help mitigate this problem.

1.4 Objectives

1.4.1 General Objective

- To design and develop a Web-based Museum Collections Management System for quick retrieval of information by members of staff.

1.4.2 Specific Objectives

- I. To find out the system used in the management of museum collection (objects)
- II. To collect data on the functional requirements of system to be developed
- III. To design and develop a system that will efficiently locate and retrieve information from the database

1.4.3 Research questions

- I. What system is used in the management of museum collections
- II. What are the functional requirements for the collections management system?
- III. Is it possible to design and develop a Web-based Collections management System for use in Museum?

1.5 Research Contribution

The researched on the development of a collections management System which is intended to be used to manage museum collections. Museums have been facing challenges of retrieving of objects and related information and use it for intended purpose in an effective and efficient manner. Unfortunately, the manual system being used has not been effective as expected. The use of a web-based collections management system is envisaged that will help mitigate the disadvantages of the current system.

1.6 Organization of the thesis

This thesis comprises five chapters. Chapter one has the introduction, motivation and significance of study, statement of the problem, general and specific objectives. The chapter ends with an outline of the thesis. From there the thesis has chapter two which looks at literature review. The chapter looks at works done by other researchers on the same topic. It then ends with prototype of the collections management system. The thesis goes further to look at chapter three. This chapter delves into the methodology that was used in the survey. This is a baseline study that was carried out at Lusaka National Museum. Chapter four is the next chapter of this research work. It basically looks brings out the findings of the study and discusses them in order to make meaning out of them. Chapter five deals with the conclusion of the thesis. It also recommends some future works.

1.7 Summary

This chapter dealt with the basic introduction of the work in the thesis. The thesis started by looking at the concepts of collections management system with its core technologies. From there it looked at motivate and scope of the study. It looked at the statement of the problem, general objectives, specific objectives, research contribution and ended with the outline of the thesis.

CHAPTER 2 LITERATURE REVIEW

2.0 Literature review

This chapter deals with the review of literature. Literature review is important because it gives the background theory as well as give understanding on what has been done on the same topic. The purpose of literature review is to find out the available information. This is important because it helps gauge the level of knowledge on information already published on the topic. Additionally, it helps to identify information gaps on related topics under study (Kombo and Thromp, 2010).

In in order to enhance the management of museum collections, technology deployment becomes critical. Therefore, the use of a collections management system could help museum manage their object in an efficient and effective manna compared with a manual system. According to the International Council of Museums (ICOM), one of the most recent museum definitions is the one adopted by Museums Australia in March 2002, that a museum is an institution with the following characteristics:

“A museum helps people to understand the world by using objects and ideas to interpret

the past and present and explore the future. A museum preserves and researches collections, and makes objects and information accessible in actual and virtual environments. Museums are established in the public interest as permanent, not-for-profit organisations that contribute long-term value to communities”.

According to (National Museum Board, 2016), the role of the museum is mainly collection and preservation tangible cultural heritage for posterity. In this study, the research had themes such as database creation for Museum Collections Management System, data capture by Museum Collections Management System, efficiency of data retrieval safety of information stored.

2.1 Technology in management of museum collections

According to Walton (2014), Collections management Software companies claim their product can be used for any type of collection or museum. Each system’s particular combination of features and characteristics may make it a better fit for some museums’ needs and not for others. A number of collections management systems are available for use such as Pastperfect, TMS and EmbARK

2.2 Web-based Collections management System

Walton (2014) states that Museum Collection Management System is a Web-based system established for the purpose of enabling easy retrieval of information by members of staff. Museums in Zambia have been using manual documentation systems to document information relating to objects. Further, where an electronic system has been used, it is an offline system. The disadvantage with an offline system is that members of staff are restricted to work

within the office premises and not coordinate with others. In order to mitigate this problem, the web-based museum collection management system comes in store solve this matter.

2.5 Related works

This section looks at some related works in the use of ICTs in museums. A number of innovations involving the use of ICTs are being witnessed that are playing significant role in resolving pertinent issues in organizations and societies at large. These include system covering all spheres such as trade, health, governance, education and culture among others.

According to Musick et al (2011), data entry procedure began after the identification, purchase and installation of the electronic system. There were no clear procedures during implementation and the important goal was speeding up the course. The collections staff is also expected to computerize records in combination with other collections tasks such as acquisition, object storage management, loans and research (Bradley, 2016).

Eugenie, P and Tam (2010), in Hong Kong, China investigated the usage of Museum Collections Management System and selected databases. A comparative study to find out whether searching for defined information through Collections Management System was more efficient and effective than searching directly in alternative databases. 30 students from Lingnan University were observed searching the Collections Management System and 3 other selected databases. The findings suggested that searching under WEB - BASED Collection Management System was more efficient and effective.

2.6 Summary of Literature Review

Many studies conducted indicate that members of staff and the general public need access to information sources available in the museum. Few studies available have disclosed that despite the availability of retrieval tools such Collection Management System and collection catalogue among others, ease and quick access to objects and information sources still remains a challenge especially without the usage of ICT. Museum collections are owned by local communities and it is vital that the move towards new technologies is not allowed to become a barrier between the two.

CHAPTER 3

RESEARCH METHODOLOGY

3.0 Methodology

Martin (2012) states that research methodology is a plan which specifies the type of information relevant to the study. The researchers endeavored to use scientific procedures during the data collection process. The study gathered data on museum collections management system from Lusaka National Museum. Data collected included primary and secondary data. Primary data was the major source of data that was used in the analysis of the findings.

3.1 Baseline Study

The baseline study was conducted in Lusaka, Zambia. Lusaka is the Capital city of Zambia. Zambia is situated in central Southern Africa. It has eight neighbors it shares the border with namely Zimbabwe, Botswana, Namibia, Angola, DRC, Tanzania, Malawi and Mozambique. There are ten (10) provinces in Zambia. In terms of land coverage, Zambia has an area of 752,612 square kilometers. Central Statistical Office (2012) indicates that Lusaka has a population of 2.8 million as at 2010 census.

The baseline study was conducted in Lusaka at Lusaka national Museum. Lusaka Museum was selected because it is visited by both foreign and local tourist and researcher. Most researchers and visitors normally request for information on different types of objects, cultural, pre- and post-colonial history of Zambia.

3.2 Data Collection

There are a number of approaches to data collection depending on the nature of research being conducted. In this project, the methods adopted included the following: Interview, Internet, references to published and unpublished data. Data collection is the process of gathering information that relate to the topic under investigation with the view to achieving the objectives of the research. The study grouped the data collected into two broad categories namely; secondary and primary data.

3.2.1 Secondary data

Secondary data are data that have already been written and published by other researchers or authors. The use of secondary data ensured that duplication of effort was avoided. The data was collected so as to provide a framework upon which to base this research and as a means of guidance in the course of the research and to provide a template for the entire research work (Martin, 2012).

3.2.2 Primary Data

Primary data are the raw and first-hand information that the researcher gathered from the field. This research based its findings on primary data. The researcher collected primary data in order to facilitate the answering of the objectives of this research before generalizations were made.

Table 1: Sampling Techniques used

Type of frame	Sampling Technique and justification	Population Element
	Used no probability sampling technique	
Primary frame	Used purposive sampling – This technique was chosen because some employees have no direct link with museum collections	Lusaka national Museum employees were targeted
Secondary frame	Convenient sampling – chosen because it is ideal for time management since it is limiting factor. There is also a constraint on resources.	Lusaka national museum was selected

3.2.3 Target Groups and Sampling Methods

This section shows the composition of the sample frame from which primary data was collected. It further highlights the sampling procedures that this study employed as well as the data collection tools.

This study had a sample size of 17 out of the total staff membership of 35 at Lusaka National Museum. The research used purposive sampling because research required respondents who collect and manage museum collections.

3.3 Data Collection Tools

The type of data collection tools that a researcher utilizes in a research has a profound influence on the quality of data that will be gathered from the respondents. In view of that, this study used in-depth Interviews. Below is a detailed description of the data collection tools that this study employed.

3.4 Data Analysis

The research will employ both qualitative and quantitative methods in the analysis of data. The Statistical Package for Social Sciences (SPSS) will be used to analyze quantitative data. It is ideal because it is a full and flexible statistical analysis and data management software programs that allows for creation of frequency tables, descriptive statistics, exploratory statistics, histograms, bar-charts, and cross tabulation tables. It is also used in describing distribution of the variables which are presented in form of tables or graphs. Qualitative data will be analyzed thematically. It is suggested that in analyzing qualitative data, the initial task is to find concepts that help make sense of what is going on.

Martin (2012), asserts that thematic data analysis is the method used to identify, analyze and report patterns or themes in social interaction. This involved reading through all responses to the questions in the questionnaire and grouping them according to responses. This is done by picking similar responses and grouping them in one category referred to as themes. As for responses that are not similar, they are equally grouped in different

categories. After the responses are categorized, they are further coded and tallied in tables. This ensures easy analysis of data on the part of the researchers. The data analyzed is then presented and findings discussed.

3.5 Research Approach

The research was conducted from Lusaka National Museum. A questionnaire was used to gather primary data. An appendix is there for questionnaire. Some other documents are also available that were used in the research process. The data collection commenced the third week of February through to the fourth week of May, 2019. The questionnaires were designed in line with the objectives of the project highlighted in chapter one.

3.6 Development of Museum Collections management System

This section delves into the issues of the system development life cycle (SLDC) that was used to develop the system. According to Guru 99 (2019), there are several development systems models that are used and among them includes the water fall model, rapid application development model, incremental model, spiral model, agile model and the prototype model. These models are also referred to as predictive life cycles because the latitude of the projects can be clearly expressed. The schedules and costs for system development can also be predicted.

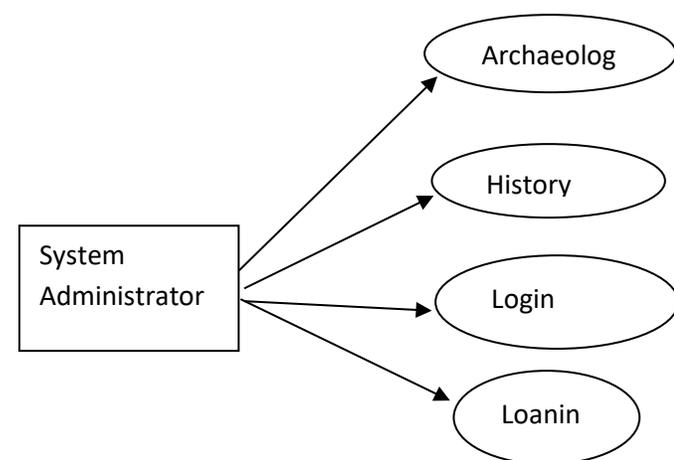
3.6.1 Agile method

Guru 99 (2019), adds that agile method is one of the prominent methods used in the software development industry. This system has led to the drifting away from traditional software development methods because of its flexibility. Agile model is ideal because it delivers payback such as handling change requests, productivity gain as well as timely

alignment of the project towards the desired goals. Agile system development life cycle model is a combination of iterative and incremental process model with emphasis on process adaptability and customer satisfaction by speedy conveyance of functioning software product. Each iterative has a group tasked to work concurrently on different areas like planning, requirements analysis, design, coding, unit testing and acceptance testing. At the end of the iterative, a working product is presented to stakeholders for the much-needed feedback.

3.7 System Design

Orodho, (2010) states that, a research design is a plan that is used to come up with answers to research problems. It is regarded as an essential tool for collection, measurement and analysis of data. It spells out steps the researcher is required to follow in order to collect data from the field and how to analyze it. The research will use quantitative and qualitative approaches to research. According to Valtin (2013) quantitative and qualitative has strengths and weaknesses. Thus, using the two approaches allows for the advantages of both



approaches while countering weaknesses inherent in each approach if used without the other.

System design is an approach where system analysis is conducted to determine the requirements of the system. This is where the Museum Collections management System requirements were generated. In order to come up with the requirements, the use case diagram and use case text were developed.

The museum collections management system is a system developed to work on the internet platform in order to allow for remote access. The system operates on the basis of three main actors namely the administrator, members of staff and the institutional organizations. The system owners will manage the system through the system administrator while members of staff and borrowers interact with the system. The system administrator grants access to members of staff and institutions. The role of the administrator is to manage the whole system. System design has the following component; Functional requirements and Non-functional requirement.

Figure 3: Use case diagram for System Administration

The use case diagram shown in figure shows how the system administrator interacts with the system. The system administrator has access to the entire system. The administrator can add, edit, delete or search a user or another administrator. The administrator can also add, edit, delete or search a record. Both the administrator and the user can add, edit, delete and search for a record on the system.

3. 8 hardware Requirements

During the implementation of Museum Collections Management System, a Laptop was used. It was running on 2.0 GHz with 2GB RAM. Boot strap and HTML was used to develop form interfaces. However for the entire system to run effectively the following are the hardware requirements: Hard drive

1TB or more - The amount of storage space required depends on the number of records and images, 4 – 8 GB RAM or more – This is ideal because the system requires fast processing of data, windows or Linux Operating system with the minimum server requirements for most systems and supported database Webserver.

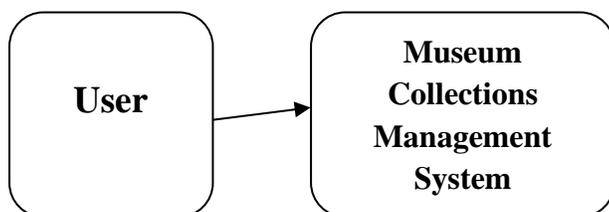
The other software requirements include MySQL used for storing data in the database using data entry forms such as the registration form. The modem that was used is a Huawei Mobile Broadband LTE USB stick Model E3272. It was configured to handle SMSs on the Airtel 4G network.

3.9 System Design of Museum Collection management System

3.9.1 Context diagram

The following diagram shows how Museum Collections management System interacts with the environment.

Figure 1: Context Diagram



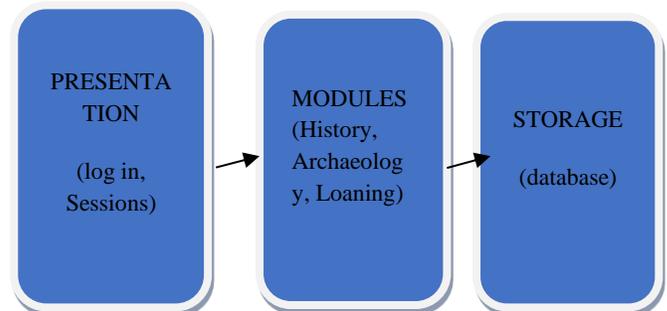
The context diagram above shows the user in an environment interacting with the Museum Collections Management System.

The context diagram of the collections management system provides users with options of what to do on the system for instance entering data or retrieving a record. It could be searching for a record. The system collects information pertaining to an object from the database via the internet.

3.10 System Software Level Architectural Design

The large-scale organization of Museum Collections Management System is as shown in the figure below.

Figure 2: System Software Level Architectural Design



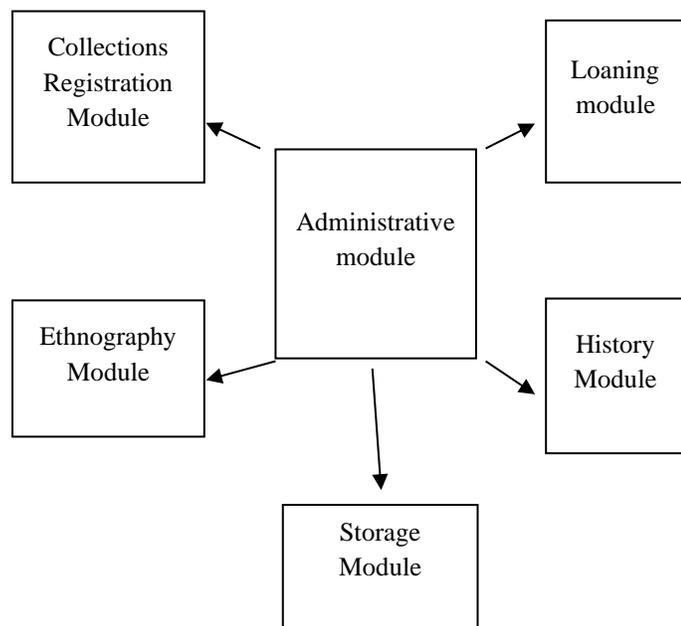
The system basically has three layers namely presentation layer, model layer and storage layer. The presentation layer is used for handling users during interaction with the system. The presentation layer also allows the administrator to grant permission to users for them to access their modules for instance accessing the history module. The other layer is the model layer. The presentation layer is dependent on model layer for its functioning. The model layer ensures that Museum Collections Management system is implemented logically. Furthermore, the model layer is responsible for implementing all administrative activities and issues to do with the gateway. The next layer is the storage layer. This layer is basically responsible for storage of data.

3.11 Modular Design of the System functions

The Museum Collections Management System comprises of a number of sub-systems. The sub-systems include the Administration, Loaning, Archaeology, History, Ethnography, storage and presentation systems.

Figure 2: below shows the sub-systems (modules).

The administrative module is mainly responsible for



ensuring that all administrative duties are executed accordingly. This sub-system belongs to the module layer of the system. One of the purposes is to interact with the administrator on the entire system.

These systems are responsible for ensuring that users interact with system by sending data to the database for storage. It also interacts with the user whenever he or she is looking for information by searching the database. Just as the name suggest, the storage module is basically responsible for data storage into the system database. This system thus belongs to the storage layer. These module/systems interact closely with the presentation and administrative layer in ensuring that only authorized users access the system.

3.12 Presentation of the System

This system is main concerned with the handling of users as they interact with the system. It provides graphical User Interfaces for the user to interact

easily. Further, it allows the user to perform all administrative requirements such as assigning of passwords to users. It also allows for the starting and stopping of SMS gateway module.

3.12.1 System Data Model Design

This section gives the design of the database at conceptual level. Museum collections management system uses MySQL database for information storage. The advantage with MySQL is that it is a free and open source software database management system.

3.13 User Interface Design

3.13.1 System Features

Museum Collection Management System is a Web-based system established for the purpose of enabling easy retrieval of information by members of staff. Museums in Zambia have been using manual documentation systems to document information relating to objects. Further, where an electronic system has been used, it is an offline system. The disadvantage with an offline system is that members of staff are restricted to work within the office premises and not coordinate with others. In order to mitigate this problem, the web-based museum collection management system comes in store solve this matter.

The core mandate of museums is to preserve cultural heritage of a particular nation. For this reason, museums have departments such as Archaeology, History, Ethnography and Education. These departments collect and preserve information pertaining to their line of expertise. The Web-based Museum Collection Management System was designed with these aspects in mind. Each

department has a data entry and retrieval form linked to the database.

The Web-based Collections Management System has been developed with the following features (modules);

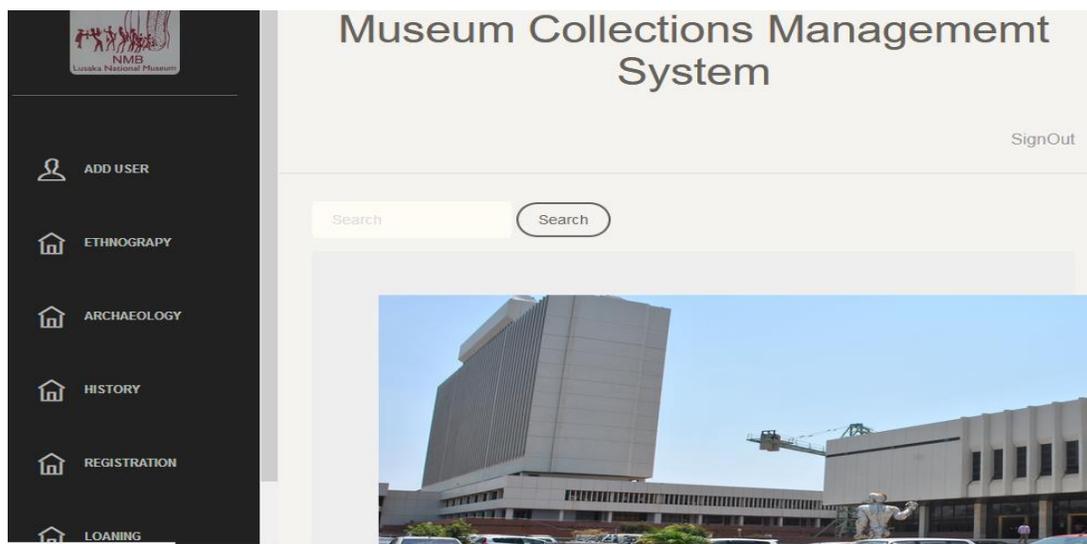
- Home with links to Contact Us, About Us, Vision and Mission statement pages among others
- Collections Registration Form
- Data entry form (History, Ethnography, Archaeology)
- Data retrieval form (History, Ethnography, Archaeology)

Museum staff usually go in the field to collect objects. While in the field objects and its bibliographical data is gathered. Since all museum in Zambia do not have an online collections management system data cannot be entered directly into the system at their convenient time or while in the field. The manual system being used forces them to use papers which is also a cost.

- Photo upload panel
- Video upload Panel

This part shows how the user interface is designed in a in a user friendly and easy to understand manner. The designs are made in a way according to decision that has to be made. The interfaces are designed using boot strap templates. The Graphical User Interface (GUI) color is generally white, blue and grey. The GUI comprises the login form and the control panel which has the links to other forms such as ethnography, history, archaeology and loan form. Below are the screen shots of the system together with the codes.

Figure 4: shows the home screen interface for the system



The system administrator enters the username and password for a particular user in the database using the Administration panel and selecting Add User. After this stage, if is the super user or system administrator who has entered the username and password, the next dialogue box will be the control panel indicating all the modules.

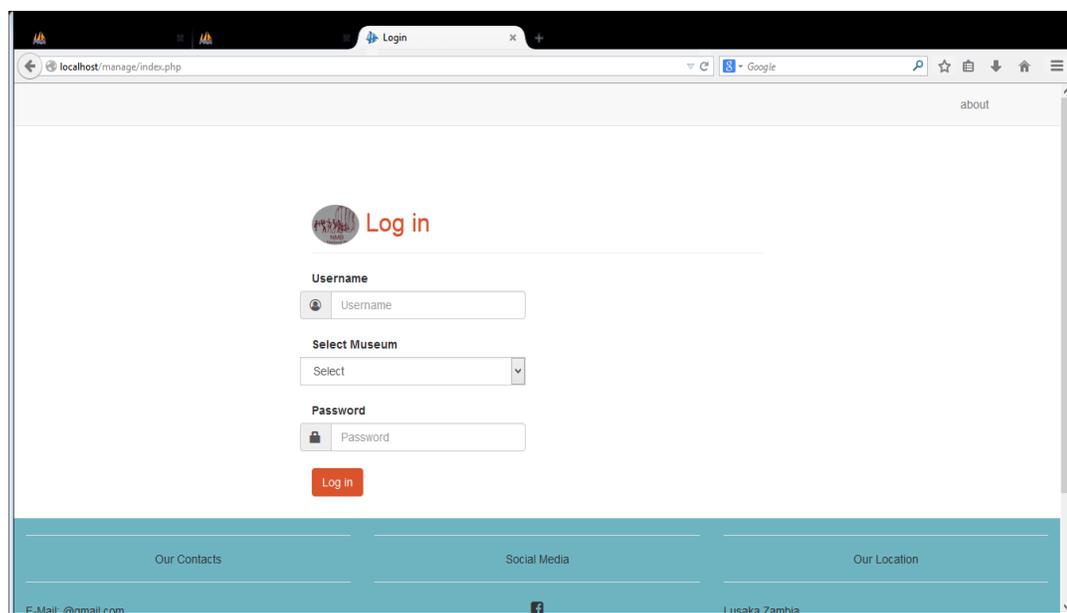
Login System

Security is paramount in the usage Information Technology. One of the mechanisms used in ensuring security data is through the approval and verification of users who wish to gain access to the system. The Museum Collections Management System has taken into consideration in the login mechanism as a way authenticating users.

In order to access the validity of the system, users of the system in this case museum staff were engaged. The system was tested and validated by assessing accessibility issues. Since the system only allows authorized users to enter data into the database after they login, the login process was thus tested for its validity. In terms of data entry, only authorized users are allowed to enter data after logging in or the system administrator logs in for them.

The system starts with a log in interface where the user enters the username, institution and password.

Figure 5: Login for the system

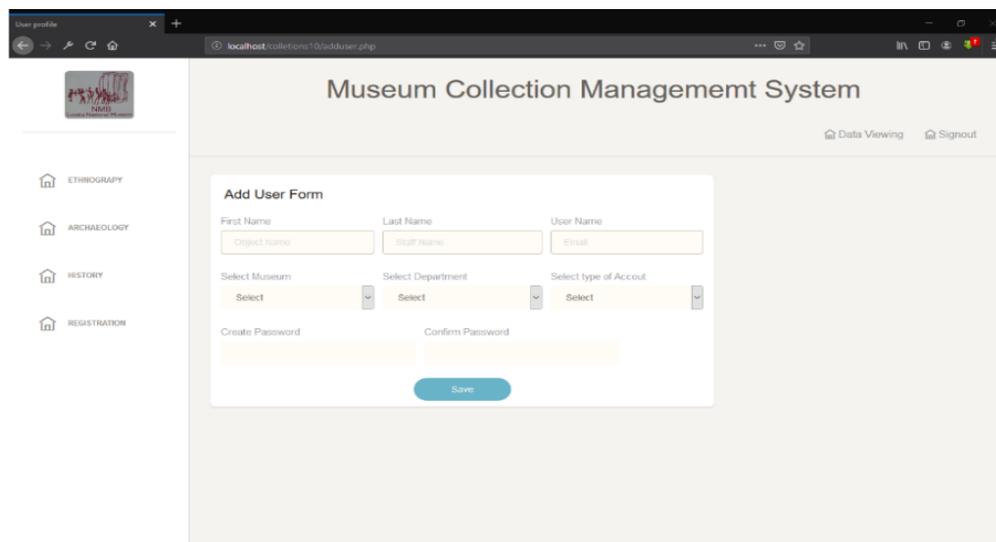


The log in has the codes as seen below which created the login interface.

When the system administrator logs into the system successfully, a user interface showing all the modules appear on the screen. The interface shows the modules available on

the left side of the interface. Among the modules available includes archaeology, History, Loaning, Ethnography and history. The system administrator has access to the entire system. He or she can edit, delete or add a record. Furthermore, he or she can search for a record as well.

Figure 6: Add user for the system administrator

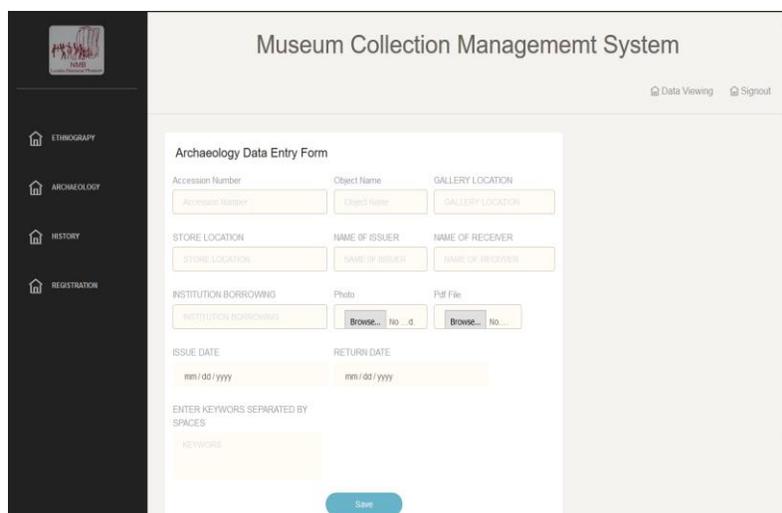


The screenshot shows a web browser window displaying the 'Museum Collection Management System' interface. The page title is 'Museum Collection Management System'. On the left, there is a navigation menu with icons and labels for 'ETHNOGRAPHY', 'ARCHAEOLOGY', 'HISTORY', and 'REGISTRATION'. The main content area features an 'Add User Form' with the following fields: 'First Name' (with a sub-label 'Object Name'), 'Last Name' (with a sub-label 'Staff Name'), and 'User Name' (with a sub-label 'Email'). Below these are three dropdown menus: 'Select Museum', 'Select Department', and 'Select type of Account'. At the bottom of the form are 'Create Password' and 'Confirm Password' fields, and a 'Save' button.

After the Administrator adds the user, he or she would have access to the module for example archaeology module. Take note that the user would not access other modules except with prior permission from the system administrator.

The system administrator also has the reserved right to change the password for the user. To do this he or she uses an interface with the provision for changing of password.

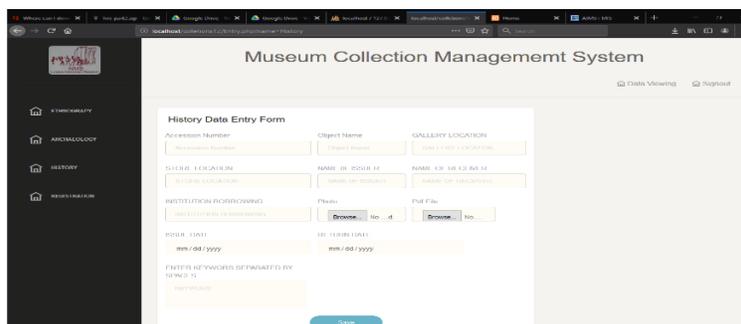
Figure 7: shows the archaeology module



The screenshot shows the 'Museum Collection Management System' interface with the 'Archaeology Data Entry Form' displayed. The form includes the following fields: 'Accession Number' (with sub-label 'Accession Number'), 'Object Name' (with sub-label 'Object Name'), and 'GALLERY LOCATION' (with sub-label 'GALLERY LOCATION'). Below these are 'STORE LOCATION' (with sub-label 'STORE LOCATION'), 'NAME OF ISSUER' (with sub-label 'NAME OF ISSUER'), and 'NAME OF RECEIVER' (with sub-label 'NAME OF RECEIVER'). There are also 'INSTITUTION BORROWING' (with sub-label 'INSTITUTION BORROWING'), 'Photo' (with a 'Browse...' button), and 'Pif File' (with a 'Browse...' button). At the bottom, there are 'ISSUE DATE' and 'RETURN DATE' fields (both with sub-labels 'mm/dd/yyyy'), and a 'KEYWORDS' field with the instruction 'ENTER KEYWORDS SEPARATED BY SPACES'. A 'Save' button is located at the bottom of the form.

History is another module available on this system. It is the module which users can use for data entry and retrieval is the archaeology module. Those in the history department are the ones that would have the privilege to access the module. The system administrator gives the password and username to the users of this module.

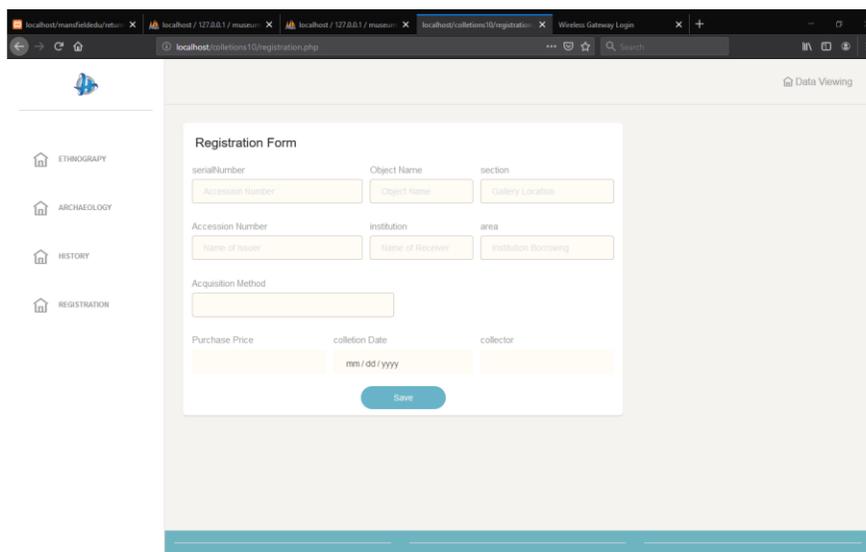
Figure 8: history module for the system



The screenshot shows a web browser window displaying the 'Museum Collection Management System'. The main content area is titled 'History Data Entry Form'. It contains several input fields: 'Accession Number', 'Object Name', 'GALLERY LOCATION', 'STORE LOCATION', 'NAME OF ROOM', 'NAME OF ROOM NO', 'INSTITUTION BORROWING', 'Place', 'File File', 'ROOM LEVEL', 'NO. OF ROOM LEVEL', and 'PROVIDED BY/POWERED BY/PARTIALLY BY'. There are also two 'Browse' buttons for file selection and a 'Save' button at the bottom.

The Museum Collections Management System also has a registration module. Users are able to access the registration module which allows for data entry of bibliographic details of the object and related information. From time in memorial museums have been associated with object collection. This is so because museum are research institutions that generate new information and preserve it for other research to benefit as well as the general public.

Figure 9: Below is the picture showing the registration module



The screenshot shows a web browser window displaying the 'Museum Collection Management System' registration module. The main content area is titled 'Registration Form'. It contains several input fields: 'serialNumber', 'Object Name', 'section', 'Accession Number', 'Object Name', 'Gallery Location', 'Name of Issuer', 'Name of Receiver', 'Institution Borrowing', 'Acquisition Method', 'Purchase Price', 'collection Date', and 'collector'. There is a 'Save' button at the bottom.

Data retrieval form

The system also has the ability to retrieve data from the database and display it for users to see. Every module has a data retrieval form that allows users to retrieve data. On retrieval the system also retrieves related information such as pdf files and pictures. The user is required to enter the accession number in order to retrieve the information related to the object. The information would then be displayed in the field accordingly along with image of the object. A pdf file icon would also display requiring the user click on it for it to open. However, this will happen if the object had more information stored in pdf file.

Figure 10: This is a screen shot of the records available in the system.

DATE OF RETURN	NAME OF ISSUER	NAME OF RECEIVER	Institution Borrowing	Photo	Pdf
2019-06-25	name	name	INSTITUTION BORROWING		View Pdf;
8 01/January/2018	hash	hash	hash.co		View Pdf;
8 01/January/2018	hash	hash	hash.co		View Pdf;

3.16 System Implementation and results

This section deals with the system design for museum collections management system and this one is meant to be a web-based system. This entails that the system will be anchored on internet technology connected servers. Information will be accessed from the database held on the server.

The coming of technology has made museums change their face and are now being referred to as digital museum, virtual museums, hybrid or museums without walls. The use of technology has not only changed the perception of museums but has also transformed information storage and retrieval procedures. Further, the use of technology has helped to improve internal management of collections and the related information. This therefore hastens to mention that technology has allowed members of staff carryout office duties away from office.

The idea of object registration was not so much automated as the case is today. This is so because most of the museums were not as quick to embrace technology as the case is with other institutions such as libraries. This was also attributed to the fact that computers or databases then were not as sophisticated and powerful as the ones available today. In most of the museums today especially those in developed countries, registration of collections is heavily done by collections management systems (CMS) which have become integrated into the daily operations of museum registration. Buck and Gilmore (2010), contends that Collections Management Systems are no-longer being used for object registration alone but also tracking of loaned objects, storage of conservation reports and keeping track of location of objects either in the storage rooms or galleries

Museum had started realizing inadequacies with the methods of record-keeping. The system often lacked the necessary information that could help retrieve objects and related information. Owing to this card catalogues

which were used in certain instances were duplicated while in other instances the cards were missing. In most extreme cases its objects that were missing. Therefore, use of this system will help mitigate these problems and improve retrieval of objects or information (ibid).

Matt (2013), argues that Web-based Museum Collections Management System is a system designed to help with the management of museum collections remotely and within the premises. The system is designed to accept input from users and display it when required. In order for members of staff to access the system offline they need to go to the museum website once the system goes live. In the meantime, the user has to go to xamp, and double click on xamp icon. From there a Phpmyadmin dialogue box appear then go to Universal Resource Locator and type “localhost/collections/index.php” then press enter to access the home page

The migration from manual system to web-based collections management system is because of inefficiencies with the manual system. With advent of technology which allows working away from the office, a web-based system is no doubt the best option. Web-based system such the museum collections management system will help quick retrieval of required information. Collections Management System is user friendly since it has friendly interfaces. All it requires is the availability of internet.

The Museum Collections Management System allows all museums to use this system by logging in and selecting their institutional name. The technology that is used in the collections management system is usually based on the server – client model where the client is the computer which is remotely located relative to the server. The server equipment could be located at the site or a host institution could be engaged (Matzen, 2013).

3.17 System Security

System security is important as data protection is very paramount. An operating system is one of the areas responsible for controlling access to system resources, which includes sensitive data. The system must therefore include a certain amount of protection for such data and must in turn control access to the parts of the system that administer this protection. System security is concerned with all aspects of these arrangements (Matthews, 2010).

The web technology has been vulnerable to numerous online frauds that have led to the issue of security being top of the agenda. In order to increase the credibility of systems there has been some security measures that have been put in place to prevent online fraud for instance the use of encrypted password, as well as encryption sensitive information being transmitted online. Collections Management System being an online system also puts in place security measures such as encryption of passwords (ibid).

3.18 Policy on Disaster recovery

The policy is developed to guide in the recovery of data, information, computing and network services in the event that a disaster destroys all or part of municipality facility. A programmatic approach is at the heart of best practice in ICT disaster recovery and business continuity. Without formally defined processes, it is difficult for agencies to evaluate their risks and ensure they can quickly respond to, and recover from, disruptive events. Implementing complementary standards for ICT disaster recovery business continuity will help agencies to ensure holistic risk management outcomes (Bela-ela Local Municipality, 2016).

A) Information backup

- a. Backups shall be scheduled to run after working hours.
- b. There shall be daily, weekly and monthly backups.
- c. Backup copies shall be taken to the safe or storage area within the first hour of the business day of the morning after finished backup process.
- d. Backup strategy or procedure shall specify the exact time on which the backup is scheduled to start running, and on when the backup copies shall be taken to the safe area.
- e. The system administrator shall inspect the backup log to verify the success of the backup and troubleshoot hardware and or software problem related to backup procedure
- f. An electronic log of each backup performed will be created by the system
- g. Log files shall be analyzed and for any errors, corrective measures shall be taken every time before taking the backup
- h. Access to the backup copies in a safe or storage area shall be limited to the system administrators.

b) Recovery procedure

- A.** ICT shall ensure that every server running municipality applications is backed up regularly.
- B.** The turn-around time to receive a backup tape for recovery is maximum 2 hours.
- C.** The system administrator will initiate data recovery processes for the data that has been destroyed by the disaster.
- D.** The restoration time will depend on the amount of data to be retrieved
- E.** A minimum level of backup information, together with accurate and complete records of the backup copies and documented restoration procedures, should be stored in a remote location, at a sufficient distance to escape any damage from a disaster at main site.
- F.** Backup information should be given an appropriate level of physical and environmental protection, consistent with the standards applied at the main site.
- G.** Backup media should be regularly tested, where practicable, to ensure that they can be relied upon for emergency use when necessary.
- H.** Restoration procedures should be regularly checked and tested to ensure that they are effective and that they can be completed within the recovery time that has been allotted in the operational procedures for recovery.

3.19 Summary

In this chapter, the research looked at the baselines study, sampling design and sampling, approach and the development of the system. The development and implementation of the collections management system which is the proposed solution for the challenges experienced in management of museum objects. The chapter also delved into issues of the methodology that was used to develop the software. It further looked at the function and non-functional requirements of the system. The museum collections management system used the agile model to develop the system.

CHAPTER 4

RESULTS

4.0 Introduction

This chapter gives a perspective of the system analysis, system testing and evaluation, system manual, and technical aspects of the system.

(Guru 99, 2019) contends that in order to develop the system an Agile Model was used. Agile methodology was ideal because of a number of advantages it has compared with other models. These includes adaptability in that it is able to respond to the changing requirements of the clients. Furthermore, it takes into consideration the direct communication and feedback from customer representatives. The other reason why Agile Model was adopted is its ability to help minimize risks by developing software in a short time

In order to successfully create the system, the following tools will be required; Hypertext Pre-processor (PHP), JavaScript, Hypertext Markup Language (html 5) and MySQL. HTML was used for creation of interfaces such as forms while MySQL was used for database creation and relational tables. PHP was selected to work as a back-end processor between the forms and the database. These platforms are chosen because they can function on any operating system and server. However, before undertaking the development of the system, an analysis was of the existing system and those on the market was conducted (ibid).

4.1 Baseline study results

This section deals with the results of the research that was carried out at Lusaka National Museum. It is out this research that the justification of the development was based. The next stage thus looks at the results of

implementation of the Museum Collections management System.

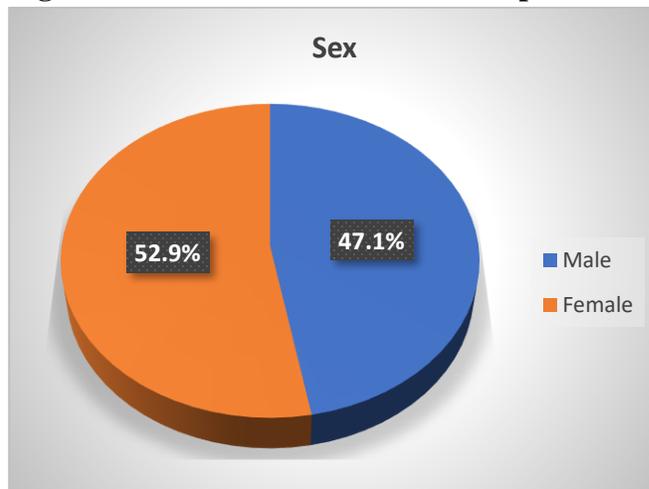
4.1.1 Survey results and discussion

This part of the report presents the survey results and discussion on the data collected. The findings and discussion were presented according to the research objectives. A total of 17 questionnaires were distributed among the members of staff at Lusaka National museum. All the questionnaires were collected representing a 100% response rate. Interviews were also conducted with 2 key informants. Here the results of the study that was conducted are discussed. The software that was used to analyze data was Statistical package for Social Sciences.

Characteristics of Respondents

The respondents consisted of 52.9% female and 47.1% males. The distribution of different numbers in terms of responses was because of the purposive sampling method that was used to select the sample for the research.

Figure 11: shows female and male respondents



They were female who participated in the study compared to their male counterparts with 52.9% and 47.1% respectively.

Table 2: Respondents response according to departments

Which department are you in?

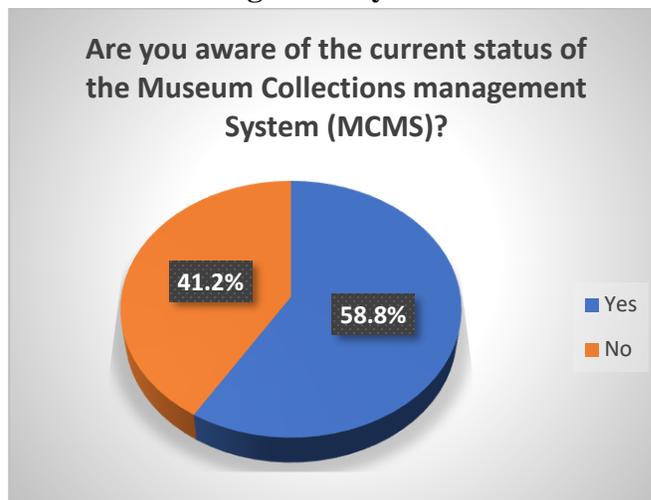
	Freq	Percent	Valid Percent	Cumulative Percent
Library	6	35.3	35.3	35.3
Vali Research d h	11	64.7	64.7	100.0
Total	17	100.0	100.0	

As regards respondents according to departments they belong to, the study revealed that 64% belonged to the research department while 35.3% belonged to the Library department. This indicates that majority of respondents belong to the research department.

Awareness of the Museum Collections management System by members of staff

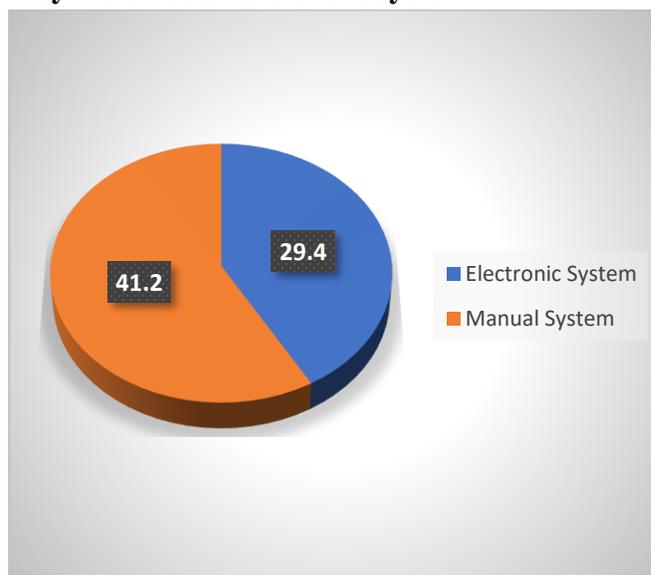
The respondents were asked if they were aware of the existence of the museum collections management system at the museum. 29.4% of respondents indicated that they were aware of the existence of the manual system while 70.6% indicated that they were not aware of the existence of the system. This indicates that majority of respondent were not aware of the existence of the collections management system at Lusaka national Museum. This is represented by 70.6%. These findings are similar to the research findings that was conducted Dulle in 2009 regarding the perspective on the museum collections management system. This research indicated that 72.1% of respondents were not aware of the existence of the collection management system in public museums.

Figure 12: shows responses on awareness of the Collections Management System



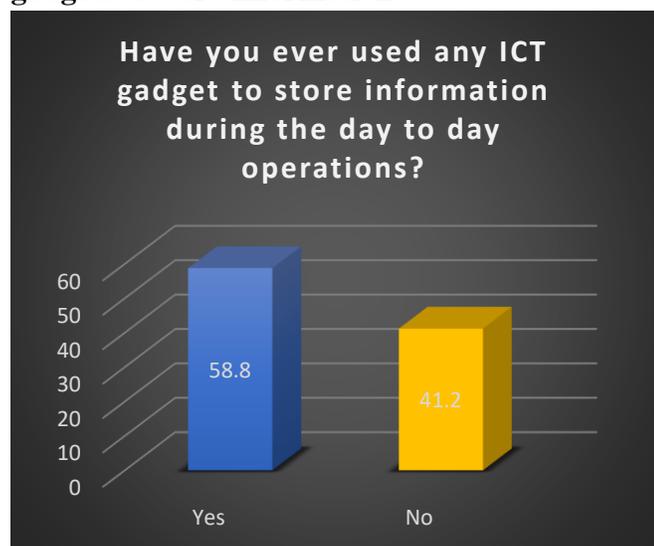
The response indicates that 58.8% knew about the system through fellow members of staff while 41.2% knew about it through workshops. This signifies information sharing among members of staff. On the other hand, there are those who stated that they were not aware of the existence of the system and they sited lack of information and non-accessibility to ICT for them to learn about the existence of the system.

Figure 13: shows response on the reasons why they were not aware of the system



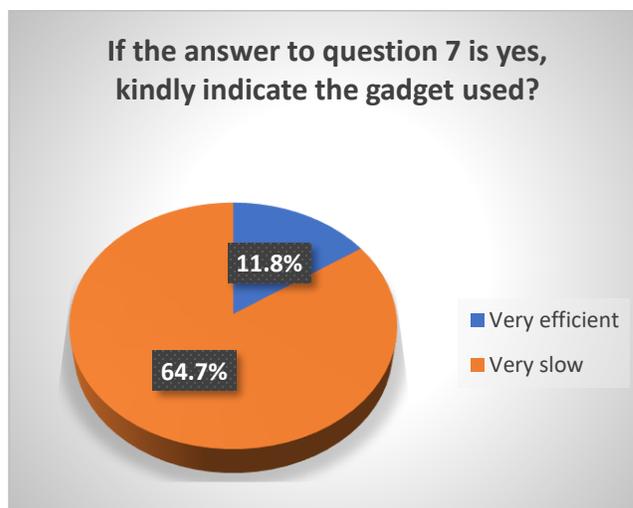
The baseline study also endeavored to find out the usage of ICT gadget by museum employees in the execution duty. 58.8% of respondent acknowledged usage of ICT gadgets for information storage while 41.2% declined the usage of ICT gadgets. The computer stood out with 58.8% as the gadget used to store information while paper came out with 41.2%. This indicates that ICT gadget are used by museum employees in the execution of their duties.

Figure 14: shows responses on the usage of ICT gadgets to store information



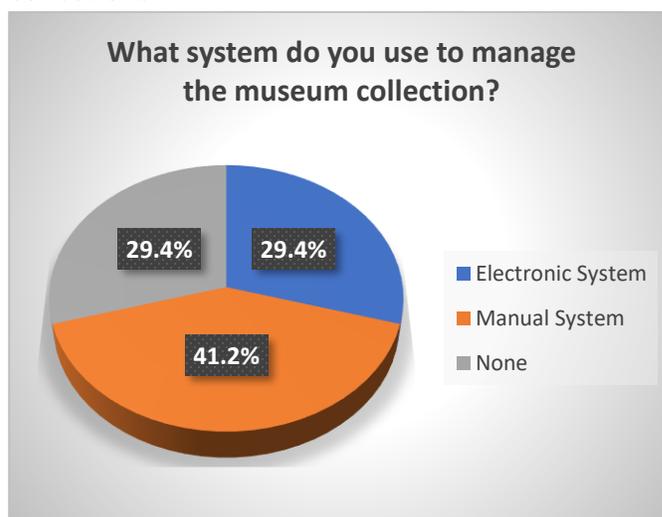
A question was asked to whether members of staff were using ICT gadgets to store information. Responses indicate that 58.8% were using computers while 41.2% were using paper for storage of information. This entails that members of staff use electronic gadgets in their day to day activities such as computers.

Figure 15: shows response on the gadgets used to store information



A question was asked to find the system used in the management of collections. Respondents were asked on the system used for management of museum collection. The study revealed that 41.2% indicated that manual system is used, 29.4% stated that electronic system is used, while another 29.4% indicated that no system is used at all. Therefore, the majority of 41.2% respondents stated that manual system is used to store information.

Figure 16: shows responses on the type of collections Management System used to manage collections



Lusaka National Museum uses the manual collections management system according to the majority of respondents.

Department respondents belong to

The respondents were asked to the departments they belong to in order to ascertain system usage as well as management of museum collections. Out of 16 respondents, 25% of them indicated that they belong to the library, 75% of respondents indicated they belong to the research department. The findings indicate that majority of respondents, 75% belong to the research department.

Table 3: response of respondent by department

Which department are you in?

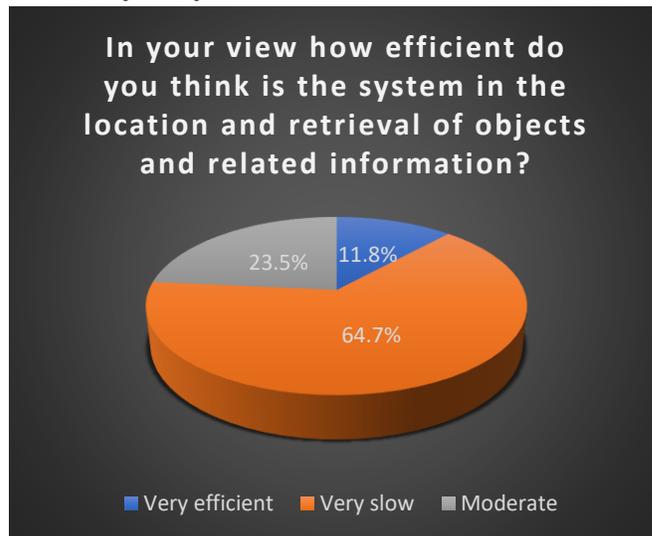
	Frequency	Percent	Valid Percent	Cumulative Percent
Library	4	25.0	25.0	25.0
Valid Research	12	75.0	75.0	100.0
Total	16	100.0	100.0	

How efficient is the current system?

The respondents were asked on the efficiency of the current collections management system. 64.7% of respondents indicated that the current system was very slow and could not easily help locate objects with its related information. 23.5% of respondents indicated that the efficiency was moderate while 11.8% stated that the system was very efficient. The findings of this study were similar to those of James (2010) who carried out a research on the collections management system. His study discovered that the manual collections management is very slow and very expensive to management in terms of printing

materials. The manual system also requires a lot of human resource and this is a cost to the institution.

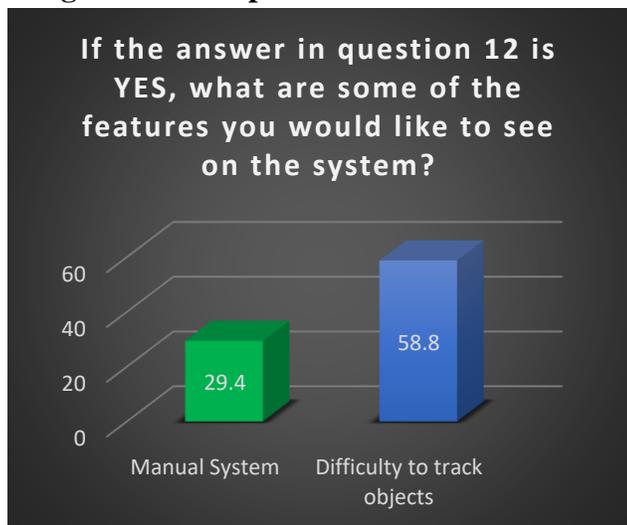
Figure 17: response of respondent on the efficiency of system



Is it possible to design and develop a Web-based Collections management System for use in Museum?

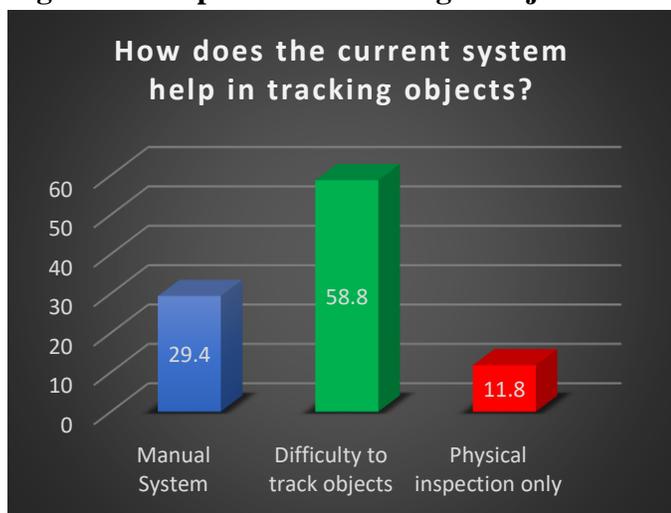
The research also wanted to find out how the system was going to be designed in order to obtain efficiency in the retrieval of objects and information. The research revealed that 70.6% of the respondents wanted a system that would help them easily and quickly access information pertaining to the objects. Further, the study indicated that 10% of respondents were comfortable with way the current system was functioning while 5% could not state their position. The findings were similar to the research conducted by Roberts (2010) on the significance of Collections management system toward information retrieval. The study revealed that 90% of respondents desired a system that would help quickly retrieve information.

Figure 18: response of respondent on system design and development



The study also wanted to find out on the tracking of objects held in the museum. The research revealed that 58.8% of respondents indicated that using the manual system it is difficult to track records and objects. 11.8% indicated tracking of objects is done by physical inspection while 29.4% said that a manual system is used.

Figure 19: responses on tracking of objects



Tracking or monitoring of objects is done using manual system and it is difficult to track and monitor objects.

Respondents were asked to suggest the features they would want to see if an online system was developed. 82.3% indicated that they would want a system that issues reports, notification, remote working while 17.6% indicated that they wanted a system that has retrieval features, data storage into the database and printing ability.

Table 4: responses on expected features

	Frequency	Percent
Valid Database storage and retrieval features, Printing Reports, Notifications, Remote working system, Invoicing and receipting	14	82.3
	3	17.6
Total	17	100.0

System Implementation Results

This section highlights the results of the collection management system anchored on web technology. This section explains the interaction of users with the Museum Collections Management System. Among the system users includes the system administrator whose duty is among others to assign username and password to users. This chapter also shows the testing of the system by users.

Owners of the Collections Management System

The Collections Management System is a system that is designed and developed for management of museum collections. For this reason, any museum or art gallery can use the system to store and retrieve

data. However, the Museum Collections management System is developed for National Museums Board (NMB). National Museums Board is an organ of the government that is responsible for the affairs of museums in Zambia. It is a board formed by the act of parliament.

In this case, any institution that acquires it assumes the role of administration. The system has a login screen for the system administrator or user to access if he or she has to access the system modules for instance the archaeology module. The system administrator logs into the system using a username and password. The administrator is also required to select the museum he or she would like to access information. Being the administrator he or she is the one that creates users on the system according to standard and operating procedure that the owner of the system could have set. The access module is defined in such a way that only the administrator can move from one module to the other while the rest of the users are restricted to their modules.

As can be seen in figure, the system administrator logs into the system using a username password. Moreover, the administrator can add, search, delete and edit's functions are highlight using a drop-down menu. The system has the advantage of producing and printing reports. The administrator's dialogue box has functions such as add user, edit, search and delete as the screen shot indicates.

4.2 Museum Collections management System Evaluation

In order to ensure that the Collections Management System met most if not all the requirements, the prototype was subjected to functional tests. This helped to ascertain whether the codes were functioning according to expectation. Further, tests

were done to ensure that the system was able to produce the expected output (results).

Web-based Collections Management System is ideal for use especially in this era as it allows members of staff to work from places of their convenience other than from office. Members of the public have access to information available on cultural issues away from the museum. This entails that they don't have to physically be at the museum for them to access information.

Evaluation was done by eight (8) members of staff at Lusaka National Museum. These included members of staff from research department, Library and administration. Out of the eight participants one performed the role of a system administrator and added users to the system. Two users were assigned with each gaining access to archaeology module while the other gained access to History module. None had access to two or more modules except the system administrator who had access to the entire system.

Table 5: evaluation of results

Museum Collections management System evaluation Results

Item	Attribute	Number of Participants who agree	Number of participants who disagree	Total number of participants
1	Ease to use	5	3	8
2	Network Connectivity	7	1	8
3	Fit for purpose	8	0	8

After testing the system, results from participants indicated that they were all satisfied with the performance of the system. However, one of them suggested that the system should be made responsive to mobile phones. The other concern was that of internet use where they expressed reservation in that in most rural areas there is no network connectivity. This meant that the system would not function effectively offline.

It is clear that a web-based Museum Collections Management System is established basically for the purpose of tracking and storage of information pertaining to museum objects. The project's outcome aimed at seeing to it that this aspect was achieved successfully after a critical analysis, design, developing and system testing. The system was successfully evaluated with stakeholders as well as most if not all the requirements and specifications were met.

4.3 Summary

This chapter presented the results of the baseline study and the development of the Museum Collections management System. The chapter covers the successful implementation of a web-based collections management system prototype that is able to carry out collections registration, data entry and retrieval to and from the archaeology, history and ethnography database using a form. The system is able to help trace the objects held in the museum since it captures detailed information. The chapter concluded by allowing intended users (Lusaka national museum employees) to test run the system.

CHAPTER 5

DISCUSSION AND CONCLUSION

5.0 Introduction

Chapter 4 mainly discusses the findings of the study in conjunction with the literature review. Therefore, this chapter basically gives the conclusion and recommendation deduced from the data that was gathered. From there the chapter will recommend some future works to be carried out. The findings of the study will be published in the International journal run by Information and Communication University.

5.1 Discussion

This section discusses the implementation and results that were laid out in the preceding chapter. It looks at how the results relate to the set objectives. Thus, as a way to justify the development of the Museum Collections Management System that seeks to overcome the challenges experienced when using the current system. Among the challenges that were experienced includes poor retrieval of information pertaining to museum collections, failure to easily locate and retrieve objects among others.

5.1.1 Baseline study

The first objective aimed at assessing the efficiency of the system being used to store and retrieve information about the objects held in the museum. The study revealed that the current system is actually very slow and demanding in terms of utilization. It uses a lot of paper for one to retrieve store or retrieve data. According to the survey conducted 83% of the respondents indicated that the system is very inefficient. In terms of retrieving data from the storeroom, majority of respondents of respondents agreed that the current system does not help in quick retrieval of library materials. From the point of view of retrieval of objects, 83% of

respondents stated that they rely on a manual system which makes object retrieval with its related information very difficult.

The second objective was to determine the levels of utilization of ICTs towards the management of museum collections. The objective was based on assessment of the utilization of information technology toward the storage and retrieval of information by members of staff. The study revealed that 58.8% of the respondents do not use an ICT in the retrieval of information. 41.2% of respondents stated that they use ICT for other purposes such as trying reports and other administrative concerns.

The third object was to design a system that would efficiently locate and retrieve information from the database. The study revealed that there was a concern about the performance of the current system as it was not very effective in the retrieval of required information. Out of 17 respondents 52.9 % supported transitioning to the new web-based collection management system while 41.7% refused. They supported the idea stating that the web-based system has several advantages such as quick information retrieval, it allows users to work from the comfort of their homes provided there is availability of internet. Therefore, this discussion motivated the design and development of the museum collections management system.

Possible Application

The Museum Collections Management System is designed to help museums employees effectively offer timely and accurate information to clients, researchers and members of staff. It is envisaged the system will also help minimize the cost as a result of reduced paper work. Furthermore, movement of objects to and from the storeroom will be closely monitored. Objects on loan will also be monitored

using the same system. This application will thus help in monitoring the objects for the museum. This in turn will contribute to the fulfilment of the mandate given to National Museums Board of preserving tangible and intangible heritage for education, entertainment and posterity.

5.5 Summary

This research proposed the development of a Museum Collections Management System that was aimed at ensuring the objects and related information is easily and timely located and retrieved for use. The system can be used by museums and any art gallery to manage their collections. This system will not only solve the problem of delayed retrieval of information but also minimize the cost of printing. It will also allow members of staff to carry out data entry from right from the field as the system is web-based. This implies that it runs on internet platform.

5.6 Conclusion

It can be attested that the design and development of the Museum Collection Management System met its objectives as it is functioning according to expectations. It is envisaged that the system will help museums interact with the general public easily in their quest to disseminate cultural information. Furthermore, the system will place a significant role towards the quick location and retrieval of information pertaining to museum objects.

5.7 Future works

A number of modules were included to the system such as archaeology, history, loaning among others. However, there still some other areas that need consideration. These could not be included due to time and financial constraints;

1. There is need to include a payment module in order to allow for on-line payments by people

who bring items purchase or field work payments

2. The system should incorporate cloud computing in future. This will minimize the usage of a lot of space on the hard drives
3. The system should consider cashless transactions between museum staff and its clients. This will promote transparency.

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REFERENCES

- [1] Ambrose, T. and Paine, C. (2012), **Museum basics, 3rd edition**. London: Routledge
- [2] Buck, R.A. and Gilmore, J.A (2010). **History of Registration: Museum Registration Methods (5 ed.)**, Washington, D.C., American Association of Museums
- [3] Bradley, C (2016). **Best Practices for Collection Documentation and Object Cataloguing**, Oregon: Gallery System Logo
- [4] Barker (2012). **Functionality of Information management System towards Library, Archives and Museums Collections**, Glenstone, USA
- [5] Bela-ela Local Municipality (2016). **Information and Communication Technology Disaster Recovery Policy**, Limpopo: Bela-Bela Local municipality.
- [6] Brawley-Barker, T (2012). **Integrated Library, Archives and Museum Collections in an Open Source Information Management System: A case study at Glenstone**, Glenstone: The University of Chicago Press Journal
- [7] Carpinone, E.C (2010) **“Museum Collections Management System: One size Does not fit all” Seton Hall University** Available at: <http://www.scholarship.shu.edu/dissertations/2366> Accessed on 22.04.2019
- [8] Central Statistical Office (2012). **Central Statistical Office Population Report 2010**, Lusaka: CSO
- [9] Dulle and Minishi-Manjanja (2009). **Collections management System in Tanzania**
- [10] Eugenie, P and Tam (2010), **Investigated on the usage of Museum Collections Management System and selected databases**, Hong Kong, China

- [11]Guru 99 (2019). **Agile methodology and model: guide for software development and testing.** Available at: www.guru99.com
Accessed on 30.06.2019.
- [12]James, M (2009). **Museums and Information Management Systems for Collections Management,** Paris: Malcorm
- [13]Kombo and Thromp, (2010). **The importance of Information Retrieval Systems in Museums,** London: Pelt Publishers
- [14]Kollar, P (2013). **Tshomarelo Ngwao: The Museum of Botswana Celebrate twenty-five years of Independence. National Museum, Monuments and Art Gallery.** Gaborone, pp 7 – 9
- [15]Kalbande, Shinde, and Ingle (2013). **Impact of Collections management system in information retrieval,** Delhi: Palrim Inc
- [16]LUSIDEA (2009). **Collection Management System for Museums,** Sydney: LUSIDEA
Available at: <https://www.lucidea.com>
Accessed on 20.02.2019
- [17]Musick, B.S et al (2011). **Development and use of a Web-based Data Management System for Randomized Clinical Trial,** Rockville:
- [18]Matthews, G (2010), **The Importance of Network Security in ICT,** Delhi: Paresi Publishers
- [19]Matt, H (2013). **Introduction to ICT,** London: Matrin Inc
- [20]Pearson, H (2013). **Introduction to Markup language used to build Websites,** California: Pulp Publications
- [21]Matzen, I (2013). **What is a Collections Management System?:** California: MLIS
- [22]Martin, H.T (2012). **Introduction to Research Methodology,** London: Malcom Inc
- [23]Radley, M (2016) **Benefits and constraints of Collections Documentation and Object Cataloguing in Oregon, United States of America.**
- [24]Walton, P (2014). **Technology in Museum,** Paris: Pareir Publishers
- [25]Jacobson, I, Spence, I, Bittner, K (2011). **Use Case 2.0: The guide to succeed in Use case,** London: Ivar Jacobson International.
- [26]Jean, A. G (2013), **Museum Registration Methods’’ (5th ed.),** Washington, DC: American Association of Museums.
- [27]John (2013), **Information retrieval as a means of managing collection,** London: Malvin Inc.
- [28]Robert A (2010). **Collections Management for Museums.** Museum Documentation Association, pp. 32 – 44
- [29]International Council of Museums (ICOM) (2007). **‘Museum Definition’. Adopted 21st General Conference in Vienna, Australia.** Available at: <http://www.icom.museum/who-we-are/the-vision/museum-definition.html>
accessed on 27.01.2019
- [30]Valtin, G (2013). **Quantitative and Qualitative Research: What are the differences and Importance,** Delhi: Pracrey Publishers

APPENDIX 1

Loan Algorithm

```
if(isset($_FILES['photo']['tmp_name'])){\n    $object_name = $_POST['object_name'];\n    $staffname = $_POST['staffname'];\n    $email = $_POST['email'];\n    $institution = $_POST['institution'];\n    $borroweddate = $_POST['borroweddate'];\n    $retundate = $_POST['retundate'];\n    $type = $_FILES["photo"]["type"];\n    $size = $_FILES["photo"]["size"];\n    $authourisedBy = $_POST['authourisedBy'];\n    $filename = $object_name.'.time();\n    $email = $_POST['email'];\n    $errors = array();\n\n    if ( $object_name == ""){\n        $errors[] = '<div class=incorrect>Enter\nobject_name</div>';\n    }\n    if($size>884142 ){\n        $errors[]="file size too large!";\n    }\n    if ($type == "image/jpeg" || $type == "image/jpg"\n|| $type == "image/png")\n    {\n        $explode =\nexplode(".",$_FILES["photo"]['name']);\n        $ext= end($explode);\n    }\n    else\n        $errors[]="file format not allowed!";\n    if($size>884142 )\n        $errors[]="file size too large!";\n    if (empty($errors)) {\n        $filename = $filename.'.'.$ext;\n        mysqli_query($con,"INSERT\nloanForm
```

```
VALUES('$object_name','$institution','$staffname\n','$borroweddate','$retundate','$filename','$authouris\nedBy','$email')");\n\nmove_uploaded_file($_FILES["photo"]["tmp_name\n"],"files/".$filename);\n    $subject = "Object is due for return";\n    //the body or message\n    $message = "The Object is due for return on the\nreturn".' '.$retundate;\n    // recipient email\n    // sendmail\n    mail($email, $subject, $message);\n        echo "saved";\n    }else{\n        foreach($errors as $e)\n            echo $e."<br />";\n    }\n    ?>\n\n        <form method="post" action=""\nenctype="multipart/form-data">\n        <div class="row">\n            <div class="col-md-3">\n                <div class="form-\ngroup">\n                    <label>Object\nName</label>\n                    <input type="text"\nclass="form-control border-input"\nname="object_name" placeholder="Object Name\nrequired">\n                </div>\n            </div>\n            <div class="col-md-4">\n                <div class="form-\ngroup">
```

```

        <label
for="exampleInputEmail1">Staff Name</label>
        <input type="text"
class="form-control border-input"
name="staffname" placeholder="Staff Name"
required>
        </div>
</div>
<div class="col-md-4">
    <div class="form-
group">
        <label>Email</label>
        <input type="email"
class="form-control border-input" name="email"
placeholder="Email" required>
        </div>
    </div>
</div>
<div class="row">
    <div class="col-md-4">
        <div class="form-
group">
            <label>INSTITUTION</label>
            <input type="text"
name="institution" class="form-control border-
input" placeholder="INSTITUTION" value=""
required>
            </div>
        </div>
    </div>
    <div class="col-md-3">
        <div class="form-
group">
            <label>Photo</label>
            <input type="file"
name="photo" class="form-control border-input"
placeholder="" value="" required>
            </div>
        </div>
    </div>
    <div class="col-md-5">
        <div class="form-
group">
            <label>Authourised
By</label>
            <input type="text"
name="authourisedBy" class="form-control border-
input" placeholder="Authourised By" value=""
required>
            </div>
        </div>
    </div>
</div>
<div class="row">
    <div class="col-md-5">
        <div class="form-
group">
            <label class=""
for="date">Borrowed Date</label><br>
            <input class="form-
control" type="date" name="borroweddate"
id="date" required="">
            </div>
        </div>
    </div>
    <div class="col-md-5">
        <div class="form-
group">
            <label class=""
for="date">RETURN Date</label><br>
            <input class="form-
control" type="date" name="retundate" id="date"
required="">
            </div>
        </div>
    </div>
</div>
<div class="text-center">
    <button type="submit"
name="submit" class="btn btn-info btn-fill btn-
wd">Save</button>
</div>

```

```

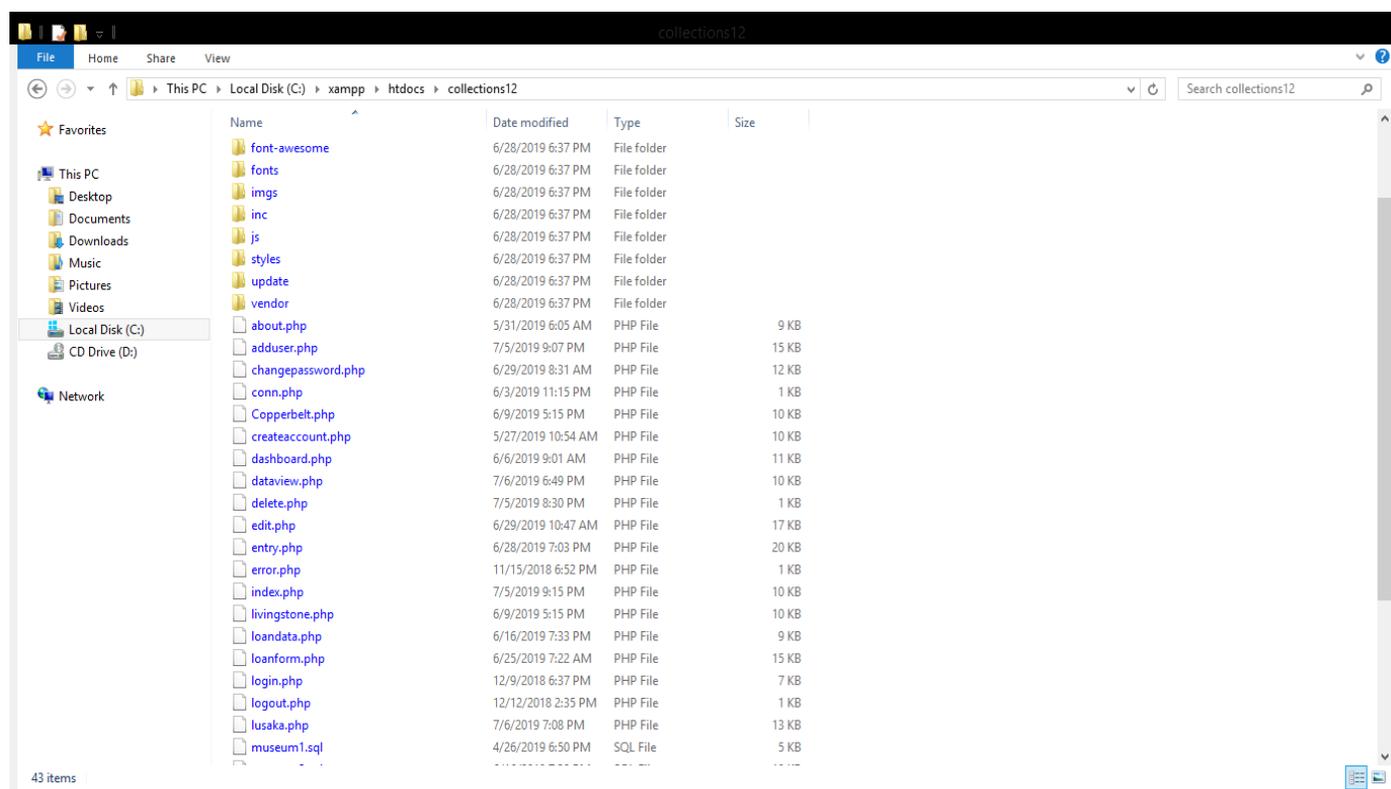
        </div>
        <div class="clearfix"></div>
    </form>
</div>
</div>
    </div>
    </div>

```

Appendix 2

A. Source Code

The diagram below shows a sample structure of the Museum Collections Management System



B. Database Connection code;

Sample source code that access the database. The code is used to add the archaeology and registration form.

```

function delete_admin($id){
    include("inc/databasecon.php");
    $array = array();

```

```

    $q=mysqli_query($con,"SELECT * FROM
`archaeology` WHERE `ACCESSION_NO`=" . $id);
    while ($r=mysqli_fetch_assoc($q)) {
        $array['id']=$r ['id'];
        $array['OBJECT_NAME']=$r
['OBJECT_NAME'];
        $array['GALLERY_LOC']=$r
['GALLERY_LOC'];

```

```
$array['STORE_LOC']=$r ['STORE_LOC'];
$array['DATE_OF_ISSUE']=$r
['DATE_OF_ISSUE'];
    $array['DATE_OF_RETURN']=$r
['DATE_OF_RETURN'];
    $array['NAME_OF_ISSUER']=$r
['NAME_OF_ISSUER'];
    $array['NAME_OF_RECEIVER']=$r
['NAME_OF_RECEIVER'];
    $array['INSTITUTION_BORROWING']=$r
['INSTITUTION_BORROWING'];
    }
    return $array;
}
function getRegiData($id)//Registration Data
{    include("inc/databasecon.php");
;
    $array = array();
    $q=mysqli_query($con,"SELECT * FROM
`registration` WHERE `accessionNumber`=". $id);
    while ($r=mysqli_fetch_assoc($q)) {
    $array['id']=$r ['id'];
    $array['objectName']=$r ['objectName'];
    $array['serialNumber']=$r ['serialNumber'];
    $array['section']=$r ['section'];
    $array['colletionDate']=$r ['colletionDate'];
    $array['institution']=$r ['institution'];
    $array['objectName']=$r ['objectName'];
    $array['area']=$r ['area'];
    $array['purchasePrice']=$r ['purchasePrice'];
    $array['collector']=$r ['collector'];
    }
    return $array;
}
function get_admin($id)
{    include("inc/dbc.php");
    $array = array();
    $q=mysqli_query($con,"SELECT * FROM
`admin_users` WHERE `id`=". $id);
    while ($r=mysqli_fetch_assoc($q)) {
    $array['id']=$r ['id'];
    $array['username']=$r ['username'];
    $array['firstname']=$r ['firstname'];
    $array['lastname']=$r ['lastname'];
    $array['password']=$r ['password'];
    $array['department']=$r ['department'];
    $array['account_type']=$r ['account_type'];
    }
    return $array;
}
return false;
else
    return true;
}
?>
```