

**X-LIB PLUS Library Automation Software: A Case Study of Software
Development in a Nigerian Organization**

By

Esther Olajope Akomolafe-Fatuyi

Emporia, Kansas

May 2006

A Dissertation

Presented to

EMPORIA STATE UNIVERSITY

In Partial Fulfillment

of the Requirements for the Degree

Doctor of Philosophy

The School of Library and Information Management

Copyright 2006

Esther Olajope Akomolafe-Fatuyi

ALL RIGHTS RESERVED

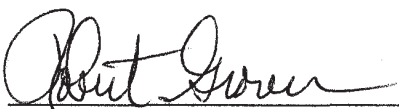
PROPOSAL ACCEPTANCE FORM

Name of Student ESTHER OLAJOPE AKOMOLAFE-FATUYI

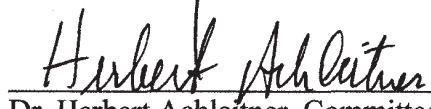
Title of Dissertation X-LIB PLUS Library Automation Software: A Case Study
of Software Development in a Nigerian Organization

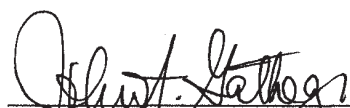
Signatures:


Dr. Ann O'Neill, Dean of the School of Library and Information Management


Dr. Robert Grover, Dean of the School of Graduate Studies and Research


Dr. John Agada, Committee Member (Chair)


Dr. Herbert Achleitner, Committee Member


Dr. John Gathegi, Committee Member


Esther Olajope Akomolafe-Fatuyi, Doctoral Candidate

AN ABSTRACT OF THE DISSERTATION
FOR THE DEGREE DOCTOR OF PHILOSOPHY IN THE
SCHOOL OF LIBRARY AND INFORMATION MANAGEMENT

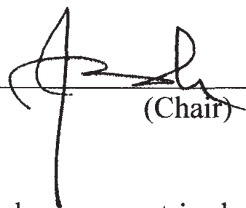
ESTHER OLAJOPE AKOMOLAFE-FATUYI

(Name of student)

Presented on May 1, 2006

Title: X-LIB PLUS Library Automation Software: A Case Study of Software Development in a Nigerian Organization

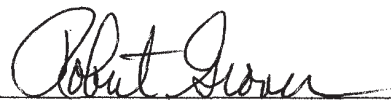
Abstract approved: _____


(Chair)

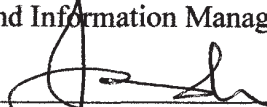
Software designers in developing countries have increased the frequency of innovation and patenting. This trend reflects an effort to reduce dependence on imported western technology and encourage the development of indigenous alternatives. Although Library Automation Systems (LAS) perform similar functions the world over, they are primarily designed to meet the needs of their local populations. Indigenous LAS in developing countries for example, are more sensitive to literature in indigenous knowledge and languages than imported LAS. Indigenous LAS are, however, relatively few and far between in Africa.

This study examined the development of X-LIB PLUS library automation software designed at the Raw Materials Research and Development Council in Abuja, Nigeria. Using a case study method, data were collected to describe the X-LIB PLUS

development process and the factors that facilitated and challenged its creation. The study also identified the factors, which accounted for the adoption of X-LIB PLUS by libraries in Nigeria. It is hoped that the process and context of X-LIB PLUS development and diffusion described by this study could serve as models of software innovation and the organizational conditions that nurture such efforts in Africa.



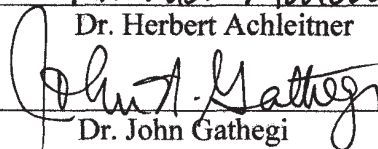
Dean of the School of Library
And Information Management



Dr. John Agada (Chair)



Dr. Herbert Achleitner



Dr. John Gathegi



Dean of Graduate Studies and Research

ACKNOWLEDGEMENTS

I am most grateful to the Most High God for His abundant provisions, strength, and wisdom to complete this degree. My sincere gratitude goes to Dr. John Agada, my mentor and chair of my dissertation committee for always finding the time, energy, and patience to work with me and for assisting me in this arduous task with wisdom, candor, and a sense of motivation. I appreciate the relentless contributions of my other committee members, Dr Herbert Achleitner and Dr. John Gathegi for providing insights and directives on the research.

Acknowledgement is also given to my research informants at the RMRDC, Abuja, Nigeria. Without the support of the participants, I would not have been able to conduct the research or provide a benchmark for further research in this area. I am grateful for the contributions of my director at the National Research Institute for Chemical Technology, Zaria, Nigeria, the late Dr. A.S Mshelbwala for believing in me and giving me free hand, and motivation to initiate the development of a LAS at NARICT library. This effort and experience has stimulated my interest in this study.

An undertaking such as this would have been even more difficult without the constant love and support of my children, my family, and all my friends who never doubted my ability and my commitment to complete this degree. These are too numerous to mention here, but among them are: Dr. Aderemi Fatuyi, Adeshola Fatuyi, Yewande Fatuyi, Prof. R.B Fatuyi, Chief and Mrs. Igbekele Akomolafe, Architect Akin and Mrs. Funbi Ajuwon, Prof. Freida High-Tesfagiorgis, Dr. and Mrs. Elegbede, late Engineer Sunny and Mrs. Ige, Dr. and Mrs. Ayo, Dr. Daniel, and Mr. Omotosho,. I am grateful to

my parents late Chief Gabriel Akomolafe and Mrs. Eunice Adetutu Akomolafe for instilling in me the aptitude to always aim for the best.

TABLE OF CONTENTS

DOCTORAL APPROVAL SHEET.....	i
ACKNOWLEDGMENTS.....	ii
TABLE OF CONTENTS.....	iv
LIST OF TABLES.....	ix
LIST OF FIGURES.....	x
<u>CHAPTERS</u>	
1 INTRODUCTION.....	1
Purpose of Study.....	3
Differentiating Xlib and X-LIB PLUS.....	3
Statement of Research Problem.....	4
Research Questions.....	5
Significance of the Study.....	6
Definition of Terms.....	7
Library Automation Software LAS).....	8
Local Library Automation Software (LAS).....	8
Innovation.....	8
Summary.....	8
2 BACKGROUND AND CONCEPTUAL FRAMEWORK.....	10
LAS in Nigeria Libraries.....	10
RMRDC.....	11
Innovation-Development Process Model.....	14
The Learning Organization Model.....	18

3	REVIEW OF LITERATURE.....	22
	Indigenous Technology.....	22
	Library Automation Software.....	23
	Basis for Library Automation Innovation in Developing Countries....	25
	Core Theories and Concepts in Learning	
	Organization.....	27
	Characteristics of Learning Organizations	
	That Supports Innovation.....	28
	Resolution of Barriers to Innovation	
	by a Learning Organization.....	32
4	RESEARCH DESIGN.....	38
	Qualifications and Experiences that Facilitated Data Collection.....	38
	Research Sites and Participants.....	39
	Research Method.....	40
	Methods of Data Collection.....	41
	Interviews.....	41
	Observations.....	42
	Participant Observations.....	48
	Focus Group.....	42
	Document Review.....	43
	Data Analysis.....	44
	Validity.....	45
	Triangulation.....	46

	Summary.....	47
5	FINDINGS AND DISCUSSION.....	48
	Overview.....	48
	Research Questions.....	48
	Findings 1	52
	Needs/Problems stage of X-LIB PLUS	
	Findings 1	56
	Research (Basic and Applied) Stage of X-LIB PLUS.....	
	Findings 1	59
	Development Stage of X-LIB PLUS	
	Findings 1	62
	Commercialization Stage/Maintenance Stage of X-LIB PLUS.....	
	Findings 2	65
	Technological Innovation Factor	
	Findings 2	68
	Cultural Factor.....	
	Findings 2	70
	Economic Factor.....	
	Findings 2	71
	Organizational Factor.....	
	Findings 3	75
	Technological Challenges.....	
	Findings 3	78
	Cultural Challenges.....	
	Findings 3	79
	Challenges of Funding and Time.....	
	Findings 3	
	Organizational Challenges.....	82
	Findings 4	84
	Relative Advantages.....	
	Findings 4	87
	Compatibility.....	
	Findings 4	89
	Complexity.....	
	Findings 4	93
	Trialability.....	
	Findings 4	94
	Observability.....	

	Summary.....	95
6	SUMMARY, LIMITATIONS AND IMPLICATIONS.....	96
	Limitations.....	96
	Summary.....	97
	Research Question 1.....	97
	Research Question 2.....	100
	Research Question 3.....	101
	Research Question 4.....	103
	Utility of Research.....	105
	Implications and Recommendations for Further Studies.....	106
	Implications for Further Research on X-LIB PLUS.....	106 107
	Implications for LIS.....	107
	Conclusion.....	107
	REFERENCES.....	109
	LISTS OF DOCUMENTS.....	119
	APPENDICES.....	120
	Appendix A: Profiles of Participants.....	120
	Appendix B: Interview Outline.....	123
	Appendix C: Application For Approval To Use Human Subjects	126
	Appendix D: Informed Consent And Information Sheet	130
	Appendix E: Letter to RMRDC.....	132
	Appendix F: Samples of X-LIB PLUS Modules.....	133

Appendix G: Samples of X-LIB PLUS Modules B.....	134
Appendix H: Samples of X-LIB PLUS Modules C.....	135
Appendix I: Permission to Copy Statement.....	136

LIST OF TABLES

Table 1. The Main Characteristics of the Learning Organization.....	30
Table 2. The Emerged Categories and RMRDC Characteristics From the Data.....	50
Table 3. NLAS Document Search Module.....	92
Table 4. X-LIB PLUS Enquiries/Reports Module.....	93

LIST OF FIGURES

Figure 1 The Nine-Step Innovation Process	
Model.....	16
Figure 2 Characteristics of a Learning	
Organization.....	20
Figure 3 The Three Arenas of the Innovative	
Organization.....	34
Figure 4 Software Development Life Cycle (SDLC) of	
X-LIB PLUS.....	64

CHAPTER 1

INTRODUCTION

Libraries in developing countries such as Nigeria have depended on library automation software (LAS) imported from the west since their creation. LAS are modular systems that automate library acquisition, cataloguing, and circulation functions, thereby enabling efficient management and retrieval of information for librarians and their patrons. LAS such as UNESCO CDS/ISIS and Graphical Library Automation Software (GLAS) are not primarily designed for libraries in developing countries. Such LAS are therefore not culturally appropriate to the needs of developing countries. Moreover, imported LAS are expensive to purchase and support with technical training and maintenance services. As a result, there have been efforts to decrease their dependence on foreign LAS by developing software that meet local, cultural, and organizational needs.

Software designers in developing countries have increased the frequency of innovation and patenting since the middle of the 20th century (Lansing & Kremer 1995). The design of X-LIB PLUS Library Automation Software took into consideration the needs of local libraries and their clientele, as well as their cultural, technical, and economic conditions. Such LAS are usually more sensitive to the indigenous literature and languages, and more affordable for local libraries, unlike the imported ones, which are designed to be one-size-fits-all software (Kumar, Van Dissel, & Bielli, 1998).

The present study examined the development of X-LIB PLUS Library Automation Software, at the Raw Materials Research and Development Council (RMRDC) at Abuja, Nigeria in 1999, and has since become one of the most popular LAS

in use in Nigerian libraries today. In 2003, Oketunji asserted that “there are now over 50 X-LIB PLUS sites in Nigeria ...buttressing its claim as one of the more successful library management systems in the country today” (p.4). The present study investigated the X-LIB PLUS development process and the organizational conditions that nurtured its creation and diffusion. The perspectives of Rogers (2003) and Dundon (2002) on the innovation development process, and those of Senge (1990) on learning organizations were used to describe these events and processes.

A case study design was used and a set of data was collected using interviews, a focus group, document review and observations and participant-observation methods. To facilitate analysis, the interview transcripts and data from the other sources were analyzed using QSR NVIVO qualitative data analysis package. In studying the X-LIB PLUS innovation process, this research examined the factors that facilitated and challenged its development and the circumstances that fostered its adoption by libraries in Nigeria. Ultimately, this study sought to understand the extent to which the designing process of X-LIB PLUS was influenced by the needs and conditions of RMRDC in particular and Nigeria in general.

RMRDC (<http://www.rmrhc.gov.ng/>) is a research center with a mandate to develop Nigerian local raw materials in a bid to promote industrial development in the nation. The center’s databases contain indigenous knowledge, including vernacular words, names, and document titles based on local raw materials that require LAS for organization and retrieval. The need to query and retrieve information from the center’s database challenged the RMRDC to develop LAS that could store and retrieve information on local raw materials better than the foreign LAS could.

Purpose of Study

The study described the processes involved in the development of X-LIB PLUS library automation software developed at the Raw Materials Research and Development Council at Abuja, Nigeria. Using the case study method, the study examined the circumstances that led to X-LIB PLUS development and the organizational context in which it was created. Although X-LIB PLUS was primarily developed for use at RMRDC, many Nigerian libraries eventually adopted it over other foreign and local LAS. This study also sought to explain the factors that account for the diffusion of X-LIB PLUS among Nigerian libraries.

Differentiating Xlib and X-LIB PLUS

In order to avoid confusion, it is necessary to differentiate X-LIB PLUS LAS, the subject of this study from the Hewlett-Packard's Xlib software. The HP Xlib software is a standard application-programming interface (API) for two-dimensional (2D) graphics (Nye, 1994). A low-level C language interface between the client (the application) and the network, Xlib, is one of the “libraries”, which are culled from the C programming language. Xlib also has routines to interface with an X server using the X protocol. It performs this main task by translating C data structures and procedures in the special form of X protocol messages (Edwards, 1995).

The X-protocol refers to a high-level communications protocol, which is used between two programs. The official name of the system is *The X Windows System*. However, in order to distinguish it from *Microsoft Windows*, the system is called *X Windows* or simply *X*. Edwards (1995) affirmed that X represents a low-level method of creating windows, receiving user input such as pressing the keyboards, using the mouse,

and performing graphical functions like drawing strings, lines, curves and bitmaps. He further contended that the behavior of this application, the blueprint, and approach of the user interface are left exclusively to the clients' plans.

HP Xlib is therefore different from the X-LIB PLUS library automation software. The development of X-LIB PLUS was based on Microsoft Access front end and backend, and linked to an Oracle Backend through ODBC (Open Data Base Connectivity) in order to facilitate interactions with RMRDC's other databases. The developers were aware of the existence of HP's Xlib in the west. An informant observed during the data collection for this study that X-LIB PLUS designers contemplated changing the name of X-LIB PLUS to avoid the conflict in name with Xlib and eventually settled for X-LIB. X-LIB Library Automation System (LAS) was later renamed X-LIB PLUS, further differentiating the software from the HP Xlib.

Statement of Research Problem

Library automation software systems such as X-LIB PLUS have been developed in Nigeria to avert continued dependence on imported LAS. Of the more than 500 computer companies registered in Nigeria, one out of five has software and information systems development activities (Alabi, 1994). Each software development project has been uniquely shaped by its local organizational needs and circumstances. For instance, the development of LAS at the National Research Institute for Chemical Technology (NARICT), Zaria, Nigeria, under the supervision of this researcher, used dBase IV as base software (Fatuyi, 1999). X-LIB PLUS developers on the other hand, used a combination of Access, SQL, and FoxPro as base software (Ayo, 1998).

Most of these library automation systems were neither commercialized, nor adopted by libraries outside the institutions in which they were developed. This non-adoption is attributed to the unstable nature of software development in Nigeria. While most software packages are not marketed, others that are hardly survive the competition of the marketplace. The challenges of LAS development and marketing in Nigeria include lack of adequate funding, qualified staff, and support services such as training and technical maintenance among others. What factors account for the relative success of X-LIB PLUS? No research studies have investigated the processes and organizational environment that nurtured LAS development in Nigeria.

There is scant knowledge about the development processes and diffusion of library automation software in Nigeria from which to draw lessons for future applications. In addition, there is little basis for comparing locally developed and foreign LAS in developing countries, and Nigeria in particular. Innovation-development processes and the characteristics of organizations that nurtured them have been extensively studied in the west. Are western theories and models appropriate for understanding the development and diffusion of X-LIB PLUS, given that Nigerian organizations operate under different socio-cultural, economic, and technical conditions?

Research Questions

The following research questions guided this study:

1. What was the development process of X-LIB PLUS at the RMRDC?
2. What factors facilitated the development of X-LIB PLUS at the RMRDC?
3. What factors challenged the development of X-LIB PLUS at the RMRDC?
4. What factors account for the diffusion of X-LIB PLUS among Nigerian libraries?

Significance of the Study

Nigerian libraries need library automation software developed in the country because such software would be more sensitive to local needs. The adoption of X-LIB PLUS by Nigerian libraries suggests that it has some advantages over foreign and other local LAS. Therefore X-LIB PLUS and RMRDC serve as models for LAS development in Nigeria and innovative organizations respectively. Understanding the circumstances and context of X-LIB PLUS development is especially significant because the characteristics of innovative organizations as described in the western management literature are often different from those associated with organizations in developing countries, including Nigeria.

There are assumptions that Nigerian organizations are strapped for resources and have management styles that are markedly different from those of their counterparts in the western industrialized nations. The former conditions are said to frustrate innovation and sustain dependence on imported western goods and services, including LAS (Ogunrombi & Bello, 1999). In 2000, Oyegade affirmed that the poor state of library funding in Nigeria was responsible for the low level of IT integration in Nigerian library services. He observed that “it is obviously not for the lack of understanding of the need for IT provision on the part of the librarians but basically due to the absence of the financial wherewithal to translate intention and wish to reality” (p.65).

In 2001, the Federal Government of Nigeria set up the National Information Technology Development Agency (NITDA) (<http://www.nitda.gov.ng>) to implement the National Information Technology (IT) Policy. In order to regulate the development of the Information Technology sector, the NITDA embarked on upgrading information

management systems in educational institutions and libraries in a bid to improve the quality of information services in the country. LAS, which are sensitive to Nigerian indigenous literature and customized to the national information infrastructure, would go a long way to ensure improved information services. This study of X-LIB PLUS is therefore supportive of this national mandate.

Although locally developed LAS evolved in response to the need to organize and retrieve indigenous literature, these systems share standard LAS features of all acquisition, circulation, and cataloguing operational modules (Clyde, 1992). Hence, locally developed LAS complement western LAS in its capacity to retrieve indigenous, in contrast to foreign literature. This could lead to the creation of LAS, which are sensitive to both Western and local or non-western literature in developing countries. Such a development in Nigeria would satisfy one of the objectives of NITDA, namely, to generate additional foreign exchange earnings through international trade in indigenous IT products and services.

Definition of Terms

Library Automation Software (LAS)

According to Bitpipe (2005), *library automation software (LAS)* is “software that automates library functions such as cataloguing, circulation, serials, or acquisition.” In this study, the operational definition for the term “library automation software” refers to the mechanisms used in computerizing core library operations for local collections with modules such as acquisition, serials, cataloguing, and circulation.

Local Library Automation Software (LAS)

In this study, Local Library Automation Software refers to locally developed library automation software, designed by citizens of non-western countries, such as Nigeria. Such software should also be capable of storing and retrieving information in local non-western languages, cultural names and concepts on local cultural artifacts, ideas and activities, and other tasks that imported LAS are not designed to accomplish.

Innovation

Rogers (1962, 1983, 1995, 2003) defines innovation as “an idea, practice, or object that is perceived as new by an individual or other unit of adoption... whether in terms of knowledge, persuasion, or decision to adopt” (Rogers, 2003, p. 12). LAS innovation can be conceptualized as the introduction of new software for automating the storage and retrieval of information. An innovation will usually have two parts: the idea and material components (Rogers and Shoemaker, 1971). Rogers (1983) called these two parts the software (the idea behind the innovation) and the hardware (the material form) aspects of an innovation.

Summary

Chapter one provides an introduction to the study of the development processes of X-LIB PLUS and the organizational characteristics that nurtured the innovation. In addition, the chapter describes the purpose, problem statement, and research questions as well as the significance of the study. Finally, it defines the key terms used in this research.

Chapter two provides the background and theoretical framework for the study. It describes X-LIB PLUS and the RMRDC, and reviews the innovation-development

process and learning organization models used as guides for the research. Chapter three presents a review of the relevant literature.

Chapter four describes the methods applied to the selection of the research design, sites and participants, and the data collection and analysis procedures. Chapter five discusses the findings obtained from data collected from interviews, observations, participant observations, and documents, organized by the research questions. Finally, chapter six summarizes and concludes the study, acknowledges its limitations and implications, recommends future research foci, and discusses the utility of the research.

CHAPTER 2

BACKGROUND AND CONCEPTUAL FRAMEWORK

This chapter describes the organization in which X-LIB PLUS was developed and discusses the conceptual framework of the study.

BACKGROUND

LAS in Nigerian libraries

Library automation has occupied a central place in the Nigerian library literature since the early seventies. Adoption of library automation has been slow because information technologies were until recently scarce as many libraries could not afford to acquire them due to their meager budgets (Ogunrombi & Bello, 1999). Recent trends in Information and Communication Technology (ICT) have generated a national debate at professional conferences, seminars, workshop, and publications in Nigeria, and Africa in general, on the need for and experiences in automating library operations (Akande (2001); Idowu (2000); Dada (1999); Daniel (1999); Mohammed (1999); Aguolu (1998); and Ajibero (1987).

The Nigerian Federal government recognizes the importance of using IT to support the work of the academic community. Accordingly, the National Universities Commission (NUC) launched projects such as Management Information Systems (MIS), the Nigerian Universities Network (NUNET), and the National Virtual Library in a bid to computerize university library services, and to promote access to national and international digital resources (NUC, 1990).

Although, there were many futile efforts at library automation in Nigeria in the early 1970s (Ogunrombi & Olanlokun, 1992), some successes were recorded since the

1980s, notably by the libraries of the Ladoke Akintola University of Technology, the Nigerian Institute for International Affairs (NIIA) in Lagos, and the University of Ibadan. These libraries successfully computerized their resources using TINLIB and later migrated to GLAS software.

The National Mathematical Centre also computerized its library collections using dBase IV software and later migrated to TINLIB and subsequently to Alice Library software. Because, the level of IT awareness among Nigerian librarians and sources of funding for IT projects have increased since the 1970s (Okojie, & Daniel, 2002), training in library automation has also become a standard feature of seminars and workshops run by the Nigerian Library Association during the last decade.

Raw Materials Research and Development Council

X-LIB PLUS is a product of the research and development (R&D) unit of Raw Materials Research and Development Council (RMRDC), also referred to as the Council in this dissertation. An agency of the Nigerian Federal Ministry of Science and Technology, this organization has the mandate of the Nigerian government to promote, support, and expedite industrial development in the country. It therefore seeks ways to optimize the use of local resources as input for the nation's industries.

Established by Decree No. 39 of 1987, the RMRDC commenced operation in February 10, 1988. The Council's vision is "to facilitate the emergence of a strong industrial and technological base in Nigeria through the creation of a strong domestic source for necessary raw materials." Its mission statement is "to promote the growth of process technology and resources-base industries in Nigeria" (RMRDC, 2004, p.3).

The Council undertakes research and development (R&D) activities based on local raw materials. For example, it promotes capacity building among institutions and companies in the design and development of industrial processes and technology. Examples include Computer Aided Process Equipment Design (CAPED), Design and Development of Cassava Pelleting Mill, a Pilot Oil Project with designs of distillation, condenser, separator, and piping instrumentation and control units. The RMRDC also collaborates with other institutions to upgrade indigenous technology for the processing and packaging of salt and spices, as well as technology for drying and packaging fruits and vegetables for both local and international markets (RMRDC, 2004).

In fulfilling its mandate, the Council undertook a Techno-Economic survey of ten major agro-raw materials that are considered to be important for industrial use and export. These major agro-raw materials are cotton, cocoa, benniseed (sesame), groundnut, gum Arabic, rubber, oil palm, soybeans, maize, and cassava. Then, the organization embarked on innovative R&D activities to increase production of these commodities both to feed the population and for foreign exchange earnings through export. For examples, rubber is one of the sources of foreign exchange in Nigeria and there is a ready market for cassava export to other countries in Africa, Asia, and Latin America where over 600 million people use it as a staple diet (RMRDC, 2004).

RMRDC has a total staff strength of 907, and a break-down of their qualifications shows the following tally: 20 with PhD, 1 M. Phil, 74 masters degree in arts, business, science, and 396 with undergraduate degrees in science, law, and library science, and 361 junior staff (RMRDC, 2004). Also, the organizational structure has a director general as

the chief executive, six departments with directors as administrative heads, and deputy directors who head fourteen divisions.

Furthermore, RMRDC has thirty-six liaison offices in the thirty-six states of Nigeria to facilitate easy contact with project collaborators and investors. In its quest to optimize local resources as input for the nation's industries, RMRDC has collaborated with institutions, companies, and industries around Nigeria. RMRDC has research programs that facilitate the processing of local food resources. These range from couscous to *gari* or cassava granules, varieties of cereal-based flour, pulverized tubers and vegetable-based soups, all of which have given African culinary traditions a distinct character. Others include research into the production of spices such as *dawadawa*, beverages like *emu* or palmwine and *burukutu* or millet-based alcoholic beverage (Nigerian Investment Promotions Commission (NIPC), (2000). RMRDC's R&D unit also develops prototypes of equipment for food processing. These prototypes are subsequently marketed through joint projects with manufacturing industries and government agencies like the Nigerian Investment Promotions Commission. X-LIB PLUS is a product of the research and development (R&D) unit of RMRDC.

CONCEPTUAL FRAMEWORK

In order to provide a seemingly good balance of ideas and unified concepts on the development of X-LIB PLUS, the environmental characteristics that facilitated it, and its diffusion, this study combined frameworks from two models: Innovation-Development Process from the perspectives of Rogers (2003) and Dundon (2002), and learning organization's characteristics from the perspectives of Senge (1990), Robbins and Decenzo, (2003). The researcher assumed that this combination of Innovation-

Development Process framework in its application to learning organizations is being predicated on the following idea by Rogers (2003) that: “An organization is a stable system of individuals who work together to achieve common goals” (p. 995, 403).

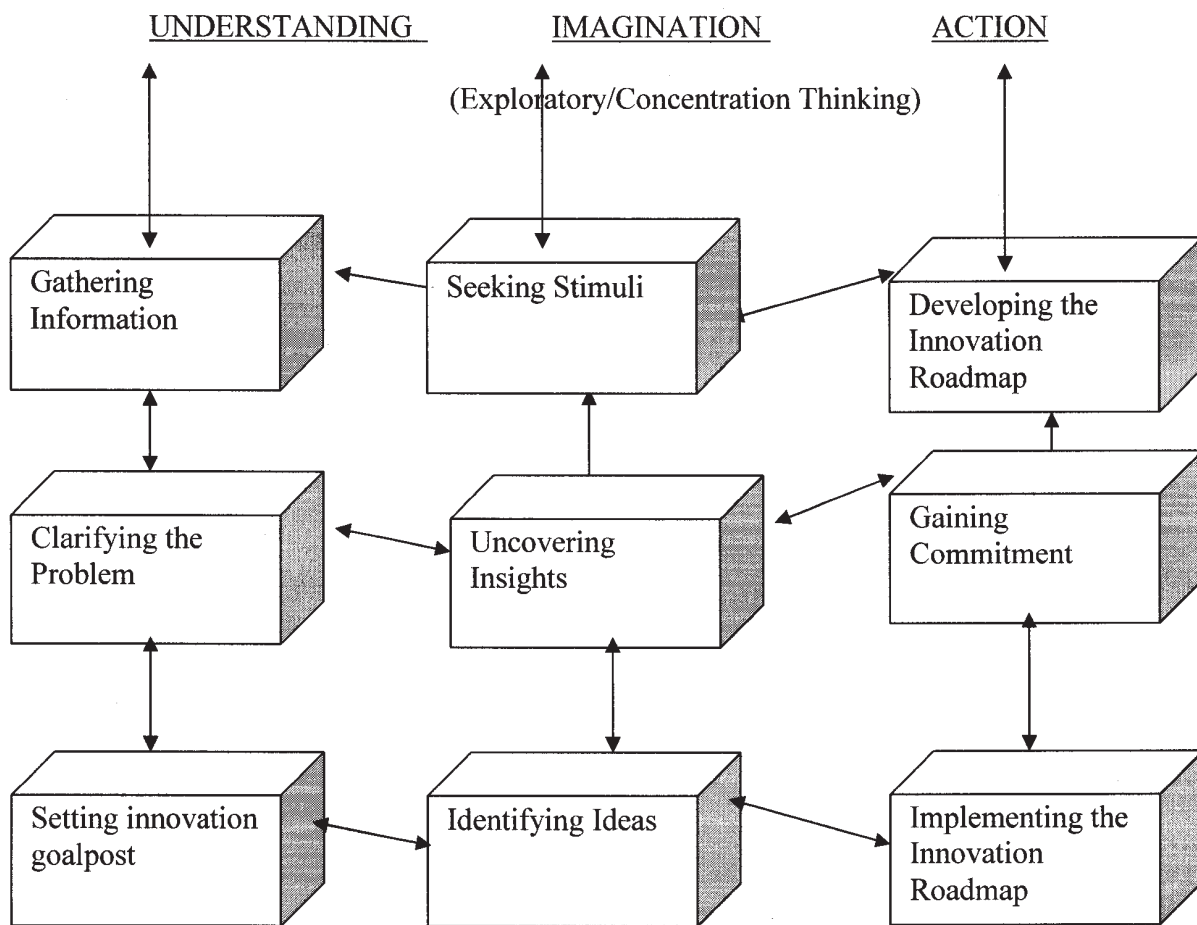
The idea has been supported by a similar study by Gladwin, Dixon, and Wilson (2003) who contend that, since the innovation model does not predict what or how much needs to be changed within an organization when a particular innovation is introduced, the addition of the organizational model has helped. Similarly, because the Innovation-Development Process Model by Rogers (2003) as applied to the development process of X-LIB PLUS does not predict the characteristics that nurtured the innovation in RMRDC, nor does it address what aspects of the environment encouraged the innovation or how much needs to be changed within the organization where X-LIB PLUS was developed. Hence, the addition of the organizational model that incorporated the organization design, culture, leadership, and information sharing to enhance an environment that nurtured the innovation of X-LIB PLUS has helped to frame the study and to identify what to look for.

Innovation-Development Process Model

This section identifies the conceptual models that guided the study. These models include Rogers’ Innovation Process Model (2003) and its elaboration by Dundon (2002), Rogers’ (2003) Diffusion Model and Senge’s (1990) Learning Organization Model. Rogers (2003) described the Innovation-Development Process as comprising six main stages: *Needs/Problems; Research (basic and applied); Development; Commercialization; Diffusion and Adoption; and Consequences* (2003). The first stage involves analyzing a situation and identifying a problem that needs to be resolved. The second stage entails original investigations to acquire the necessary scientific and

technical knowledge base for solving the problem. The third involves using new ideas to develop a solution that responds to the need. The fourth stage is the packaging of the innovation for marketing and distribution. The fifth stage is diffusing an innovation to potential adopters. The sixth stage considers the consequences of adoption or rejection of an innovation on a social system or on the developers of such innovation. In Dundon's model, these stages are labeled as *Understanding*, *Imagination*, and *Action*, each of them consisting of three processes, as depicted in the visual below.

Fig.1 The Nine-Step Innovation Process Model adapted from Dundon (2002)



The *Nine-Step Innovation Process* entails alternating *exploratory* and *concentrated* thinking activities at each stage and the activities that follow them. The first stage of Dundon's model is *Understanding*. This stage consists of three steps: the processes of gathering information; clarifying the problem; and setting the innovation goalpost.

The second stage is *Imagination*; this stage also contains three steps: seeking stimuli; uncovering insights; and identifying ideas. The third stage is termed *Action*; this stage involves three active processes: developing the innovation roadmap; gaining commitment; and implementing the innovation roadmap. Dundon's (2002) model is related to the development concept of Rogers's (2003) innovation-development model.

These stages and processes are interrelated and provide a framework for encouraging innovation and its diffusion. The innovation process is considered in diffusion studies as an interactive process within innovation systems, which according to Lundvall (1992), implies a group of "organizations, institutions, and people that interact in the production and diffusion of new economically useful knowledge" (p.11). RMRDC is the organization for the development of X-LIB PLUS, and the diffusion of the software was among Nigerian libraries institutions.

Diffusion is manifested when an innovation is adopted. Rogers identified five attributes, which influence the rate of innovation diffusion. These attributes are *relative advantage*: "the degree to which an innovation is perceived as better than the idea it supersedes" (p. 15), *compatibility*: "the degree to which an innovation is perceived as being consistent with the existing values, past experiences, and needs of potential adopters" (p. 15), *complexity*: "the degree to which an innovation is perceived as difficult

to understand and use” (p. 16), *trialability*: “the degree to which an innovation may be experimented with on a limited basis” (p. 16), and observability: “the degree to which the results of an innovation are visible to others” (p. 16).

The Learning Organization Model

Senge (1990) defined learning organizations as “organizations where people continually expand their capacity to create the results they truly desire, where new and expansive patterns of thinking are nurtured, where collective aspiration is set free, and where people are continually learning to see the whole together” (p.3). It is said that in an era of rapid change, only those organizations that are flexible, adaptive, and productive will excel and survive. Such organizations therefore draw from individual worker’s commitment and capacity for learning to ensure growth through change and innovation.

In order to achieve continuous cycles of learning and change, Senge (1990) contended that the Learning Organization is founded upon five disciplines:

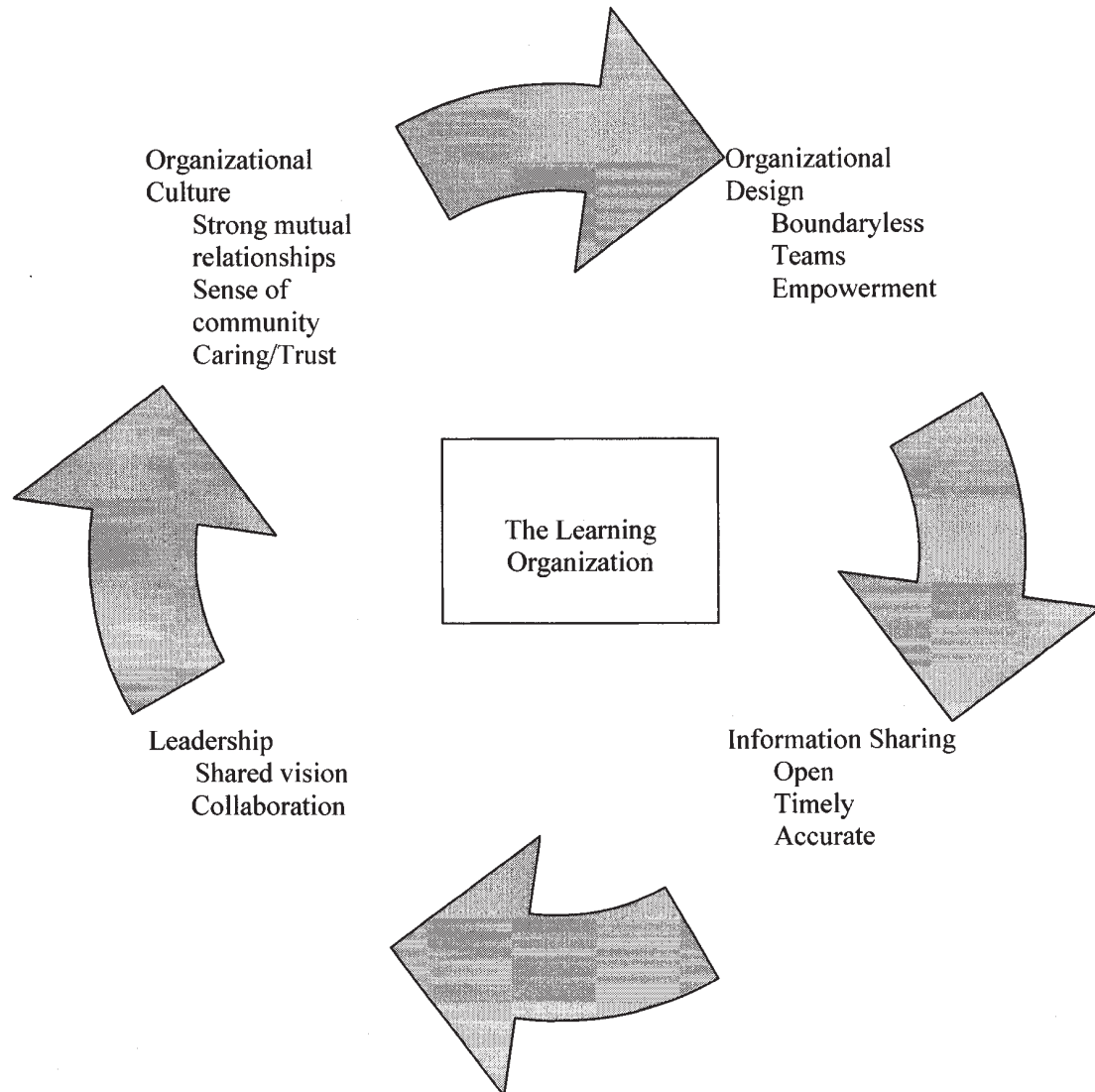
1. Personal Mastery - Expecting individuals to develop their personal vision and personal capacity to meet their own objectives, and those of the organization. This in turn, is organized to encourage that personal effort.
2. Mental Models - Developing the right "mind-set" to guide actions and decisions. This concept refers to the ability of individuals to expose their thinking effectively and to allow such thinking to influence others in the organization.
3. Shared Vision - Commitment of all the members of the organization to its aims and its ways of achieving objectives. In a learning organization, the power to uplift and encourage experimentation and innovation derives from building a shared vision.

4. Team Learning - Exploiting the fact that group thinking is greater than the sum of its individual parts. People are seen as active participants in shaping their reality and creating the future within the organization.
5. Systems Thinking - Acting on the understanding that actions and decisions cannot be isolated but have ramifications throughout the organization. The system thinking is the conceptual cornerstone of the learning organization and is said to integrate the disciplines (p. 373).

The concepts of organizational culture, design, leadership, and information sharing, are common to both Senge's Five Disciplines and Robbins and Decenzo's (2003) characteristics of learning organizations. According to Robbins and Decenzo, the *Organizational Culture* relates to the crucial role of managers in promoting mutual relationships among staff. The learning organization culture has sense of community that is caring and trusting.

The second characteristic is *Organizational Design* which offers employees the ability to learn and apply that learning as they perform their work in order to promote a sustainable source of competitive advantage. *Leadership* is the third characteristics which plays a supportive role in ensuring that an organization moves toward becoming a learning organization. The leadership of a learning organization is strong and committed. Any barrier between the leaders and followers are minimized. The fourth characteristic is *Information Sharing* which cannot take place without learning; hence, employees need to engage in knowledge management in order to facilitate their learning and sharing of both the tacit and explicit knowledge of the organization (Robbins & Decenzo, 2003). The characteristics of a Learning Organization model are depicted in the visual model below:

Fig. 2 Characteristics of a Learning Organization adapted from Robbins and Decenzo, (2003).



These models and their underlying assumptions served as guides for the study design, data collection, and interpretation. Efforts were made to assess their relevance and utilization for each of the processes and conditions observed in this study. The next chapter summarizes previous studies related to the present one.

CHAPTER 3

REVIEW OF LITERATURE

This chapter briefly reviews previous studies related to the core concepts investigated in this study. The chapter also identifies issues and gaps in the literature on LAS development.

Indigenous technology

The creation of locally developed LAS in developing countries represents a shift from the reliance on imported LAS, seen as inappropriate in meeting the needs of their libraries and patrons. Rogers (2003) in evaluating cross-cultural technology transfers to developing countries stressed the importance of indigenous knowledge (IK) systems. IK systems refer to “the unique, traditional, local knowledge existing within and developed around the specific conditions of women and men indigenous to a particular geographical area” (Grenier, 1998, p. 1).

Current research on indigenous knowledge suggest that the exclusion of such knowledge from development activities result in less than optimal benefits for indigenous peoples, especially where local knowledge has been supplanted by external knowledge (Cashman 1989; Lansing & Kremer 1995). Rogers (2003) and other diffusion researchers from different disciplines have also acknowledged the importance of indigenous knowledge systems in facilitating the development of new technology in non-western societies (Rogers, 2003). The design of X-LIB PLUS software to manage and retrieve local Nigerian knowledge resources for research purposes seeks to meet this need.

Library Automation Software

Historical background

Library automation software (LAS) evolved since the last century from manually searchable information resources to automated searchable databases. The use of CD-ROM and search engines revolutionized information retrieval (IR) during the last two decades. Machine language-driven or natural language terms are now used in searching. Although controlled vocabularies have been used to solve such problems, these search terms are not easily adaptable for descriptors of indigenous resources in the literature of indigenous knowledge.

The need for international and cross-cultural exchange of data between library systems led to a shift from local to global concerns in library automation. Borgman observed in 1997 that cross-cultural exchange of data between libraries entailed global technological and policy standards. Although LAS creation in the west started in the 1950s, developing countries like Nigeria are still at the experimental stages of developing LAS.

Computer usage was first introduced to Nigeria in 1962 (Mursu, Olufokunbi, Soriyan, & Korpela, 2000). Pioneer organizations in systems automation in Nigeria include banks, oil industries, government ministries, educational institutions, and government corporations. However, by 1988, there were more than 200 registered corporations offering computer-related services (UNIDO, 1989). This trend has continued and has increased awareness for development of library automation systems within the country.

Functions of LAS

LAS are designed to provide efficient searching capabilities that return search results from multiple databases. The diffusion of LAS in both the developed and developing countries has facilitated information retrieval in libraries. Nahar (2001) found that technical support and maintenance for LAS imported to developing countries are offered only for the 12 initial months of purchase. After this training period, the client organization would need to pay exorbitant fees for consultancy if further support is desired for training and maintenance.

Optional modules of LAS may include a Web OPAC and Z39.50, which would enable worldwide access to local library resources via the Web. By employing the optional Z39.50 module, LAS would make possible cross-library searching for resources. Also, texts from each library are usually customized in the interface and setup options to enable identification of individual libraries and their service information such as hours of operation. Users' login requirements can be set, as well as users' range of service options such as access to circulation status. This facility also provides online help, as well as accurate updates on transactions, without library staff conducting batch updates to keep the catalog current. Libraries with LAS therefore offer more efficient and effective IR services than those without LAS.

Another useful function of LAS is its access to GoPAC (Graphical OPAC) software, which facilitates advanced searches. LAS could provide a MARC (Machine Readable Cataloging) support for bibliographical records with optional module facilities. An example of LAS with these facilities is the latest version of the Graphical Library Automation Systems (GLAS) software (3.1), which is a 32-bit windows application with

various features of user-requested enhancements. These include the facility for linking and managing URI (URL/URN) hyperlinks within bibliographic records (<http://www.eosintl.com/>). This facility ensures effective information retrieval in support of R & D functions in organizations.

Basis for Library Automation Innovation in Developing Countries

Dependence on library automation software has become indispensable for information management and retrieval in this era, putting pressure on local software developers to innovate or adopt existing software. Laskowski and Ward (2001) confirmed a preference for the development of an in-house library software system at the University of Illinois, Urbana-Champaign. Laskowski and Ward (2001) said: “Ultimately, the library decided on creating a homegrown system over buying a turnkey system...” (p.364). They also proclaimed that apart from the cost of a turnkey system not being justified, a “self-made software system” would allow considerable flexibility, hence “creating a system would ensure that we could establish adequate tracking and reporting methods for measuring use and not be limited when it came time for the system to grow” (p.364). Morgan (2005) also emphasized the need for system designs to fit one’s needs. Such opportunities are especially relevant to cultural institution like libraries, museums, and archives (p.540).

The development of library automation software is fundamental to library operations in developing countries. In 2002, Jeevan discussed the developments of in-house library automation software in a premier academic institute in India. The author described the library automation software as “different from many other ready-to-use

commercial software/electronic products procured in a library” (p.46). Jeevan (2002) while describing the experience of using commercial software said:

The crucial and perennial problems that we encountered while working with the commercial ware include extra charges for platform changes and server upgrades, difficulty in effective customization of all the modules, discrepancy with respect to system requirements suggested and actually required, delays in responses to the user’s command, insufficient training to local system analysts, absence of Relational Database Management Systems (RDBMS) and Application Programming Interfaces (APIs), distracting user interface, rigidity in menus and discouraging customer support (p. 46).

In Nigeria, the failure of imported software such as TINLIB led to a software crisis in the Nigerian university library system, leading to adoption of alternative software, including CDS/ISIS, X-LIB, GLAS, ALICE (Sani and Tiarniyu, 2005, p. 284). X-LIB is the only software among these alternatives that was developed locally in Nigeria.

The above concerns among others have been echoed by librarians from developing countries, and are responsible for some of these nations striving to develop local library automation software (Ayo, 1998; Jeevan & Raja Kumar, 2002). Chuong (1998) also confirmed the difficulties experienced by academic libraries in Vietnam when automating their libraries using CDS/ISIS system (designed by UNESCO for developing countries). Chuong (1998) said: “the CDS/ISIS software does have some disadvantages...it is difficult to use because of an unfriendly user interface...it does not belong to the standard client/server relational database management systems (RDBMS)”

(p.333). Consequently, users of the software found it difficult to exchange library materials among libraries since CDS/ISIS cannot relate to other relational databases.

Core theories and concepts in learning organizations

Learning organizations

The concept of the learning organization is becoming increasingly popular as organizations are called upon to be more responsive to change by developing structures and systems that nurture innovation (Peters & Waterman, 1982; Kanter, 1989; Senge, 1990). Recent studies conceptualize organizational learning as a research discipline and the learning organization as an approach for translating organizational learning theory into practice (Xinhua, 2001).

It is necessary for a learning organization to combine its adaptive learning (having tendencies for adaptation to learn) with generative learning (having the capability to originate learning) in order to enhance its capacity to be creative (Senge, 1990). Buttolph (1992) sees generative learning theory as the construction of knowledge by relating new information to that which is previously known. She believes that such learning can take place either consciously or unconsciously, and notes that *unconscious learning* might also be unintentional.

Peter Senge (1990) contends that leaders and managers in a learning organization are responsible for building their organizations. In this context, workers are continually expanding their capabilities to understand complexity, clarify their vision, and improve their learning. It is expected that the fundamental responsibility for the manager or director of an organization is to design a learning process whereby workers can deal productively with the issues facing the organization, develop mastery in the learning

disciplines, experience feelings of belonging, and contribute to the success of the organization.

The learning organizational theory that Senge (1990) proposes to practicing and aspiring managers and leaders is meant to identify the interventions that can be made in order to turn organizations into learning organizations. Therefore, an organization has the imperative to look to its long-term growth and sustainability by focusing on enhancing innovations through technology hardware and software upgrades, as well as developing its intellectual capital through training and systems maintenance to keep costs down.

Lastly, there is a need for this process to be embedded in organizational structures and strategies. The vision of the workers must be recognized as primary to becoming a learning organization. Giesecke and McNeil (2004) explored why organizations become learning organization, and described the efforts at the University of Nebraska-Lincoln (UNL) libraries to become learning organizations. In their conclusion, they noted that: “As we found at UNL the learning organization model has helped the organization adapt to a changing environment. Staff has the skills to adjust to a new organizational structure and to new working relationships within their units” (p. 66).

Characteristics of a Learning Organization that Supports Innovation

The management literature also offers perspectives on how organizations should be designed and managed to promote effective learning. Many researchers agree on five key characteristics of the Learning Organization, as shown in Table 1 (see for example: Pedler, Boydell & Burgoyne, 1989; McGill, Slocum & Lei, 1993; Nevis, DiBella & Gould, 1995). These five keys give a broader picture of Robbins and Decenzo’s (2003)

four characteristics discussed earlier. Each of these five key characteristics is explained here to reflect in more details how innovation is enhanced in a learning organization.

Table 1: The Main Characteristics of the Learning Organization
Adapted from Effecting Change in HE (2004).

Characteristics	Descriptions
Structure	Learning Organizations have flat managerial hierarchies that enhance opportunities for employee involvement. Members are empowered to make relevant decisions. Such structures support teamwork, strong lateral relations, and networking across organizational boundaries both internal and external (e.g. project teams). These features promote systems thinking, information sharing and openness to information necessary for organizational learning. Temporary forms are favored as they cater for current needs but can be shaped through experimentation to respond to future changes and innovation.
Information systems	Learning Organizations require information beyond that used in traditional organizations where information is generally used for control purposes (single-loop learning). Transformational change requires more sophisticated information systems that facilitate rapid acquisition, processing, and sharing of rich, complex information that enables effective knowledge management.
Human resource practices	People are recognized as the creators and users of organizational learning. Accordingly, human resource management focuses on provision and support of individual learning. Appraisal and reward systems are concerned to measure long-term performance and to promote the acquisition and sharing of new skills and knowledge.

Organizational culture	Learning Organizations have strong cultures that promote openness, creativity, and experimentation among members. They encourage members to acquire process and share information, to nurture innovation, and provide the freedom to try new things, to risk failure, and to learn from mistakes.
Leadership	Like most interventions aimed at securing significant organizational change, organizational learning depends heavily on effective leadership. Leaders model the openness, risk taking and reflection necessary for learning and communicate a compelling vision of the Learning Organization, providing empathy, support, and personal advocacy needed to lead others towards it.

These five characteristics could be summed up to indicate the need for learning organizations to conceptualize long-term growth and sustainability.

Resolution of Barriers to Innovation by a Learning Organization

An innovative organization can also provide a culture that enhances innovation while resolving any barrier that hinders creativity and innovation. The “Three Arenas” Model (Prather & Gundry, 1995) depicts how learning organizations can incorporate activities that involve generating new ideas and being innovative. According to Prather and Gundry (1995), the “Three Arenas” are: *Applications Arena*, *Education*, and *Setting the Climate for Innovation*. *Applications Arena* consists of the problem-solving processes and is the most critical arena because at this level *bottom-line innovation* occurs.

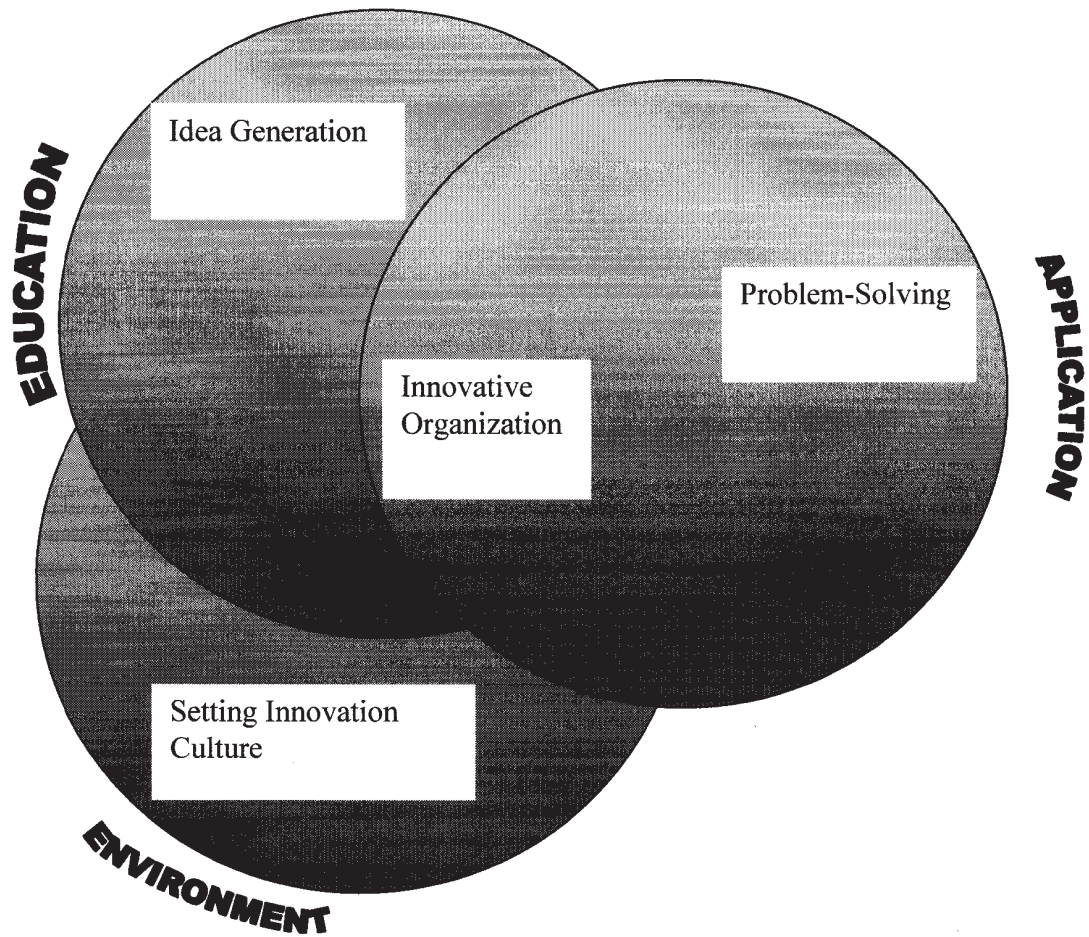
The bottom line innovation is a set of techniques and processes that generate new, useful, and unexpected solutions to important organization problems. An innovative organization focusing on the applications arena ensures the identification of the ‘right’ problems, the generation of unexpected ideas, the selection of the most effective of such ideas, and the development of sponsorship and action plans (Prather & Gundry, 1995).

Education refers to the process of teaching people the core concepts of creativity and has provided demonstrations for “thinking out of the box” or moving beyond brainstorming. Essentially, education consists of an idea generation process. The task in this arena is to empower people at all levels to become active participants in the innovation process (Prather & Gundry, 1995).

Setting the Climate for Innovation refers to the relationship between the climate or the environment and the workers’ perceptions of what it is like to work in the

organization. However, it is a critical part of the innovative organization. The cultural environment is a learning organization's asset in resolving barriers, yet, leaders often neglect this arena because the working environment is seldom perfect and when such imperfection is exposed, it is a reflection on the leadership (Prather & Gundry, 1995). So, it is the leaders' responsibility to create an environment that promotes organization's innovation efforts.

Fig.3: The Three Arenas of the Innovative Organization adapted from Prather and Gundry (1995):



In learning organizations, it is unrealistic for a manager to expect every individual to do well in every part of the innovation processes discussed above. The *Application Arena* enables an organization to focus on developing an innovative team to the degree that all employees have different problem-solving styles. Creative problem-solving processes can be encouraged by considering mistakes as opportunities for learning and seeking ideas about what might be tried next. This requires the commitment of each one of the employees working as a team.

Subsequently, every problem-solving style should contribute towards the goal of the organization, and such valuable contributions of workers play a major role in the innovation process. The *Education Arena* requires that employees brainstorm and generate diverse ideas without the leader or anyone else dismissing them as absurd.

This generation of ideas can lead to innovative productions and research breakthroughs. In addition, organization directors can train workers to develop skills that are suited for the challenges created by the new technology, and blend their strategies to solve problems in a unified and effortless manner. This achievement is only possible with training, and exposure to new technology development.

The *Environment Arena* is an indication of what an organization management creates to nurture creativity. The management provides a cultural environment that does not confine workers in “boxes” and limit their creative thoughts. Therefore, a management ought to eliminate organization secrets and “business as usual” attitudes, while encouraging employees to understand the larger picture and support the goals of the organization by seeking solutions to their common challenges.

As learning organizations prepare to compete globally in this information age, effective deployment and exploitation of Information Technology (IT) will resolve barriers to innovation. It will create the difference between those who are successful and innovative and those who are not. Also, as technology continues to advance, its impact on a variety of organizations will become greater and increasingly more important. With increasing access to the Internet and the opportunity for networking, organizations have the potential to access vast volumes of information and opportunities for collaboration in the global virtual community.

Organizations should provide an environment that encourages principles of personal mastery as a continual ongoing process in the daily life of employees. According to Senge (1990), “that means building an organization where it is safe for people to create vision” (p.172). Leaders with creative and innovative thoughts can easily come into terms with the fact that it is profitable to develop an environment that supports innovation. Because as Deiss (2004) observed,

Organizational leaders willing to abandon the safety of the now and the known in order to realistically be able to say they are willing to see people make mistakes on the road to innovation will be repaid through a higher level of commitment and energy throughout the organization (p.30).

The present study has been able to identify the above characteristics within RMRDC. As such, the study can ascertain that similar organizational traits that encouraged the development of X-LIB PLUS and other innovative ventures discussed earlier are also attainable in developing countries.

Summary

Chapter three has provided a review of literature on the creation of locally developed LAS in other developing countries. These include the need for local LAS development in both western and non-western nations.

In non-western countries, development of LAS software has to address the need to manage multi-lingual literature. Local development of such software is fostered in organizations that nurture creativity and innovation.

The characteristics of Learning Organizations are said to provide enabling environments for innovation.

CHAPTER 4

RESEARCH DESIGN

This chapter discusses the research design and the qualifications and experiences of the researcher that facilitated the collection of data in Nigeria. It also describes the methodology applied to the selection of the site, the data collection methods and the participants, and it concludes with an analysis of the data.

The structure for this study is the interpretive research design as proposed by Burrell and Morgan (1979). This framework enabled participants in RMRDC to describe the design process of X-LIB PLUS based on their experiences. Using case study and the qualitative research methods, this research described the development process of X-LIB PLUS from the viewpoint of the developers (Denzin & Lincoln, 2000).

This study examined the organizational structures and features of RMRDC that fostered the development process of X-LIB PLUS. It assumes that the people who live and work within a culture construct their social reality, creating and associating their own subjective meanings as they interact on the job. This study used Rogers' (2003) model of the innovation-development process to examine the creation of X-LIB PLUS and its diffusion among Nigerian libraries. Senge's (1990) model on the learning organization theory was also used as a framework for examining the characteristics of RMRDC, which influenced the X-LIB PLUS development and diffusion processes.

Qualifications and Experiences that Facilitated Data Collection

Based on her experience as a librarian in Nigeria, the researcher understands that Nigerian libraries are faced with the dilemma of adopting and adapting LAS from industrialized countries for library functions. This experience assisted the researcher with

respect to the protocol and the ethical aspects of the study. The researcher was able to develop rapport with the RMRDC staff because of her familiarity with the organization and with some of the informants, who freely responded to her interview questions. Having grown up in the Nigerian culture, the researcher understood both the verbal and the non-verbal cues of the informants. Another useful attribute is that this researcher speaks the two major indigenous languages of the informants in the organization (Yoruba and Hausa), which assisted in understanding cues during the observation and the participant-observation methods, as well as in authenticating and making sense of indigenous titles such as local names in the RMRDC database.

Research Sites & Participants

The site for the study is the Raw materials Research and Development Council (RMRDC) in Abuja, Nigeria. The researcher conducted thirty-two hours of unstructured interviews of key personnel and others involved in the innovation–development process of X-LIB PLUS. The interviews were recorded on audiotape. The researcher completed the human subject protocol as required by the Emporia State University Institutional Review Board for Treatment of Human Subjects. Thus, the informants received both consent forms for completion, as well as information on how their confidentiality and anonymity would be maintained by the researcher (Kvale, 1996).

The use of pseudonyms for informants and preventing any association of individual informants with their respective data also enhanced their confidentiality and anonymity. Data from interviews was used only for research purposes. A report of the interviews was provided as the findings on this study. Under no circumstances were informants' names or identifying characteristics included in the report. In addition, tape

recordings and field notes of the interview and observation were erased at the conclusion of the study.

Research method

The case study method was used as the strategy of inquiry because the development process of X-LIB PLUS and the organizational characteristics that nurtured it involved exploration of processes, activities, and conditions. This approach has been effectively used in technology innovation research (Ash, Lyman, Carpenter, & Fournier, 2001; Gladwin, Dixon, & Wilson, 2003; Tran, 2005) and was adopted for this study for the reasons explained below:

First, a case study is “an empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and the context are not clearly evident” (Yin, 2003, p.13). This approach is useful here because the use of a case study enabled this researcher to obtain a holistic and meaningful picture of the real-life events, including the organizational and managerial processes that took place during the period when X-LIB PLUS was developed.

Second, a major premise in case studies is the ability to deal with data from a variety of sources such as interviews, observations, participant observation, and documents review (Yin, 2003). Hence, the researcher used multiple approaches for collecting data and tried to ensure accuracy by seeking corroborations between the data sets. Thirdly, the case study method investigated the “what” and “why” questions of X-LIB PLUS development in RMRDC (Yin, 2003). The research questions therefore sought information about the activities and events that led to the development of X-LIB

PLUS, the factors that facilitated or limited the processes, and why Nigerian libraries adopted it.

Methods of Data Collection

The data was collected in two weeks, including weekends, through interviews, observations and participant-observation, and one month of phone calls to informants to verify the information collected. The researcher collected data at the research site using five methods: unstructured and semi-structured interviews, focus group interviews, observation, participant-observation, and document review. This use of multiple methods of data collection is important because it allowed for crosschecking of information, and stronger substantiation of findings (Strauss & Glaser 1967).

These methods were grouped into two major categories: primary and secondary data sources. For primary data, the researcher interviewed the software developer and other staff who played significant roles in the design of X-LIB PLUS, in order to understand their experiences, and perceptions. Also, a focus group was held; observation and participant-observation methods were used to collect primary data. Documents were reviewed for secondary data.

Interviews

The researcher used open-ended questions and guided conversations and historical story-telling inquiries with the interviews. The interviews were recorded on audiotape and transcribed within twenty-four hours of each interview. The data collection focused on the development process, the developers and their organizational environment. Information on the environment included the organization's mission and

vision, its structure and culture in order to understand the characteristics that nurtured the development of X-LIB PLUS in RMRDC.

Observations

The researcher conducted formal observations of the working conditions and recorded behaviors of employees around on-going R&D activities such as new innovation processes both in the organization's Technology Development Department and at the unit for upgrading indigenous technology. These were recorded as field notes, which enabled the understanding of the features of RMRDC, which influenced the development of X-LIB PLUS.

Participant Observations

The researcher became an active participant in the operations of X-LIB PLUS by using it to retrieve information for the research officers and other users of the RMRDC library. Thus the participant-observation method allowed the researcher to understand the functions of all the modules of the software (Denzin & Lincoln, 2003). These observations, which reflect the characteristics of the software, including ease of use, and sensitivity to Nigerian indigenous languages, names, and words, were recorded in field notes.

Focus Group

The researcher systematically questioned the chief developer and his associates in a focus group interview format. This interview used unstructured and semi-structured questioning techniques in order to elicit information on their experiences and perspective on the development process of X-LIB PLUS (Fontana & Frey, 2003). The focus group interview was used to build on data collected from individual interviews by verifying and

elaborating on information supplied by informants individually. Emphasis was placed on understanding the factors responsible for the design of X-LIB PLUS and its adoption by other Nigerian libraries. These interviews were audio-taped and transcribed verbatim. The researcher then used data checks and peer verifications to enhance data validity by transcribing the interview within twenty-four hours, and making the written excerpts available to the participants for checking and verification (Morgan, 1997).

Document Review

The researcher obtained documents from the organization to corroborate and augment evidence from other data sources. Also, the researcher reviewed the documents from the viewpoint of the research questions and analyzed relevant data from them. These documents included training manuals used for workshops on X-LIB PLUS, user guides on X-LIB PLUS, minutes of meetings related to discussions on the X-LIB PLUS software, and communiqués related to X-LIB PLUS development and related R&D activities. Other documents reviewed included relevant past records from the inception of X-LIB PLUS library automation software, annual reports, web sites, and Internet information related to X-LIB PLUS development (Kvale, 1996).

After that, the researcher reviewed and analyzed the documents to verify specific details, then crosschecked to seek corroboration and correction of information obtained from other data sources. Hence, the researcher used multiple approaches in order to confirm the data collected. The researcher also made efforts to ensure that the data

collected was not only valid but also credible, by allowing the participants to review the researcher's analysis and conclusions.

Data Analysis

This section reports on the processes used in analyzing the data. The researcher conducted a total of eighty-five 'person-hours' of observation and participant observation, and thirty-two hours of interviews. Using multiple data collection methods was meant to add to the richness of the research data set. The data was analyzed according to the steps listed by Creswell (2003). These include:

- Organizing details on X-LIB PLUS innovation process and arranging them in patterns;
- Categorizing the data into meaningful clusters;
- Interpreting institution reports and documents from the conception to fruition of X-LIB PLUS;
- Identifying data patterns, and interpreting them for underlying themes;
- Describing and summarizing the data.

The data collected from audio tapes of participant, and focus group interviews, field notes from observation, and participant-observation, were transcribed and word-processed. Secondly, they were analyzed manually using the constant comparison process (Denzin & Lincoln, 2000), and thirdly, the transcripts were analyzed using QSR NVIVO software for data verification and accuracy.

The researcher used QSR NVIVO software to code the transcripts of the audio-recorded interviews and the documents according to core subject groupings in order to identify patterns and themes in the data (Miles & Huberman, 1994). Furthermore, the

data analysis was guided by the research questions and conceptual framework. The patterns and themes, which emerged from field notes from observation and participant-observation, were matched with those from the interview transcripts.

The following section presents the results of the analysis from (i) the interviews of three participants: the chief developer, the library staff that participated in the development process, and another library staff that contributed library-relevant information during the development process of X-LIB PLUS; (ii) the focus group; (iii) observations of three offices, restaurant, and entrance lobby, which includes the security post of RMRDC; (iv) the participant observation as researcher used X-LIB PLUS modules to retrieve information; and (v) the review of documents such as manuals, guides, research reports, receipts, and annual organizational reports provided by the participants and retrieved on-line at the organization's website and from the library.

Validity

The researcher interviewed the participants involved in the development process of X-LIB PLUS, in order to understand their perspectives (Creswell, 2003). The researcher used data checks, and peer verifications (Morgan, 1997) for validity by constantly providing the participants with the transcribed data for verification of their interview responses and the researcher's analysis and interpretations. According to Creswell (2003), validity is a strength of qualitative research, and it is used to determine the accuracy of research findings "from the perspective of the researcher, the participant or the reader of the account" (p. 195-196). Creswell also suggested that triangulation could be used to establish validity. Triangulation in this study occurred as a result of using five data collection methods to seek answers to the same research questions.

Triangulation

Besides the interviews and focus group, the researcher sought data that would answer the research questions by observing the goings-on in the organization, participation in X-LIB PLUS-related activities and services and reviewing the organizations records and documents. Often the documents provided inferences that required clarification from the informants. Some clarifications which related to the organizational culture of RMRDC were sought by observing organizational processes, work habits and inter-personal relations at RMRDC. Hence, the researcher used multiple approaches in order to enhance corroboration and confirmation of the data collected, thereby confirming the validity and reliability of the findings.

A typical instance was the corroboration of information on non-access to the source code of TINLIB by RMRDC staff prior to the development process of X-LIB PLUS. Each participant interviewed, as well as the focus group, confirmed this information. In another example, every participant separately referred to the use of the SQL and ORACLE during the development process of X-LIB PLUS. There was also consistency in the accounts by every interviewee, the focus group and in documents that the original intent of X-LIB PLUS did not include commercialization. The software was developed primarily to enable the RMRDC library and staff to access the organization's database. Diffusion to other libraries in Nigeria was a secondary motive.

The researcher established rapport with the informants, thereby facilitating communication and mutual understanding of data collected. In addition, the experience of the researcher in supervising the development of a LAS and in participating in the use,

training and trial tests of X-LIB PLUS, facilitated understanding and sharing the perspectives of her informants.

Summary

This chapter includes an analysis of the data and a description of the procedures used in the data collection and analysis. Furthermore, the chapter also discusses how the researcher sought to enhance the validity of the research by seeking corroboration of findings. The findings of this research are discussed in the next chapter.

CHAPTER 5

FINDINGS AND DISCUSSION

Overview

The purpose of this chapter is to summarize the findings of this study as they relate to the research questions presented in chapter one. The findings are based on the data obtained from the field. The discussions focus on the factors that facilitated or challenged the development of X-LIB PLUS, as well as the factors that account for its diffusion among Nigerian libraries.

Whenever the quotations from transcriptions of the interview tapes include ellipsis marks, they indicate that the participants paused in their response. To protect the anonymity and confidentiality of the informants, generic terms such as “developer” and “library staff” were used to refer to particular actors in the research study. Similarly, the investigator disguised other data that could be used in any way to identify any of the participants.

Research Questions

The data collection for this study was driven by four research questions:

1. What was the development process of X-LIB PLUS at the RMRDC?
2. What factors facilitated the development of X-LIB PLUS at the RMRDC?
3. What factors challenged the development of X-LIB PLUS at the RMRDC?
4. What factors account for the diffusion of X-LIB PLUS among Nigerian libraries?

The researcher read the transcribed data and identified the subject areas in the transcripts and coded them appropriately. The themes emerging from the data were noted

and grouped into categories for coding. The following four themes were identified from the data as the factors which facilitated or limited the X-LIB PLUS development process: Technological Innovation factor, Cultural factor, Economic factor, and Organizational factor.

The themes were reclassified into thirty-five subcategories, which were subsequently grouped into the following seven clusters: Technology, Human resources, Organization design, Organization culture, Information sharing, Organization capabilities, and Leadership. The seven categories and their components, which reflect RMRDC characteristics, are graphically displayed in table 2.

Table 2: The Emerged Categories and RMRDC Characteristics from the data

Emerged Categories	Emerged Characteristics
Technology	Customized software Innovation Adaptation Fundamental problems of Technology
Human resources	Personal mastery Risk-taking Recognitions as developers and users Experimentation Vision sharing
Organizational design	Empowerment Promote openness Collaborative team work Limitations of Library management procedures Opportunity to grow
Organizational culture	Managerial hierarchies Capacity building Manpower development Support of individual learning Risk tolerance Trust
Information sharing	People focus Open-system focus Future projections
Organization capabilities	Competitiveness Provision of professional services Developer's lack of library skills Maintenance and technical support Affordability of X-LIB PLUS Indigenous capability of X-LIB PLUS
Leadership	Shared vision Perceived need Exploration Effective leadership

The four main themes that emerged from the data were used to create a manageable thesaurus of terms for coding. The researcher transcribed the recorded interviews as soon as possible after each interview. The transcripts were studied while repeatedly listening to the audio recordings, to verify the data. The QSR NVIVO software was used to import the transcribed documents. Also, the software facilitated coding and determination of patterns and themes. The findings of this study are explained below, in the order of the research questions. Rogers' model of Innovation-Development Process and Dundon's Nine-Step Innovation Process model were used as framework for analyzing the data from the responses to research question one.

Research Question 1: What was the development process of X-LIB PLUS at the RMRDC?

Data used to answer this question were derived from various sources: formal interviews of X-LIB PLUS developer and his collaborators, focus group, observation, participant-observation, and document review.

The stages of X-LIB PLUS development entailed (i) analysis of need and problem the organization was facing and the desire to solve it;

(ii) the programming of the software which was designed to facilitate use by less technologically-savvy librarians and library users;

(iii) implementation, which entailed testing the software using RMRDC library as base for operation; and seeking feedback from Nigerian librarians on functionalities of the modules; and (iv) maintenance to accommodate suggestions from use, to provide updates, and to ensure use of the software.

Needs/Problems Stage of X-LIB PLUS:

The first stage of the phase in the development of X-LIB PLUS is the needs/problems analysis stage. This stage started with a perceived need by the organization to have an information management system in RMRDC. The chief developer of X-LIB PLUS experienced problems with using Access as base software for the development of the LAS. He confirmed this in the interview transcripts as follows:

I did this [development of the LAS] on Access, but the problem with Access is that it is not distributable. You cannot really combine it into a package, you have to have Access running on systems, so I started looking at other possible databases where I can compile them into a program and deploy it on a zone as an executable bar.

This initial base software was used to develop XLIB PLUS after identifying the need for the automation of the collections of the RMRDC, and gathering information to clarify the problems posed by using imported software without access to the source code.

These basic procedures started the development cycle for the LAS. Rob and Coronel (2000) confirmed the standard procedures for software development saying that the traditional Systems Development Life Cycle (SDLC) is divided into five phases: planning, analysis, systems design, implementation, and maintenance. The authors said:

The SDLC is an iterative rather than a sequential process. For example, the details of the feasibility study might help refine the initial assessment, and the details discovered during the user requirements portion of the SDLC might help refine the feasibility study (p.288).

Although the developmental stages of X-LIB PLUS were similar to the universal steps in software development, the peculiar situation of the RMRDC library called for some modifications.

Identified Problems

The chief developer's initial efforts to get the source codes of the TINLIB imported LAS were corroborated by informants and documents. The minutes for one of the meetings of the Information and Documentation Division (IDD) of RMRDC sometime in 1992, attested to the sponsorship of two officers who traveled to London to explore if EOS, the company that developed TINLIB could assist RMRDC in customizing the software to suit the needs of the organization.

RMRDC Needs

The design of X-LIB PLUS took into consideration some of the functionalities of library operations. These functions and some other library activities were not attainable when RMRDC library was using the foreign software that was operated on DOS. An electronic document titled "Response to Questions Posed on X-LIB PLUS", confirmed that: "X-LIB PLUS was initially designed to address the gaps observed in TINLIB and CDS/ISIS which our organization was using". These gaps included: "Non graphical inter phase (CDS/ISIS later introduced a window version); and non-openness [non-compatibility] of the software to enable interaction with other databases in the organization".

The functions of X-LIB PLUS that addressed these needs include:

- Provisions for computation of cost of publications selected for acquisition.
- Documentation of books at a mouse click before cataloguing.

- Categorization of sources of funds for different publications.
- User friendliness, with self-explanatory interfaces such that a two-day training is sufficient for an average librarian to get used to the software.
- Ability of users to make requests for acquisition of publications on line.
- An interface (notice board) through which users can be notified of new arrivals in the library and any other important information.
- Elements of document management as newspaper clippings can be read on-line.
- Ability to maintain statistics of users of libraries, publications consulted over various periods of time with graphical presentations.

Gathering Information

The motives for automation at RMRDC were considered by the members of the committee charged with resolving the challenge of creating an integrated information management system for the organization's databases. The committee on computerization was set up in 1989. The committee was aware that the organization has project collaborations with national and international institutions. In order to promote the growth of process technology and resources-based industries in Nigeria; the Council needed a system for efficient management and dissemination of information to their collaborators. An informant confirmed the processes of learning about possible software to serve their needs when he said: "I read all applications and magazines from IFLA, and I was also using all the information from those magazines". Hence, efforts were made to search for the type of software that could meet this need.

Clarifying the Problem

The RMRDC management was aware that the Council needed to use information retrieval technology and to access its Integrated Management Information System (IMIS) database, which contains data on foreign and local materials on researches done in the organization. The management believed that access to the database could enhance exchange of research findings between their collaborators.

In an effort to achieve this aim, the organization set up an internal committee on automation between 1989 and 1990. At the initial stage, they undertook feasibility studies to determine the processes of automation, and were unsure how to proceed. They therefore sought to clarify the organization's needs.

Setting innovation goalpost

Some members of the committee were not certain about what automation entailed, and some thought that the idea of automation involved just having computers and a network. Others who were more knowledgeable about automation led the committee in successfully planning the automation of the organization's library processes. The committee eventually included in their recommendations, the automation of the organization's staff personnel records and library's information management systems and functions.

In 1990, RMRDC acquired TINLIB software for the automation of its information management system in order to collaborate with Nigerian universities who had adopted TINLIB. The Nigerian Federal Government had acquired TINLIB in order to facilitate inter-library loan facilities among the universities and research institutes in the country (NUC, 1990).

Their perceived need to retrieve information efficiently from the database, to maintain staff documentation, and also to automate the organization's finances reflects Rogers' (2003) model of the first stage of *Identifying the problem*, and with Dundon's (2002) *Understanding stage* of the Nine-step innovation process, which consists of gathering information, clarifying the problem, and setting of innovation goalpost.

Research (Basic and Applied) Stage of X-LIB PLUS

RMRDC received the CDS/ISIS free from UNESCO for retrieving data in 1990. However, TINLIB and CDS/ISIS software were discovered to be too cumbersome and had limitations (Ayo, 1998). Research was done on how to implement the design of X-LIB PLUS, which consisted of both logical measures to address the DBMS characteristics, and to define storage structures; implementation; testing for validation; integration; and maintenance. Maintenance entailed efforts to sustain and enhance the software in order to cope with newly discovered problems or requirements. This stage conforms to the *Imagination stage* described by Dundon, which consists of three steps: seeking stimuli, uncovering insights, and identifying ideas.

Seeking Stimuli

There were no source codes to enable the chief developer to integrate the foreign software in the graphical representations and the modules within the organization's database for easy retrieval of information. The researcher found that the RMRDC staff was aware of the limitations of the TINLIB software, one of them being that it did not retrieve graphical data. Also, TINLIB was not sensitive to indigenous names and literature, which formed the core of the content of the organization's Integrated Management of Information System (IMIS) database.

The findings related to the problems/perceived needs, the research stage, and the development stage of X-LIB PLUS, are in accord with the innovative-thinking skills suggested by Dundon (2002). This consists of the chief developer's identification of the problem, the creative thinking about which software could be adapted as foundation for the development, and actual development of the innovation.

Uncovering Insights

The chief developer embarked on designing a new software when TINLIB was found inadequate in meeting the information management needs of RMRDC. According to him, "I was just trying to develop software to just do my job. I mean the library management software was just to do my job, to make my job easier...." The informant decided to create a database that can interact with the organization's Integrated Management Information System (IMIS) database to facilitate retrieving information to support his assigned duties in the organization.

Identifying Ideas

The second stage featured the programming language of X-LIB PLUS, which was written to be accessible by librarians and library users without technical computer skills. The chief developer started by developing a simple database in Access, and used Open Data Base Connectivity (ODBC) to interact with Oracle. The informant commented "I came up with the idea...that we could have a simple database, so I developed a simple database in Access; it was an individual effort then." The chief developer further explained that the technological process of X-LIB PLUS changed with the introduction of Windows 98.

The programs for the development of X-LIB PLUS were originally written to run on Windows 95. This informant said, "... We had to change a lot of underlying codes. But people were already used to X-LIB PLUS, so we didn't want to change the facial appearance [screen], but try to maintain the same facial appearance [screen] while changing the underlying codes." Moreover, the researcher observed that the navigation of all the main functional modules of X-LIB PLUS such as acquisition, circulation, catalogue, and enquiries were designed to be easy and quick to execute because the interface is not menu but button-driven and user friendly.

X-LIB PLUS also has special features for producing identity cards, overdue charges, sound recordings, budgeting, image and video capture, and notification of new arrivals and library news. A training manual document titled "X-LIB + Library Automation System" confirmed that: "A distinct module is dedicated to newspaper cuttings and electronic files" (p.3). The illustration on newspaper cuttings can be seen in appendix G. Also, the researcher browsed the features of X-LIB PLUS that provide a notice board facility, which inform users of the arrival of new books, and other materials in the library.

The above document also indicates other features of X-LIB PLUS that include the provision to capture pictures, drawings, audio (sound), and video clips. The researcher used the circulation module, which provides a photographic facility for registering library users and producing library user identity cards. There is also corroboration in the X-LIB PLUS training manual for the provision of interface with "barcode reader, on-line help, and GREENSTONE-the UNESCO supported digital library software" (p.4).

Development Stage of X-LIB PLUS

This third stage of the X-LIB PLUS is also similar to that of stage three of Rogers' (2003) model of *Innovation-development process*, and the *Action* stage of Dundon's (2002) *Nine-Step Innovation Process* model, which entails developing the innovation roadmap, gaining commitment, and implementing the innovation roadmap. The development of X-LIB PLUS was influenced by a potential market, which is Nigerian libraries. Lubelczyk and Parra (2000) said that: "the goal of any software development project is to produce a product that is delivered on time, within the allocated budget, and with the capabilities expected by the customer..." (p.1)

Developing the Innovation Roadmap

The developers are aware that libraries that bought imported LAS faced the challenge of inadequate and expensive training and maintenance services from vendors. The transcribed data revealed that the initial development process of X-LIB PLUS was not expansive; it was basically built for use beside RMRDC's database. This means that it was developed to enhance the functions of RMRDC so as to support the work of the RMRDC staff.

Subsequently, more modules were added to the LAS and tested. Access, SQL, and ORACLE were used at various trial stages as base for the development, but the chief developer soon discovered a problem with Access because it was not distributable, and was not capable of interacting with other database. The electronic document dated April 25, 2006 titled "Response to Questions Posed on X-LIB PLUS" confirmed that: "at the point of commercialization, Access front end was changed to Visual FoxPro for ease of

distribution and to take advantage of the Rushmore Technology of FoxPro which ensures faster search operations”.

The staff embarked on personal learning in order to resolve the problems of developing the software for managing information in RMRDC’s database (Prather & Gundry, 1995). The researcher found that X-LIB PLUS is an innovation developed through adaptation of other software to meet information needs of RMRDC.

Gaining Commitment

The chief developer reviewed the development process of other software, and was committed to learning the procedures and functions of libraries in information management and to enhance his preparations for the development process of X-LIB PLUS. An informant who became committed to the development of the LAS commented that: “Then, I was understudying other library software, and was trying to understand all the terminologies of library [operations]”.

Use of X-LIB PLUS software in the RMRDC library to retrieve data and disseminate information to library users, revealed the challenges posed to the chief developer. For instance, the participant observation method allowed the researcher to use the X-LIB PLUS software extensively for retrieving information for library users while noting the efforts that must have gone into its development. In order to gain the confidence of users (i.e. Nigerian librarians) the chief developer made the software as simple and user friendly as possible.

Implementing the Innovation Roadmap

The final action taken by the chief developer of X-LIB PLUS identifies with the third step, and the action stage of Dundon's (2002) Innovation Process Model, and with the Development Stage of Roger's Innovation-Development Process Model. The *Action* Stage in the development process of X-LIB PLUS occurred when the chief developer had the initial breakthrough while working on another software project. This other software project enabled him to learn FoxPro which he eventually used as base software for the development of X-LIB PLUS. The chief developer described this experience in these words:

Luckily, about that time, somebody had approached us with a program, a project that came together with software for something completely different, and I had wanted it on FoxPro. I did that project with another friend and I used that project to learn FoxPro, so I decided to develop the X-LIB PLUS Library Automation Software in FoxPro.

At this implementation stage, the chief developer of X-LIB PLUS, in 1997 presented the software at a conference to the members of the Nigerian Library Association (NLA) for testing and feedback.

Thereafter, the software was modified to meet the particular needs of the library profession in Nigeria. An informant confirmed this experience at the initial demonstration of X-LIB PLUS in this comments:

We were invited to present a paper [at a Nigerian Library Association conference], we took X-LIB PLUS there, and we were surprised by the reception, but there was a lot of criticism. In fact, at that time, there was almost discouraging

criticism about the software, but it helped, because at the presentation, we had to take a lot of information and a lot of comments down and went back to the drawing board and that brought out what we have now. So that is basically the genesis of X-LIB PLUS.

Subsequently, X-LIB PLUS was customized to meet the specifications of client libraries. An informant explained to the researcher that there were organizations that requested additional features in order to track their newspaper records and to manage their library using the X-LIB PLUS for retrieving information relevant to their activities. This informant confirmed that:

In response to the request of one of our users, in two of the newspaper houses, they wanted to keep track of their library online. So it's almost like documentation/library management software. We have added the newspaper interface, which I know at least two or three organizations are running right now.

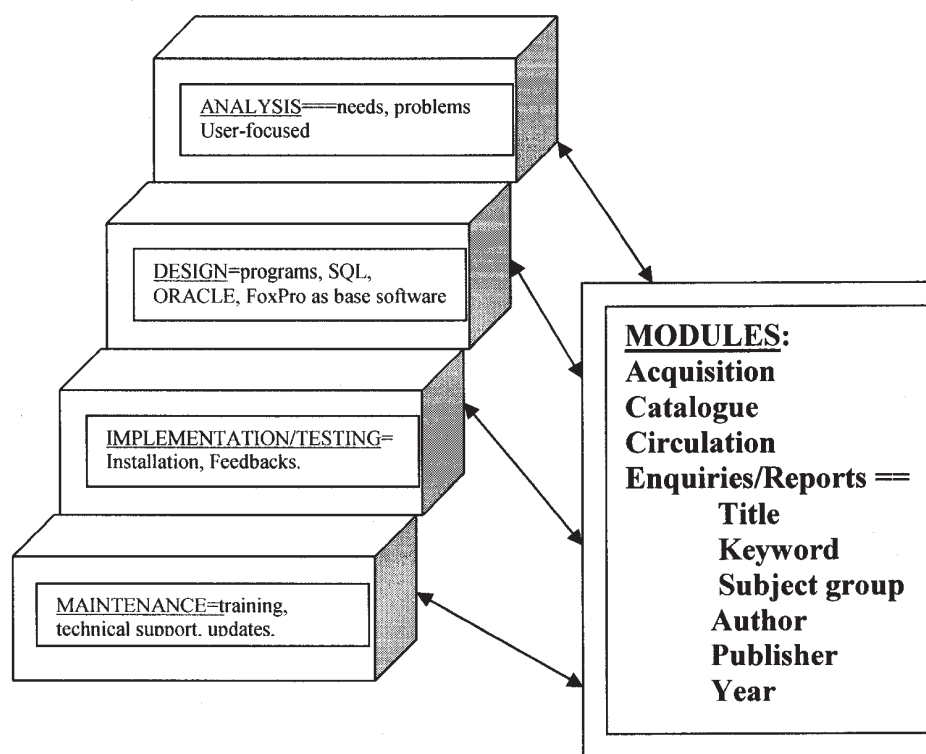
This customization of X-LIB PLUS to meet individual patron's request was made possible because of the initial flexible source code used for its development.

Commercialization Stage/Maintenance Stage of X-LIB PLUS

The commercialization stage in Rogers' model is considered the fourth stage in the development of X-LIB PLUS. This stage in the life cycle of X-LIB PLUS emerged from the research data as the Maintenance Stage, rather than Rogers' Commercialization Stage. This is due to the fact that there was initially, no commercial incentive in the development process of X-LIB PLUS. It was developed primarily to serve the local information management needs of RMRDC. However, training, technical support, and maintenance were offered to support libraries that eventually sought to implement the

software to their operations. The developmental stages of X-LIB PLUS are indicated in fig. 4 below.

Fig.4: Software Development Life Cycle (SDLC) of X-LIB PLUS



The development process of X-LIB PLUS seen in Fig. 4 was influenced by the universal functions of library information management as depicted in the inset (box to the right of model) with the four main interactive modules, and functions under the modules. The development process went through the four procedures identified in the boxes on the left. Some of the reviewed documents especially the X-LIB PLUS training manuals, guides, and occasional reports obtained from the offices, library, and other venues within the site of study corroborated the content of the modules as listed in the inset of the table above on the SDLC of X-LIB PLUS.

Research Question 2: What factors facilitated the development of X-LIB PLUS at the RMRDC?

Technological Innovation Factor

Integrated Management Information System

The need for an Integrated Management Information System (IMIS) was one of the factors that facilitated the development of X-LIB PLUS. The chief developer had perceived the need to access the IMIS database, and to automate it for easy information retrieval. Data from interview transcripts and documents confirmed that the Council needed an IMIS to provide seamless exchange of information for staff, researchers, and the organization's investors and collaborative organizations.

Therefore, the modules of X-LIB PLUS have an interactive base with the Council's IMIS. A respondent corroborated this with the sense of satisfaction that X-LIB PLUS was meeting the organization's needs by having the capability of interacting with other databases when he asserted:

That means the information on X-LIB PLUS and our other databases are relational databases ... as well. So on our personnel record, I can interact with them, I can take information by staff, a borrower [client], and I can do a link of the borrower [client] to staff directly. Because of the website now [this is currently being modified], I can pass data to the website [[http: //LIBPLUS.net.](http://LIBPLUS.net)], so that if you want to search for a record, you can search for the information on the Internet.

Another IT related factor that facilitated the development of the software is the ability to control the source code.

The advantage of developing X-LIB PLUS software locally in Nigeria is that the chief developer has the source code, and could control the structure of the software. This offers the flexibility required for customization of the LAS to meet individual patron's needs. This flexibility is not possible when you acquire foreign LAS as the underlying databases would be inaccessible, making links to other databases without contacting the developers of the software difficult. As earlier indicated, another informant also corroborated this concept by saying that, "When you develop software, you have access to the underlying databases; so it's still under your control."

Updating the Technical Knowledge of Staff

A factor that facilitated the development of X-LIB PLUS is the continuing education on technological innovations provided to RMRDC staff. The RMRDC promotes manpower development by frequently sending officers to conferences nationally and internationally to update their technical knowledge. A participant, who had just returned from the 8th International Conference on Asian Digital Libraries in Babcock,

Thailand held the week prior to this research interview, shared his experience of continuing technical education by declaring that:

Yes, there is manpower development..., in the beginning of this year; I was in Mobai in Thailand also, on a similar course of this nature, for a short period for about three days or so. Similarly, this is extended to all other areas of Engineering... Agriculture, Mineral base, and all that. So, we normally participate in conferences that are relevant, workshops, seminars within the country and outside the country. Those are the courses that the management has sent our staff to participate and by the time they come, they will write their reports and some of these reports are deposited in the library. So the Council is ... interested in the area of capacity building for the staff.

Learning Library Functions

The X-LIB PLUS developers had to learn the functions and modules of library operations for automation. The findings revealed that library operation procedures and modules for automating library functions. The library staff described their experiences of assisting the chief developer by identifying the required modules for LAS during the development process of X-LIB PLUS. The librarians also educated the chief developer on the cataloguing and classification procedures using the AACR2; as well as procedures for collection development.

The chief developer confirmed the initial research undertaken in planning the automation of the library's information management system. The automation committee had to study various literatures on technology and automation processes in order to facilitate their plan for automation. This capacity to learn and innovate enables an

organization to be competitive (Kline & Saunders, 1998). Such RMRDC characteristic therefore facilitated X-LIB PLUS development.

Cultural Factor

RMRDC Culture

The organization culture of RMRDC played an important role in facilitating the development of X-LIB PLUS. A respondent confirmed this when he said:

When I was in RMRDC, we were given the opportunity to develop ourselves; we were given the opportunity to grow. You are the master of your own self and it is your own input that will determine your output and overall success of the organization....

The interview transcripts and document review sources corroborated that RMRDC's organizational culture embraced member identity, which allows employees to feel a sense of belonging, and encouragement to be innovative. The Service Charter of RMRDC confirmed the expectations of employees from the management in these words: "Staff expects that for effective and efficiency service delivery to thrive, management should provide working environment that has conducive and adequate facilities/tools that would enhance performance" (<http://www.rmrhc.gov.ng.servicomcharter.doc.>).

The staff is provided opportunity to grow with the organization. Employees are constantly retrained for innovative changes. RMRDC promotes exploration of creative ideas of staff by providing financial support, encouraging teamwork, and empowering staff to take risks, and make relevant decisions. RMRDC encourages continuity in staff research through training, sharing in the cultural values and missions of the organization. The Service Charter of RMRDC document also corroborated this by indicating that:

“Staff expects that adequate training program should be packaged from time to time”

(<http://www.rmrhc.gov.ng.servicomcharter.doc.>).

Many Nigerian ethnic groups are represented in the RMRDC. Whenever feasible, the employees are recruited from various Nigerian cultural groups such as: Yoruba, Ibo, and Hausa, in compliance with the requirements of the Nigerian Federal Character Commission to support diversity in the work force. While initial employment requirements are based on their qualifications, employees are often given the opportunity to develop their skills through frequent training and workshops for job enhancement (RMRDC, 2004). The staff is found to be quite willing to share their vision and experience to the advantage of RMRDC. Vision sharing is done through interaction, and brainstorming on creative ideas. This kind of cultural environment is an asset in resolving innovation barriers.

The chief developer of X-LIB PLUS disclosed that RMRDC encouraged workers to express their creative ideas in writing books on raw materials, consulting services, and project collaborations. He remarked that:

The management didn't have objection about anybody expressing himself [being creative and experimenting with ideas and processes]. That I will say in fairness to the management of Raw Materials Research and Development Council, that if you have opportunity, and you want to express yourself in any way, you are encouraged.

RMRDC management is committed to discharging its mandates to the satisfaction of its clients.

Consequently, the Service Charter document pointed out that the Council “expects that staff should be committed to discharge their duties diligently, timely, effectively and efficiently with all honesty and courteousness”. The same document also confirmed that to this effect, RMRDC management set up a “Service Delivery Unit ... manned by well trained and equally committed officers to ensure that performance standards and targets are realized with high degree of success” (<http://www.rmrhc.gov.ng.servicomcharter.doc.>).

Economic Factor

Training, Time, and Technical Support

Availability of funds for training and time for learning and implementing the software in RMRDC were advantageous to X-LIB PLUS development. The interview transcripts confirmed that the chief developer was allowed to explore and take risks in developing X-LIB PLUS. The trial-and-error stages in the development process entailed some expenses on time, training, base software acquisition, and hardware procurement. As noted earlier, there was initially no intent to commercialize X-LIB PLUS.

The affordability of X-LIB PLUS, as well as low cost of maintenance and staff training for early adopters of X-LIB PLUS encouraged further development of the software. Rogers (2003) confirmed, “Initial cost of an innovation may affect its rate of adoption” (p.230). An example of time commitment as a facilitator to the development process of X-LIB PLUS was also displayed while observing employees on their jobs at the RMRDC. Employees were observed to be doing their jobs enthusiastically, and spending long hours at work in order to accomplish their jobs. A typical example of such time commitment was an instance in which the personal assistants to the chief developer

that stayed at her job long after the official closing hours in order to conclude an important project report.

Organizational Factor

Organization as Enabling Environment

The researcher found that RMRDC encouraged its researchers to brazen out research ambiguities and experiment with them until meaningless patterns of creative ideas become useful innovation. The RMRDC organizational culture as revealed from the transcripts, promotes an enabling environment for creativity and innovation. Employees are allowed to explore creative ideas until they become fruitful. A participant corroborated this by saying: “But like I said over and over again, the management did not stop anybody from expressing him or her self, you express yourself” [employees are motivated to be creative and express their vision without fear of reprisals or failure].

The findings revealed that the development process of X-LIB PLUS was facilitated by RMRDC’s staff development policies. This was evident in the commitment of the chief developer to learning and personal mastery and sharing the vision of X-LIB PLUS with other employees. An informant said: “I would like to add that technology moves. XLIB PLUS moves and it is a lot of hard work and risks-taking. Obviously, as software developers, you take risks, and take advantage of new technologies”. Robbins and Decenzo (2003) opined that organizational culture is “a system of shared meaning within an organization that determines to a large degree how employees act” (p.25). The data revealed a shared value for scholarship at RMRDC.

An informant disclosed that the RMRDC is aware that the staff can only function well when they are given the required training. He asserted that: “Training is very

important in order to get the input from your staff.” The informant further cautioned that “the ICT is very dynamic and is never stationary; you have to learn as things are evolving, and if you are not sent to conferences, seminars, and workshops, then how do you learn?” This evidence is echoed in the RMRDC (2004) annual report, which stated that: “a national workshop was organized on *Capacity Building for the Design and Development of Process Equipment and Plants* at the African Regional Center for Engineering Design and Manufacturing (ARCEDEM), Ibadan in August 2003”. This was in response to an identified need for capacity building on engineering designs. In 2004, RMRDC organized a national competition on Design and Process Equipment and Plants as a follow-up. The competition yielded 40 designs out of which 8 won awards.

Other corroborative evidence from the data transcribed from the interviews and the categories that emerged from the data analysis suggested that RMRDC promoted capacity building, manpower development, support of individual learning, and risk tolerance. The organization’s capacity building policies also promote empowerment of staff, openness, collaborative teamwork, and opportunity for staff to grow.

These findings are in agreement with Senge’s (1990) five disciplines of learning organizations and Prather and Gundry’s model of “Setting the Climate for Innovation”, which refers to creating an environment that encourages learning and change. An informant corroborated this saying, “I think we take advantage of each other’s skills... Both of us worked on different platforms before now...we are now able to take advantage of the various platforms”. The teamwork of the staff of RMRDC is a reflection of the Team Learning of Senge (1990) in seeing the organization as working towards a common goal to shape the future of the organization.

Collaborative Efforts

The staff is encouraged to work as a team. There are therefore many collaborative teams on several RMRDC projects which are executed jointly with national and international organizations (RMRDC, 2004). The chief developer confirmed these collaborative efforts in one of his experiences in the development process of X-LIB PLUS, when he invited personnel from other organizations to brainstorm with him on designing a Web interface for the latest version of the software:

To do that Web interface, I'm bringing a lot of people in. I have already done the basic structure, the basic design to some extent, but I want to have more professional input, so I've called two companies. They are individuals, but they are representing companies in their own rights, who are giving me designs we are looking at the interface. One of them you met yesterday is (NAME), he is doing an interface, another one is the one I call (NAME), he is also giving me an interface we are test-running i.e. we want to test-run the issue of Web interface with this.

The RMRDC annual report (2004) also revealed that there is collaboration with several other institutions and organizations on various projects.

One of such collaborations involves upgrading *Indigenous Technology* for salt processing by collaborating with Federal Polytechnic, Nassarawa; processing and packaging of spices by collaborating with a local processor (Tripartite Farmers International, Owerri); drying fruits and vegetables by collaborating with Nigerian Stored Products Research Institute (NSPRI), Ilorin (RMRDC, 2004). The Service Charter of RMRDC also confirmed the efforts made by the Council in "Promoting the development

of *Indigenous Technology*, sponsoring research and development (R&D) activities for raw materials utilization and products” (<http://www.rmrhc.gov.ng.servicomcharter.doc.>). The development of X-LIB PLUS benefited from the culture of collaborations already at RMRDC, and the need for information exchange between the collaborators and their organizations.

Manpower Development

The researcher also noted from the RMRDC (2004) annual report documents that the organization has an aggressive policy of manpower development. The document stated that: “In line with its policy of manpower development, and the public service policy of training and retraining of staff, management dedicated 10% of its emolument to staff training” (p.74). The organization retrains staff by allowing them to go on training while being paid, or enrolling in classes on full or part time basis. Employees are constantly being trained to enhance staff development and capacity building.

These are evident in the following data obtained from the 2004 RMRDC annual report, which indicated that 72 members of staff, comprising 63 senior and 10 junior staff attended various seminar, workshop and conferences during the year; 32 officers attended the RMRDC organized computer training program; 23 members of staff from both the organization’s headquarters and liaison offices were sponsored to enroll for courses in various universities and higher institutions within Nigeria; 10 secretarial/clerical staff were sponsored for 18 months-2 years of staff development programs at the Federal Training Centers within Nigeria; 5 members of staff were sponsored for overseas training in South Africa, China, and Israel (pp.62-63; 74-75).

Leadership of RMRDC

The findings on manpower development indicate that RMRDC is not a traditional organization where leaders would say to their employees, “if you want to get ahead here, you must be willing to make sacrifices” (Senge, 1990, p.307). Senge asserted that “leading in a learning organization involves supporting people in clarifying and pursuing their own visions, ‘moral suasion,’ helping people discover underlying causes of problems, and empowering them to make choices” (p. 311). The X-LIB PLUS developer said: “I will give a lot of credit to the management of RMRDC, because they did give me a freehand, but ... I think they actually believed in me, I had a lot of ideas and I did a lot of experimentation.” Evidently, the leaders encourage a strong sense of community, belonging, trust, and caring for each other. Whenever the exploration indications are in operation in organizational environment, nurturing of innovation would thrive. Since, the management operates an open policy where employees can freely communicate, share, experiment, and learn without fear of criticism or punishment.

Research Question 3: What factors challenged the development of X-LIB PLUS at the RMRDC?

Technological Challenges

The researcher found that the chief developer faced challenges that arose from the nature of the technology of X-LIB PLUS. When the software was being upgraded from Windows 95 to 98, it could not run on Windows 98, and it took the chief developer three months to resolve the problem. The development of X-LIB PLUS was halted during the period. The chief developer acknowledged this as follows:

Yes, in term of challenges, the task was quite challenging. We had to ground X-LIB PLUS, people were making request for it, people wanted to buy it but we had to stop, and we had to say it was not available because we couldn't resolve some of the fundamental problems that were there. I think that was the greatest challenge because, at that time, I saw X-LIB PLUS almost dying, but I tried hard to rewrite it all over again, and to develop X-LIB PLUS all over again wasn't so easy within a short time.

The chief developer went back to the drawing board to ensure that the underlying technology problems were resolved. This was achieved without changing the initial interface, which had been identified as X-LIB PLUS.

The findings from the focus group interview also revealed that a lot of time was spent on the learning curve where the chief developer had to learn the basics of software development including programming languages. Also, since software development is prone to competition, it is challenging to keep abreast of emerging technology models. An informant observed that: "We are aware of competition, we are conscious of technology". It is therefore challenging to compete with other LAS especially with respect to the proprietary software developed in the western industrialized nations.

The chief developer invited technical partners from outside the organization to join X-LIB PLUS design team to update him with information on the trends of latest technology. He confirmed this by saying that, in addition to searching the Internet for information on current technology, he got his information from a technologically inclined person, "because he (the technical partner) travels every quarter or half year and he comes back and tells us the latest direction that technology is going."

The task became more challenging when new functions and technology such as “visualbasic.net” and “open-source” environments were being considered for use with X-LIB PLUS. These findings corroborate Gaines’ (1991) when he opined that “the growth of information systems technology overall may be seen as the cumulative impact of a tiered succession of learning curves, each triggered by advances at lower levels and each supporting further advances at lower levels and the eventual triggering of new advances at higher levels” (p. 10).

The chief developer experienced challenges at the learning curves during the development of X-LIB PLUS in terms of the time spent in learning the new technology. An informant disclosed that when a new library function was introduced in the programming, the task became challenging and “you will need to do what we call the regression test because you will need to test all the functionalities that has been working perfectly before.”

Cheung, Willis, and Milne (1999) corroborated this type of challenges when the authors analyzed the repository of data based on projects that were drawn from 14 countries in North America, Europe and Asia/Australasia. The authors observed that developers working on software projects are familiar with “problems of projects falling behind schedule and projects not fully meeting the specifications and requirements of clients”. They further reasoned that: “The so-called “software crisis” has led to many investigations into such problems of software development” (p.269).

Limited Knowledge of Library Functions

The transcripts revealed that the X-LIB PLUS developer initially had inadequate knowledge of library management, and the basic functions of library activities. He had to

learn about library operations by visiting the library daily to understudy library operations and other library applications. He held informal meetings with members of the Nigerian Library Association (NLA) to demonstrate the developmental stages of X-LIB PLUS for their feedback.

The library staff at the RMRDC also provided information on library management and global cataloguing procedures based on AACR2. The chief developer had the following comments on the challenges he faced in learning the terms and functions of the library, and how he overcame them: “There are several aspects of working on the X-LIB PLUS software. There is the aspect of programming and there is the aspect of understanding library management... But every day I go [went] to the library to understudy the library operations.”

The chief developer further disclosed how he would go to the library to also share his thoughts on the X-LIB PLUS development with them and demonstrate its features to them at every stage of the project for their comments. This aptitude for working as a team and seeking input assisted him in facing some of the challenges experienced. He observed that “some informal meetings influenced the development; a lot of members of NLA [Nigerian Library Association] became my friends.”

Cultural Challenges

Cultural challenges were among the limitations experienced by the X-LIB PLUS developers. The initial reaction of Nigerian librarians to the marketing of the software, for instance suggest that they perceived the relatively cheap price of X-LIB PLUS as indicative of its inferiority to their foreign counterparts. An informant also contended that the initial lack of interest in acquiring the software was due to the low cost of X-LIB

PLUS, which ranged from ₦1million to ₦2 million, depending on the customer's specifications of desired features, while equivalent imported LAS sold for ₦20 million and above. Hence, some customers thought that, since the software was priced lower than the imported LAS, X-LIB PLUS was not as effective as the foreign LAS.

Another major challenge was the marketing competition from imported LAS. This became evident mainly because, according to an informant, many of the potential clients are not computer literate enough to be able to evaluate X-LIB PLUS. They based their evaluation of the LAS on their relative prices, and there was already an assumption that expensive items were more effective than their cheaper local alternatives. This is a cultural bias which can only be reduced through creating more awareness, and education through testimonials. The developers struggled with this cultural issue concerning the initial acceptance of X-LIB PLUS versus imported LAS.

Challenges of Funding and Time

The findings from the transcribed interviews, focus group, and documents reviews indicated that there were challenges in the forms of inadequate money for software upgrades, and time pressures during the development process of X-LIB PLUS. At a point after the early years of testing the LAS for feedbacks, the chief developer had to consult a software vendor and technical partner on X-LIB PLUS to finance further development of X-LIB PLUS. The chief developer confirmed this arrangement saying: "So he paid ₦ [Money] to make us develop X-LIB PLUS for him with the agreement that when he sells ... and there was the developmental fee".

The chief developer further discussed these challenges while considering the funds invested in X-LIB PLUS and its market price:

In Nigeria, and I guess may be in the third world in general, when something is imported, they are taken more seriously. And I must confess, I've had people who approached me that [we should] take X-LIB PLUS out of Nigeria and bring it back as a foreign software so that they can make more money... We would have made a lot more money but the purpose would have been defeated, because it is one of the pet projects we want to be identified with.

Although the cost of X-LIB PLUS was not primarily the issue, it was however challenging to be selling the software at a lower rate than as determined by universal assessment standards of software pricing. There is need to investigate what would be an appropriate cost for X-LIB PLUS. Cheung, et al. (1999) suggested that: "When there is a lack of information on software project measures in an organization, the use of software benchmarks can be a useful tool for planning and estimating the costs of software projects" (p.278).

Time Constraint

Frequent meetings and travels to training workshops, conferences, and technology expositions cost money and took the time of the chief developer away from X-LIB PLUS to focus on other duties. The findings from the transcripts of interviews, the documents, and the observation method revealed that the chief developer was quite busy with management meetings during the office hours; and there were few staff members with the necessary technical skills in the organization that could assist him on X-LIB PLUS project.

This finding revealed that time was also a constraining factor, which stretched the duration of the development process. The first version 2.0, which was designed in 1992,

was used till 2000 when the version 3.0, termed X-LIB PLUS millennium was released.

The chief developer had the following to say about the time constraint:

The volume of work that I had to do at my level as a developer, the amount of time available to me wasn't there, so a lot of my work was done in the night. And I had to do most of the development of X-LIB PLUS in the night, when I come back from office ...but the bulk of the programming was done in the night and that put a lot of pressure on me.

Gonzalez-Barahona, Robles, and Herraiz (2004) confirming the challenges that software developers faced said: "In traditional software development environments, software developers have tight schedules and a fixed number of hours per week to devote to a given set of tasks (programming/maintaining software being just one of them" (p.3).

As discussed above under (technology section) a library staff traveled to England to seek technical assistance for adapting TINLIB to suit the RMRDC's data retrieval needs based on its Integrated Management Information System (IMIS) database. Other interviewees also corroborated this information. The trip was not productive, turning out to be a waste of resources.

The library staff then resorted to seeking assistance from within Nigeria by contacting a director of technology development who took the challenge and initiated the process of developing X-LIB PLUS. The library staff said:

TINLIB is based on DOS and DOS doesn't support graphics, and as a result, we, I and the person from the computer department, traveled to see them in EOS, in London, the maker of TINLIB and they were not ready to assist us. And based on that, when we came back, we had to put our heads together with (name) who

happened to be our Director at that time and who has the knowledge of IT to a reasonable extent.

The researcher found that although, the document review did not reveal the actual budget expended on training annually, the number of staff trained (as discussed earlier) corroborated the findings on economic challenges related to money and time spent on travels for conferences, fairs, exhibitions, workshops, and training. (RMRDC, 2004).

Organizational Challenges

The chief developer faced a challenge in organizing the design of X-LIB PLUS interface. Some RMRDC managers and workers have limited knowledge of computers hence; they did not appreciate the full potentials of technology, and thus, desired less complicated software in performing their duties. So, X-LIB PLUS developers designed its interface, in form of buttons, so as to be simple for people to relate to because they could see the functions to choose from, instead of a cumbersome menu driven software that required pulling down menus before searching for functions.

Organizational Culture

The themes that emerged from the data pointed to organizational characteristics that nurtured rather than hindered innovation in RMRDC. However, as Farago and Skyrme (1995) observed, too much top-down driven, over tight supervision, and lack of real motivation and empowerment can hinder innovation. The researcher observed the top-down pattern of communication from superiors to subordinates at RMRDC. Also, junior officers stood up for senior officers whenever the latter were passing, and senior officers had better furnished offices than their junior counterparts. This observation challenged the Council to motivate employees for better productivity.

The Nigerian culture promotes respect for senior staff members. The culture also encourages expectancy among the junior staff to become senior staff, to which they eagerly look forward and would willfully respect their superiors in order to gain respect when they reach senior positions. Hence, the junior staff is motivated to bridge the gap between them and their superiors. Such self-motivation is supported in the organization through staff training and promotion exercises in which junior staff are elevated to senior staff position (RMRDC, 2004).

The researcher observed RMRDC employees at work. On a particular instance, a director gave orders to a personal assistant to follow-up on the computers that were ordered. The personal assistant then gave orders to the clerical assistant to check the status of the order. This is a reflection of what Hofstede (1997) said of organizations that “centralize power as much as possible in a few hands. Subordinates are told what to do. There are a lot of supervisory personnel, structured into tall hierarchies of junior staff reporting to senior staff” (p.35). The researcher observed this trait as a symptom of an organization in transition between traditional Nigerian cultural traits that encourage respect for seniors to those of modern bureaucracies.

The researcher observed respectful interactions between juniors to seniors during the observation and participant observation period of this study. Junior employees answer their superior with “yes sir”, and “no sir”; and with polite greetings. The RMRDC management is constantly challenged to avoid barriers to innovation by being positive towards resolution of dilemma at workplace; by promoting support for the learning process itself, and for communication processes that bring people together as teams for pursuing organizational goals.

Research Question 4: What factors account for the diffusion of X-LIB PLUS among Nigerian libraries?

Research Question 4

Katz, Levin and Hamilton (1963) discussed diffusion from a sociological perspective as: “the acceptance, over time, of some specific item-an idea or practice, by individuals, groups, or other adopting units, linked to specific channels of communication, to a social structure, and to a given system of values, or culture” (p.240). Other researchers such as Strang and Soule (1998); Everett M. Rogers, a seminal author of diffusion of innovation (1962, 1983, 1995, 2003); and Rogers and Shoemaker (1971) shared this same sociological view because they see diffusion embedded with the concepts of acceptance, time, communication channels, adopting units, social structure, and value system.

The five attributes of Rogers (2003) innovation diffusion found applicable to this study are: *relative advantage, compatibility, complexity, trialability, and observability*. These attributes are five major dimensions that influence the adoption of an innovation; hence, they will be discussed as they affect the diffusion of X-LIB PLUS in this section.

Relative Advantages

The advantages of X-LIB PLUS over imported LAS are in the areas of costs, technical support, availability of training, and maintenance. Evidence found in the RMRDC communiqué titled: X-LIB: A Brief History” indicates that the difference in the cost of the initial X-LIB PLUS contract with a marketing organization and its market price is lower than that for imported LAS as discussed earlier.

The researcher found corroborative evidence from the transcripts of interviews, from the focus group interview, and document review that X-LIB PLUS is cost effective for Nigerian libraries. Since Nigerian libraries, as in many developing countries, are not well funded, they can least afford exorbitantly priced imported library automation software, and their maintenance costs.

A participant observed that Nigerian librarians “just couldn’t identify [with] the fact that this (TINLIB) software is for ₦3 million (in 2006, one dollar exchanged for approx. 140 naira)...I think by that time X-LIB PLUS value was about ₦ 300,000 which is $\frac{1}{10}$ th the price of TINLIB.” Another informant, while comparing X-LIB PLUS with imported LAS and explaining why it was found affordable by over 30 libraries that currently adopted it, said: “Pricing is a major index... The two modules of TINLIB that were acquired in 1990 were at a cost equivalent to US \$150,000.00 while X-LIB PLUS sold at an equivalent of US \$28,000.00”.

The libraries also needed technical support in terms of staff training and software maintenance. The X-LIB PLUS developers trained a technical crew for installing, marketing, troubleshooting, and maintaining the software. The technical crew was always available at short notice to attend to any technical, or maintenance problems experienced by X-LIB PLUS clients. Another participant had this to say on technical support: “Then help is less than hours away, sometimes it could even be one hour ... immediately they call, I sent somebody there, five minutes, it is solved, so help is readily available, and it is cheaper” [than what the foreign LAS vendors offer].

On one occasion, while observing the staff, a director sent two technical crew to a client institution that requested assistance. The crew did not return to the office that day.

They however reported the following day that the maintenance task lasted the entire afternoon beyond their official hours and was successfully done. Thus, the technical crew also spends time after official hours to attend to calls from customers for maintenance.

The 2004 annual report document also confirms that the management invested the necessary funds and other resources for technical training that enhanced the employees' knowledge in the maintenance of the software. The report indicates that: "computer training programs are run on regular basis" (p.60).

The X-LIB PLUS software also has a number of unique features as discussed earlier (under research question 1). These features are considered very vital for sustaining the LAS, a service that imported LAS cannot offer. X-LIB PLUS enables an efficient use of staff and resources by simplifying library operations in line with the constraints in library budgets in Nigeria. Obajemu and Ibegwam (2006), in a survey of 43 libraries, compared the three major software used in Nigerian libraries, featuring two imported LAS: TINLIB and CDS/ISIS, and X-LIB PLUS LAS. The authors found that CDS/ISIS was most used in Nigerian libraries (44%), because the software is free and has been made available to the libraries by UNESCO. This is followed by TINLIB (33%), also, because the software has been introduced into the Nigerian market for some time. The X-LIB PLUS was found to be the third most used software (19%), because the software had recently been developed and introduced to the Nigerian library market. Although the study by Obajemu and Ibegwam (2006) found a relatively low percentage of users of X-LIB PLUS, Oketunji (2003) presented a different viewpoint on its rate of adoption as discussed earlier.

Compatibility

A major compatibility issue for the Nigerian libraries is that the X-LIB PLUS software can be adapted for library budget control. Since the libraries have accounts for the acquisition of books, and serials from several agents, and have to contend with the management of different accounts for foreign and national donors, the developers made provisions for such features in the development of X-LIB PLUS. The developers were able to address this because of their previous experience in solving such problems for the RMRDC library. An informant corroborated this by saying:

When we were setting up our own Project Library and Documentation [name of the project], we had support [financial] from the UNDP, and then we had our own government counterpart funding, so we made provision for...charging one book under this budget and another that is bought under another budget [under its separate budget]. So if there is a report that needs to be generated, you can query the database, say, like how many books we have bought under the UNDP funded project ...then I think basically what we do is that we respond to the peoples' vision, peoples' ideas.

For example, an informant cited one instance when an organization wanted to acquire X-LIB PLUS and requested for a design that can be adapted to query the organization's database. The X-LIB PLUS developer wrote a program that achieved this. These facilities for customization are not available to Nigerian libraries that use imported LAS because the developers of those systems are abroad and had not anticipated the needs of the Nigerian library market.

Retrieving Indigenous Literature with X-LIB PLUS

X-LIB PLUS is also sensitive to words in indigenous languages such as local names, and titles in Nigerian literature, making the software compatible with local collections. X-LIB PLUS is capable of retrieving indigenous information from the IMIS database of the RMRDC. Grenier (1998) considered indigenous knowledge (IK) systems unique, and Rogers (2003) emphasized the importance of IK systems in both the developing and developed societies, as discussed earlier under indigenous technology section of this dissertation.

The X-LIB PLUS has a number of unique features, which has been listed above. Further more, there are options to customize its features to represent local alphabets with nearest ASCII characters. For example the letters X, Q, Z, and V are not present in Yoruba alphabet. X-LIB PLUS can be customized to use this key to generate ASCII characters similar to the alphabets that occur in Yoruba language, which are not present on standard keyboards.

The chief developer can also customize the X-LIB PLUS software to facilitate the retrieval of indigenous data of the entire Nigerian ethnic groups according to the customers' specifications. For instance, it can be customized to provide features for retrieving indigenous data in newspapers from Yoruba, Hausa, and Ibo languages. The common data to these three major ethnic groups is those on foreign literature. A participant provided the following answers to the question posed on whether X-LIB PLUS is capable of retrieving indigenous data:

That one is simple, that one is a question of the keyboard issue, and you can program your keyboard. But then, the word has even made it indigenous, is just

like in developing X-LIB PLUS software, I understudied the activity in our library, how it operates and the keywords...

On further probing, the researcher received the following comment from another participant on whether X-LIB PLUS can retrieve indigenous names:

There is no problem because in as much as we have it as keywords so whatever you put in, you will be able to retrieve, depending on your cataloguers, whatever they are able to catalogue, the way and manner they are able to catalogue, whatever keywords they decided to use, with that, you can always make your search using your keywords. So if you put the keywords in indigenous language, definitely you will be able to retrieve also indigenous data.

X-LIB PLUS modules are also consistent with the procedures required of library functions. The modules are also simplified enough to accommodate the librarians' limited experiences with computers and LAS in general.

Complexity

The interface of X-LIB PLUS is simpler to use than those of imported LAS. An RMRDC staff said the following to confirm this point:

We had a training program ... people are not too computer literate. In fact, if you look at the structure of X-LIB PLUS, it is simple, because you see catalogue, acquisition, you don't even need training if you are a good librarian to use it, and so we have minimized the complexities.

The complexity of X-LIB PLUS is also reduced for Nigerian libraries by simplifying the interface to resemble the manual procedures of retrieving information, and by retaining

the interface of the earlier version of the software. Another informant commented on librarians' perceptions in these words:

We still try to retain the old one that is almost mimicking what they [librarians] would do on paper, so that they will not feel suddenly out of place, they will not suddenly feel like it's too much of computer [technical] because I've seen a lot of programs abandoned, because it is too complex, because they [users] are not used to that kind of interface, so we are trying to simplify X-LIB PLUS.

X-LIB PLUS is organized using these easily identifiable buttons that can lead users towards easy searching rather than use menu-driven drops.

This organization of the interface for easy retrieval is necessary to facilitate ease of use. Hence, the developers of the LAS structured it "so that it is very simple." An informant further explained that "we even have to hide functions underneath to be behind bar so that they [the software modules] will not scare people away, because we [the developers] are cautious that local people are not computer literate...." The developers were people-centered, conscious of the immediate need of customers, which they considered a priority in the design of X-LIB PLUS. For instance, in addition to the general provision of simplified interface for user friendliness, the developers also made provision for customers with few personnel by customizing their applications to accept keywords and facilitated easy saving of data entries.

This advantage corresponds with Rogers (2003) third attributes of complexity. The developers addressed the issue of complexity in the development of X-LIB PLUS by providing technical training both for introducing participants to computers, and on how to use the X-LIB PLUS for library functions. The introduction to computers was intended to

provide the customers with the awareness of the technology, while the intensive workshops were meant to equip them with information retrieval skills.

The researcher's participation in the operation of the X-LIB PLUS modules to retrieve documents attested to the user-friendliness of the navigation tools of X-LIB PLUS. From her previous experience in developing the National Research Institute for Chemical Technology (NARICT) Library Automation System (NLAS), the researcher could appreciate the challenge faced by the X-LIB PLUS developer to simplify the X-LIB PLUS interface. For instance, with NLAS interface, a menu driven format was used and a user had to be familiar with the system before the software could retrieve relevant data. For instance, the document titled: "NLAS: A guide to its use" described the submenu of NLAS document search mode, which allows limited searching. The menu reveals options that allow users to perform the following functions listed in Table 3 below:

Table 3: NLAS Document Search Module [this is termed “Mode” in NLAS interface]

Search with Class No. Search with Book Title Search with Author Name Search with Subject Search with Publisher Exit Searching
--

Hence, with NLAS, there was a need to put the library staff through training programs before they could use the software effectively for retrieving information.

The participant-observation experience provided an insight into the user centeredness of X-LIB PLUS. The Enquiries/Reports Module of X-LIB PLUS is grouped into three: Enquiries-Catalog; Enquiries-Circulation; and Enquiries-Acquisition. The document titled: “X-LIB Library Automation System National Workshop Manual” confirmed that the module enables the users to search for information with options for screen display or printable results. The searching mode of X-LIB PLUS is simplified; it has button-driven menu and displays the following options as listed in Table 4 below:

Table 4: X-LIB PLUS Enquiries/Reports Module

Search by Author
Search by Publisher
Search by Year of Accession
Search by Branches
Enquiries on Periodicals (Titles)
Enquiries on Periodicals (Issues)
Enquiries on Articles

Using the X-LIB PLUS software shed some light on the challenges of ensuring that other users, who might not have advanced computer skills, were able to retrieve information more easily than when they used foreign LAS.

Trialability

The fourth of Rogers' attributes is trialability. The functions of X-LIB PLUS was piloted from its inception using the RMRDC library as a testing ground. When feedback was implemented and the modules were working interactively, the software was presented to Nigerian libraries for testing through the Nigeria Library Association. Feedback from librarians was used to refine the system forms and functions. Hence, the X-LIB PLUS provided future adopters with various opportunities to experiment with the software before deciding to adopt it for use in their library. An informant observed that:

At RMRDC library, we are using it [X-LIB PLUS] online here, so whatever areas we feel that needs modification, we will make suggestions to the Programmers and Systems Analysts, and this is also taken into consideration in all subsequent editions, and we have also exhibited in virtually all the conferences especially

those that are major ones. X-LIB PLUS was exhibited at the NLA [Nigerian Library Association] conferences, the Academic and Research Libraries [Divisions], and the Cataloguing and Classification [Divisions], of the Nigerian Library Association.

Another informant said, “Every year, we are at the NLA conference, to demonstrate it [X-LIB PLUS] and get feedback from people, to see the direction and add one or two things and modify it.”

The developers formed a group termed the Users Forum within the NLA that provide feedback from trying X-LIB PLUS. The forum usually meets at the major national conferences to discuss their experiences in using X-LIB PLUS, to assist each other on any technical issues experienced while using the software, and to offer suggestions for improvement. An informant also affirmed: “We also have opportunity of having [a] Users Forum. We had a slot [program] during the conference and people were able to exchange ideas in the areas where they were having difficulties and I was able to share my experience.”

Kshetri (2005) confirming the advantage of such organized forum on the diffusion of Linux software said: “For instance, the Israeli Group of Linux Users (IGLU); IGLU organizes “Linux installation parties” several times a year in which less experienced users get installation and other help from knowledgeable and experienced users” (p.9).

Observability

The performance of X-LIB PLUS in libraries that were early adopters served as evidence of its usability, efficiency and effectiveness. The use of X-LIB PLUS by more than fifty libraries within the few years of its development is an indication that these

libraries appreciated the advantages of X-LIB PLUS over alternative software (Oketunji, 2003). An informant reported, “The government parastatals [agencies] were the earliest users, recently the Polytechnics and you know, is like a word of mouth, they go to a place, they see it working there, they now begin to have confidence” [on it].

Summary

In this chapter, the researcher presented analyses and findings of the research. The data presented has been extracted from the transcripts of the personal interviews with the participants, focus group interview, observations, participant observations, and documents obtained from the organization under study. The data was analyzed using qualitative analysis methodology, as described in chapter three.

CHAPTER 6

SUMMARY, LIMITATIONS, AND IMPLICATIONS

The previous chapter presented the findings gathered from formal interviews of the chief developer and two other personnel involved in the development of X-LIB PLUS, focus group, observations of RMRDC environment, participant-observation of X-LIB PLUS use, and documents review. This chapter identifies the limitations of the study, and discusses its conclusions and implications.

Limitations

The study took place in a natural setting with intent to understand the context and activities at the RMRDC relevant to the development and diffusion of X-LIB PLUS. Using a qualitative approach, the researcher served as an instrument for data collection and interpretation. This approach poses limitations with respect to the individual and subjective aspects of the researcher's access to, and interpretations of data and perceptions.

The data was analyzed based on naturalistic inquiry perspectives; and as such, the findings enable understanding the relevant processes and context of the RMRDC. The data collected is limited to the development process of X-LIB PLUS and the characteristics that influenced this process positively or negatively at this organization. Data collection was also limited to the experiences and perceptions of RMRDC staff and librarians on the subjects on which they proffered information.

Summary

Research Question 1

Needs/Problems Stage of X-LIB PLUS

The Research Question One for this study investigated the process used to develop X-LIB PLUS library automation software at RMRDC.

X-LIB PLUS is an innovation developed through adapting other software to meet the information management needs of the RMRDC. The assistant director of Information Documentation Division (IDD) (now a director for technology development) at RMRDC perceived the need to automate the organization's records and related activities. The chief developer identified a problem with TINLIB; the imported LAS software which had been acquired by the organization to facilitate collaboration with Nigerian universities that used TINLIB. However, it was soon realized that the imported software was limited in its capacity to meet these automation and collaboration goals.

The RMRDC also received the CDS/ISIS, a free UNESCO software which was found to be cumbersome and limited in its functions. Other problems related to the source code of TINLIB, which was not made available to the RMRDC to enable the organization integrate the software modules within the RMRDC database for easy retrieval of information. The librarian traveled to England to seek technical assistance on adapting the software which was denied. Subsequently, the librarian turned to the RMRDC director of technology development who took up the challenge to develop the in-house LAS.

Research (Basic and Applied) Stage of X-LIB PLUS

Thereafter, efforts were put in place to resolve the need. The chief developer explored different ideas on developing a library management software that could interact with the RMRDC database and retrieve data for the library users, which include the organizations' staff and external collaborators. Since the chief developer is not a librarian, he studied library processes and their implications for software design. He also held various formal and informal meetings with practicing librarians within and outside the organization to seek clarifications on library procedures and feedback on the performance of X-LIB PLUS.

Librarians interested in the development of X-LIB PLUS discussed all the functions of the library departments and the activities in each division with respect to the management of library materials, including library bookkeeping with the software developers. Based on some universal features of LAS such as the basic modules for retrieval of information, and use of AACR2 rules for cataloguing procedures, the chief developer made adaptations to Access and FoxPro software to create X-LIB PLUS. The initial development process of X-LIB PLUS followed the sequential processes of LAS development prevalent elsewhere in the world (Tate, 2005).

The development process of X-LIB PLUS took into consideration the computer literacy skills of its users. The chief developer made the interface user-friendly and simple to use. Once data is entered into the system, it interacts and integrates with other modules for easy search and retrieval. The first phase of the development process of

X-LIB PLUS started with first version on Windows 3.1, which was able to run on Windows '95. An upgraded version termed “the millennium version” was developed in year 2000 to run on Windows '98.

Development Stage of X-LIB PLUS

The program for the development process of X-LIB PLUS was first started using Microsoft Access front end and backend, and it further continued with linkage to an Oracle Backend through ODBC (Open Data Base Connectivity) for interaction with the RMRDC databases. At the point of commercialization, the front end was changed to Visual FoxPro for ease of distribution and to take advantage of the Rushmore Technology of FoxPro, which ensures faster search operations. Subsequently, some interfaces were developed using Visual Basic for the purpose of Web operation in order to meet the demands of the customers on the latest technology.

The programming platform for the development of X-LIB PLUS was originally Microsoft Access/Visual Basic applications and later Visual FoxPro/Visual Basic. In order to compete with the software market, the X-LIB PLUS developer explored several choices of backend from Visual FoxPro (DBF), MS ACCESS, MS SQL, and Oracle, which is currently being implemented using Visual Basic.Net. The third and latest version of X-LIB PLUS, which is being implemented using Visual Basic Net incorporates the web, and could run on Window XP. This version will be released in the later part of 2006.

Commercialization Stage/Maintenance Stage of X-LIB PLUS

The upgraded versions of the LAS are made available to consumers that acquired an earlier version at an additional handling fee. From the initial stage of the development,

X-LIB PLUS is flexible and could be customized to meet diverse consumer's needs.

Hence, the flexible and adaptable nature of X-LIB PLUS was tested when the developers implemented changes to meet the needs of the users at National Communication Commission (NCC) as example of meeting user's requirements, and ensuring that the same version is not running anywhere else.

The flexibility of X-LIB PLUS was demonstrated when the software was acquired by NCC. The NCC wanted a specific function of their organization to be incorporated in their LAS version. The chief developer successfully implemented this to the customer's satisfaction. This success was acknowledged with an assertion that, if NCC had bought foreign software, they would never have had that functionality because they would never have been able to pay for the developmental cost and implementation cost of the foreign LAS. The researcher also used X-LIB PLUS extensively to retrieve information for library users and was able to attest to the efficiency of the technical crew in maintenance of the software.

Research question 2

The second research question sought data on those factors that positively influenced the development of X-LIB PLUS at RMRDC.

RMRDC Culture

The development of X-LIB PLUS was facilitated largely because of the commitment of the organization to staff training and a shared vision. The staff was encouraged to develop their skills for the common good of the organization. For instance, although there were no plans to commercialize X-LIB PLUS for profit, the chief

developer was encouraged to explore a variety of options and take risks while the RMRDC absorbed the costs.

There was also cooperation and collaboration among the staff to ensure successful development of the software. For instance, the software developers relied heavily on the RMRDC library staff for library professional knowledge and skills to facilitate the X-LIB PLUS development. The organizational culture, which supported staff learning and innovation, was therefore a positive influence on the X-LIB PLUS development process.

Cost-Effectiveness

Although the cost of X-LIB PLUS was initially not an issue for the chief developer and the RMRDC, it was a factor for most Nigerian libraries that wanted to adopt X-LIB PLUS. Compared to imported LAS, X-LIB PLUS was more affordable and provided local technical support and training. Describing the features of LAMP (Library Automation and Management Program), a CDS/ISIS-adapted software in Pakistan, Mahmood (1998) observed that libraries in developing countries are deterred from automating due to the high cost of American or European library software packages (1998, p. 37). The cost effectiveness of X-LIB PLUS eventually enhanced the diffusion of the software among Nigerian libraries. Besides, local librarians willingly contributed their feedback during X-LIB PLUS prototyping and testing, and subsequent upgrades at formal and informal meetings with the developers.

Research question 3

The third research question sought data on factors that challenged the development process of X-LIB PLUS at RMRDC.

Limited Knowledge of Technical/Library Skills

These factors at the initial development stage included a lack of appropriate technical skills. First the chief developer was faced with the challenge of trying to learn the library procedures necessary to produce an effective for information management. When this challenge was addressed, he was then faced with the task of choosing the right software as a base for the development.

Another challenge faced in the X-LIB PLUS development process was that the chief developer first had to learn the technical basics for developing the software. The task also became more challenging as the need for new functions and technologies came with upgrading the software (Gaines, 1991). The need to design a user friendly interface as well as customize X-LIB PLUS to different clientele needs and collections also posed challenges to the developers.

The biggest challenge however came when the chief developer had to stop further sales of X-LIB PLUS because it was not compatible with Windows 98. This problem was resolved after three months of inactivity. The chief developer did the research necessary to resuscitate X-LIB PLUS and was determined to keep it from experiencing such setback again. Accordingly, the third version, which is currently the latest version of X-LIB PLUS, is now Web-based.

Administrative Challenges

The other major challenge was administrative. The chief developer lacked the time to concentrate on developing X-LIB PLUS because of his busy schedule as an administrator. He therefore opted to work in his spare time at night to ensure that the development process not only met deadlines but that the software survived. Many of the

interviews with the chief developer were done in the evenings after work and at the weekends. Cheung, et al. (1999) argued that because developers often have busy schedules, they experience delays, and fall behind schedules while designing software.

Research question 4

The fourth research question sought data on the factors, which account for diffusion of X-LIB PLUS among Nigerian libraries.

Relative Advantage/Affordability/ Training and Maintenance

Affordability

There are relative advantages of X-LIB PLUS over imported LAS in the following specific areas: the Nigerian libraries wanted LAS that is cost effective and affordable for their meager budget. There are vast differences between the cost of X-LIB PLUS and the foreign LAS. For instance, the imported software cost ₦30 million, (in 2006, one US dollar was equivalent to approximately 145 naira, the Nigerian currency), relative to the cost of X-LIB PLUS at ₦2million. Acquiring imported LAS was therefore out of the reach of most libraries in Nigeria.

Training and Maintenance

X-LIB PLUS also offered affordable and timely technical support in terms of training and maintenance. These provisions were found in X-LIB PLUS because the chief developer and the technical crew valued customer training, and were always available at short notice to attend to any technical or maintenance problems. In many cases, help on X-LIB PLUS was less than 24 hours away. The developers also created a user forum within the Nigerian Library Association, where problems encountered in the uses of X-LIB PLUS are discussed and resolved.

The technical and maintenance crew often went out of their way to offer support on other computer-related problems in their client organizations, such as trouble shooting for virus. These services were considered essential to LAS adoption in developing countries. X-LIB PLUS could be customized at first acquisition, and whenever there is need to upgrade its features to meet changing needs of client organizations. This is possible because the chief developer knows the structure of X-LIB PLUS, and can add additional information to the design to meet customer requests, such as adding newspaper-cutting functions to a package. This would not have been possible if the LAS have been acquired from the west.

Compatibility

The X-LIB PLUS is compatible because it is consistent with, and can relate to the RMRDC database (RMIS). It is also compatible because it can be adapted to retrieve words, names and titles in Nigerian languages. Rogers (2003) remarked that: "one indication of the compatibility of an innovation is the degree to which it meets a felt need" (p.246). X-LIB PLUS met this need for Nigerian libraries.

Complexity

One of the obstacles to library automation in Nigeria and other developing countries has been the complex nature of LAS technology such as CDS/ISIS (Chuong, 1998). X-LIB PLUS has a simple and user-friendly interface. The developers were conscious of the needs of customers, and their relatively low computer literacy skills and unfamiliarity with LAS. According to Rogers (2003), complexity is a very important barrier to adoption.

Triability

The RMRDC library was used as a testing ground to demonstrate the functions of X-LIB PLUS at the initial stages of its development. Trial “demo” of the LAS was later made available to librarians at the NLA conferences for feedback. Every feedback from librarians was later incorporated for further modification of the software. The “demo” provision was to create awareness of the X-LIB PLUS among librarians and its performance. Rogers (2003) opined that: “if an innovation can be designed so as to be tried more easily, it will have a more rapid rate of adoption” (p. 258).

Observability

Librarians that had access to the “demo” version of the LAS were opportuned to discuss the features of the software with their peers from other libraries. Those who saw the performance of X-LIB PLUS at workshops organized by the developers or the Nigeria Library Association were the early adopters of the software. Subsequently, testimonials based on the features of X-LIB PLUS, its functions, and adaptability to meeting the peculiar needs of different organization were ultimately responsible for the diffusion of X-LIB PLUS.

Utility of Research

X-LIB PLUS has raised awareness of the need to create culture-specific library automation software systems to meet local needs. By examining the processes of its development and diffusion, this study has put in the public domain the experience and the challenges of developing a local library automation software that is sensitive to indigenous languages and literature, thereby addressing the cultural needs of users in developing countries. The study therefore enhances awareness of other advantages local

LAS such as their less capital-intensive nature, and lower entry barriers into the information systems development market.

The results of this study would be of interest to all libraries, but especially academic and special libraries/librarians, because of their development of specialized collections, with indigenous resources, languages or names. This study would also be relevant to studies of information systems and organizational management as it addresses the challenges of software development in a developing country, and the organizational environment which influenced development and diffusion of the software.

Implications and Recommendations for Further Studies

Implications for further research on X-LIB PLUS

Hatch (1997) contends that organizations are manifestations of larger cultural systems. RMRDC is responsible for researching into the use of Nigerian raw materials to sustain industrial growth. It therefore has a mandate to serve the needs of the Nigerian economy with its population of more than 120 million people who speak about 450 languages and dialects. Mahmood (1998) explained, "Most of the library resources in Pakistan are in the Urdu language" (p.40). He contends that the project "has converted all menus and data entry worksheets in LAMP (Library Automation and Management Program) into Urdu" (p.40). X-LIB PLUS needs to have versions capable of retrieving indigenous names and titles in local literature in all Nigerian languages. There is also a need for future research on the diffusion pattern of X-LIB PLUS, which could be assessed based on technology dimensions (Kshetri, 2005).

X-LIB PLUS demonstrated flexibility and sensitivity to local Nigerian words and names. It would be ideal to have this feature as a main module, which is activated as soon

as ethnic names appear for cataloguing. It is assumed that X-LIB PLUS would be sensitive to words in at least the main indigenous languages in Nigeria. Moreover, there is need to accommodate unique regional and cultural needs of distinctive Nigerian names such as those with “nasal tones” as in Adérèmi. Since X-LIB PLUS can be customized to address the unique needs of individual libraries, such a goal should be explored.

Implications for LIS

Information technology has transformed library organizations since the last century due to rapidly improving price/performance ratio of technology and a general increase in computer literacy. In 2002, Mosenkis cautioned special librarians to keep their skills current and be aware of trends in their environment that could affect their career (p.10). For instance, the library staff at RMRDC was able to promptly respond to and accept technological innovation, and constantly offered professional input in the development of X-LIB PLUS. Further research is needed on how to manage library organizations to foster the conditions that nurtured such collaborative learning and innovation.

Conclusion

Using a naturalistic inquiry approach, qualitative research methods, and a case study composition, this study described the development process and diffusion of X-LIB PLUS among Nigerian libraries. This study found that the development process of X-LIB PLUS is similar to that of the process of software development elsewhere in the world (Rogers, 2003). The X-LIB PLUS process was unique because the chief developer took the culture of developing countries, especially the Nigerian culture into consideration

(Rogers, 2003). X-LIB PLUS has a simplified interface that made it user-friendly, and RMRDC provided technical support, training, and maintenance services to customers.

The study findings revealed that the factors that facilitated the development of X-LIB PLUS outweigh the factors that challenged the development of X-LIB PLUS. It also identified the advantages X-LIB PLUS had over imported LAS, which include affordability, and access to technical support and training. X-LIB PLUS is currently the main Web based LAS software developed in Nigeria, and is connected to the RMRDC library network.

The developer explored the possibilities of marketing X-LIB PLUS outside the shores of Nigeria to other West African markets, such as Ghana. In a bid to market the LAS globally, the technical partners (BERAM) of X-LIB PLUS have demonstrated the software at international exhibitions in Germany. The adoption of X-LIB PLUS by Nigerian libraries can be attributed to a combination of the five attributes identified by Rogers (2003) as relative advantage, compatibility, trialability, observability, and less complexity.

REFERENCES

- Aguolu, I.E. (1998). Library Automation in Nigeria: towards steadier progress. *Lagos Librarian*, 19 (1 & 2), 8-13.
- Ajibero, M. I. (1987). Factors Affecting the Attitudes of Librarians Towards Media Technologies in Nigerian Universities. *Lagos Librarian*, 14 (1&2), 65-71.
- Akande, F. (2001). Application of Information Technology to Information Systems of Nigerian Agricultural Research Libraries. *Middle Belt Journal of Library and Information Science*, 1 (1 & 2), 70-779
- Alabi, G.A. (1994). *Effectiveness of Informatics Policy Instruments in Africa: Case Study of Nigeria*. IDRC.
- Ash, J. S., Lyman, J., Carpenter, J., & Fournier, L. (2001). A diffusion of innovations Model of physician order entry. *Journal of the American Medical Informatics Association*, 22-26.
- Ayo, D. (1998). X-LIB: an indigenous library automation software. Paper presented at the Association of Government Libraries Seminar, 10.
- Bitpipe (May 25, 2005). *Bitpipe Research Guide: Software Development Management Overview*. Retrieved May 25, 2005, from <http://www.bitpipe.com>.
- Borgman, C.L. (1997). From acting locally to thinking globally: A brief history of Library automation. *Library Quarterly*, 67 (3), 215-249.
- Burrell, G., & Morgan, G. (1979). *Sociological Paradigms and Organisational Analysis*. London, Heinemann.
- Buttolph, D (1992). A New Look at Adaptation. *Knowledge: Creation, Diffusion, Utilization*, 13 (4), 460-470.

- Cashman, K. (1989). Agricultural Research Centers and Indigenous Knowledge Systems in a World Perspective: Where Do We Go From Here? In Warren, D.M.; L.J. Slikkerveer; S.O. Titilola, Eds. *Indigenous Knowledge Systems: Implications for Agriculture and International Development. Studies in Technology and Social Change No.11*. Ames: Iowa State University, Technology and Social Change Program.
- Cheung, Y., Willis, R., & Milne, B. (1999). Software Benchmarks Using Function Point Analysis. *Benchmarking: An International Journal*, 6 (3), 269-279.
- Clyde, L.A. (1992). *Research on Current Trends and Developments in Library Automation Systems*. Paper presented at the Annual Meeting of the International Association of School Librarianship. 21st, Belfast, Northern Ireland, July 19-24
ED 354 918.
- Creswell, J.W. (1998) *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*. Thousand Oaks, CA: Sage.
- Dada, G. (1999). Computer Networking in National Libraries. *Lagos Librarian*, 20 (1&2), 1-5
- Daniel, J.O. (1999). Electronic networking in the emerging information society: the Internet at a glance. *Nigerian libraries*, 33 (1), 5-9.
- Deiss, K.J. (2004). Innovation and Strategy: Risk and Choice in Shaping User-Centered Libraries. *Library Trends*, 53 (1), 17-32.
- Denzin, N.K., & Lincoln Y.S (2000) *Handbook of Qualitative Research*. 2nd Edition, Thousand Oaks, CA: Sage.

Denzin, N.K., & Lincoln Y.S (Eds) (2003). *Collecting and Interpreting Qualitative Materials*. 2nd Edition, Thousand Oaks, CA: Sage.

Dundon, E. (2002). *The Seeds of Innovation: Cultivating the Synergy that Fosters New Ideas*. New York: AMACOM. American Management Association.

Edwards, G. (1995). An Introduction to X 11 User Interfaces: A Tutorial

Prepared for SciC 8011. Retrieved July 6, 2006, from

<http://www.visi.com/~grante/Xtut/>

Effective Change in Higher Education. *Approaches to Change> Ways of Doing>*

Organizational Learning and the Learning Organization. Retrieved May 2, 2005,

from http://www.effectingchange.luton.ac.uk/approaches_to_change/.

Farago, J. & Skyrme, D. (1995). The Learning Organization. *Insights No. 3*. Retrieved

June 13, 2005, from <http://www.skyrme.com/insights/31rnorg.htm>

Fatuyi, E.O.A. (1999). *Library Management Systems and dBase IV*. Academic and

Research Libraries (ARL) Training Workshop on Computer Applications to

Library and Information Services, Umudike, Abia.

Fontana, A. & Frey, J. (2003). The Interview: From structured questions to

negotiated text Chapter 2, in Denzin, N.K., & Lincoln Y.S (Eds) (2003).

Collecting and Interpreting Qualitative Materials. 2nd Edition, Thousand Oaks,

CA: Sage.

Gaines, B.R. (1998). The learning curves underlying convergence. *Technological*

Forecasting and Social Change, 57 (1), 7-34.

Gladwin, J., Dixon, R.A., & Wilson, TD (2003). Implementing a new health management

information system in Uganda. *Health Policy and Planning*, 18 (2), 214-224.

- Giesecke, J., & McNeil, B. (2004). Transitioning to the Learning Organization. *Library Trends*, 53 (1), 54-67.
- Gonzalez-Barahona, J.M., Robles, G., & Herraiz, I. (2004). Challenges in Software Evolution: The Libre Software Perspective. Retrieved May 10, 2006, from <http://libresoft.urjc.es/debian-counting/sarge>
- Granath, J., Adler, N., & Lindahl, G. (1995). *Organizational Learning Supported by Design of Space, Technical Systems and Work Organization: A case study from an electronic design department*. 5th International Conference- FAIM' Flexible Automation & Intelligent Manufacturing, June 28-30, Stuttgart, Germany.
- Grenier, L. (1998). *Working with indigenous knowledge: A Guide for Researchers*. IDRC.
- Hatch, Mary Jo (1997). *Organization theory: Modern Symbolic and Postmodern Perspectives*. New York: Oxford UP.
- Hofstede, G. (1997). *Culture's consequences: International Differences in Work-Related Values*. Berverly Hills, CA: Sage.
- Idowu, A. O. (2000). Ready-Made Software for Nigerian libraries' Automation Projects: A survey of existing facilities. *Lagos Librarian*, 21 (1 & 2), 38-45.
- Jeevan, V. K. J. (2002). Application of Leadership and Management Principles for Libraries: Some Reflections from India. *Science & Technology Libraries*; 23 (2 & 3), 43-55.
- Jeevan, V. K. J., Raja Kumar, R.V. (2002). *Design of Indigenous Library Automation Software: Experiences of the Central Library, IIT Kharagpur, Information Management in e-Libraries*. Proceedings of the National Conference on

- Information Management in e-Libraries (IMeL), New Delhi, Allied, 401-410.
- Kanter, R. M. (1989). *When Giants Learn to Dance*. New York: Simon and Shuster.
- Kline, P. & Saunders, B. (1998). *Ten Steps to a learning Organization*. 2nd Ed. Arlington, Virginia: Great Ocean Publishers.
- Katz, E., Levin, M.L., & Hamilton, H. (1963). Traditions of Research on the Diffusion of Innovations. *American Sociological Review*, 28: 237-253.
- Kshetri, N. (2005). Diffusion Pattern of Linux: An Assessment on Major Technology Dimensions. *First Monday*, 10 (8), 1-18.
- Kumar, K., Van Dissel, H. G., & Bielli, P. (1998). The Merchant of Prato- Revisited: Toward a third rationality of information systems. *MIS Quarterly*, 22 (2), 199-226.
- Kvale, S. (1996). *Interviews: An Introduction to Qualitative Research Interviewing*. Thousand Oaks, CA: Sage Publications.
- Lansing, S.J., & Kremer, J. N. (1995). A Sociological Analysis of Balinese Water Temples, (pp.258-269). In Warren, D.M.; L.J. Silkkerveer; D. Brokensha, (Eds.) *The Cultural Dimension of Development: Indigenous Knowledge Systems*. London: IT publications.
- Laskowski, M.S., Ward, D. (2001, September). Creation and Management of a Home-Grown Electronic Reserves System at an Academic Library: Results of a Pilot Project. *The Journal of Academic Librarianship*, 27 (5), 361-371.

- Lubelczyk, J. & Parra, A. (2000). Managing the Software Development Process. In *ASP Conference Series, 216*, Astronomical Data Analysis Software and Systems IX, eds. N. Manset, C. Veillet, D. Crabtree (San Francisco: ASP), 3. Retrieved July 10, 2006, from <http://www.adass.org/adass/proceedings/adass99/05-01/>.
- Lundvall, B. A. (1992). *National Systems of Innovation*. London: Pinter.
- Mahmood, K.M. (1998, January). The development of the LAMP (Library Automation and Management Program) software for use in developing countries and its marketing in developing countries and its marketing in Pakistan. *Program: Automated library and information systems*, 32 (1), p.37-48.
- McGill, M., Slocum, J., & Lei, D. (1993). Management practices in learning organizations. *Organizational Dynamics*, autumn, 5-17.
- Miles, M.B., & Huberman, A. M. (1994). *Qualitative data analysis* (2nd Edition). Thousand Oaks, CA: Sage.
- Mohammed Z. (1999). Automation and Internet ting in Nigerian libraries and Information Centres: obstacles, prospects and strategies. *Lagos Librarian*, 20 (1&2), 20-25.
- Morgan, D.L. (1997). *Focus groups as qualitative research* (2nd Edition). London: Sage.
- Morgan, E. L. (2005). Creating and Managing XML with Open Source Software. *Library Hi Tech*, 23 (4), 526-540.
- Mosenkis, S. (2002). Coping With Change in the Workplace. *Information Outlook*, 6 (10), 5-10.

- Mursu, A., Olufokunbi, K., Soriyan, H.A., & Korpela, M. (2000). *Information Systems Development in a Developing Country: Theoretical Analysis of Special Requirements in Nigeria and Africa*. Proceedings of the 33rd Hawaii International Conference on System Sciences.
- Nahar, N. (2001). *Information technology supported technology transfer process: A multi-site case study of high-tech enterprises, University of Jyväskylä, Jyväskylä Studies in Computing-9*. Jyväskylä University Printing House, Jyväskylä and ER-Paino Ky, Jyväskylä, Finland.
- National Information Technology Development Agency (NITDA) (2001). Retrieved July 25, 2005, from <http://www.nitda.gov.ng>
- Nevis, E. C, DiBella, A. J., and Gould, J. M. (1995). *Understanding Organizations as Learning Systems*. Retrieved April 14, 2005, from http://www.solonline.org/res/wp/learning_sys.html
- Nigerian Investment Promotions Commission (NIPC) (2000). Retrieved July 21, 2005, from http://www.nipc-nigeria.org/solm_pro.htm
- Nye, A. (1994). *XLIB Reference Manual R5: Definitive Guides to the X Window System*. Cambridge, MA: O'Reilly Media.
- Obajemu, A.S. & Ibegwam, A. (2006). A survey of Librarians' Attitudes to Training Programmes on ICT Application to Cataloguing and Classification Workshops in Nigeria. *African Journal of Library, Archives, and Information Science*, 16 (1), 19-27.

- Ogunrombi, S.A. & Bello, M.A. (1999). Photocopying and the Awareness of Copyright in Tertiary Institutions in Bauchi State, Nigeria. *African Journal of Library, Archives, and Information Science*, 9 (1), 49-58.
- Ogunrombi, S. A. & Olanlokun, S.O. (1991-1992). TINLIB: Application to library automation in a Nigerian university of Technology. *Nigerian libraries*, 25 & 26 (1-4), 1-7
- Oketunji, S.F. (2003). X-LIB PLUS: a Library Application Software for Libraries and Information Centres. *Library Hi Tech News*, 20 (9), 26-29
- Okojie, V.O. and Daniel, J. O. (2002). *Nigerian Library Association 40 years of Library and information service to the nation*, NLA National Conference and AGM, Topo Badagry, Lagos, Nigeria June 16-21.
- Oyegade, E. A. (2000). *An overview of information technology in Nigerian public libraries*. Papers presented at the 10th Biennial Conference of The National Association of Library and Information Science Educators (NALISE), Department of Library, Archival and information studies, University of Ibadan.
- Pedler, M., Boydell, T. & Burgoyne, J. (1989). Towards the learning company. *Management Education and Development*, 20 (1).
- Peters, T. & Waterman, R. (1982). *In Search of Excellence*. New York: Harper and Row.
- Prather, C. W. & Gundry, L. K. (1995). *Blueprints for Innovation: How Creative Processes Can Make You and Your Company More Competitive*. AMA Management Briefing, AMA Membership Publication Division, American Management Association.

- Raw Materials Research and Development Council (2004). *Annual Report*. RMRDC, Abuja, Nigeria
- Raw Materials Research and Development Council (RMRDC) (2005). Retrieved June 5, 2005, from <http://www.rmrdc.gov.ng/>
- Raw Materials Research and Development Council Servicom Charter (2006). Retrieved July 10, 2006, from (<http://www.rmrdc.gov.ng.servicomcharter.doc.>).
- Rob, P. & Coronel, C. (2000). *Database Systems: Design, Implementation, and Management*. Fourth edition, Cambridge, MA: Course Technology, a division of Thomson Learning.
- Robbins, S. & Decenzo, D. (2003). *Fundamentals of Management: Essential Concepts and Applications*. New Jersey: Pearson Prentice Hall.
- Rogers, Everett M. (1962). *Diffusion of Innovations*. New York: Macmillan
- Rogers, Everett M. (1971). *Diffusion of Innovations*. New York: Macmillan.
- Rogers, Everett M. (1983). *Diffusion of Innovations*. New York: Macmillan.
- Rogers, Everett M. (1995). *Diffusion of Innovations*. Fourth edition, New York: The Free Press.
- Rogers, Everett M. (2003). *Diffusion of Innovations*. Fifth edition, New York: The Free Press.
- Rogers, E.M., & Shoemaker, F.F. (1971). *Communication of Innovations: A cross-cultural approach*, (2nd Ed.). New York: Free Press.
- Sani, A. & Tiarniyu, M. (2005). Evaluation of Automated Services in Nigerian Universities. *The Electronic Library*, 23 (3), 274-288.

- Senge, P.M. (1990). *The Fifth Discipline. The art and practice of the learning organization*, London: Random House.
- Strang, D., & Soule, S. (1998). Diffusion in organizations and social movements: From hybrid corn to poison pills. *American Sociological Review*, 24, 265-290.
- Strauss, A. & Glaser, B. (1967). *The discovery of grounded theory: Strategies for qualitative research*. Chicago: Aldine.
- Tate, K. (2005). *Sustainable Software Development: An Agile Perspective. The Agile Software Development Series*. Addison Wesley Professional.
- Tran, L. A. (2005). Diffusion of community information networks in New Zealand public libraries: a case study. *New Library World*, 106 (5/6), 269-283.
- UNIDO (1989). *Computers for industrial management in Africa: The case of Nigeria*, prepared by Michael Nwachuku. United Nations Industrial Development Organization. V. 89-57624, PPD. 126.
- QSR NVivo (2002). *Qualitative Analysis Software*. QSR International Pty. Ltd. Doncaster Australia.
- Xinhua, Z. (2001). *Organizations in the 21st Century: knowledge and Learning-the Basis for Growth*. Nov.16-17 at the Social Science Research Center (WZB), Reichpietschufer 50, 10785 Berlin. Retrieved May 3, 2005, from <http://www.global-insight.com/WZB/Summary/Summary06.htm>
- Yin, R. (2003). *Case Study Research: Design and Methods*. Applied Social Research Methods Series. CA: Sage.

LISTS OF DOCUMENTS

A Communiqué on Partnership Agreement between RMRDC and BERAM Limited, 1993.

Minutes of the Information and Documentation Division of RMRDC meetings (Mid-1992).

NLAS: A Guide to its Use, NARICT, 1996

Response to Questions on X-LIB PLUS: A Communiqué.

RMRDC Library Newsletters

X-LIB: A Brief History by Daniel Ayo, 2002.

X-LIB: A Documentary Report by Daniel Ayo, 1997.

X-LIB+ Library Automation System. Marketed by BERAM LIMITED, Lagos

X-LIB Library Automation System National Workshop Manual, RMRDC, 2000

APPENDIX A

PROFILES OF PARTICIPANTS

Three participating officers were interviewed for general interview for this study, and two participants were interviewed as a focus group. The participants are from various disciplines: the chief developer is a chemical engineer and the other two are library staff, while the focus group participants are a chemical engineer and a computer engineer. They were all staff of RMRDC during the development process of X-LIB PLUS, except the computer engineer in the focus group.

However, there were differences in terms of their academic status: there were two PhD officers; some had different ranks in the organization; others had different administrative roles, various years of experience, higher or lower exposure to IT, assorted ages, and mixed genders. These participants' profiles are described in this section in order to provide the readers with the understanding of the circumstances surrounding the natural setting for the study.

The chief developer

The chief developer is the chief developer of X-LIB PLUS. This subject is a male of about forty-eight years old. He and his family lived in Lagos at the initial development stage of X-LIB PLUS, and they moved to Abuja to live in the organization's residential quarters. He obtained his undergraduate and PhD in chemical engineering. He is the chief developer of technology development department of the organization; he has other divisions under his department: pilot plant division, indigenous technology development division, and process equipment design and development division. The chief developer has a very busy schedule of meetings and travels as the administrative head of the

technology development department with three divisions consisting of three deputy developers, and forty-two senior staff under his administration.

He started the development process of X-LIB PLUS in order to assist him in his job, which is also to assist in meeting the mandates of RMRDC. As a chemical engineer, he had to think like a library staff, and did a lot of research to get acquainted with library terminologies and library automation modules and functions. His typical busy day starts at 8.30 am in the office going through files and writing minutes or memos on employees' file. Next, he gets briefings from his personal assistant, and gives directives to the PA on office issues. Then, he goes for any scheduled meetings at the conference room or at the general office of the chief developer. He comes back to the office for consultations with his deputy developers or other senior officials of his department on their on-going R&D projects as related to the organization's goals.

The chief developer usually leaves the office at about 5.30 pm daily with an hour's break in between, which is sometimes spent in the office while attending to visitors or files. The evenings of the chief developer and most part of his nights were said to have been spent working during the development process of X-LIB PLUS. He described his experience during the development period as follows: "...so a lot of my work was done in the night. And I had to do most of the development in the night, when I come back from office, and in the night."

Library Staff (Female)

This participant is female and is about 40 years old. She has an undergraduate degree and a master's degree in library and information science. Her area of concentration is information technology. She lived in Lagos and was the first library staff

involved in the initial development process of X-LIB PLUS. She provided required professional skills to facilitate the development of X-LIB PLUS. She later moved to Abuja where the development process of X-LIB PLUS continued and she continued to offer her advice during the testing periods of X-LIB PLUS. She later on left the RMRDC to another organization where she works in the information technology section of the institution.

Library Staff (Male)

The participant is about 45 years, and is a deputy developer in RMRDC. He was involved with the development process of X-LIB PLUS from the initial stage when the RMRDC was in Lagos. He moved to Abuja with the organization and continued to offer his professional skills to facilitate the development process of X-LIB PLUS. He participated in demonstrating the functional modules of X-LIB PLUS at conferences, while getting feedbacks from other colleagues on the performances of the software during the testing stages.

Appendix B

Interview Outline

UNSTRUCTURED / GUIDED QUESTIONS

Research question no. 1. What was the process used to develop X-LIB PLUS library automation software by the RMRDC?

Interview questions:

- a) How did the idea of designing library automation software originate in your organization?
- b) Can you describe the initial process taken by the system designer to implement the decision?
- c) Describe the activities that resulted in the development and final production of X-LIB PLUS?

Research question no. 2. What factors facilitated the development of X-LIB PLUS at the RMRDC?

Interview questions:

- a) Can you describe what circumstances led to the development process of X-LIB PLUS in RMRDC?
- b) What factors most contributed to the design process of X-LIB PLUS?
- c) Describe any incident that smoothes the progress of the development of X-LIB PLUS.

Research question no. 3. What factors challenged the development of X-LIB PLUS at RMRDC?

Interview questions:

- a) What are the challenges faced during the development process of X-LIB PLUS?
- b) Tell me a story of a frustrating experience during the development of X-LIB PLUS?
- c) What factors delayed the development process? What were the things you wish you had and you did not have?
- d) Describe the factors that impeded the development process of X-LIB PLUS.
- e) Describe unexpected events that changed or affected the flow or direction of the development process of X-LIB PLUS?

Research question no. 4. What factors account for the diffusion of X-LIB PLUS among Nigerian libraries?

Interview questions:

- a) Describe the reception of X-LIB PLUS in RMRDC, and Nigerian libraries.
- b) How will you describe the factors that account for the diffusion of X-LIB PLUS?
- c) How was the development of X-LIB PLUS different from imported LAS?
- d) Describe the motivation for the initial concept of X-LIB PLUS?
- e) Describe the organization attitude towards the development of local substitutes to imported LAS. How do you perceive the organizational culture of RMRDC?

FOCUS GROUP INTERVIEW QUESTIONS

- 1 What is the motivation behind the development of X-LIB PLUS?
 - a. What circumstances led to the development of X-LIB PLUS?
 - b. Describe the factors that challenged the developmental process of X-LIB PLUS?
- 2 What are the future prospects of X-LIB PLUS? Is there a new version of X-LIB PLUS? If yes,:
 - a. When did you perceived the need for a new version and what were the steps taken to implement it?
 - b. As a team, what were the advantages experienced in the developmental stages of X-LIB PLUS?
 - c. How are the features of the new version of X-LIB PLUS different from the old version?
- 3 What do you envisage will be the global contributions of X-LIB PLUS?
 - a. Describe the advantages that X-LIB PLUS has over the imported LAS in the Nigerian society.
 - b. How do you think X-LIB PLUS will contribute to LAS globally?
 - c. What are the socio-cultural and political influences experienced by the team in the development of X-LIB PLUS?

Appendix C

APPLICATION FOR APPROVAL TO USE HUMAN SUBJECTS**For R&G Use Only**

Date approved _____

File No. _____ Full Review _____ Expedited Review _____ Exempted Review _____

This application should be submitted, along with the Informed Consent Document and supplemental material, to the Institutional Review Board for Treatment of Human Subjects, Research and Grants Center, Plumb Hall 313F, Campus Box 4003.

1. Name of Principal Investigator(s) (Individual(s) administering the procedures):

Esther Olajope Akomolafe-Fatuyi

2. Departmental Affiliation: School of Library and Information Management

3. Person to whom notification should be sent: Esther O. Akomolafe-Fatuyi

Address: 1201 Triplett Dr. Apt. F 64, Emporia KS, 66801

Telephone: 620-342-1451

4. Title of Project:

X-LIB PLUS Library Automation Software: A Case Study of Software
Development in a Nigerian Organization

5. Funding Agency (if applicable): N/A

6. This is a dissertation * thesis _____ class project _____ other

7. Project Purpose(s):

The study described the processes involved in the development of X-LIB PLUS library automation software developed at the Raw Materials Research and Development

Council Abuja, Nigeria. Using the case study method, the study examined the circumstances that led to X-LIB PLUS development and the organizational context in which it was created. Although X-LIB PLUS was primarily developed for use at RMRDC, many Nigerian libraries eventually adopted it over other foreign and local LAS. This study sought to identify the factors, which account for the diffusion of X-LIB PLUS by Nigerian libraries.

8. Describe the proposed subjects: (*age, sex, race, or other special characteristics, such as students in a specific class, etc.*)

The subjects are between ages 35-65, they are both males and females workers at RMRDC. They are Africans and senior Nigerian federal government officials.

9. Describe how the subjects are to be selected:

The subjects are selected based on their roles in the invention process of X-LIB PLUS library automation software in RMRDC.

10. Describe the proposed procedures in the project. Any proposed experimental activities that are included in evaluation, research, development, demonstration, instruction, study, treatments, debriefing, questionnaires, and similar projects must be described here. **Copies of questionnaires, survey instruments, or tests should be attached.** (*Use additional page if necessary.*)

The study uses a qualitative research approach. The subjects will be interviewed based on unstructured interviews to elicit information on the design process of the X-LIB PLUS library automation software. Five methods of data collection will be used: interviews, focus group, observation, Document review, and participant-observation.

11. Will questionnaires, tests, or related research instruments not explained in question #10 be used?

_____ Yes * No (*If yes, attach a copy to this application.*)

12. Will electrical or mechanical devices be applied to the subjects? ___ Yes * No (*If yes, attach a detailed description of the device(s) used and precautions and safeguards that will be taken.*)

13. Do the benefits of the research outweigh the risks to human subjects? * Yes ___ No
(*If no, this information should be outlined here.*)

There is no risk involved.

14. Are there any possible emergencies, which might arise in utilization of human subjects in this project?

_____ Yes * No (*If yes, details of these emergencies should be provided here.*)

15. What provisions will you take for keeping research data private? (*Be specific.*)

Informants' recorded and interview field notes and related documents will be kept strictly confidential, and will be used only for the purpose of research study. The informants will be assigned pseudonyms for anonymity. The audiotape, notes, and any video recording and all related documents will be erased upon completion of dissertation.

16. Attach a copy of the informed consent document, as it will be used for your subjects.

See Appendix D

STATEMENT OF AGREEMENT: I have acquainted myself with the Federal Regulations and University policy regarding the use of human subjects in research and

related activities and will conduct this project in accordance with those requirements.

Any changes in procedures will be cleared through the Institutional Review Board for Treatment of Human Subjects.

Signature of Principal Investigator

Date

Faculty advisor/instructor on project (if applicable)

Date

APPENDIX D

INFORMED CONSENT AND INFORMATION SHEET

My name is Esther Olajope Akomolafe-Fatuyi. I am a PhD student of the School of Library and Information Management at Emporia State University, and undergoing a research under the supervision of Professor John Agada, on the development process of X-LIB PLUS library automation software designed by the Raw Materials Research and Development Council Abuja, Nigeria.

One of the requirements for this study is to conduct an interview with the inventors and all others that are involved in the design of X-LIB PLUS in RMRDC, and to observe the working environment to determine the culture that nurtured the invention of X-LIB PLUS, and to understand the functions of X-LIB PLUS LAS for library services in RMRDC.

I appreciate your willingness to participate in this study.

Before I start the interview and observation, I would like to reassure you that you have several very definite rights. These include the following:

Your participation in the interview for this study is entirely voluntary;

You are free to refuse to answer any question at any time;

You are free to withdraw from the interview at any time;

This interview will be kept strictly confidential and any information from it will be available only for teaching and research purposes within the context of the study identified above;

A report of this interview will be given as the findings on the study identified above.

Under no circumstances will your name or personal identifying characteristics be

included in this report; any tape recording and field notes of the interview and observation will be erased at the conclusion of the study.

Please sign this form to show that you have read and understood its contents, to indicate that you have been given sufficient opportunity to ask questions you had concerning the procedures and possible risks involved, and that you understand these risks and you assume them voluntarily. Signing this form also indicates that you have been fully advised, and in agreement with the procedures to be used in this study.

_____ (signed)

_____ (printed)

_____ (dated)

If you have any further questions, please contact Professor John Agada at 620-341-5816;
OR 1-800-552-4770.

School of Library and Information Management

Emporia State University,

1200 Commercial Street,

Emporia Kansas, 66801

APPENDIX E

Letter to RMRDC

Dear Sir/Ma,

My name is Esther Olajope Akomolafe-Fatuyi from the School of Library and Information Management of the Emporia State University. I am conducting a study to investigate the development process of X-LIB PLUS library automation software, and the environmental characteristics that nurtured the development at the Raw Materials Research and Development Council, Abuja, Nigeria. I will be interviewing all personnel involved in the development of X-LIB PLUS. The following methods will be used to collect data towards this research: interview, focus group, observations, participant observation, and Document review.

Please, assist in responding to the interview questions to facilitate the success of this study.

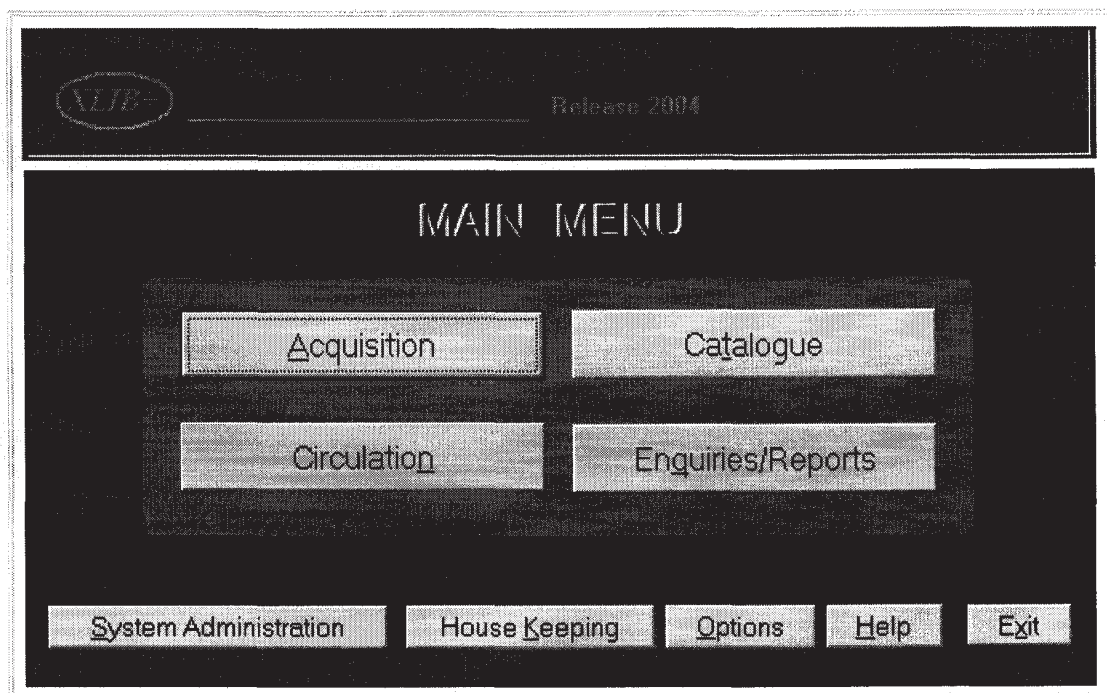
Thank you for your time.

Yours Sincerely,

E.O. Akomolafe-Fatuyi

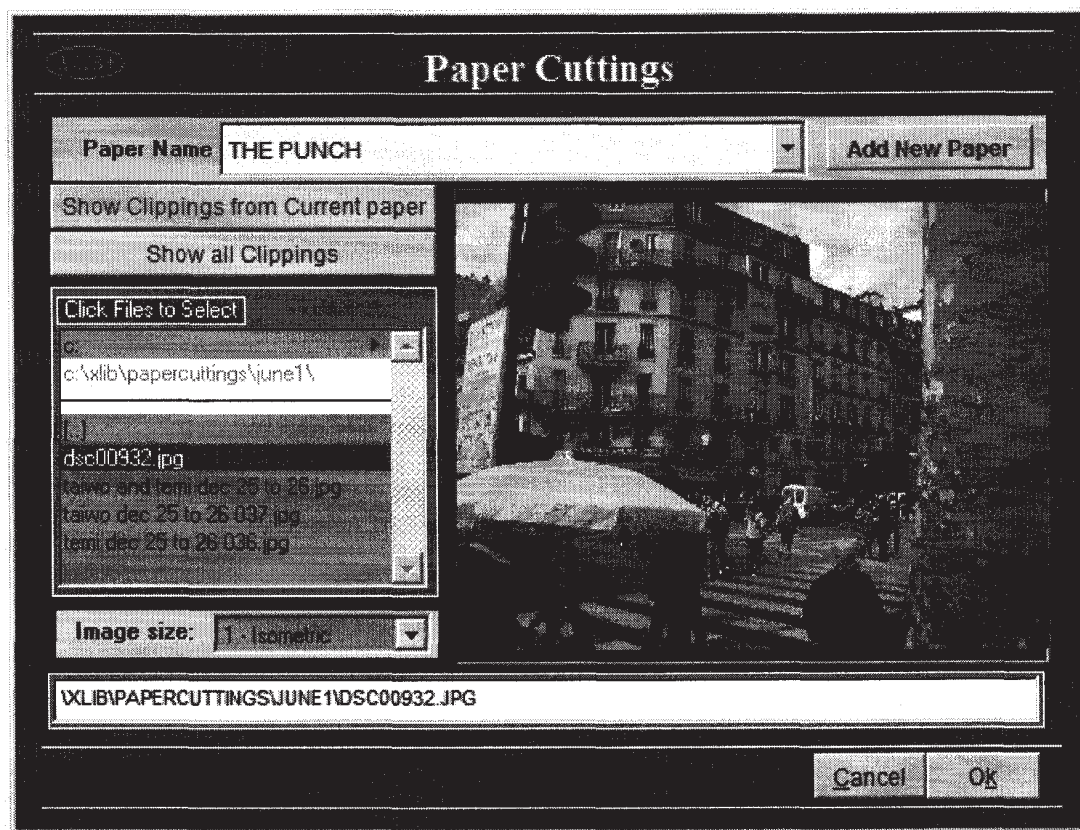
APPENDIX F

Samples of X-LIB PLUS Modules



APPENDIX G

Samples of X-LIB PLUS Modules B



APPENDIX H

Samples of X-LIB PLUS Modules C

VLIB+

Book

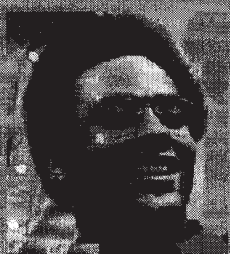
CHARGING

Accession Number

ac22

Information Highway

Borrower



Charges on Transaction:

0.00

Amount Paid:

0.00

Total Outstanding Payment:

0.00

Date Due:

21/12/2004

Mr. Lucac Adedayo

Reset


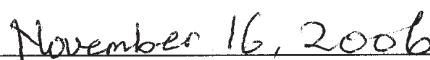
Charge

Discard

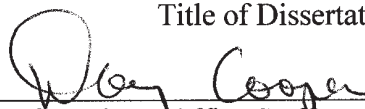
APPENDIX I

Permission to Copy Statement

I, Esther Olajope Akomolafe-Fatuyi, hereby submit this dissertation to Emporia State University as partial fulfillment of the requirements for a doctoral degree. I agree that the Library of the University may make it available for use in accordance with its regulations governing materials of this type. I further agree that quoting; photocopying, or other reproduction of this document is allowed for private study, scholarship (including teaching) and research purposes of a nonprofit nature. No copying, which involves potential financial gain, will be allowed without written permission of the author.

_____
Signature of Author_____
Date

X-LIB PLUS Library Automation Software: A Case Study of
Software Development in a Nigerian Organization

Title of Dissertation_____
Signature of Graduate Office Staff member_____
Date Received