RESEARCH DATA MANAGEMENT AND INFORMATION SECURITY: ROLE OF LIBRARY AND INFORMATION TECHNOLOGY SERVICE (ITS) UNITS IN FEDERAL UNIVERSITIES OF TECHNOLOGY IN NIGERIA

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ABSTRACT

This exploratory study presents how information security affects research data management in all the Federal Universities of Technology (FUTs) in Nigeria. These FUTs in Nigeria are: The Federal University of Technology, Minna; Federal University of Technology, Akure; Federal University of Technology, Owerri; Modibbo Adama University of Technology, Yola; and Abubakar Tafawa Balewa University, Bauchi. Lack of trust in the available security systems and safety procedures guiding the Institutional Repositories (IR) have been identified as perceived impediment to depositing intellectual outputs and the underlying research data by researchers. The consequence of this is poor patronage of the IR and low content of repositories of FUTs in Nigeria. The objective of this study was therefore to identify the available support systems in the Libraries and Information Technology Service (ITS) Units of FUTs in Nigeria. The study used oral face-to-face semi-structured interview method conducted on five university librarians and five heads of ITS Units of FUTs in Nigeria, who are responsible for the development and management of institutional repositories and are also stakeholders in effective research data management. For the data transcription and analysis, this study adopted the Braun and Clarke (2006) thematic analysis approach, which involve a six-phase of qualitative data analysis. Findings of the study confirmed that hacking, as a cyber threat, still pose a great threat to intellectual output and research data deposited in the IR of FUTs in Nigeria. The study recommended the need for continued capacity building to improve the cyber security skills and data management skills of ITS staff and librarians, respectively.

Keywords: Research Data, Research Data Management, Federal Universities of Technology, Information Technology Service, Library, Information Security, Cyber Security, Hacking, Nigeria.

INTRODUCTION

Research is a systematic enquiry towards answering a question or unravelling mysteries around a particular phenomenon. Research outputs are results of such enquiries accepted within a scientific community to be able to better human life and the society. Research, as further seen by (Madu & Dike, 2012), forms the basis for academic productivity, which is seen as the measure of the required output expected of an academic staff. A well conducted research will project not only the image of the researcher, but also of the institution the researcher is affiliated to. Furthermore, academic research is considered to be efficient and socially valuable if it offers solution to real problems that companies and/or individuals confront (Milena, Dainora, & Alin, 2008). Most researches are achieved through collating and analysing of recorded data over a period of time.

Data are collection of facts, concepts, numbers, words, measurements, observations, or instructions in a formalised manner, which should be suitable for

communication, interpretation, or processing by human or electronic machine. Data that are collected and presented in a form that the computer system can understand are referred to as digital data. Data vary across disciplines; they can be numeric, textual, audio, video, and graphic. They can also be samples (such as Deoxyribonucleic Acid (DNA), blood), physical collections (plant specimens, animal samples), software codes, and programmes, algorithms, geospatial data, databases, modules, reports, experimental observations, survey results and interview transcripts, instrument measurements, laboratory notebooks, to mention but a few. Hence, data generated during the conduct of any research for the purpose of sharing and reuse is known as research data.

Research data covers a broad range of types of information and digital data can be structured and stored in a variety of file formats. Deventer and Pienaar (2015) defined research data as the recorded factual material commonly accepted in the scientific community as necessary to validate research findings. They are data collected, observed, or created for the purposes of analysis to produce and validate original research results. Research data can be in the form of facts, observations, images, computer program results, recordings, measurements, or experiences on which an argument, theory, test or hypothesis, or another research output is based (Deventer & Pienaar, 2015). Research data are valuable products of the scientific enterprise that historically have not been well preserved or archived. International sponsors and scientific journals are now encouraging or requiring sound data management and data sharing before granting fund or accepting article for publication indicating how critical effective data management practices are to the scientific research processes (Holdren, 2013; Schubert, Shorish, Frankel, & Giles, 2013; Thoegersen, 2015).

Research Data Management is a standard part of good research practice, offering a lot of benefits to the society, research funders, and the research community. Jones, Guy, and Pickton (2013) gave the Digital Curation Centre (DCC) definition of Research Data Management (RDM) as "the active management and appraisal of data over the lifecycle of scholarly and scientific interest". It can help researchers by potentially increasing efficiency, saving time and resources and boosting the impact and visibility of their work through openness and transparency. Research data management refers to activities and practices, such as planning of data, documenting, formatting, storing, anonymising, and controlling access that support long-term preservation and use of data.

A study by Smith (2014) observed that the challenge of how to effectively manage research data affects all scientists and researchers within and across multiple domains. The study observed further that most researchers struggle unsuccessfully with storage and management of their burgeoning volume of documents and datasets that they need and the result from their work. The consequent of this is that rising accumulation of useful findings may be lost or unavailable when conducting future research. There is therefore the need to incorporate a good data management practice throughout the research workflow. However, for effective RDM, there are stakeholders that should work together to make it a success. These stakeholders are the researcher, library, Information Technology Service, and research and development Units.

Universities, research institutes, and related academic institutions are charged with the responsibility of conducting problem-targeted researches aimed at improving human lives and the society. According to Oyedum, Abduldayan, and Chuks-Ibe (2014), universities are established for the reading, learning, research, and community development. They are regarded as institutions where knowledge is transferred from one individual to another for the sole aim of manpower development in the nation. This is achieved by encouraging research activities and dissemination of research findings through publications, and establishing libraries to serve as a store house of knowledge where various information (and data) is stored for preservation, access, and use. There are various units established within the university and charged with various mandates, vision and mission towards achieving the general objectives of the parent institution. Some of these Units are Library and the Information Technology Service (ITS) Unit; also known

as Information and Communication Technology (ICT) Unit.

Library is a system comprising a collection of recorded knowledge, retrieval devices, users and library personnel; all associated in such a way as to maximise the knowledge transfer process (Oyedum, 2006). There are different types of libraries established to provide services to a defined user community. There are public, academic, special, private, and national libraries. Academic libraries are libraries found in institutions of higher learning. Collections in academic libraries are available in both print and non-print formats covering different areas of human knowledge. Part of the objectives of an academic library is to make relevant, detailed, and current information available whenever it is requested for by users. Another objective of the academic library is to support research and preserve and make available intellectual contents emanating from the institution it is serving. Traditionally, recorded knowledge in the form of print and non-print materials are required to be deposited in the library for long-term preservation and access. Due to the emergence of information and communication technology, intellectual contents are now presented in digital formats, which are also expected to be kept and preserved for long term in the library via a digital institutional repository.

The ITS Unit is a service-oriented unit that has a generic function of providing Internet services, provision of wired and wireless network solutions, repair and maintenance of computer facilities, train staff and students on use of computer and associated technologies, and supporting computer-based examinations and tests. They are also in charge of the universities' Management Information System (MIS), which encompasses students' online registration, course registration, allocation of students hostels, checking of results, uploading staff profile, and a host of other services as directed by the university management. ITS Units also offer support to researchers through sensitization on available open source materials, electronic resources, local digital contents emanating from the university, library databases, computers, and software for research purposes, free internet access, development of researchers' ICT skills, provision of bandwidth for data-driven researches, provision of software defined networking e.g., classroom simulations, open source journal development, assist in setting up electronic library, and ensures there is Internet access in every faculty/school and department. Also, the ITS Unit supports and collaborates with the university library in installation, configuration, and management of the Institutional Repository (IR).

A repository is a 'container', where things are permanently kept. According to Rouse (2018), a repository in information technology is a central place in which an aggregation of data is kept and maintained in an organized way usually in computer storage, to ensure that access and retrieval is achieved with minimal efforts. Repository found in institution of higher learning are referred to as Institutional Repository (IR). Digital contents are stored in institutional repository, example of which include students projects, theses and dissertations, staff's publications and articles of various kinds, inaugural lectures, public lectures, and most recently research data or datasets. IR ensures that digital contents emanating from the host institutions are preserved for long-term and secured from unauthorised access. The library and ITS Units must work together to ensure the safety, security and continued preservation of research data and its management for long term.

Information security is seen as any measure taken to protect stored digital data in an institutional repository from unauthorised access and use. Research data is generated throughout a particular research cycle, which usually takes a lot of time, efforts, and money. Depositing in an IR requires that the repository must be properly secured and can ensure data safety for as long as the data owner or the institution wants it. Information security is of utmost importance to researchers in FUTs in Nigeria, especially as it affects research data and other intellectual outputs. There is therefore the need to ensure the confidentiality, integrity, and availability of stored data in a computer system (Techopedia, 2018).

FUTs were established with the core mandate of ensuring sustainable development of science and technology in Nigeria. NUC (2016) gave the following as the registered FUTs in Nigeria across four, out of the six, geopolitical zones in

Nigeria Federal University of Technology, Minna, Niger State (North Central); Federal University of Technology Akure, Ondo State (South West); Federal University of Technology, Owerri, Imo State (South East); Modibbo Adama University of Technology, Yola (North East) formerly Federal University of Technology, Yola; and Abubakar Tafawa Balewa University, Bauchi (North East). The remaining two geopolitical zones which are South South and North West are yet to have a Federal University of Technology (NUC, 2016). Each of the listed universities has a library and an ITS Unit offering similar services and support to the universities.

1. Statement of Problem

Researchers are expected to provide contents for safe keep and long term preservation in their universities' institutional repositories. Libraries and Information Technology Service Units work together in ensuring the development, management, safety, and security of intellectual contents submitted to the institutional repositories. Preliminary investigations conducted by the authors through visiting FUTs in Nigeria and accessing the level of patronage of the IR and available content, have shown the low patronage and hence low contents of IR as a result of non-submission of articles and underlying research data. What is obtainable in large quantities is usually students' projects, theses and dissertations, public lectures, and inaugural lectures. Further investigation revealed that the non-submission, as revealed by the researchers, is because of perceived lack of security of contents in the institutional repository.

2. Objective of the Study

The aim of this study is to identify the role of libraries and information technology service units in FUTs in Nigeria towards a successful research data management. To achieve this aim, the following objective was set to:

- Determine the available support systems for research data management by the libraries and ITS Units of FUTs in Nigeria.

3. Research Question

The study answered the following research question:

- What are the available support systems for research data management by the library and ITS Units of FUTs in Nigeria?

4. Methodology

This is a qualitative study that used semi-structured interview method to interact and gather data from University Librarians and Heads of ITS Units in Abubakar Tafawa Balewa University, Bauchi (ATBU); Federal University of Technology, Akure (FUTA); Federal University of Technology, Minna (FUTMIN); Federal University of Technology, Owerri (FUTO); and Modibbo Adama University of Technology, Yola (MAUTECH). This answered the research question that guided the study. Five university librarians and five heads of Information Technology Service Units, or their representatives, were interviewed orally and face-to-face in their respective offices. It took approximately three months from August to October, 2017, to travel across the four geopolitical zones that have a Federal University of Technology in Nigeria. Interview sessions took about fifteen to forty minutes in respondents' workplaces and responses were recorded using a phone recorder after an informed consent form has been duly filled by respondents. Notes were also taken where necessary.

For the data transcription and analysis, this study adopted Braun and Clarke (2006) thematic analysis approach, which involves a six-phase qualitative data analysis. These phases are: transcribing data, generate initial code, search for themes, review themes, define, and name themes, and finally present the final report of the analysis. Furthermore, the Provalis Qualitative Data Analysis (QDA) Miner (Version 5) software (Provalis Research, 2018) was used for generating themes and subthemes from the coding framework and the final report is presented in Section 5.

5. Data Presentation and Discussion of Findings

5.1 University Libraries in FUTs in Nigeria

FUTMIN, ATBU, FUTA, and FUTO all have an institutional repository except MAUTECH that are really working to deploy theirs soon (Figure 1).

FUTA have a dedicated digital repository, where research data are kept while ATBU is still working on creating a database for research data. Other university libraries are yet to record any research data submission. This is shown in Figure 2.

ATBU, FUTA, and FUTO librarians are aware of research data management. The awareness was either through an International Conference they attended or read through Journal Articles. Libraries that already have repositories have better support systems available for a successful research data services; availability of an IR is an indicator that shows that the skill sets, longevity, and most of the infrastructure needed to accomplish RDM task are available (Heidorn, 2011).

Research Data Management (RDM) services are implemented by academic and research libraries globally in support of university research activities. According to Chiware and Mathe (2015):

"In South Africa, some libraries are beginning to provide frameworks for these services with some degree of success as policies are formulated, infrastructure set up, library staff trained, and awareness and advocacy campaigns held with academic staff and researchers".

Furthermore, Chiware and Mathe (2015) presented the research data management initiatives at the University of Edinburgh, UK, to include adoption of university policy that sets out rules for the retention of and access to data related to research publications, as well as the obligations of institutions to provide support for doing so. Heads of Libraries that are aware of RDM are shown in Figure 3:

Only FUTA and MAUTECH have research data submitted to the library or on the IR (Figure 4).

On the issue of access to continuous professional development of librarians' skills to cope with emerging trends in research data management and sharing, most university libraries specifically ATBU, FUTA, FUTO, and FUTMIN encourage this and such developmental programmes were organised both internally and externally and funded either by Tertiary Education Fund (TETFund) or through international funding agencies that support Continuous Professional Development (CPD) programmes. Although such training programmes may not specifically be on research data management.

On librarians' ability to provide access to research data by means of standard metadata generation, librarians in FUTMIN, FUTA, and FUTO have the required skills, while none in ATBU and MAUTECH. It was further noted in ATBU that:

"Presently, we do not have that skill, but we can provide access to all the resources on our database currently, but

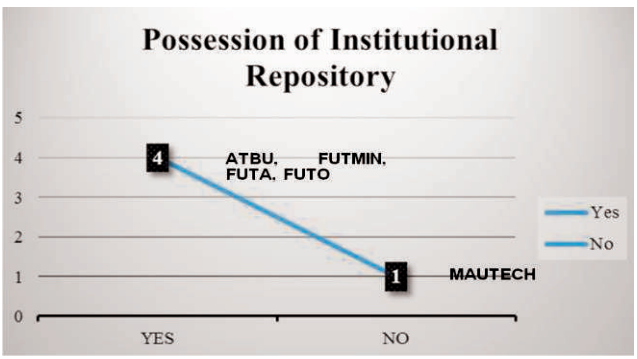

Figure 1. Possession of IR in Libraries of FUTs in Nigeria

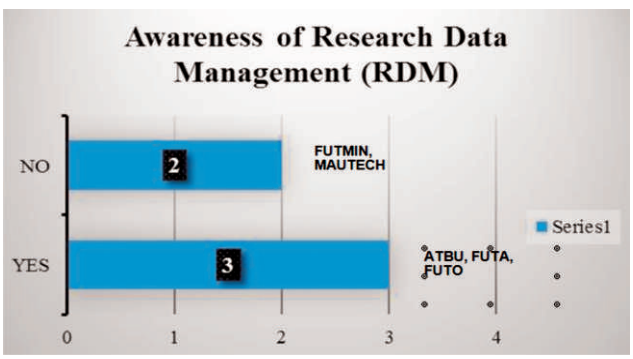

Figure 3. Awareness of RDM

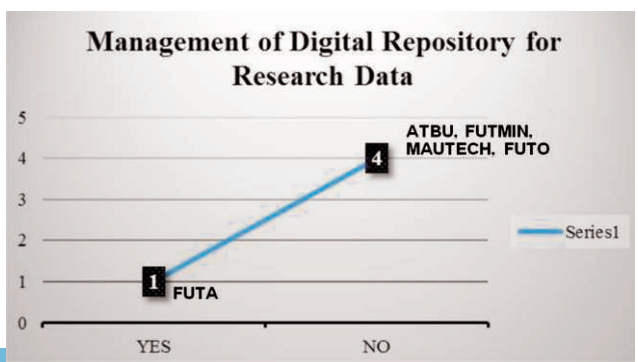

Figure 2. Management of Digital Repositories for Research Data

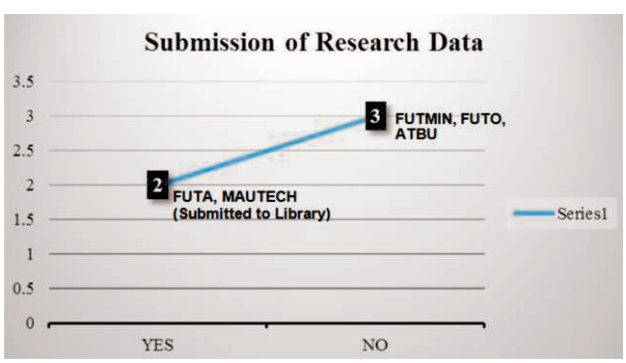

Figure 4. Submission of Research Data to Library or IR

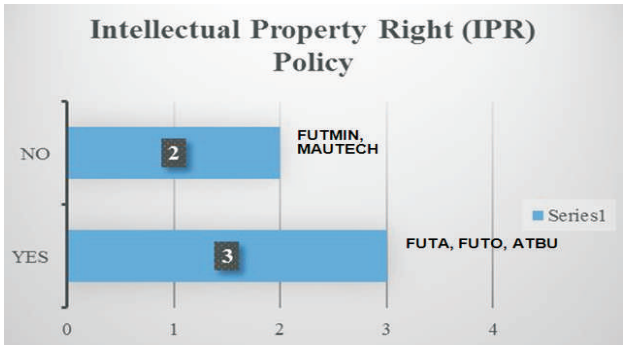

Figure 5. Libraries having IPR Policy

in terms of metadata data management, No! Librarians do not have enough skill in that area."

Chiware and Mathe (2015) also suggested the need for further skills development for librarians as they strive to support research data services, and awareness and advocacy campaigns to be held with academic staff and researchers.

All university librarians are familiar with open access, while some are familiar with open data. None of the libraries is aware of open science. All the libraries have access to several open access repositories, which cuts across all disciplines but none for open data repositories.

MAUTECH and FUTMIN are yet to have an Intellectual Property Rights (IPR) policy guiding the use of their institutional repository while FUTA, FUTO and ATBU have one guiding the IR. IPR policy ensures that the rights guiding researchers' intellectual output, including research data, is protected against unauthorized use and reuse (Figure 5).

5.2 ITS Units in FUTs in Nigeria

The relationship between the ITS Unit and library is said to be cordial and smooth in the FUTs in Nigeria. The ITS Units collaborate with the libraries in the areas of Internet connectivity, installation, and software configurations, computer maintenance and management, ensuring secured accessibility to institutional repository through wired or wireless access, facilitate collaboration with international electronic databases, e.g., EBSCOHost, and the hosting and management of library management systems, e.g. KOHA as well as repository managers, such as DSpace, E-Prints, and departmental e-libraries. This relationship has a positive effect on effective research data management in the university.

In FUTO, there is a dedicated ITS Unit within the library building specifically meant for deploying library services like the open educational resources and open access to repository contents. In ATBU, ITS Unit is helping the library in setting up a data centre with complete Internet protocol IP address so they can host and manage their electronic resources and repository locally. This is to ensure that the university has, to a large extent, total control of the institutional repository and its contents.

The institutional repository of FUTO is managed by the library; MAUTECH's repository is managed by ITS Unit and the library; FUTA's repository is managed by the ITS Unit and hosted on the university's website; FUTMIN repository is managed by the ITS Unit although it is currently expired; ATBU repository is on-going and almost completed.

When asked if the ITS Unit has adequate storage space for research data, all ITS Units of FUTs in Nigeria said they have enough storage space for research data. However, FUTA ITS Unit had an unfortunate fire incidence, but plans are already on the way to develop a data centre offshore. FUTMIN also noted that storage space is relative as there is enough space for now, but in the long term, there would be need for upgrade to accommodate the growing intellectual output emanating from the university. This opinion is also noted by the ITS Unit of ATBU.

The safety and security of research data stored on the repository is of utmost concern to all researchers. ITS Units noted that they will ensure this by deploying adequate physical security measures, use of firewalls and anti-virus, encouraging sharing of data among researchers as a way of backing up their research data, and regular update of software and programmes used on the institutional repository. The ITS Units also noted that repository manager like DSpace comes with a lot of security features and patches that make it less vulnerable to security threats. However, hacking of servers and programs still pose a great threat to most of the ITS Units in FUTs in Nigeria.

5.3 Challenges to Effective Research Data Management in FUTs in Nigeria

The following are challenges to effective research data

management as stated by ITS Units in FUTs in Nigeria:

- Lack of continuous upgrade of software and programs which are usually capital intensive;
- Trust issues on the part of some researchers to come forth with their research data and other intellectual output;
- Poor turnout at workshops and trainings on use of the repository;
- Inadequate human resources on various critical areas of ICT;
- Corrupt data submitted by researchers or uploaded on the repository;
- Lack of power backup and erratic power supply;
- Poor or outdated infrastructure and inadequate storage space;
- Poor data management skills.

The ITS Units however noted that for a successful implementation of research data management in the university, the following should be considered:

- Special provisions for equipment procurement by university management;
- Establishment of a standard data centre for RDM with full power backup and up-to-date software and programs;
- Capacity building for ICT staff;
- User education to build researcher's trust in the system;
- More funding and commitment from the university management.

Conclusion

This paper concludes that FUTs in Nigeria have the basic infrastructure necessary for research data management services. However, security of institutional repositories should be improved upon through appropriate information security systems; this will perhaps, improve researchers' confidence and trust in depositing their research data and related publications in the IR. Furthermore, libraries should keep providing support and advocacy on the benefits of submitting research data to the library and uploading same on the IR to ensure visibility of the research, data, and institution of affiliation.

Recommendations

The university management of FUTs in Nigeria should provide funding and support for:

- Capacity building programmes for ITS staff on latest cyber threats such as hacking, and its related solutions;
- Enhanced data management skills of librarians through training and workshops for effective provision of research data services;
- Continued advocacy, workshops, and seminars on research data management for the entire university community.

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