AOSIS

Digital preservation practices in academic libraries in South Africa in the wake of the digital revolution

CrossMark
click for updates

Authors:
Tlou M. Masenya[1]
Patrick Ngulube[2]

Affiliations:
[1]Department of Information Studies, University of Zululand, KwaDlangezwa, South Africa

[2]Department of Interdisciplinary Research and Postgraduate Studies, University of South Africa, Pretoria, South Africa

Corresponding author:
Patrick Ngulube, ngulup@unisa.ac.za

Background: The preservation of digital resources in academic institutions in South Africa is an imperative because of the proliferation of digital resources and the realities of the digital revolution. The study focused on digital preservation practices within academic libraries in South Africa. A number of studies were undertaken in the field of preservation in South Africa and they focused on the preservation of cultural heritage, preservation of electronic government and preservation of public digital information. The major gap in the literature reinforces the need to closely examine digital preservation practices in academic libraries in South Africa. There is a need to understand the extent of preservation of digital resources in various contexts in order to guarantee access to them for future generations. This will improve our understanding of the preservation of digital resources in academic libraries in the wake of the digital revolution.

Objectives: The purpose of this study was to investigate digital preservation practices in academic libraries in South Africa in order to suggest solutions for effective digital preservation.

Method: The survey research method was used for data collection. Twenty-seven academic institutions in South Africa were surveyed. Data were analysed through the Statistical Package for the Social Sciences.

Results: The findings revealed that academic libraries experienced difficulties in preserving and sustaining their digital resources because of the absence of established standards, policies and procedures, inadequate resources, as well as a lack of skills and training. They also had difficulties with limited funding and collaboration efforts, and the threat of technological obsolescence because of the constantly changing software and hardware, poor technology infrastructure and legal issues.

Conclusion: All these challenges have created the need for best practices and solutions to facilitate the long-term preservation of digital resources in the academic libraries. Recommendations were made on the basis of the results.

Introduction

With the advent of digital technologies, digital preservation is becoming a necessity for academic institutions. However, as digital technologies become more sophisticated, it is likely that they are going to trigger more changes in the way academic institutions practise and deliver on their mandate. These changes provide compelling reasons for academic libraries to rethink their structures, operations and services to remain relevant in this digital era. Wawrzaszek and Wedaman (2008) emphasised that the libraries must actively embrace the changes in the information environment in order to fulfil its traditional mission and to stay relevant in the digital world. Academic libraries have now expanded their scope to include generating, collecting, organising, capturing and preserving digital materials. However, digital preservation has become a significant problem facing academic libraries today and it poses immense challenges for libraries attempting to preserve their digital materials and data repositories.

The challenges of long-term preservation of digital information have also been recognised by archival and academic institutions around the world. In 1996, the Task Force on Archiving of Digital Information (TFADI) identified a need for trusted organisations capable of providing long-term digital preservation (Waters & Garret 1996). The TFADI developed the Trustworthy Repositories Audit and Certification (TRAC) checklist for 90 organisational, technological and digital object management criteria for digital repositories (RLG/NARA 2007). The University of Manchester (UML) in UK has also been in the forefront in developing a digital preservation strategy for facilitating perpetual access to its digital materials (UML 2014).

The National Digital Information Infrastructure and Preservation Program (NDIIPP) (Library of Congress 2018; NDIIPP 2005), University of British Columbia's (UBC) School of Library, Archival and Information Studies and the International Research on Permanent Authentic Records in Electronic Systems (InterPARES) projects also provide useful insights into the preservation of digital resources (Duranti & Preston 2008). The Scalable Preservation Environments (SCAPE) also developed a framework for automated, quality-assured preservation workflows and integrated these components into a policy-based preservation planning and watch system (Palmer 2014). All these initiatives are aimed at addressing the challenges posed by digital information.

The Council of Canadian Academies (2015) also observed that libraries, archives and museums are facing numerous challenges as they attempt to adapt the digital age. This included dealing with rapid obsolescence of the technology used, making accessible mass quantities of digital data and remaining trusted as repositories that hold documentary evidence of scholars and citizens. The phenomenal growth of digital content has therefore posed a number of challenges for preserving digital resources in academic libraries. Furthermore, studies undertaken by Ngulube (2012), Sigauke and Nengomasha (2011) and Kanyengo (2006) underscore the enormous challenges the institutions in Africa face when it comes to preserving digital resources, despite placing the efforts to promote digital preservation. Among others, the problems include:

- lack of trained staff or experienced library and information science (LIS) professionals in management and preservation of digital resources in the academic libraries;
- poor technological infrastructure and adequate resources to enable preservation practices;
- lack of policies, standards and procedures to regulate the creation, storage, retrieval and preservation of digital information resources;
- poor collaboration efforts and partnerships.

Raju (2014) noted that the digital revolution has also impacted significantly the knowledge and skills requirements for LIS professionals practising in this environment as they need to be relevant to the electronic setting created by technological changes. According to Halder (2009), LIS professionals are stressed because they lack information, clarity and knowledge about handling the acquisition of electronic or digitised resources, data entry, data coordination and administrative requirements, specialised skills, experience, attitude, training and maximum attention. The question is how do the traditional library mission, structure, processes and staffing get transferred to this new environment and remain relevant in the digital era? This dramatic change to the digital era and associated challenges of preserving digital assets have therefore entrenched the dire need for best practices and strategies in ensuring long-term preservation of digital resources in academic libraries.

Against this background, academic libraries in South Africa were investigated in order to establish if they were also experiencing similar changes that are compelling academic institutions around the world to adopt digital preservation, and the challenges hindering the effective preservation of their digital resources.

Problem statement

The increasing application of digital technologies in the world has undoubtedly raised various opportunities and challenges in the practice of librarianship. According to Maxwell (2006), one instance of the library's sacred role is to provide a sense of immortality and that the library will remain stable and dependable even in an ever-changing external environment. The change to a digital world has raised serious and pressing issues on how to organise, access and preserve digital resources, created by academic institutions, into perpetuity. The major challenge faced by academic institutions is to ensure that users can access their digital content that has been ingested in their institutional repositories (IRs) and other institutional archives over a long period of time through digital preservation. Digital preservation aims at ensuring that digital content remains accessible to user communities for a long period of time and for future generations. The long-term access to digital materials is questioned and this uncertainty is a major hurdle that prevents libraries from moving fully from an analogue to a digital environment. Digital preservation has, however, become a significant problem facing academic libraries today and it posed immense challenges for libraries and archives attempting to preserve their digital materials and data repositories. Studies undertaken by Ngulube (2012), Sigauke and Nengomasha (2011) and Kanyengo (2006) underscore the enormous challenges that most organisations in African countries are confronted with when it comes to the preservation of digital resources, despite the efforts that have been made to promote digital preservation. Academic institutions risk losing vital digital information if all these challenges are not addressed or if urgent measures are not taken to rescue deteriorating conditions. Little is known about how academic libraries in South Africa are dealing with the difficulty of ensuring that their electronic resources remain accessible for the current and future generations. The main question is as follows: what are academic institutions in South Africa doing to ensure long-term access to their electronic resources? The following objectives were formulated to address this research problem:

- to establish the extent to which digital preservation programmes are implemented in academic libraries;
- to determine the challenges hindering the effective preservation of digital materials in academic libraries;
- to assess whether management in academic libraries supports digital preservation practices.

Literature review

This section presents the changing library environment and an overview of digital preservation.

The changing library environment

For many years, researchers had to physically walk into the libraries to access services. However, this is changing as many libraries are now accessible online. Academic libraries are changing dramatically by adopting new means of technology in all activities and have so far evolved from focusing on managing physical resources and related services to transforming resources and services into digital formats (Choi & Rasmussen 2009:457). These institutions are presently faced with not only the decision on what books and journals to acquire to satisfy faculty and students but also on how to remain relevant in the digital era (Anunobi & Okoye 2008). As also observed by Campbell (2006), numerous creative and useful services have evolved within academic libraries in the digital age, including providing quality learning spaces, creating metadata, offering virtual reference services, managing resource licenses, collecting and digitising archival materials, as well as developing and maintaining digital repositories. According to Wawrzaszek and Wedaman (2008), the success of the academic library in the digital world will, to a large extent, depend on higher education's response to this changing environment.

This change to modern digital information environment has prompted several projects and initiatives such as IRs and digital libraries. Guenther (2000) also observed that the demands of users for access to information have forced libraries to increasingly adopt a 24-h facility for core services and to offer these through what is often called the digital libraries. This shift from print to digital collections has therefore resulted in more innovations such as digital libraries. A digital library has been described as an environment that brings together collections, services and people in support of the full life cycle of creation, dissemination, use and preservation of data, information and knowledge, which form an integral part of the services of a library, and applies new technology to provide access to digital collections (IFLA/UNESCO 2010). Digital preservation action must be at the heart of any future digital library research agenda, given the core dependency of digital libraries on guaranteeing the authenticity, integrity, interpretability and context of the digital material across systems, time and context (Ross 2012). The digital library research agenda should consider the strategies that have been formulated for the long-term access to holdings, especially in Africa where digital preservation projects are conspicuous by their absence.

In practice, the majority of African libraries, particularly in South Africa, have already digitised their scholarly output and established IRs and digital libraries, and few are at some intermediate stage. The Association of African Universities (AAU), the Rhodes University in South Africa, the University of Nigeria and the African Digital Library (ADL) are some of the institutions implementing digital library projects in Africa. The projects ensure that university communities are able to access the growing quantities of digital resources. In 2005, the United Nations Educational, Scientific and Cultural Organization (UNESCO) and the Coalition of South African Consortia (COSALC) held a workshop for building digital library collections, using the Greenstone digital software at the University of Cape Town. The workshop was attended by delegates from Ethiopia, Lesotho, Namibia, New Zealand, Swaziland, Sudan and the host country, South Africa (UNESCO 2005). The workshop aimed at:

- raising awareness on open access models for information exchange;
- building capacity of information and communication technologies (ICTs) professionals in African institutions;
- supporting the creation of digital libraries and providing archivists and librarians in Africa with the skills to utilise electronic information tools and resources in their work, as well as to enhance access to online resources (UNESCO 2005).

The changing information environment that is characterised by the digital revolution has also changed the role of information professionals in academic libraries, and they have the fundamental role in managing and preserving digital resources. They should be able to communicate the requirements related to digital libraries, formulate strategies for organising and preserving digital resources, integrate technologies, tools, software and media within existing functions of collection management and provide access to digital resources.

The concept of digital preservation

For decades, libraries have managed their information in various analogue formats (hard copy) including parchment, paper, videotape and photographic film, and they now need to preserve their digital resources for as long as they are needed. It is therefore important to understand what digital preservation is and how it can be used effectively to preserve collective knowledge for future generations (Perry 2014). The concept of digital preservation was originally developed in libraries as an aid to ongoing library analogue preservation efforts and it is a relatively new one that has developed side by side with concepts such as digital libraries (Chowdhury 2010:209) and digital curation (Beagrie 2006:4). Digital preservation interests different organisations and has been defined in various ways by various authors. Beagrie and Jones (2008) describe digital preservation as a series of managed activities necessary to ensure continued access to digital materials for as long as they are necessary. Das, Sharma and Gurey (2009) define digital preservation as aiming to ensure protection of information of enduring value for access by present and future generations, and hence it consists of planning, resource allocation and application of preservation methods and technologies necessary to ensure that digital information of continuing value remains accessible and usable. Digital preservation is also explained as a combination of policies, strategies and actions to ensure that digital objects remain authentic and accessible to users and systems over a long period of time, regardless of the challenges of component and management failures (American Library Association [ALA] 2018).

Ruusalepp and Dobreva (2013) describe preservation as a complex activity not only because of the increasing complexity of digital objects, but also because the context of use needs to be recreated. This means sustaining not only the data, but also any specific software that was used to work with the data and the technological infrastructure. It is therefore important not only to preserve the record itself, but also the hardware and software it was created on and designed to be used with. The selected preservation methodology must therefore allow the preserved entities to continue to be readable and usable, regardless of any technological changes to the underlying hardware or software environments (Ruusalepp and Dobreva 2013). The preserving organisation should account for these technological changes so that the entities may continue to be migrated to newer platforms as needed to avoid technological obsolescence. This means that institutions must create mechanisms that allow for the determination of authenticity, based on the trustworthiness of the source of the digital entities and the chosen method of their transmission through time, and then adopt the necessary methods and strategies to preserve them in a sustainable way. Digital curation is one of such attractive strategies. In this study, digital preservation is therefore perceived as a combination of plans, strategies, actions, policies, procedures, resource allocation, preservation methods and technologies (ALA 2018; Beagrie & Jones 2008; Das et al. 2009).

Digital preservation can be divided into the following levels of access (Ruusalepp & Dobreva 2013):

- long-term preservation – continued access to digital materials or at least to the information contained in them indefinitely;
- medium-term preservation – continued access to digital materials beyond changes in technology for a defined period of time but not indefinitely;
- short-term preservation – access to digital materials either for a defined period of time while use is predicted but which does not extend beyond the foreseeable future or until it becomes inaccessible because of changes in technology.

This article focuses on the long-term preservation of digital resources in South African academic libraries.

Methodology

A quantitative research methodology and survey research design was adopted. The conceptual framework was also adopted in this study in line with the positivist research paradigm; however, the research started with theory because it was a quantitative study. As pointed out by Ngulube (2018) and Ngulube, Mathipa and Gumbo (2015), social science researchers start out with models and then progress to concepts that represent an identified research problem within a subject matter and collect data to understand and establish linkages between concepts. This study thus followed the same pattern by reviewing theoretical models, collecting data and establishing linkages between concepts through interpretation and discussion of findings. A survey questionnaire was used as a data collection instrument. The questionnaire was pretested to get opinions of three experts on digital preservation from the Council for Scientific and Industrial Relations (CSIR) and University of Pretoria, and modified based on expert's comments and suggestions. Following this, the survey questionnaire was distributed to all 27 academic institutions in South Africa, so all these institutions constituted the target population and no sampling was carried out. One questionnaire was sent to the head or director in each academic library in South Africa. In other words, the complete collection ensured that all 27 academic libraries were covered in the study, of which only 22 completed questionnaires were returned, giving a response rate of 81.5%. The Statistical Package for the Social Sciences was used for data analysis. This software package was chosen because it offers the most comprehensive solution for reporting, modelling and analysing data (Powell & Connaway 2004). For that reason, the study used descriptive statistics such as frequencies, percentages, cross-tabulation, pie charts and bar graph to assess digital preservation practices in academic libraries in South Africa. The study focused on digital preservation practices in academic libraries, not public libraries or school libraries, and the results of the study are thus limited to academic libraries in South Africa and cannot be generally applied to other libraries.

Findings and discussion

This section provides the findings on the extent to which digital preservation practices were implemented in academic libraries before presenting the findings on the other objectives.

Extent to which digital preservation programmes were implemented

The results from the questionnaire confirmed that the majority of academic libraries were deeply committed to implementing digital preservation programmes in their institutions. Overwhelmingly, 15 (68.2%) of the respondents indicated that they had a formal digital preservation programme in their institutions, while only a few (7, 31.8%) respondents indicated that they did not have a formal preservation programme. Again, the majority (21, 95.5%) of respondents further stated that they had undertaken efforts to preserve digital materials in their institutions. Lastly, only one (4.5%) respondent indicated that they had not undertaken any effort to preserve their digital materials. This is also confirmed from the literature review that the majority of African libraries, particularly in South Africa, have digitised their scholarly output. Also, these libraries have already established IRs and digital libraries to preserve their digital materials (Macha & De Jager 2011; OpenDOAR 2015; Pienaar & Van DeVenter 2007).

The implication of the findings is that most academic libraries were fully committed to digital content preservation and

they were thus prioritising their digital preservation practices and considered it as one of their strategic objectives. The fact that the majority of the institutions implemented digital libraries, IRs and other archives in their institutions shows that they were fully prepared to continue with the digital preservation activities. Bishoff and Smith (2015) also conducted a study of digital collection management activities at academic libraries to determine the status of their current digital content creation, management and preservation. Therefore, 66% of the respondents indicated that there was an overall commitment to digital content preservation at their institutions. A comparative study conducted by Bekele (2006) to examine the status of digital preservation practices in Botswana, Ethiopia and South Africa also showed that there was a growing awareness of the need to implement digital preservation programmes. The research revealed that 65% of the institutions surveyed were aware of the risks associated with inadequate preservation; however, only 35% had developed in-house guidelines or policies on how digital files could be managed. Bishoff and Smith (2015) also conducted a survey of digital collection management activities in academic libraries to reveal the status of their current digital content creation, management and preservation, and reported that 66% of their respondents indicated that there is an overall commitment to digital content preservation at their institutions.

The findings of this study also revealed that all of the institutions (22, 100%) stated that the major reason for digital content preservation was to ensure long-term access to digital resources. This is in line with the literature review that the main goal of preserving digital resources in academic libraries in South Africa is to ensure long-term preservation of these resources. The findings also agree with researchers such as ALA (2018), Beagrie and Jones (2008) and Das et al. (2009) who stated that the main rationale behind digital preservation was to ensure protection of information of enduring value for access by present and future generations.

It is, however, useful to break down what is understood as effective preservation in order to understand the process necessary to achieve the long-term preservation of digital objects. In order to gauge their understanding of effective preservation of digital resources, the respondents were asked to indicate the phrase(s) that best described the state of effective digital preservation in the academic institutions. Table 1 shows that all respondents considered effective preservation as a situation where data were preserved over

a long period of time, and 21 (95.5%) responded that data should be found, extracted and served to a user. Again, 21 responded that if data were maintained in the repository without being damaged, lost or maliciously altered, then this will be considered effective digital preservation. Lastly, 18 (81.8%) of the respondents stated that effective digital preservation meant data could be interpreted and understood by a user.

The literature also reveals that for an institution to adopt and practise an efficient and effective digital preservation system, the engagement of digital preservation experts is vital to the successful implementation of the system (Rinehart, Prud'homme & Huot 2014). Based on that, the study sought to determine the persons, departments or units that were responsible for implementing and facilitating digital preservation systems in the academic libraries in South Africa. The survey established that repository managers, digital preservation units, librarians, archivists and library management were responsible for implementing and facilitating digital preservation processes in the academic libraries. Repository managers were responsible for digital preservation in 16 (72.7%) academic libraries. This result may be partly explained by the fact that most of the academic libraries in South Africa have implemented IRs in an attempt to preserve their digital resources and are therefore managed by repository managers who are initiating digital preservation projects within their institutions (Masenya 2018). However, five (22.7%) respondents indicated that the information technology (IT) division was responsible for implementing and facilitating digital preservation practices in their institutions. This is raising a concern especially because digital preservation is an integrative and complex task that requires a creative team from different areas of specialisation such as IT specialists, librarians, archivists and content managers, to mention a few. Therefore, there needs to be a collaboration of the technology-savvy and preservation-savvy advocates in order to elucidate a fundamental 'framework of basic concepts' to support digital preservation (Verheul 2006:268).

The respondents were also asked about the level of the importance they attach to long-term preservation in their institutions. A combined score of 21 (95.5%) by the respondents indicated that long-term preservation of digital resources is very important or extremely important; only one (4.5%) respondent believed that it is somewhat important. However, Meddings (2011) found that despite 85% of respondents claiming that 'digital preservation is either

TABLE 1: Phrases that best describe effective digital preservation in academic libraries.

Effective digital preservation	Strongly agree (1)		Agree (2)		Neutral (3)		Disagree (4)		Strongly disagree (5)	
	n	*%*	*n*	*%*	*n*	*%*	*n*	*%*	*n*	*%*
Data are maintained in the repository without being damaged, lost or maliciously altered	18	81.8	3	13.6	0	0	1	4.5	-	-
Data can be found, extracted and served to a user	16	72.7	5	22.7	1	4.5	-	-	-	-
Data can be interpreted and understood by a user	9	40.9	9	40.9	4	18.2	-	-	-	-
Data can be preserved over a long period of time	19	86.4	3	13.6	-	-	-	-	-	-

important or very important to their library', only less than half (46.1%) stated that they were currently taking steps to ensure the long-term preservation of digital content. The majority of respondents (21 , 95.5%) stated that they made efforts to preserve digital materials in their institutions and only one (4.5%) indicated that they have still not undertaken any efforts to preserve their digital materials. Although these institutions expressed their desire and interest in developing programmes for preserving their digital materials, they are still faced with many challenges hindering the effective preservation of their digital resources.

Challenges hindering the effective preservation of digital materials in academic libraries

Despite making efforts to promote digital preservation, there are still many challenges that need to be addressed to ensure long-term preservation of digital resources in academic libraries in South Africa (Masenya 2018). It was thus crucial to identify the challenges that hindered the effective preservation of digital resources in academic libraries in South Africa in order to identify practical and sustainable solutions to digital preservation problems. The questionnaire item to investigate the factors that hindered effective digital preservation consisted of a list of the different possible factors that may inhibit digital preservation in academic libraries.

The majority of respondents (18, 81.8%) considered inadequate staff with expertise in digitising resources and a knowledge and understanding of intellectual property rights and copyright issues as major challenges inhibiting the effective preservation of digital resources. The copyright issue relates to acquiring permission to use copyright-protected content. Copyright issues should be investigated to ensure that proper intellectual property rights have been granted that are legally required to perform the actions necessary for long-term preservation (Corrado & Moulaison 2014:35). Memory institutions must identify all content that is part of the project, as there may be content in the public domain, or protected content, and they may have to undertake a search to identify copyright holders, locate the holders and obtain required permission from them (Council of Canadian Academies 2015:51). This is followed by inadequate funding to purchase enough infrastructure with a score of 17 (77.3%), poor technology infrastructure scored 17 (77.3%) and lack of human resources scored 16 (72.7%).

Other preservation challenges included lack of relevant training, software obsolescence and low awareness on

preservation issues with the same score of 15 (68.2%). These findings concur with the findings of several scholars (Ezema & Ugwu 2013; Kalusopa & Zulu 2009; Kanyengo 2006; Ngulube 2012) who revealed numerous issues and challenges concerning the preservation of digital resources among various organisations and institutions. These include lack of human capacity and skills, absence of established standards and policies, lack of knowledge and adequately trained personnel in managing digital resources, technological obsolescence because of constantly changing software and hardware, copyright and intellectual property rights, lack of collaboration efforts, poor ICT infrastructure and lack of awareness.

Studies undertaken by Sigauke and Nengomasha (2011) also identified some of the challenges that hindered the National Archives of Zimbabwe's efforts to preserve their historical records in the long term. These challenges included that staff required further training and exposure to modern digitisation technologies, an absence of a digitisation policy programme, inadequate funding and a lack of collaboration efforts. These challenges can pose threats and destabilise the implementation of digital preservation initiatives in an institution if management does not take immediate action. Again, respondents were given other possible options and asked to rank the general problems faced by their institutions in preserving their digital resources. Table 3 presents the general problems faced by academic libraries in preserving their digital resources: lack of knowledge in university leadership and lack of collaboration and partnerships with other institutions, with the same score of 13 (59.1%); inadequate resources (human and financial resources) and lack of management support, both with the same score of 11 (50.0%); followed by slowness in the implementation of the preservation policy, with a score of 10 (45.4%), recording a percentage score within the 50% – 60% range.

This study focused on long-term preservation of digital resources in academic libraries in South Africa. To achieve this objective, it was also necessary to establish the challenges faced by academic institutions in providing access to digital content. A list of possible challenges identified in the literature was presented in the research questionnaire. The main problems encountered in providing access to digital content were staff's lack of training in digital preservation, with the score of 12 (54.5%), followed by poor management of digital resources (score 10, 45.4%), lack of procedure (score 9, 40.9%)

TABLE 2: Challenges hindering the effective preservation of digital materials.

Digital preservation challenges	Strongly agree (1)		Agree (2)		Neutral (3)		Disagree (4)		Strongly disagree (5)	
	n	%	n	%	n	%	n	%	n	%
Inadequate staff with expertise in digitising resources	13	59.0	5	22.7	1	4.5	3	13.6	-	-
Inadequate funding to purchase enough infrastructure	10	45.5	7	31.8	1	4.5	4	18.2	-	-
Lack of relevant training	8	36.4	7	31.8	2	9.1	5	22.7	-	-
Software obsolescence	8	36.4	7	31.8	3	13.6	4	18.2	-	-
Low awareness on preservation issues	6	27.3	9	40.9	5	22.7	2	9.1	-	-
Intellectual property and copyright issues	14	63.6	4	18.2	1	4.5	3	13.6	-	-
Lack of human resources	9	40.9	7	31.8	3	13.6	3	13.6	-	-
Poor technology infrastructure	7	31.8	10	45.5	3	13.6	2	9.1	-	-

TABLE 3: Problems faced by academic libraries in preserving digital resources.

Digital preservation challenges	Strongly agree (1)		Agree (2)		Neutral (3)		Disagree (4)		Strongly disagree (5)	
	n	%	n	%	n	%	n	%	n	%
Inadequate resources (human and financial resources)	8	36.4	3	13.6	2	9.1	9	40.9	-	-
Lack of knowledge by university leadership	7	31.8	6	27.3	4	18.2	5	22.7	-	-
Lack of training among staff members	6	27.3	7	31.8	3	13.6	6	27.3	-	-
Slowness in the implementation of preservation programmes at your institution	7	31.8	3	13.6	2	9.1	10	45.5	-	-
Lack of management support	5	22.7	6	27.3	4	18.2	7	31.8	-	-
Lack of collaboration and partnerships with other institutions	7	31.8	6	27.3	4	18.2	5	22.7	-	-

and staff do not understand user's needs (score 8, 36.4%). Only few institutions (7, 31.8%) reported the lack of access policy as one of their challenges in providing access to digital content. The study further established factors that hinder the professional growth in digital preservation in academic libraries. The evidence showed a limited budget as the major obstacle to digital preservation, to which 16 (72.7%) agreed, 5 (22.7%) were neutral and only 1 (4.5%) disagreed. Limited time was rated as the second barrier to digital preservation growth in academic libraries ranked (14, 63.7%). The research findings by Meddings (2011) also revealed that 41% of surveyed institutions that were participating in digital preservation programmes cited lack of human resources and limited budget as major digital preservation concerns.

It was also established that limited support from institutional leadership, lack of policy, lack of training and lack of motivation were inhibiting digital preservation growth in academic libraries. By implication, it could be that management in some of the institutions was not fully supporting digital preservation and, therefore, digital preservation practices were not prioritised. The results may also reflect that there is a lack of commitment in digital preservation practices by management within these institutions. Therefore, in order for digital preservation programmes to be effectively implemented, academic institutions often have to deal with many cost-related issues and need to allocate budget and more time to digital preservation practices.

Management support

Management support and consulting with some of the best digital preservation experts from other institutions is key in meeting the challenges of digital preservation (Rinehart et al. 2014). Developing clear policies and processes requires effective leadership or library management that makes recommendations to staff about standards, technology options, feasibility and training. According to Corrado and Moulaison (2014), management is responsible for creating policies and documentation, as well as the oversight of resource issues, namely human resources and financial resources. The majority (17, 77.3%) of respondents reported that their institutions had a written digital preservation policy in place, while only five (22.7%) indicated that they did not have a policy for digital preservation. The implication of these findings is that most of academic libraries in South Africa had paid attention to the development of digital preservation policies that guides in the preservation of their

digital records. Although it was evident from the survey responses that management played an important role in crafting digital preservation policies and strategies and creating awareness of digital preservation in some of academic libraries, some of the respondents indicated that there is still a lack of clear policies, proper procedures and awareness in digital preservation in their institutions.

Some of the studies reviewed in this study, such as Gbaje (2011), Kalusopa and Zulu (2009), Kanyengo (2006) and Keakopa (2006), revealed that there were no policies and guidelines on the preservation of electronic records in most of the African institutions and organisations and this differs from the findings of this study. Also, Adu and Ngulube (2016) observed that although preservation policies attempt to address the issue of accessibility to information and recognise the potential role of ICT on national development, very little has been done on digital preservation infrastructure in public institutions in countries like Ghana. The differences in the results may be accounted for by the fact that the academic library environment may differ from archival institutions in the way they treat preservation issues.

Again, if staff members do not have a clear mandate from management to provide preservation solutions, then digital preservation collaboration is stymied. The respondents were requested to state whether management was supporting digital preservation practices in their institutions. The following are percentage rankings of the perceived management support from the highest to the lowest: supportive for preservation practices (21, 95.5%), willing to collaborate with other organisations (21, 95.5%) and willing to benchmark with other institutions (15, 68.2%), while five (22.7%) respondents indicated that management did not support the initiative.

Conclusion and recommendations

The study established that most academic libraries in South Africa had implemented digital preservation programmes and it is therefore clear that these institutions made efforts to preserve their digital materials. Although ensuring long-term access to digital resources in academic libraries was very important, the findings revealed that academic institutions have been plagued by digital preservation challenges. Major concerns were inadequate resources and lack of practical capacity to preserve digital records, inadequate staff with expertise in digitising resources,

intellectual property and copyright issues, inadequate funding to purchase enough infrastructure, poor technology infrastructure and software obsolescence. Other problems such as lack of management support, lack of knowledge by university leadership and slowness in implementing preservation were also identified.

Ensuring continued access to digital records also calls for collaborations and partnerships with other institutions. However, the study observed that in some instances, the academic institutions were not fully involved in collaborative and partnerships with other institutions. By collaborating and partnering with other institutions, they would be exposed to new ideas, strategies and tools, and be able to acquire knowledge and skills needed to successfully preserve and manage their digital resources. The findings also revealed the implementation of policies and strategies, allocating budget for all digital preservation efforts and initiatives, building a proper technology infrastructure, allocating adequate resources (human and financial resources), raising awareness and digital preservation knowledge and skills as some of the major factors for effective preservation of digital resources in academic libraries. This study therefore recommends that library management can address some of the digital preservation challenges if they leverage on these factors. A critical component in leveraging these factors is the implementation of the infrastructure supporting the reliability and sustainability of digital repositories so that digital resources will be preserved for the long term.

Digital preservation activities also have legal implications as preservation may infringe upon current copyright laws. Copyright law and licensing arrangements should be properly managed so that they may not create problems for libraries that aim at preserving their digital resources in the long term or even short term. Policy makers and responsible staff in digital preservation thus need to identify where current copyright protection inhibit digital preservation and how technical strategies might impinge on copyright laws.

Factors such as the necessary resources to preserve the information, skilled and technical staff, budget provision by the parent organisation, institutional commitment and involvement of every staff member in the library, knowledge of metadata systems, selection of software (open source or commercial) and file formats, copyright issues and adherence to preservation standards thus need to be kept in mind before proceeding with digital preservation. For effective digital preservation, management in academic institutions should therefore:

- be ready to go extra mile to address issues and challenges as they arise by assembling very specific and concrete resources such as funding, the necessary infrastructure and equipment and organise training for staff;
- consider getting external expertise and be in support of digital preservation initiatives;

- attend annual conferences and workshops, together with staff members who are responsible for facilitating digital preservation initiatives within their institutions, to discuss challenges they face and improvements on the system they would like to be made.

Acknowledgements

Competing interests

Authors' contribution

T.M.M. was a PhD student and this is part of her study, and she conceptualised and conducted the study. P.N. was the project supervisor and assisted in converting the study into a publishable article and dealt with the reviews and editorials.

References

Adu, K.K. & Ngulube, P., 2016, 'Preserving the digital heritage of public institutions in Ghana in the wake of electronic government', *Library Hi Tech* 34(4), 748–763. https://doi.org/10.1108/LHT-07-2016-0077

American Library Association, 2018. *Digital preservation in libraries: Preparing for a sustainable future*. American Library Association, Atlanta, GA.

Anunobi, C.V. & Okoye, I.B., 2008, 'The role of academic libraries in universal access to print and electronic resources in the developing countries', *Library Philosophy and Practise,* viewed 15 November 2015, from http://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1194&context=libphilprac

Beagrie, N., 2006, 'Digital curation for science: Digital libraries and individuals', *The International Journal of Digital Curation* 1(1), 3–16.

Beagrie, N. & Jones, M., 2008, *Preservation management of digital materials: The handbook*, Council for Museums, Archives and Libraries, London.

Bekele, D., 2006, *Ethiopia holds national digital preservation workshop*, Report to UNESCO under its Digital Heritage Project, UNESCO, Paris.

Bishoff, L. & Smith, C., 2015, 'Managing digital collections survey results', *D-Lib Magazine* 21(3), 4–19. https://doi.org/10.1045/march2015-bishoff

Campbell, J.D., 2006, 'Changing a cultural icon: The academic library as a virtual destination', *Educause Review* 41(1), 16–31.

Choi, Y. & Rasmussen, E., 2009, 'What qualifications and skills are important for digital librarian positions in academic libraries? A job advertisement analysis', *The Journal of Academic Librarianship* 35(5):457–467. https://doi.org/10.1016/j.acalib.2009.06.003

Chowdhury, G., 2010, 'From digital libraries to digital preservation research: The importance of users and context', *Journal of Documentation* 66(2), 207–223. https://doi.org/10.1108/00220411011023625

Corrado, E.M. & Moulaison, H.L., 2014, *Digital preservation for libraries, archives, and museums*, Rowman & Littlefield Publishers, Lanham, MD.

Council of Canadians Academies, 2015, *Leading in the digital world: Opportunities for Canada's memory institutions*, The expert panel on memory institutions in the digital revolution, Council of Canadian Academies, Ottawa, Canada.

Das, T.K., Sharma, A.K. & Gurey, P., 2009, 'Digitization, strategies and issues of digital preservation: An insight view to Visva-Bharati Library', In *Proceedings of the 7th international Convention on Automation of Libraries in Education and Research (CALIBER) held at Pondicherry University from the 25th–27th February 2009.*

Duranti, L. & Preston, R., (eds.), 2008, *International research on permanent authentic records in electronic systems (InterPARES) 2: Experiential, interactive, and dynamic records*, Associazione Nazionale Archivistica Italiana, Padova.

Ezema, C.I. & Ugwu, C.I., 2013, 'Electronic theses and dissertations in Nigeria university libraries: Status, challenges and strategies', *The Electronic Library* 31(4), 493–507.

Gbaje, E.S., 2011, 'Digital preservation strategies: A case study of Nigerian national information centers', *IFLA Journal* 37(3), 218–227. https://doi.org/10.1177/0340035211418727

Guenther, K., 2000, 'Designing and managing your digital library', *Computers in Libraries* 29(1), 34–39.

Halder, S.N., 2009, 'Multimodal roles of library and information science professionals in present era', *International Journal of Library and Information Science* 1(6), 92–99.

IFLA/UNESCO 2010, 'IFLA/UNESCO Manifesto for Digital Libraries', viewed 18 September 2018, from https://www.ifla.org/publications/iflaunesco-manifesto-for-digital-libraries

Keakopa, S.M., 2006, 'Management of electronic records in Botswana, Namibia and South Africa: Opportunities and challenges', PhD thesis, University College London, London.

Kalusopa, T. & Zulu, S., 2009, 'Digital heritage material preservation in Botswana: Problems and prospects', *Collection Building* 28(3), 98–107. https://doi.org/10.1108/01604950910971125

Kanyengo, C.W., 2006, 'Managing digital information resources in Africa: Preserving the integrity of scholarship', *The International Information and Library Review* 41(1), 34–43. https://doi.org/10.1080/10572317.2009.10762795

Library of Congress, 2018, *Digital preservation*, viewed 03 September 2018, from http://www.digitalpreservation.gov/

Macha, A. & De Jager, K., 2011, 'A comparative overview of the development of the institutional repositories at the University of Cape Town and at the University of Pretoria', *Proceedings of the 14th International Symposium on Electronic Theses and Dissertations*, University of Cape Town, South Africa, 13–17th September 2011.

Masenya, T.M., 2018, 'A framework for preservation of digital resources in academic libraries in South Africa', PhD thesis, University of South Africa, Pretoria.

Maxwell, N.K., 2006, *Sacred stacks: The higher purpose of libraries and librarianship*, American Library Association, Chicago, IL.

Meddings, C., 2011, 'Digital preservation: The library perspective', *The Serials Librarian* 60, 55–60. https://doi.org/10.1080/0361526X.2011.556437

National Digital Information Infrastructure and Preservation programme (NDIIPP), 2005, 'NDIIPP holds three workshops for states, territories at library', *Library of Congress Information Bull* 64(9), 1–2.

Ngulube, P., 2012, '"Ghosts in our machines": Preserving public digital information for the sustenance of electronic government in sub Saharan Africa', *Mousaion: South African Journal of Information Studies* 30(2), 127–135.

Ngulube, P., 2018, 'Overcoming the difficulties associated with using conceptual and theoretical frameworks in heritage studies', in P. Ngulube (ed.), *Handbook of research on heritage management and preservation*, pp. 1–23, IGI Global, Hershey, PA.

Ngulube, P., Mathipa, E.R. & Gumbo, M.T., 2015, 'Theoretical and conceptual frameworks in social sciences', in E.R. Mathipa & M.T. Gumbo (eds.), *Addressing research challenges: Making headway for developing researchers*, pp. 43–66, Mosala-MASEDI Publishers & Booksellers, Noordywk.

OpenDOAR, 2015, *Directory of open access* repositories, viewed 12 June 2016, from http://v2.sherpa.ac.uk/opendoar

Palmer, W., 2014, *Scalable preservation environments: The nuts and bolts of digital preservation software tools*, viewed 03 September 2018, from http://blogs.bl.uk/collectioncare/2014/01/the-nuts-and-bolts-of-digital-preservation-software-tools.html

Perry, S.R., 2014, 'Digitization and digital preservation: A review of literature', *SLIS Student Research Journal* 4(1), viewed 12 July 2017, from http://scholarworks.sjsu.edu/slissrj/vol4/iss1/4

Pienaar, H. & Van Deventer, M., 2007, 'Capturing knowledge in institutional repositories …playing leapfrog with giraffes', paper presented at the Knowledge Management preconference workshop at the World Library and Information Congress (WLIC), 73rd IFLA General Conference and Council, viewed 12 May 2014, from https://researchspace.csir.co.za/dspace/bitstream/handle/10204/1107/Pienaar_2007.pdf?sequence=

Powell, R.R. & Connaway, L.S., 2004, *Basic research methods for* librarians, Libraries Unlimited, London.

Raju, J., 2014, 'Knowledge and skills for the digital era academic library', *The Journal of Academic Librarianship* 40, 163–170. https://doi.org/10.1016/j.acalib.2014.02.007

Research Libraries Group and National Archives and Records Administration Digital Repository Certification Task Force, 2007, *Trustworthy Repository Audit and Certification (TRAC): Criteria and checklist,* viewed 18 September 2018, from http://www.crl.edu/archiving-preservation/digital-archives/certification-assessment

Rinehart, A.K., Prud'homme, P. & Huot, A.R., 2014, 'Overwhelmed to action: Digital preservation challenges at the under-resourced institution', *Emerald* 30(1), 28–42.

Ross, S., 2012, 'Digital preservation, archival science and methodological foundations for digital libraries', *New Review of Information Networking* 17(1), 43–68. https://doi.org/10.1080/13614576.2012.679446

Ruusalepp, K.I. & Dobreva, M., 2013, *Innovative digital preservation using social search in agent environments: State of art in digital preservation and multi-agent systems*, viewed 02 December 2013, from http://www.durafile.eu

Sigauke, D.T. & Nengomasha, C.T., 2011, 'Challenges and prospects facing the digitization of historical records for their preservation with national archives of Zimbabwe', *2nd International conference in African Digital Libraries and Archives*, viewed 14 June 2012, from http://wiredspace.wits.ac.za/handle/10539/11533

UNESCO, 2005, *UNESCO supports training for building digital libraries in Africa*, viewed 18 September 2018, from http://www.unesco.org/new/en/communication-and-information/resources/news-and-in-focus-articles/all-news/news/unesco_supports_training_for_building_digital_libraries_in_a/

University of Manchester Library (UML), 2014, *University library wins digital preservation award*, viewed 03 September 2018, from https://www.manchester.ac.uk/discover/news/article/?id=13338

Verheul, I., 2006, *Networking for digital preservation: Current practices in 15 national libraries*, International federation of Library associations and Institutions, Saur, Munchen.

Waters, D. & Garrett, J., 1996, *Preserving digital information. Report of the task force on archiving of digital information*, Council on Library and Information Resources(CLIR) Publications, Washington, DC.

Wawrzaszek, S.V. & Wedaman, D.G., 2008, 'The academic library in a 2.0 world', *Research Bulletin* 19(2), EDUCAUSE Center for Applied Research, Boulder, CO, viewed 14 June 2016, from http://www.educause.eud/ecar