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Digital curation of archives through free open-source software in South Africa

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Abstract

Purpose – Although the cabinet of South Africa has shown support for enacting a policy on free and open-source software (FOSS), its adoption and implementation by public entities are lagging. A literature review signalled a similar trend of low to no existence of FOSS in the sphere of digital curation of archives in South Africa, as proprietary software continues to be the most popular choice. This study aims to investigate the digital curation of archives through FOSS in South Africa.

Design/methodology/approach – This qualitative study triangulated interviews with document analyses to investigate the digital curation of archives through FOSS in South Africa. Interview data were collected from records managers and chief information officers from seven purposively selected public entities that have implemented electronic content management. Data were analysed and presented thematically with the use of tables and verbatim quotations, as in line with the objectives of the study.

Findings – The main finding shows that proprietary software continues to dominate the digital curation of archives within national government departments in South Africa. This trend persists even among departments that profess knowledge of and acknowledge the benefits associated with FOSS implementation for digital archive curation.

Research limitations/implications – The findings of this study may provide a basis for public entities, including the national archives, to take the necessary steps to ensure the effective implementation of FOSS in the digital curation of archives.

Originality/value – The study used constructs from the digital curation centre lifecycle model. It also puts forth strategies that can be used to implement FOSS for the digital curation of archives.

Keywords Digital archives, Free and open-source software, South Africa, Digital curation, Skills, Proprietary software

Paper type Research paper

Introduction and background

Many studies lament the lack of technological infrastructure and skills for digital curation of records in South Africa (Katuu, 2023; Ngoepe, 2017; Ngoepe and Mello, 2021; Shibambu, 2022;

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Shibambu and Ngoepe, 2020). Such studies put forward the argument that free and open-source software (FOSS) can be used to advance digital curation of archives in South Africa as opposed to proprietary software. This is so because, when internal staff members implement FOSS, internal skills remain, and the product can grow because it has a source code. However, it would seem that many public organisations in South Africa prefer the use of proprietary software as opposed to FOSS. A study by Ngoepe (2015) found that of all the national government departments that implemented electronic content management, only two were using a FOSS product. This is true despite the fact that the cabinet of South Africa approved and passed a FOSS policy in 2003. Ngoepe (2015, 2017) notes a lack of infrastructure to ingest digital records as the main factor in the curation of digital records, especially by the National Archives and Records Services of South Africa (NARSSA). Elsewhere, Gabriela Andaur and Díaz (2022) report that the Electronic Archives of the National Archives of Chile has created a digital platform to ingest digital records into archival custody, although the transfer of such archives has been much slower than expected. The platform is accompanied by a series of guidelines to explain the procedures and requirements to carry out the transfer process. If such infrastructure or platform is available in South Africa, it may assist public sector organisations that are ready to transfer digital records of enduring value into archival custody. In this way, FOSS presents itself as a viable solution to NARSSA, along with the technology and infrastructure needed for the preservation of digital archives in their repository. FOSS solutions such as Alfresco, AtoM, DSpace and flexible extensible digital object repository architecture (FEDORA) are leading in terms of the digital curation of archives implemented by various archives around the world. In this instance, FOSS presents an opportunity not to be missed, as it may bridge the digital divide in an affordable way both financially and technologically, as well as provide skills for developing countries such as South Africa. However, with regard to Alfresco, an assessment by InterPARES Trust Project (2012) concluded that it did not appear to fully comply with the intent or spirit of open-source licensing and ideally should not be considered a FOSS-compliant application.

FOSS is a software that is developed, tested or improved through public collaboration and distributed with the understanding that it will be shared with others without limitations (Sanchez *et al.*, 2020). It requires developers to share insights, ideas and, most importantly, the source code to generate more innovative software solutions both collectively and individually (Drake, 2017). This creates a way for the global community to collaborate, share and assist each other to meet both individual and group goals. In this regard, the software operates with the underlying principles of peer production and mass collaboration, creating more sustainable software development for end users.

FOSS, as explained above, can enhance local skills in the digital curation of archives. According to the Smithsonian Institution Archives (2021), digital curation encompasses the acquisition, selection, maintenance and preservation of digital materials or data. Post *et al.* (2019) define digital curation as an on-going care and attention needed to keep objects viable for the present and future, which starts at or before the time of acquisition and continues well after the initial provision of access. The common factor in the definitions seems to be preservation or long-term storage. However, digital curation is more than just digital preservation, as it includes aspects such as creation, selection appraisal and maintenance to enhance access to digital contents. Therefore, in the context of this study, the definition of digital curation as provided by Post *et al.* (2019) was deemed fit and in line with what the researcher means by digital curation of archives. This is because the study backs up the idea that digital curation of archives is an ongoing process based on the stages of the records lifecycle model. Records are created in national government departments, used for different purposes (records management stage) and then important records are kept (preservation stage) at NARSSA. Therefore, this means that, for FOSS to have the desired

impact in the digital curation of archives in South Africa, its implementation should adhere to the process of the records lifecycle model. Despite the FOSS policy in South Africa, Mello (2020) noted that its uptake in digital curation of archives was low; hence, organisations such as Rand Water, which implemented electronic records as far back as 1991, were struggling to transfer digital records of enduring value into archival custody. Since implementing first in-house developed electronic records management system in 1991, Rand Water has migrated to five electronic document and records management system products and is ready to transfer digital records of enduring value into archival custody (Mello and Ngoepe, 2020).

The problem of a lack of skills and technological infrastructure for digital curation has led to the disappearance and loss of records (Katuu, 2012). Several studies in South Africa, such as those done by Ngoepe and Keakopa (2011), Archival Platform (2015) and Ngoepe (2017), noted that both governmental bodies and the national archival system have struggled to effectively manage digital records and facilitate their long-term preservation. It is the thesis of this study that the advancement of FOSS may help alleviate the problem associated with digital curation of archives where a country lacks infrastructure and skills, like South Africa. As Ngoepe (2015) would attest, while in the process of implementing the FOSS with its available source code, archivists and records managers can also develop technical skills in the digital curation of archives. FOSS solutions such as Archivematica, FEDORA, repository of authentic digital objects, Greenstone, Eprints, DSpace, DAITSS, Invenio, LOCKSS and Xena, to mention just a few, are continuing to aid archival institutions around the world to curate digital records and to ensure protection of information of enduring value for access by present and future generations (Shekgola *et al.*, 2021). This study investigates the digital curation of archives through open-source software in South Africa.

Problem statement

The implementation of FOSS in South Africa holds the potential to enhance the digital curation of archives. FOSS provides organisations the freedom to run, inspect, modify and distribute source code for digital archive curation without restrictions. Some notable advantages of FOSS include lower costs, improved debugging, the formation of supportive communities and fewer usage restrictions. FOSS is considered cost-effective compared to proprietary software, as it eliminates expenses related to licensing and access to the source code (Drake, 2017). Numerous record-creating entities, including national government departments in South Africa, face challenges such as insufficient storage capacity, insecure digital systems, a shortage of skilled practitioners and inadequate care for digital archives (Katuu, 2023; Ngoepe, 2017). These shortcomings may result in inaccessible archival systems, the disappearance of archives and the compromise of records' authenticity, reliability and trustworthiness. FOSS implementation presents an opportunity for agencies, NARSSA and similar entities to acquire the necessary skills and infrastructure for effective digital archive curation. By addressing these challenges through FOSS, there is potential to mitigate issues related to the transfer of digital records into archival custody. This study uses a digital curation model to investigate the application of FOSS in the digital curation of archives in South Africa.

Purpose and objectives of the study

The purpose of this study was to investigate the digital curation of archives through FOSS in South Africa. The specific objectives were to:

- Analyse the policies and legislative framework regulating the digital curation of archives in South Africa in relation to open-source software.
- Determine the implemented FOSS solutions for the digital curation of archives.
- Assess the skills required for the digital curation of archives.
- Propose FOSS implementation strategies for the digital curation of archives.

Conceptual framework and literature review

This study used constructs from the digital curation centre (DCC) lifecycle model. The DCC curation lifecycle model is one of the most influential digital curation frameworks for archives. The DCC model was developed by the UK digital curation centre (Choudhury *et al.*, 2020). The DCC supports a lifecycle approach to the management of digital materials from the time of original conceptualisation until either disposal or selection for reuse and long-term preservation. As observed by Cox and Tam (2018), the DCC model outlines the stages that are involved in the lifecycle of digital information, from creation to preservation. It is commonly known for providing resources and expertise in digital curation. This model also provides a graphical, high-level overview of the stages required for successful digital curation and preservation of records (Cox and Tam, 2018).

The DCC lifecycle is a model that is constantly used and adopted in studies investigating digital record management and preservation. Similar to the record lifecycle, the DCC lifecycle model offers users and organisations a platform that they may adopt to successfully curate their digital records when adequate steps are followed (Cox and Tam, 2018). As such, this model consists of constructs that informed the formulation of the three objectives of the study, namely, policy and legislative framework, skills and the implementation of FOSS solutions during the record and archival phases. To ensure dependable governance, policy, legislation and international standards of record management serve as a guide for the digital curation of archives. This is also the case in South Africa, as the country has policies and legislation for the curation of archives. Furthermore, according to Akintomide (2016), in one way or another, digital curation of archives depends on software from the moment that these records are received or created in an organisation, then to the use and possible distribution of digital records and ultimately disposition. This thus renders the records lifecycle model very important in the implementation of any particular software, either proprietary or open-source, and crucial, more so, to the continued access and use of records throughout their active, semi-active and inactive stages.

The advent of technology in the archives and records management (ARM) fields has increased the need for records practitioners to constantly sharpen their skills to effectively conduct their work. As alluded to by Ngoepe and Jiyane (2014), it is imperative to possess the necessary skills and competencies, especially in dealing with electronic records. Failure to apply appropriate skills, especially when dealing with fragile materials such as digital archives, may endanger accessibility, transfer, utilisation and subsequent permanent preservation of records. It is therefore vital that both records practitioners and IT specialists in the records management division equip themselves with skills, knowledge and competencies to safeguard the records in their systems throughout their lifecycle. Besides offering a partial solution to minimising the digital divide in developing countries, FOSS also presents countries like South Africa with numerous benefits, such as increasing local information and communication technology (ICT) skill development (Oreku and Mtenzi, 2013). Many governments are adopting FOSS as a strategy to develop digital skills in a

country (Wheeler, 2015). As such, FOSS can offer a developing country like South Africa opportunities to close the gap in digital skills development.

The literature review is presented in accordance with the themes emanating from the research objectives, such as policies, standards and legislative frameworks for digital curation of archives, solutions implemented for digital curation of archives and skills required for digital curation of archives.

Policies and legal framework for digital curation of archives

Policies, standards and legislation are implemented in the digital curation of archives to give directives, as to how records should be managed throughout their lifecycle. Ngoepe and Saurombe (2016) allude to the fact that policies, standards and legislative frameworks give authorities the authority to ensure constant and consistent records in institutions such as creating agencies, including central government, local government and parastatals, as well as archival bodies. Since policies, standards and legislation in the digital curation of archives are law-giving rules used to lay instructions and guidelines on how to act, they require archivists and records managers to ensure compliance (Malatji and Marutha, 2023). Policies, standards and legislative guidelines on the curation of digital archives stipulate who can do what, how it can be done and to what extent (Malatji and Marutha, 2023). As such, these law-giving concepts play a pivotal role in the digital curation of archives in every government, including archival institutions.

Ngoepe and Saurombe (2016) indicate that policies, standards and legislation have a huge impact on how records, including those that are created and kept in networked environments, are managed and preserved in any country. This is a common view and agreement among various scholars who have explored the use of policies, standards and legislation in South Africa and the African continent in general. African scholars such as Netshakhuma (2019), Chaterera (2017), Marutha (2016), Ngoepe and Saurombe (2016), to name just a few, concur that the use of policies, standards and legislative frameworks is important in providing the basis of understanding as well as offering clarity on how they impact digital records, especially in the times when the advent of technology has taken over most organisations.

In South Africa, there are various legislative frameworks used in terms of the management of digital records. The supreme legislative framework is the National Archives and Records Services of South Africa Act 43 of 1996. This Act provides institutions, such as governmental bodies, with the basis on which records should be managed from the creation or receipt phase up to the disposal or archiving phase (Malatji and Marutha, 2023). The Act also gives clear directives as to who has the authority and responsibility to destroy or archive records with enduring value (Malatji and Marutha, 2023). There are other supporting pieces of legislation, such as the Constitution of the Republic of South Africa Act 108 of 1996 (Republic of South Africa (RSA), 1996a), the Promotion of Access to Information Act 2 of 2000 (PAIA) (RSA, 2000a) and the Promotion of Administrative Justice Act (PAJA) 3 of 2000 (RSA, 2000b), to name but a few. Section 195 of the Constitution (RSA, 1996a) provides for the effective, economical and efficient use of resources and the provision of timely, accessible and accurate information, in addition to requiring that public administration officials and departments be held accountable (Malatji and Marutha, 2023).

Free and open-source software implemented in South Africa for digital curation of archives

According to Akintomide (2016), in one way or another, digital curation of archives depends on software from the moment that these records are received or created in an organisation to the use, possible distribution of digital records and ultimately disposition. This thus renders the DCC lifecycle model very important in the implementation of any software, either

proprietary or open-source, and crucial to the continued access and use of records throughout their active, semi-active and inactive stages. According to Katuu (2023), African countries are making very little progress with the implementation of technologies, particularly for the management and preservation of digital records, when compared to developed countries in the world. On the other hand, most international countries continue to come up with initiatives and innovative ways to use technology in the curation of records, which include the implementation of FOSS solutions (Katuu, 2023). Archival associations such as the International Council on Archives (ICA), as well as other government institutions in countries such as Australia, New Zealand, the UK and the USA continue to embrace and reap benefits from FOSS-adopted solutions in digital records, particularly by their national archives and other public institutions (InterPARES, 2012).

Alfresco, Dspace, Greenstone, AtoM, FEDORA and others are some of the FOSS solutions, particularly for archival institutions to consider the management and preservation of digital records (Akintomide, 2016). However, it is the developed countries that continue to be at the forefront of implementing these software solutions to deal with the digital landscape and develop preservation infrastructure, models and frameworks, aiming to ensure continuous access and curation of digital records and lessen the risks of digital obsolescence for their collection in the foreseeable future.

Numerous scholars, including Ngoepe and Keakopa (2011) and Katuu (2023, 2012), have observed that among African countries, South Africa seems to have the best-established practice of implementing systems to manage and preserve digital records. Following the implementation of the digital records management system set by Rand Water in the early 1990s, the majority of governmental bodies, such as the Department of Science and Technology, the Department of Cooperative Governance and Traditional Affairs, the Department of Public Service and Administration, the Department of Transport, the Department of Arts and Culture, the Department of Trade and Industry and many others, also began to implement enterprise content management (ECM) systems to enhance their competence in the digital world in the early 2000s (Ngoepe, 2017). Other institutions, such as the University of South Africa and the South African Bureau of Standards, have also implemented an ECM solution in the form of open text.

Skills and competencies required for digital curation of archives

The skills and competencies required for the digital curation of archives are important throughout the lifecycle of records. Competent, knowledgeable and skilled records practitioners are thus vital for the creation, storage, usage, transfer, retrieval and preservation of materials to ensure their long existence. Failure to assign relevant, knowledgeable and skilled records practitioners during the digital curation of archives poses serious threats to the lifespan of stored materials and the information contained in them. Furthermore, Mosweu (2019) emphasises that archivists and records managers must prioritise gaining knowledge of the legislative and policy frameworks that affect records management and the theoretical foundation of archival science. By doing so, they would be equipping themselves with sufficient knowledge pertaining to the management and preservation of archival documents, including digital records, in a proper manner.

Information on the competencies, knowledge and skills needed to carry out or support digital preservation activities is provided by the Digital Preservation Coalition Competency Framework (DPCCF) (2022), which builds on earlier attempts to identify competencies and curricula for digital preservation, such as the DigCurV lenses1 and the DigCCur Curriculum Matrix. This framework is pertinent because it may be applied to a variety of tasks, such as organising professional development, helping to recruit archivists, as well as developing

skills for digital preservation through curriculum development. It has different levels for novice (0), beginner (1), intermediate (2), advanced (3) and expert (4). The framework provides examples of "activity descriptor" words for each of these levels. A novice in the area of policy development, for instance, might be "aware of" the organisation's policies, while an expert would be expected to "develop" them. The framework incorporates legal and regulatory requirements, as well as information technology competency areas and skills elements (software, infrastructure and computer security, general IT literacy, system procurement and implementation). Such competencies and skills might be useful when the organisation adopts a FOSS.

According to Ngoepe and Saurombe (2016), it is important that records management practitioners be equipped with the necessary education and training to deal with the digital curation of archives. Such skills are imperative, as they may ensure that records practitioners are able to deal with emerging technological innovation in the ARM field, and that they ensure good governance as well as accountability. Hence, ARM practitioners are mostly encouraged to further their education, reskill and constantly acquire new knowledge, particularly in terms of best practices for the management and preservation of digital records.

Although there is a need for archivists and records managers to empower themselves with knowledge and skills, particularly in the sphere of the management and preservation of digital records, little attention is paid by many African countries to these issues (Maluleka *et al.*, 2018). Formal education and training on the management and preservation of records created in network environments can be achieved through the use of records management consultants, workshops, vendor-sponsored programmes and undertaking records management courses in universities and colleges (Maluleka *et al.*, 2018). However, Onyancha *et al.* (2015) noted that in the few libraries and information science schools found in African countries, little emphasis is placed on the provision of courses in ARM, more so at the undergraduate level. Furthermore, Garaba (2015) argues that the state of records created in a network environment is not given the attention it deserves, as much emphasis is still placed on paper-based records in many African countries. Hence, various African countries continue to send their archivists and records managers overseas to study ARM (Katuu and Ngoepe, 2017).

Recent studies such as Erima and Mosweu (2023), Mojapelo *et al.* (2021), Katuu (2023), Ngoepe *et al.* (2024), Ngoepe and Tsabedze (2021), as well as Tsabedze and Ngoepe (2021) paint an optimistic future picture for skills in the management and preservation of digital records, as various universities in southern Africa are reviewing their curriculum to make provision of these records. This transformation in various universities in South Africa, Botswana, Namibia and Eswatini was stimulated by the ICA Africa Strategy (2015–2020) as well as the InterPARES Trust Project (2013–2018), in which universities from these countries participated. For example, through the Africa Strategy, the ICA proposed a generic curriculum for modules focusing on digital curatorship. These modules ensure that students are prepared for applying new knowledge within changing workplace environments.

Methodology

This qualitative study triangulated interviews with document analyses to investigate the digital curation of archives through FOSS in South Africa. Interview data were collected from records managers and chief information officers from seven purposefully selected national government departments that have implemented electronic content management. All national government departments were approached, and those that did not implement electronic content management were excluded. South Africa is a constitutional democracy with three spheres of government, that is, national, provincial and local levels of government. Only national departments were included in this investigation. At the time

of conducting the study, during the sixth administration (2019–2024), the country had a total of 29 national government departments. Only seven departments consented to participate in the study, although 10 departments indicating that ECM had been implemented. The three departments that declined to participate cited the dormant state of their ECM as the reason for not participating.

Documents analysed include archival legislation, as well as FOSS policy. It is important in social science research to ensure anonymity and confidentiality to protect the participants' right to privacy (Creswell, 2014). In the current study, the researchers adhered to the ethical standards of upholding the privacy of individuals who participated in the study. To ensure the confidentiality and anonymity of participants, participants and public entities were assigned codes. For records managers, the researcher used codes such as RM-1 and RM-2, and for ICT personnel, ICT-1, ICT-2 and so forth were used. In a bid to protect participating organisations in the current study, the codes Dept-1, Dept-2 and so on were assigned. This was done to ensure confidentiality and anonymity, which are ethical practices designed to protect participants. It should be noted that chief information officers from public entities six and seven never honoured appointments for interviews despite several attempts. Data were analysed and presented thematically with the use of tables and *verbatim* quotations in line with the objectives of the study.

Findings and discussion

Semi-structured interviews were conducted with the 13 participants, including records managers, archivist and IT specialists. Table 1 indicates the codes and positions of participants, as well as names and types of software implemented in each organisation.

Policies, standards and legislative frameworks for digital curation of archives

The sequential phases of the DCC lifecycle model begin with the create and receive phase. Throughout the lifecycle, the curation is guided by policies, legislation and standards. Once legal and legislative requirements are ensured, selection is made of the type of records to either discard or preserve for the long term, as well as strategies to be used for preservation, whether proprietary or open-source software is used. As indicated by Malatji and Marutha (2023), the development and adoption of existing policies, standards and legislative frameworks are critical components in the pursuit of effective digital curation of archives, particularly in the public sector. Malatji and Marutha (2023) further point out that implementing relevant policies, standards and legislative frameworks for digital curation of archives is imperative to achieve the short-, medium- and long-term goals of the organisation, as they provide a basis that stipulates steps to be followed. Hence, for the first objective of the current study, it was important to assess and analyse the policy, standards and legal framework used in the digital curation of archives by both national government departments and NARSSA. This was achieved through document analysis, as well as through interviews with participants in the study.

Participants in the study provided various perspectives when asked to elaborate on the policies used by their organisations in relation to the digital curation of archives. The following policies, namely, the Minimum Information Security Standards policy, the IT Disaster Recovery Plan policy, the Records Management Policy Manual, as well as various policies that were devised by individual organisations in a bid to guide the digital curation of their archives. It was also established that even though some of the participating organisations did implement FOSS solutions for digital curation of archives, their records management policy statement was not addressing the issue of open-source software.

In terms of standards, participants in the study have indicated that their respective organisations are currently following the globally accepted standards for records

Table 1. Implemented software for digital curation of archives

Department	Participants	Gender	Position	Age in years	Software currently implemented	Type of software	Functional use of the solution
Dept-1	ARMP-1	Female	Records manager	36	Alfresco	Open source	Records management
	ICTP-1	Male	Director: ICT infrastructure	48			
Dept-2	RMP-2	Female	Deputy director: records management	39	AtoM	Open source	Archival solution
	ICTP-2	Male	Director: IT	48			
Dept-3	RMP-3	Male	Records manager	40	FileDirector and SmartGov	Proprietary	Records management
	ICTP-3	Male	Director: information systems	46			
Dept-4	RMP-4	Female	Records manager	30	SmartGov	Proprietary	Records management
	ICTP-4	Male	Director: ICT	49			
Dept-5	ARMP-5	Female	Chief records manager	33	Alfresco	Open source	Records management
	ICTP-5	Male	Acting chief information officer	42			
Dept-6	ARMP-6	Female	Manager: archives and records management	50	Archivematica	Open source	Archival solution
	ICTP-6	Male	Director: IT	59			
Dept-7	ARMP-7	Male	Director: records management	60	Documentum	Proprietary	Records management

Source(s): Authors' own work

management that include ISO/SANS15489 Records Management, ISO 31010 Risk Management Principles – Assessment Techniques – and Minimum Information Security Standards (field data). The participants of the study also alluded to the fact that using an international standard allows end users to find digital curations of archives that are relevant to their needs. The following was the response from one participant when asked about some of the standards, principles and best practices that are used in relation to the digital curation of archives:

> Our digital records management system complies with the ISO/SANS15489 standards. I have can [sic] say that the ISO standard is the most followed principle especially in records management practices in various organisations. I guess that it is the reason why it is also opted in this department.

The study also aimed to determine which legislative frameworks are currently being used for digital curation of archives. It was noted that the majority of these organisations that formed part of the study were mostly using similar legislative frameworks, apart from one or two. For instance, ARMP-2, ARMP-5 and ARMP-6 mentioned similar legislative frameworks as the main or key legislative instruments guiding the digital curation of archives. The same trend was witnessed in ARMP-4 and ARMP-7. The NARSSA website also lists key legislative frameworks that are mostly used to govern records management in the public sector. The key policy and legislative frameworks identified were:

- The Public Service Corporate Governance of Information and Communication Technology Policy Framework;
- National Archives and Records Service of South Africa Act (No. 43 of 1996);
- Promotion of Administrative Justice Act (No. 3 of 2000);
- Electronic Communication and Transactions Act (No. 25 of 2002);
- Promotion of Access to Information Act (No. 2 of 2000);
- Protection of Personal Information Act (No. 4 of 2013); and
- Policy on Free Open-Source Software.

Hofman and Katuu (2023) indicated that archival legislation in South Africa provides the anchor for the management of digital records. The pieces of legislation were analysed to check if they make provision for managing digital records through FOSS. Only the NARSSA Act has two relevant provisions, which indicate that the National Archivist shall determine the conditions subject to which electronic records systems shall be managed and which records may be reproduced electronically. In this regard, the first provision implies that the National Archivist can decide if records can be managed through proprietary or open-source software. As the FOSS Policy exists in South Africa, NARSSA is propagating for migration to FOSS in the area of ECM although it is moving at a snail pace.

Implemented software in digital curation of archives

Digital curation of archives depends on software from the moment records are received or created in an organisation to the use and distribution of digital records and their ultimate disposition. The second objective of this study was formulated to determine the software currently implemented for digital curation of archives in national government departments as well as NARSSA. To achieve this objective, the participants of the study were asked to elaborate on the software that are currently implemented by their department for the digital curation of archives and to indicate whether the implemented software are proprietary or open-source.

As reflected in Table 1, the targeted organisations in the study are slowly migrating from proprietary to FOSS. For example, both ARMP-1 and ICTP-1 concur that the implementation of the Alfresco solution was initiated and gathered pace after witnessing that NARSSA was also migrating to an open-source software, i.e. AtoM. An earlier study by Ngoepe (2015) indicated that very few national government departments had implemented FOSS in ARM. However, the current findings show that organisations are starting to take note of FOSS, more so for the digital curation of their archives.

Skills required for digital curation of archives

In terms of digital curation of archives, the importance of skills, particularly those of both records management practitioners and information technology practitioners in the public sector, cannot be overemphasised. Only if knowledgeable staff are in charge, can digital archival curation practices be successful. The third objective of this study was to assess the skill set of practitioners in digital curation of archives through open-source software. The study revealed that a shortage of skilled, experienced and knowledgeable staff is a concern for most participant organisations. This was the case for both organisations implementing FOSS and proprietary software. Participants point to various factors ranging from top management's inability to take records management seriously, employees leaving for "greener pastures", the inability of the government to attract skilled personnel due to a lack of growth and compensation, a lack of budget to support staff training needs in line with reskilling and enhancing existing knowledge, workshops, short learning courses and the like.

When asked to elaborate on the skill set possessed by staff for digital curation of archives, ICTP-1 mentioned that two of their trusted employees tendered resignation letters after receiving good offers elsewhere and had subsequently left the public sector. The ICTP-1 further echoed that:

> Even if we can fill the posts, it is unlikely that the department will attract staff with similar skills, knowledge, and capabilities of the departed employees. We are currently overburden as the department. We need professionals who are able to use records management software, applications, and platforms that assist in implementing retention and disposition policies and procedures, such as disposition automation, records inventory, records transfer, or records destruction. Therefore, it is often hard to find such professionals.

ARMP-6 was of the view that records practitioners should be equipped with information technology skills to cope, especially in this era of constantly changing technology. The participant highlighted that it is imperative that records management staff possess skills such as the ability to store digital data, access and retrieve digital records and ensure that such information is safeguarded. ARMP-6 indicated that:

> It is highly important that staff in digital curation of archives show understanding and knowledge of basic records management functions. If you are required to preserve digital records, you need to ensure that such records are protected against unauthorised access and is [sic] able to be retrieved when is needed.

Free and open-source software implementation strategies for digital curation of archives

This section proposes recommendations to address issues identified during the study.

Policies, standards and legislative frameworks for digital curation of archives

Although there is a policy that supports FOSS implementation by governmental bodies in South Africa, it is clear that such a policy is often not considered by public entities. This is

due to several reasons, including the fact that the policy is not mandatory by nature. Therefore, the study recommends that the policy be made mandatory for adoption, subsequent implementation, and use in all spheres of government, including the national level, especially when it comes to infrastructure for ARM. This would ensure that the policy is put into application and used as the basis for its creation in the first place.

Moreover, there is currently no legislative framework that makes provision for digital curation of archives through FOSS in South Africa, although the FOSS policy advocates for the use of open products. This means that FOSS implementation is currently not legislated or supported by any legal laws except policy. The study recommends that the government of South Africa considers including legislative provisions for FOSS in either existing legislation or new one. This would give clear directives on how FOSS should be implemented in the digital curation of archives and other areas. The authors recommend that the process begins by amending the NARSA Act of 1996, which is the primary legislative framework governing the management of records in governmental bodies. Furthermore, technical standards and guidelines for government IT systems, including those related to the management and curation of digital archives, could also be set.

Solutions implemented for digital curation of archives

The study has outlined various FOSS solutions in the sphere of ARM, including DSpace, Alfresco, Archivematica and AtoM. Each national government department's primary goals should guide the selection of the best solution for digital curation of archives. The choice of the preferred FOSS solution should be informed by various aspects that include compatibility, interoperability, existing skills, security and the associated cost of implementation. Most importantly, the authors advocate for participation in the FOSS community by national government departments to receive timely updates and improvements to their chosen software. In this way, the strengths, weaknesses, opportunities and/or potential threads may be quickly spotted and necessary action may be taken.

The above-stated FOSS solutions were found essential by individual national government departments after taking into consideration their specific needs, the type of digital archives, as well as organisational resources including budget, skills and usability. Metadata standards, scalability, long-term sustainability and community support are also important aspects that need to be considered, especially when implementing FOSS solutions for the digital curation of public archives. Additionally, national government departments may opt to use a combination of these tools to create a customised digital curation workflow that suits their specific needs and requirements.

Skills and competencies required for digital curation of archives

FOSS represents a possible route to developing local talent to contribute to the local software industry. As suggested by Ward and Tao (2009), developing the local skills base through FOSS implementation may be used by developing countries such as South Africa as a way of responding to the digital divide. In the era of artificial intelligence, the use of DPCCF in countries such as South Africa can come in handy as archivists may be able to develop algorithms and generate related programs and/or scripts. This way, they can contribute to FOSS development in the area of ECM, as they acquire skills and competency in the design, documentation and use of workflows to manage the preservation of digital objects. This will also include the identification of the requirements for a new system or service and use these to select and procure a solution. Such IT skills, obtained from the implementation and use of FOSS in the digital curation of archives, may be a key strategy to create IT revenue-generating opportunities, as professionals may be needed both locally and abroad. In return,

the country may benefit from having well-trained developers who may be able to put their skills to good use, especially in national government departments that may struggle with digital curation of their archives due to a lack of credible, skilled and knowledgeable professionals.

It is important that ARM practitioners possess key digital curation skills to effectively support the digital curation of archives. As per the findings of this study, many national government departments struggle to attract skilled and knowledgeable ARM practitioners that may be able to work with FOSS. It was also noted that staff turnover is high, especially in a bid for better positions and remuneration. This tends to leave a void in the ARM sections. The authors recommend that:

- National government departments should prioritise staff training through various seminars, conferences and workshops to equip members with skills and knowledge on digital curation of archives.
- ARM practitioners in national government departments should constantly engage with the broader archival and digital preservation community to exchange knowledge, share experiences and collectively address opportunities, challenges and threads.
- Upskilling and reskilling are essential for ARM practitioners in governmental bodies who should be constantly requested to further their studies through short learning programmes in a bid to supplement and expand their existing knowledge and qualifications.
- Finally, the authors advocate for mentorship and on-the-job training by senior and knowledgeable ARM practitioners in national government departments. This strategy would assist relatively new professionals who join governmental bodies from universities.

Conclusion and recommendations

This study investigated the extent of digital curation public archives in South Africa with FOSS. FOSS solutions are increasingly being used to digitally curate public archives, ensuring the preservation, management and accessibility of digital materials. They are typically chosen for their flexibility, community support and source code transparency, which enable institutions to customise and adapt them to their specific requirements. FOSS implementation and utilisation can benefit a variety of government bodies, particularly in developing countries like South Africa.

Given South Africa's current economic situation, the authors suggest that using FOSS for digital archive curation is a natural way to reduce the costs associated with purchasing proprietary software. As a result, these entities may be able to break free from dependency by participating in the development of records management system solutions, allowing them to play an important role in the world of software.

Implementing FOSS for digital archive curation can benefit public entities. As highlighted in the current study, FOSS has the potential to provide both creating agencies and archival institutions with the necessary technology and infrastructure, as well as skills for digital archive preservation. This could be critical for NARSSA, which is struggling to maintain a reliable infrastructure for digital archive preservation. NARSSA's continued lack of infrastructure for digital archives has forced various public entities to seek alternative methods of protecting their archives. However, due to a lack of necessary skills and robust security measures, these public entities frequently struggle with issues related to digital

material storage, access, use and reuse as technology and file formats change. FOSS represents one potential path for developing local talent to contribute to the local software industry. The competency frameworks discussed in this study can be used to find ways to improve employability and advance professionally since participants have bemoaned the lack of proper information and training possibilities.

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Further reading

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