Application of Disruptive Technologies to the Management and Preservation of Records

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Abstract

Disruptive technologies are widely used in semi-periphery and core countries such as the United States of America, Australia, Croatia, and China to manage and preserve records. However, the same cannot be said about periphery countries, especially on the African continent. These countries, including South Africa, are struggling with the digitalisation of records, let alone the management of paper-based records. This study, conducted in the public sector in South Africa, explores literature review to critically analyse challenges to archival functions that can be mitigated through the application of artificial intelligence technologies. Findings reveal problems relating to governance in a digital environment, a lack of accountability, the high level of litigation rates, bad audit results, and a lack of or poor service delivery emanating from a breakdown in records systems in South Africa. Both paper-based and digital records management systems in the public sector in South Africa are in a state of disarray. As a result, the preservation of digital records is slowly taking place, which leads to the loss of memory for the entire public sector. It is concluded that the market is ripe for disruptive technologies such as artificial intelligence, cloud computing and blockchain in the management and preservation of records in the South African public sector. The study recommends that governmental bodies cautiously consider exploring the possibility of storing their records in a trusted digital repository cloud as an interim solution while observing legal obligations. Other technologies such as blockchain technology can also be adopted to ensure the security of records.

Keywords: artificial intelligence technologies; disruptive technologies; records

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management; archives; preservation

Background to the Problem

The management and preservation of public records, whether analogue or digital, are still an Achilles heel in South Africa. This is despite the mandate allocated to the national and provincial archives through Schedule Five of the Constitution of the Republic of South Africa (South Africa 1996a). The Constitution mandates public archives repositories in South Africa to regulate records management in governmental bodies (national departments, provincial departments, municipalities and statutory bodies). This mandate emanates from Jenkinson's (1922) assertion that the primary role of the archivist is to manage the records while the secondary role is to make the records accessible to the users. The mandate charges public archives repositories with a statutory regulatory role regarding the management of records in governmental bodies, as well as the preservation of records of enduring value to be used or accessed by the public at large. Despite this mandate, governmental bodies in South Africa are characterised by poor records management, as well as a lack of resources and skills to manage records, resulting in poor accountability (Ngoepe 2012; Ngoepe and Ngulube 2014), provision of poor health services (Katuu 2015; Marutha 2017; Marutha and Ngoepe 2017), travesty of justice (Ngoepe and Makhubela 2015), and massive loss of digital memory and cultural heritage (Harris 2007; Katuu and Ngoepe 2015; Ngoepe and Keakopa 2011; Ngoepe 2017; Ngulube 2003), to mention just a few issues.

As Katuu (2015) would attest, the challenges of managing and preserving records are compounded by the vast technological developments that have impacted how public records are created and managed in devices such as mobile and cloud computing technologies. Despite these developments in technology, in South Africa, the identification and transfer of digital records from public institutions into archival custody, which are legislative requirements, have not happened in any systematic manner because the national archival system has wriggled to effectively manage such records and enable their long-term preservation (Ngoepe and Keakopa 2011). This is because the national archival system is plagued by poor infrastructure and the lack of skilled capacity to ingest digital records for permanent preservation (Katuu and Ngoepe 2015). As a result, the management and preservation of these records are left to the offices of origin, even though they themselves lack the infrastructure, knowledge and skills to preserve digital records in the long term. On the other hand, Ngulube and Tafor (2006) alluded that the digital preservation is likely to remain a global information management challenge in the foreseeable future. The problems to grapple with include machine-dependent accessibility, technological obsolescence, media longevity, lack of organisational commitment and willingness to allocate enough resources for digital preservation, limited expertise and research on digital technology, and the sheer growth of electronic records.

The challenges are not only limited to digital records, as Ngoepe and Makhubela (2015) alluded that the poor records management also affects the judicial system thereby compromising the provision of justice due to cases thrown out of court because of the lack of recorded evidence or missing police dockets. This is also confirmed by Kgosana (2019) in the *Citizen* newspaper that the Pretoria High Court's filing system is a "mountain of unruly paper mayhem". He also reports that the basement of the High Court in Pretoria contains a mess of more than 500 000 court files, with evidence, transcripts and summons dumped and stacked up to the ceiling, with much of it inaccessible for court proceedings. In one unrelated case, reported by Ramothwala (2019) in the *Sowetan* newspaper, Polokwane high court judge Joseph Raulinga was forced to postpone delivering judgment in the murder case of businessman Rameez Patel as evidence in the form of records has mysteriously gone missing. In this regard, a CD recording in the trial was missing and some evidence on the tapes was deleted. As Ngoepe and Makhubela (2015) would attest, such a situation can result in the travesty of justice as the case might be thrown out of court and the culprit walks free.

The provision of public healthcare services is also one of the areas affected by poor records management in South Africa. Katuu (2015), Luthuli (2017), Luthuli and Kalusopa (2017), Marutha (2017), and Marutha and Ngoepe (2018) paint a picture of a healthcare service that is on the brink of collapse, partially due to poor management of medical and patient records. For instance, when these records are needed by the healthcare providers, they cannot be retrieved. Marutha (2017) reports of a case where the Polokwane Hospital was unable to provide medical records for one of its chronic patients who suffered from cervical cancer. The file was needed for further treatment by the private doctor to conduct radiotherapy on the patient. Unfortunately, when that doctor needed the patient's file to get her medical history, the medical records, including X-rays could not be found. This negatively affected the provision of healthcare to the patient. Furthermore, commentators lament medical records not integrated in a single system, resulting in a new file being opened every time a patient visits a different hospital. For example, in a study by Marutha (2017) it was established that even within one province in South Africa, medical records are not integrated. As such, a new file is opened every time a patient visits a different hospital within the same province. This compromises the quality of healthcare, as a medical practitioner diagnoses a patient without the full medical history.

Accountability, transparency and good governance through auditing are also affected by poor records management. Masegare and Ngoepe (2018), and Ngoepe (2012) report that every year the public sector in South Africa is plagued by an abyss of audit results and a perilous financial state. This is partially attributed to poor record-keeping. In this regard, when the external auditor of government (Auditor-General of South Africa) audits governmental bodies, one of the constraints it faces is that records are either not available or could not be retrieved. With regard to preservation and access, Ngulube (2006) emphasises that some of the preserved records in South Africa cannot be

accessed owing to the lack of physical and intellectual control of these records. In this regard, records are not classified, arranged and described. Moreover, it is not known where these records are kept.

The consequence of the challenges alluded to in the preceding paragraphs is that governmental bodies in South Africa are unable to provide effective and efficient services to their clients, resulting in widespread service delivery protests (Ngoepe 2012). Bigirimana, Jagero, and Chizema (2015) opine that poor management and preservation of records have a destructive influence on the economy, governance and the delivery of services in the public sector in South Africa. To mitigate the problem of mismanagement and preservation of records in the public sector in South Africa, possible and innovative measures are needed. Therefore, this study demonstrates through literature review the need for adoption of disruptive technologies such as artificial intelligence (AI), cloud computing and blockchain technology in dealing with records management and preservation issues in South Africa. First, the study identifies the problems associated with management and preservation of records in South Africa, and the functions that can be executed through the use of disruptive technologies.

Management of Records in South Africa

In South Africa, the National Archives and Records Services of South Africa (NARSSA) is charged with the management of records in the public sector in terms of section 13 of the National Archives and Records Service of South Africa Act (South Africa 1996b). This particular section is applicable to current records that are still in the custody of creating agencies. In terms of the mandate, the NARSSA is responsible for determining classification systems in governmental bodies, issuing disposal authorities, conducting records audits and training records managers. Despite this mandate, both the NARSSA and other governmental bodies are struggling to manage records, resulting in a lack of access to information in terms of freedom of information legislation (Mojapelo 2017; Ngulube and Tafor 2006), bad audit results in governmental bodies (Ngoepe 2012; Ngoepe and Ngulube 2014), health services not rendered properly (Marutha 2018; Marutha and Ngoepe 2017; Marutha and Ngoepe 2018; Marutha and Ngulube 2012; Katuu 2015), justice delayed due to a lack of records (Ngoepe and Makhubela 2015), service delivery protests (Ngoepe 2012), and failure to preserve records both in analogue and digital media (Asogwa 2012; Ngulube 2003; Ngoepe 2017).

This is largely caused by a lack of skills in records management, inadequate ICT infrastructure, and capacity and manpower to manage and preserve records in the public sector in South Africa. For example, Ngoepe and Van der Walt (2010, 88) indicate that many governmental bodies implement records management without proper planning. In this regard, records management practitioners go about their day-to-day chores hoping that things will change for the better in the future. As a result, governmental bodies in South Africa tend to adopt a "pay-off line" which Ngoepe (2016) calls "only the future will tell". Ngoepe (2012, 140) concludes that most records management programmes in

South Africa were teetering on the brink of collapse and were on life support and unable to support service delivery due to poor planning and implementation. The situation is exacerbated by the regulatory body (NARSSA) that does not have the capacity in terms of skills and human resources to tackle records management problems in governmental bodies. For example, Ngoepe and Nkwe (2018) report that one governmental body applied for a disposal authority in 2005 from the NARSSA, but it was only issued in 2014. The NARSSA cited a shortage of staff as the reason for the delay in issuing disposal authorities as only one official was responsible for this task (Ngoepe and Van der Walt 2010). This has a serious impact on the retention of records as no record can be disposed of without the written authority from the NARSSA.

It is clear from the discussion above that the management and preservation of records are a concern in the public sector in South Africa. For example, Luthuli and Kalusopa (2017) opine that there is a problem of lost and duplicated records because of poor systems in the public sector in South Africa. Electronic records management systems crash due to their limited storage capacity, records are sent to unintended recipients, and the security of records is exposed to hackers. Ngoepe (2017) alluded that there is a lack of technological infrastructure for the preservation of digital records in South Africa. The author further indicated that, as a result, almost all government entities have not transferred to the NARSSA any digital records but have kept them in their own possession. According to Ngoepe (2017), the storing of these records in the public agencies cannot be considered preservation for the future, since many do not have the capability to locate and retrieve a document after a certain period. As a result of poor records management in South Africa, public entities struggle to retrieve records at a reasonable time, records are destroyed without disposal authorities (Ngoepe and Nkwe 2018), there is shortage of storage space in the archival custody, and records are not transferred to archives repositories for permanent preservation.

Digital data archiving and research data management have become increasingly important for institutions in South Africa (Yuba 2013). Numerous institutions in South Africa have implemented electronic records systems, for example, Rand Water (a South African water utility), the Department of Arts and Culture, the Department of Cooperative Governance and Traditional Affairs, the Department of Science and Technology, the Department of Public Enterprise, and the Presidency (Ngoepe 2017). Records in such systems are ready for transfer to the NARSSA which does not have the necessary infrastructure to ingest them into archival custody.

Preservation of Records in South Africa

Preservation of public records in South Africa is the mandate of both national and provincial archives repositories. Section 3 of the National Archives and Records Service of South Africa Act (South Africa 1996b) stipulates that the objects and functions of the National Archives of South Africa shall be to preserve public and non-public records with enduring value for use by the public and the State. The NARSSA collects non-

public records with enduring value of national significance which cannot be more appropriately preserved by another institution, with due regard to the need to document aspects of the nation's experience neglected by archives repositories in the past, and maintains a national automated archival information retrieval system in which all provincial archives services shall participate (South Africa 1996b). Without proper preservation of records, South Africans will not have access to the past events and transactions that took place in the public sector (Yuba 2013).

Even though Ngoepe (2017) indicated that national and provincial offices are not transferring their records into archival repositories, the National Archives and Records Service of South Africa Act requires that records be transferred into archival repositories. The said Act stipulates that the National Archivist may defer the transfer of any public records and may grant permission for any public records to be transferred to an archives repository before they have been in existence for 20 years (South Africa 1996b). Records are not transferred due to numerous reasons such as a lack of space at the archives repositories, a lack of disposal authorities, and records not being managed properly from offices of origin. As a result, Ngoepe (2017) laments that government entities which have long implemented digital records systems in South Africa are forced to create an interim solution for the preservation of digital records. The challenge is compounded by the fact that since implementing digital systems in the 1990s, some government entities have migrated from one product to another. For example, he mentions Rand Water having migrated to three systems (File Tracking System in 1996, Papertrail in 2003, and FileNet in 2009), while the Department of Science and Technology and the Department of Arts and Culture migrated from Hummingbird to Alfresco. In this regard, there is a possibility that some records might have been lost during the migration as audits of this process are not conducted. Government entities face the dilemma of what to do with digital records of enduring value that are older than 20 years and that are still managed through the digital records system. Perhaps these problems can be mitigated through the application of AI technologies to management and the preservation of records.

Application of AI Technologies for the Management and Preservation of Records

The meaning of AI technologies has changed over the years since the 1950s and is continuing to grow. Liu (2011) and Techopedia (2018) define AI as an area of computer science that puts emphasis on the erection of intelligent machineries that function and respond like humans. In this study, AI refers to robotic machines, programmes and software that have the capacity to carry out a complex series of actions automatically in the area of archives and records management (West 2015). Anything intelligent enough, from cell phones' virtual assistants such as Siri to search engines such as Google to mobile apps, is powered by AI. AI started as a pursuit to build human-like robots that could understand people, do chores and help to overcome loneliness. However, the field of AI has grown to incorporate various techniques that assist in creating smart,

functional and dependable software applications (Pathak and Bhandari 2018). Although Gillin (2018) contends that organisations have been trying to apply AI technologies to the task of records management for more than 20 years, mostly without success, the researchers believe that AI technologies can be applied to alleviate some of the issues identified in relation to the management and preservation of records in South Africa. This technology has not been explored fully in the management and preservation of records in South Africa.

Records in South Africa are supposed to be managed throughout their entire life cycle to enable transparency, accountability and good governance. However, Ngoepe (2016) reveals that most records managers in South Africa are not included in the management of records at the creation stage. By the time they become involved, the records would no longer be retrievable and preserving them becomes a problem. This is despite Duranti (2012) advising the records management community that records managers should be included even before a record is created in order to identify the records to be preserved at the moment of their creation, assess the authenticity of the records, monitor them throughout their existence, and determine the feasibility of preservation on the basis of the archives' technological capacity. Therefore, AI technologies can be one of the ways to deal with the records management challenges. AI technologies will ensure that records can be stored in the cloud, that digitisation of records will take place faster, that records will not be duplicated, that access to records will be effective, and that records can be accessed anywhere. There are certainly many AI automation concepts that can apply to records management. This refers to concepts such as the digitilisation of records, as well as enabling the digital preservation of records in the public sector in South Africa.

One way of using AI technologies is through fingerprinting technology. In this regard, sample documents can be provided to an application that represents the types of content in a governmental body. The application will analyse these to find common characteristics. These common characteristics are referred to as the document's "fingerprints" (Woodward 2018). When the documents are uploaded, the application extracts data and metadata from the samples. It then uses analytics to determine what records series should be applied to the content. This will then solve the problem of records classification systems, which also informs the retention of records. One of the primary inhibitors to the use of AI technologies in records management has been the tedious and time-consuming process of training the computer algorithms to look for specific elements. This helps to classify content correctly against the file plan and enhances search and retrieval of records, thus eliminating loss of records.

The key approach to alleviate records management problems would include an automated classification system in which there is application of categories, label and metadata content using fingerprinting or linguistic analysis. Machine-learning algorithms can comb through unstructured text and learn about the format and the content as they go. Machine learning uses statistical techniques to give computers the

ability to learn. Giving a computer a few documents that have been preclassified by humans provides enough information to get it started on larger sets of records. Humans are needed to confirm the machine's work in the beginning, but one of the benefits of machine intelligence is that the computer gets "smarter" as it goes along – eventually eliminating the need for any human intervention (Gillin 2018).

Another way of mitigating the records management problem through AI technologies is by using natural language processing (NLP). NLP is AI technology concerned with the interactions between computer and human (natural) languages. However, currently NLP will only be programmed to use English as a medium of instruction in South Africa. It also looks at how to program computers to process enormous amounts of natural language data using linguistic analysis. NLP includes a large group of automation tasks, but only a few directly apply to records management. Firstly, NLP can be used to identify terms and metadata that are relevant to the document, as if a person had manually read and chosen terms, rather than the terms that appear most frequency. Secondly, optical character recognition (OCR) can recognise text in images and classify them appropriately. Thirdly, given a chunk of text, NLP can identify the relationships among named entities. For example, it could pull the name of a person from the document and automatically look up what department they work in, even if the department is not mentioned in the document directly.

Furthermore, automated rules can also be used as they perform repetitive actions on behalf of the records manager. In this regard, the automated rules are triggered when certain criteria are met. For example, when a record is classified on the system, a retention schedule is automatically assigned. This can help to alleviate the problem of disposal authorities and retention schedules as identified by Ngoepe and Nkwe (2018). Closely related to NLP is black box automation that identifies relationships between data and predicts the next data sequence. It uses the informetric techniques of word counts in a document. A fingerprint is then developed through comparison with similar documents so that when, in future, a document matches that fingerprint, an inference can be made regarding what metadata to apply. This will ensure that records are classified correctly to minimise loss. With regard to paper-based records, for the purpose of security, files can be installed with trackers and not be arranged in order on the shelves, but rather be shelved randomly where there is space.

Another potential application of AI technology to records management is compliance. Literature review has indicated that records are not always available or retrievable when needed for auditing purposes. Normally, governmental bodies often have only a few days to assemble all the supporting documentation needed for an audit query from external auditors. It is typically a frantic and error-prone process for humans, but machines can be trained to spot keywords, labels or patterns that identify a document as relevant for compliance purposes, and then extract it in minutes.

It is reported in the literature that patients in hospitals do not receive full medical health services owing to incomplete files (Marutha 2017). Cases are thrown out of court owing to missing files, resulting in the miscarriage of justice (Ngoepe and Makhubela 2015). For security of digital records in this regard, the South African government can consider using blockchain technology. Blockchain is a document with entries that are shared with a group of people and organisations. In other words, it is a digital and distributed ledger of transactions which are recorded and replicated in real time across a network of computers or notes. With blockchain, it is impossible to change information without leaving a digital trail. The shared document is encrypted and verified to ensure that the data it stores is always correct. Every record added to the blockchain ledger has a unique key associated with it and that can be trusted. This can help to trace people who delete case files and ensure that patient files in integrated systems are secure. Blockchain can be used to secure such information so that when medical records are integrated, a complete, accurate and secure medical history can be generated. In that regard, a medical record of a patient can be accessed anywhere in the country, leaving a digital trail for a system that can be trusted inherently (Harman 2012).

With regard to converting analogue records to a digital environment, AI technologies can be applied to speed up the process. AI technologies process information faster and quicker than humans. For example, the Ripcord Company (2018) claims that its robot can do what humans do for eight hours just in two hours in the process of digitalising records. This will ensure that records are managed and digitised faster than when processed by humans. Currently, records practitioners consume a lot of time sorting out the documents before scanning them. They start by removing the staples on each document and classify them accordingly before scanning and storing them on the system. However, programmed robotic machines can be utilised to perform any task, from removing staples and scanning images to automatically converting them into searchable text and uploading them to a cloud server (Ripcord Company 2018). The machines can be programmed to take stacks of paper, pull out any staples and load them one sheet at a time onto a conveyor belt for rapid scanning up to one sheet in a second (Prigg 2017). In this regard, as AI technology is involved, records management practitioners would just package and ship the records to the robotic machine. Upon receipt, the content is logged, assigned a unique barcode, and tracked as it moves through the digitisation process (Ripcord Company 2018). The utilisation of AI technologies such as machine learning performs functions that are normally assigned to many staff members and that take hours to perform.

One of the issues identified in literature is a lack of infrastructure to ingest digital records into archival custody, as well as space to store both paper-based and digital records. The preservation of records in the public sector is of paramount importance for heritage and historical purposes (Schellnack-Kelly 2014; Yuba 2013). In most countries, including South Africa and Botswana, the national archival institutions are charged with the tasks of ensuring the proper management of public records, promoting the preservation and accessibility of archival heritage and overseeing the national

archival system (Ngoepe and Keakopa 2011). As such, proper technological infrastructure is required to ensure that records are preserved successfully in the public sector in South Africa.

One other option that can be used to preserve records is in the cloud storage. Cloud storage can be defined as the storing, processing and use of data on remotely located computers accessed over the Internet (Goh 2014). It involves sharing computer resources, thus giving users unlimited computing power on demand and accessing their data anywhere through the Internet, without making a major capital investment. Although public servants informally and unwittingly put some records in the clouds, governmental bodies in South Africa are sceptical to entrust their records in the cloud owing to a number of reasons such as a lack of trust of the cloud storage, jurisdiction, legal implications, data privacy and security risks (Ngoepe 2017). Cloud storage offers a world without online storage, unlimited data storage at the speed of light and it is an enabler for big data. As cloud storage is not very prevalent among governmental bodies in South Africa, given present challenges in managing digital records, it would be advantageous to have cloud storage tested rigorously before embarking on the exercise. Paper-based records can also be converted to digital objects and stored in the cloud. This will help to alleviate the problem of space and provide accurate access to records in the public sector in South Africa. Like any other countries, South Africa has relevant ICT policies that enable the application of the fourth industrial revolution technologies to be applied in all spheres of lives.

Conclusion

From the challenges outlined in the discussion, it is clear that the market is ripe for the application of disruptive technologies in the management and preservation of records in the South African public sector. The cloud and blockchain are some of the key enablers for the AI revolution, especially in the area of management and preservation of records. The cloud provides both the storage and computing power, while blockchain offers the security needed for records. Although AI has the potential to alleviate problems associated with the management and preservation of records, it has not been tested in South Africa in this area. Owing to a lack of infrastructure for the management and preservation of digital records in South Africa, for the purpose of increased storage and access, this article recommends that governmental bodies cautiously consider exploring the possibility of storing their records in a trusted digital repository cloud as an interim solution while observing legal obligations. AI technologies in most cases utilise the cloud and online platforms to store the records. AI technologies have resurfaced, and with the emergence of blockchain technology, it is on the brink of a revolution that involves creating complete product offerings with intelligent software and hardware (Pathak and Bhandari 2018). This article recommends that the public sector in South Africa invest in the adoption and application of AI technologies to acclimatise to the fourth industrial revolution technologies just like other developed countries in the world.

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