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Original Article

Digital Record-Keeping Practices: Electronic Records and Archives in the Cloud

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Abstract *- The lure of cloud computing services tremendously impacts electronic records and archives management. Due to the use of many different clouds by employees, organizational records and archives are stored in a widespread manner that no longer conforms with the principles, rules, regulations, and legal requirements of the way public records and archives are managed. Thus, protecting national governments, state, or business secrets and long-term preservation of the organizational memory in the cloud have become critical issues. Given the increasing use of various architectures for digital government, it is crucial to investigate the impact of cloud computing architecture on the fundamental principles of records and archives. This literature review aims to explore whether the cloud computing architecture is sufficient to maintain the life cycle process, provenance and original order of electronic records and archives. The finding revealed that there is a lack of consensus on the concepts of records and archives architecture that support records and archives management.*

Keywords *- Cloud computing, Cloud storage, Electronic records, Archives, Electronic records management system.*

1. Introduction

In today's digital landscape, up-to-date record-keeping practices are essential for businesses and organizations; thus, organizations can optimize their operations by adopting digital record-keeping practices. As a result of the Fourth Industrial Revolution's (4IR) technological advancements, archives and records management professionals must display a diverse set of abilities that allow them to serve as multi-disciplinary guardians of records and enhance their roles in their organizations and society as a whole. By demonstrating their competency proficiency, archivists and records managers can fulfil their mandate of safeguarding and managing records in a rapidly evolving technological environment (Ngoepe et al., 2022). As a result, several organizations and research groups have developed guidelines for cloud-based record creation. These guidelines offer a framework for entities to create and maintain records in the cloud while adhering to industry standards and best practices. Adopting cloud computing is believed to allow organizations to increase their ability to manage and store data virtually. Cloud computing has provided many benefits for managing electronic records, including widespread access and flexibility in creating, storing, using and managing records and archives (Pillen & Eckard, 2023). Consequently, cloud systems services have also provided efficiency and effectiveness in managing organizational memory, which is part of the nation's and, collectively, the world's memory. The technology underlying cloud computing ensures the availability of data, records, and information at any time and from any location. This has significant implications for organizations seeking to enhance the efficacy and efficiency of their operations by enabling real-time access to critical information. By leveraging the benefits of cloud computing, organizations can streamline their data management processes, allowing their staff to focus on higher-level tasks and priorities (Mosweu et al., 2019). Thus, cloud computing is increasingly recognized as a game-changer for organizations hoping to maintain competitiveness in today's data-driven, fast-paced world. Even though the cloud computing providers claimed that their services could provide efficient and effective services to user communities and the market, with records and archives specifically, there are specific rules, regulations, conceptual foundations, and legal requirements that should be made known and understood by the cloud system developers and providers and the keepers of the records themselves (Han et al., 2021). Therefore, when contemplating records management within the context of cloud computing, it is imperative to acknowledge the substantial advantages for organizations and the capacity to mitigate risks effectively. In light of these considerations, incorporating cloud computing for electronic records and archives has substantially advanced the capacity for disseminating specific information. Nonetheless, the absence of lucidity and standardization of laws at the

national and international levels has resulted in data breaches and inappropriate utilization. As noted by Pillen and Eckard (2023), the complexities associated with cloud computing are manifold, rendering the archival of digital information in the contemporary era notably challenging. Therefore, this paper explores whether the architecture of cloud computing is capable of preserving the life cycle process, provenance, and original order of electronic records and archives. This literature review aims not to provide an analytical discussion and debates of cloud architecture from the technical perspective but rather to explore whether the cloud computing architecture has thus far fulfilled the fundamental requirements of records and archives based on the articles selected for this review. The adoption of cloud-based storage has emerged as a critical area of concern for organizations, and it must be addressed to ensure the safety and integrity of the data. This paper is organized into four main sections. Section 1 introduces the electronic records and archives. Section 2 presents the related works on cloud computing. The research plan is outlined in Section 3, and the findings and recommendations for future research are presented in Section 4.

1.1. The National Governments' Records and Archives

Government organizations conduct business on behalf of the public, and their functions, programs, and services involve creating, exchanging, and disseminating records. Governments require records to make informed decisions about public service delivery, demonstrate public accountability, and maintain government continuity and integrity (IRMT, 2009). The continuity and integrity of government should be reflected in the life cycle process, provenance, and original order of records. The process of the records life cycle is traditionally interpreted as starting from the creation or reception of the record by the organization until the appraisal process to determine their value. However, the life cycle process of electronic records should start at the design stage of the record-keeping system. Decisions concerning the retention and disposal of records, file classification and the flow of information within the electronic record-keeping system must be embedded at this stage (Kandur, 1992).

On the other hand, cloud computing is a technological phenomenon that brings with it an array of advantages and opportunities for the digital transformation of private and public organizations spanning various sectors of the economy (Shibambu, 2022). As a result, cloud computing has emerged as a key driver of growth and innovation, offering immense potential for organizations to transform their operations and achieve greater efficiencies. Meanwhile, every nation's archival institution is responsible for acting on behalf of society to ensure the prevention and continued accessibility of the nation's collective memory. The responsibility for protecting all public records must be maintained, regardless of the medium in which they are stored (IRMT, 2009). In the traditional environment, the archival process begins at the end of the records life cycle; when the decision has been reached, records are appraised for their permanent or archival values. The archival process is based on the principles of provenance and original order derived from the records' life cycle process. Frequently referred to as 'respect des fonds', the concept of provenance indicates that records and archives of the same creators (agencies) must not be intermingled with those of any other creators (Kandur, 1992). Archives of a single provenance should retain the arrangement established by the creating agency, institution, or organization to preserve their existing relationships within the original order of records at their current stage in the life cycle, demonstrating the decision-making process. The arrangement of records in a file system or a sequence clearly demonstrates the pattern of events that lead to a decisive outcome. For researchers, this information is as important as the file's content. Therefore, the records life cycle concept, provenance principles, and original order must be considered before the cloud computing architecture is explicitly developed for born-digital records and archives. More than two decades earlier, Kandur (1992) and Yusof and Chell (1999) conveyed their sentiments on the impact of IT on the records' life cycle concepts and provenance and original order.

1.2. Electronic Records Management Systems (ERMS)

Records created by government sectors generally are grouped into two main types: housekeeping group and functional group. Housekeeping records are common across all organizations and business enterprises, comprising records of general administrative matters (land matters, building and infrastructure), assets, fiscal/financial, and human resource management. Functional records group, which differs from housekeeping records, comprises records pertaining to core functions and responsibilities of the organizations (for example, policies, decisions, transactions, etc.) that are different across organizations. These records must be managed in an ERMS that has functional requirements that could protect the key attributes of records: authenticity, reliability, and accuracy.

The ERMS tool is widely viewed as a helpful means of collaboration (Oladejo and Hadžidedić, 2021), enhancing productivity and outcomes, making it a preferred choice among professionals in various industries. This is possible as the ERMS, at the time of its development, should consist of a detailed explanation of high-level business processes of the records life-cycle, which involved the functional requirements embedded into the system for Records Creation and Capture Management, Records Usage and Access Management, Records Maintenance Management, Appraisal Management, and Records Disposal Management (MoReq 2010, National Archives of Canada 2006, National Archives of Malaysia 2008; Walker 2002; DoD Standard 5015.2 2007; ISO 16172; and ICA, 2007).

Table 1. Significant differences between an ERMS, EDMS, EIMS and DBMS

ERMS	EDMS	EIMS	DBMS
Implement measures to ensure the integrity of records, hence safeguarding their validity, correctness, dependability, and trustworthiness.	Allows for the modification and/or existence of several versions of documents.	Facilitates the alteration and/or existence of many versions of documents and other forms of digital information.	
Imposes limitations on the removal of data unless under particular and strictly controlled conditions.	Enables owners to erase documents.	It allows owners to remove papers and other forms of digital information.	
Must have strict retention guidelines	"It may entail the implementation of certain retention controls."		
Must include a classification in which determines the required arrangement structure and this maintained by a designated administrator.	Users may manage the structure of document storage.		
It has to have a strict classification strategy for records management, which is kept up to date by the administrators.	This document system has been developed explicitly for daily use to facilitate ongoing company transactions.	The primary goal is to make it easier for people to use papers and other forms of information in their day-to-day work.	
The system must provide long-term preservation and secure storage of critical records for archival purposes.	Document preservation might be a part of it.	Preservation of information might be part of it	It might encompass the preservation of data

An ERMS is a digital system that enables organizations to assign a specific life cycle (captures, receives, uses, manages, maintains and disposes) to the information created as records, eliminating the need to manage paper-based and analogue records (Hawash et al., 2020). Other than using the ERMS, many organizations also manage their born-digital housekeeping and functional records in other systems, such as Electronic Document Management Systems (EDMS), Electronic Information Management Systems (EIMS), and Database Management Systems (DBMS). Table 1 illustrates the significant differences between these four types of systems suggested by IRMT (2009). Organizations worldwide find it increasingly necessary to adopt the latest technologies, particularly those encompassing fundamental categories such as ERMS, EDMS, EIMS, and DBMS. However, the survey of ERMS implementation found that over half of institutions could not guarantee electronic record authenticity and reliability (Q. Xiao et al., 2021). It is supported by Shibambu (2022) that certain organizations continue to hold the opinion that transferring their records to the cloud is dispensable due to apprehensions regarding data security, confidentiality, and reliability. Based on current research, it is imperative to possess a comprehensive and in-depth understanding of ERMS and the utilization of cloud-based storage to make significant strides forward.

2. Related Works

ARMA International describes the cloud computing field as characterized by its dynamic and evolving nature, which has led to its widespread adoption across industry, government, and academia (Katuu, 2022). This versatile technology has demonstrated its ability to revolutionize the way organizations operate and has become an essential component of modern-day computing infrastructure. As such, professionals across various sectors must stay informed on the latest advancements and best practices in cloud computing to ensure optimal performance, security, and efficiency. The 2016 InterPARES Trust report states with confidence that cloud computing services have experienced exponential growth in adoption by organizations over the years (Mosweu et al., 2019). Accordingly, the findings of the InterPARES Trust report highlight the growing importance of cloud computing in modern organizations' operations and the need for organizations to adopt the technology to remain competitive in the market.

2.1. The Key Attributes of Electronic Records that Need to be Protected in the Cloud Systems

The record created by the various computerized systems is defined by the International Council on Archives (ICA) Committee as recorded information produced or received in the initiation, conduct or completion of an institutional or individual activity and that comprises content, context and structure sufficient to provide evidence of the activity (ICA, 2005). The content is the information or data; context is the relationships of the records to other records and to the organization that created it; the structure is the inherent logic to the way in which the information it contains; and the metadata which is likely to define its context-are laid out and which is ultimately interpretable by the human eye (IRMT, 2009; Park and Liang, 2017). These key elements are the essential foundation for the reliability, accuracy, authenticity and trustworthiness of electronic records and archives, which is the foundation of the principles of provenance and original order (Pillen and Eckard, 2023). Whether the records are created on paper or in an IT environment, the provenance and original order of records and archives need to be protected. It has an ancient root, is fundamental to archival

science, and enjoys a centuries-long theoretical foundation (Rogers, 2016). The computerized technology used in the creation of organizational records has had tremendous impacts on the traditional systems of records and archives management fundamentals of the key attributes of the so-called machine-readable records in the 1990s (Rogers, 2016). The creation of authentic, reliable, and accurate records and archives over time and across technological change has become more challenging with the advent of cloud technology, which started with the introduction of Artificial Intelligence (AI) concepts in 1969, followed by network operating systems and internet connectivity in 1985. The nightmare began following the explosion of the Internet with the launching of the World Wide Web in 1991, which optimized the foundation technology for the cloud with the emergence of the dotcom revolution (Maguire et al., 2021).

International governments and international consortiums of research projects, in their efforts, revisited the fundamentals of archival science in developing specific functional requirements for evidence in record-keeping and long-term preservation of reliable, authentic, and trustworthy permanent records in electronic systems (Rogers, 2016). Significant international electronic records management research projects, among others, include VERS (1990s); CEDARS (1990s); LMER (2005); ESPIDA (2005); CRMK (2007); DAVID (2007); RODA (2007); DRIVER (2009); DATA-PASS (2009); DPE (2009); and the most extended UBC InterPARES Project series started in 1999 until presently.

International in scope, multi-disciplinary in nature and the longest-running InterPARES has developed knowledge essential to the long-term preservation of authentic records created and/or maintained in digital form and provided the basis for standards, policies, strategies and plans of action capable of ensuring the longevity of such material and the ability of until its users to trust its authenticity (Rogers, 2016; Park and Liang, 2017).

2.2. Cloud Computing

Maguire et al. (2021) have listed the top Cloud Service Providers/leaders, among others, as Amazon Web Services (AWS), Microsoft Azure, Google Cloud Platform, IBM Cloud, Oracle, VMware, Salesforce, and Alibaba, with numerous key players companies involved. With billions of devices connected to the Internet by cloud service providers, micro data centres are forced to go undersea. Technology giants Facebook and Google have announced Apricot, a new subsea cable that will boost connectivity in the Asia Pacific region, which is expected to launch in 2024 (Kenechi Okeleke, 2022). Currently, the cloud is overcrowded, and the impact on records and archive management is tremendous as they have different approaches, purposes, and importance (Opgenhaffen, 2022).

Table 2 shows the overview of ERMS by comparison to cloud computing. Humayun (2020) has listed the characteristics of the cloud computing system.The core business of cloud computing consists of four service models available to cloud consumers: cloud Software as a Service (SaaS), cloud Platform as a Service (PaaS), and cloud Infrastructure as a Service (laaS) and business as a service (BPasS) (Humayun, 2020). As the cloud market matures, specialized services that boost cloud-based product adoption, including Desktop-as-a-Service (DaaS), Metal-as-a-Service (MaaS), Disaster Recovery-as-a-Service (DRaaS), and Storage-as-a-Service (STaaS). These services are delivered through four computing infrastructure models: private cloud, community cloud, public cloud, and hybrid cloud (Shibambu, 202; Mosweu et al., 2019; Ngoepe et al., 2022; Han et al., 2021).

Table 2. Overview of ERMS versus cloud computing

Item	Electronic Records Management system	Cloud Computing
Definition	Provide ways to handle administrative/business records within an organization.	Ubiquitous: Virtual resources accessible from everywhere for massive users
Computational capabilities	▪ Limited within an organization and its entities ▪ Data-oriented ▪ Original copies ▪ Stable/static ▪ Admissibility	▪ Virtually unlimited ▪ Service-oriented ▪ Multiple copies ▪ Changeable Provision ability
Purpose	Providing administrative tasks and interconnectivity of real-world objects within an organization.	Enable data storage, processing, and accessibility.
Working mode	Centralized Network within the organization.	Computing on a large scale
Benefits	The implementation of automated processes for everyday administrative and business duties, as well as continuous monitoring, ensures complete confidence and transparency.	Low maintenance, backup facility, and centralized platform.
Challenges	▪ Consistency, authenticity, trustworthiness, reliability, chain custody, availability, security, and privacy. ▪ Long-term maintenance of authentic documents.	Flexibility, security, availability, transformation

Table 3. Records and archives management functions provided by SaaS (Hidalgo, 2013)

No.	Records and Archival Functions
1.	**E-mail and office productivity:** Applications for e-mail word processing, spreadsheet presentations, etc.
2.	**Billing:** services for applications to handle client paying according to product and service subscriptions and use.
3.	**Customer Relationship Management (CRM):** CRM Applications include sales force automation and call centre software.
4.	**Collaboration:** Tools for users to form work groups within and across organizations.
5.	**Content Management:** Services for overseeing the development and distribution of web application content.
6.	**Document Management:** Applications that facilitate document management, ensure compliance with document creation processes, and offer collaborative workspaces for groups or organizations to locate and retrieve documents.
7.	**Financials:** Software that manages fiscal matters, including but not limited to processing invoices and costs processing taxes.
8.	**Human Resources:** Software for managing human resources functions within companies.
9.	**Sales:** Applications that are specially tailored for sales operations, such as pricing and commission monitoring.
10.	**Social Network:** Social software facilitates and sustains connections between users with one or more specified categories of interdependencies.
11.	**Enterprise Resource Planning (ERP)** is an all-inclusive computer-based system that is utilized for the management of resources, both internal and external, encompassing physical assets, fiscal resources, materials, and human resources.

The literature suggests that cloud services such as SaaS may include records and archival functions whereby many national governments, among others such as China, European countries, Japan, New Zealand, Thailand, the United Kingdom, United States and Vietnam and many others, have adopted SaaS for administrative and business transactions specifically (Omurgonulsen et al., 2021; Han et al., 2021). Table 3 shows eleven related records and archives management functions provided by SaaS, as listed by Hidalgo (2013). SaaS allows clients to remotely access software hosted on the provider's infrastructure (Mosweu et al., 2019).

The model eliminates the need for local installations and frees up resources that can be redirected to other critical areas of organization operations. In the SaaS layer, various applications are provided for electronic document management, including systems for formation processing, management, handover reception, and long-term storage (Han et al., 2021). By leveraging SaaS, organizations can streamline their operations and improve their bottom line while enjoying scalability, flexibility, and real-time access to cutting-edge technology.

2.3. Cloud Computing System Architecture

Cloud system architecture is a systematic and structured mechanism that creates a pathway for the advanced ICT sector and gives an integrated approach to organization (Mosweu et al., 2019). At the same time, Y. Wang (2019) defined cloud system architecture as the conceptual interpretation that describes the data flow, arrangement, and relation between the elements of the system, which provides a detailed field of vision. In cloud computing technology, system architecture is the essential component that guides design decisions, as different areas of business processes and workflows need different architectural designs.

There are different types of architectural design discussed in the literature, among others such as software engineering architecture (Kitchenham & Charters, 2007; Humayun, 2020); Service Oriented Architecture (SOA) (Mosweu et al., 2019; and Y. Wang, 2019); semantic web services architecture (Alouffi et al., 2021; Baheer et al., 2020); integrated and interoperable architecture (Baheer et al., 2020); layered architectures (Xue, 2017; Mosweu et al., 2019); Distributed System Architecture (Baheer et al., 2020); and Governance Enterprise Architecture (GEA) (Ngoepe et al., 2022; and Shibambu, 2022). However, in the area of e-government and Electronic Medical Records (EMR) or Electronic Health Records (EHR), the cloud systems architecture commonly used are layered structure and Service-Oriented Architecture (SOA) (Baheer et al., 2020; Humayun, 2020). The literature suggests numerous papers on cloud architectures have been published resulting from discussions, analysis and case studies.

However, architecture specifically suitable for records and archives management in the cloud is not well documented to assist record managers and archivists, particularly in developing operable and effective infrastructure. Thus, the cloud's common models and architecture design need to be adjusted to the needs of the long century's fundamental principles of records and archives practices. Even though the business processes of the records life-cycle are indispensable main tools and real administrative products of e-government functions and activities, records and archives management architecture should be treated differently and specifically within the e-government generated cloud architecture. The design of electronic records and archives architecture must reflect the multiple aspects of the records' life cycle and their functional requirements, including organizational, administrative, and legal factors and standards. Therefore, exploring cloud

management information within the context of records and archives management lays the groundwork for implementing robust digital records and archives management strategies.

2.4. Challenges of Cloud Migration

Cloud computing has fundamentally transformed data storage and archiving paradigms, offering unprecedented efficiency, scalability, and cost benefits. As emphasized by McLeod and Gormly (2017), given the rapid evolution of technology, it is imperative for organizations responsible for records and archives management to embrace cloud-based operations. Nonetheless, this technological evolution has concurrently ushered in substantial challenges, necessitating meticulous attention and sophisticated strategies from organizations to mitigate potential risks effectively. According to Mosweu et al. (2019), one of the biggest challenges in adopting cloud computing is the Internet and its architecture; their study on public services indicated that most institutions have not yet implemented cloud services for managing records and archives due to the reasons.

On the other hand, Shibambu (2022) emphasized that compliance with records and archives management requirements is a significant challenge in implementing cloud computing in the organization. Thus, Guo et al. (2016) believe that understanding the concept of records and archives requirements is critical to protecting records' authenticity in the cloud environment. In addition, Alouffi et al. (2021) highlighted that data security and privacy have been considered the leading factors when deciding whether to adopt cloud computing due to inadequate resources and guidelines to implement cloud services. Therefore, it is imperative to consult pertinent legislation that delineates the requirements for cloud-based records and archives management (Shibambu and Marutha, 2021).

As there is an increasing demand for cloud computing, it is imperative to establish a comprehensive framework to serve as a guideline for its implementation. On the other hand, Shibambu and Marutha (2021) emphasized that cloud computing can potentially resolve challenges such as damaged records, misplaced files, and extended turnaround times for record retrieval. Thus, it is essential to understand the challenges associated with cloud migration to reduce potential risks. Besides, the complexity associated with cloud computing is not only in the technological aspect but also involves other factors that make the adoption of cloud computing in records and archives management more challenging (Pillen and Eckard, 2023). Consequently, the migration to cloud storage for records and archives management necessitated a significant, large-scale transition. As Baheer et al. (2020) emphasized, it is essential to identify the challenges associated with migration cloud archives to avoid potential failures. The adoption of targeted strategies is imperative in the context of utilizing cloud-based records management systems (Mosweu et al., 2019). Thus, it is essential to conduct a comprehensive review of the cloud computing architecture and its development in accordance with the requirements for records and archives management.

2.5. Case Study of Cloud Services

For professionals specialized in archival and records management, cloud services for storing records and archiving collections hold considerable significance (McLeod and Gormly, 2017). The progression of information technology has facilitated the widespread adoption of cloud computing, delivering numerous benefits to various facets of record and archive management (Han et al., 2021). Despite the advantages offered by cloud services, certain organizations have yet to embrace this technology fully for several reasons.

In the context of engagement in the decision-making process pertaining to the adoption (or otherwise) of cloud services for storing an organization's records, the data reveals that 28% of participants were extensively involved, 49% were moderately involved, and 23% reported no involvement (McLeod and Gormly, 2017). In South Africa, the government encounters significant challenges in managing manual paper records, attributed to the lack of a comprehensive framework for managing digital records within cloud-based environments (Shibambu and Marutha, 2021). In other cases, many public organizations in developed countries struggle to adopt cloud services due to disruptive technologies (Manyeke, 2023). In Kenya, the government has provided limited support for the cloud industry, which indicates a slow adoption of cloud computing (Mosweu et al., 2019). Thus, these cases indicated that adopting cloud computing requires a specific strategy to support its usage needs effectively.

On the other hand, Ethiopia has reported that companies adopting cloud computing technologies face significant concerns regarding security, privacy, and trust due to the absence of robust data protection legislation within the country (Manyeke, 2023). At the same time, McLeod and Gormly (2017) delved into the trust concerns surrounding the viability, sustainability, and trustworthiness of cloud services and their implications for records and archives storage. In Ethiopia, the adoption of cloud computing also faces challenges of security, privacy, and trust issues due to an insufficient understanding of the benefits and drawbacks associated with adopting cloud technology (Mosweu et al., 2019).

In contrast, Han et al. (2021), in their research, revealed that a critical issue in cloud computing systems is security, which needs to be emphasized in implementing digital records systems. In the end, these studies indicated that the service provider's reliability is more significant than the trust in the technology. In nations like South Africa, Nigeria, Botswana, and Ethiopia, where data protection laws are established, organizations involved in records management

encounter significant challenges due to the inadequate alignment of cloud data protection legislation with records management practices (Manyeke, 2023). In Africa, non-compliance with legal requirements presents a significant challenge for cloud computing services, as they are impeded by insufficient and outdated legislation in the field of archives and records management (Mosweu et al., 2019). These cases demonstrate that certain organizations continue to encounter challenges due to the insufficient integration of data protection legislation within records management practices. Therefore, it is suggested that the success or failure of any cloud services implementation is highly dependent on cloud architecture (Baheer et al., 2020). While cloud computing presents a multitude of benefits to organizations, it is imperative to acknowledge the existence of certain disadvantages. Consequently, an exhaustive evaluation of its advantages and disadvantages is crucial prior to its adoption.

3. Research Methodology

A systematic literature review is essential to prove that the findings of the review are valid and reliable (Snyder, 2019; Alsalami, 2022). Y. Xiao and Watson (2019) have outlined several methods of conducting systematic reviews that researchers can carry out, including narrative review, textual narrative synthesis, metasummary, meta-narrative, and scoping review. However, this article used the review protocols suggested by Kitchenham and Charters (2007), which involve several discrete activities appropriate to this review's objective. The protocols consisted of three main phases (PCR): planning the review, conducting the review, and reporting the review. It is important to note that the stages listed may seem to follow a sequential order; however, it is essential to understand that most of them involve iteration (the process may not always be linear, and it may have to revisit certain stages multiple times to refine the work continually) for better Quality Assessment Criteria (QAC).

3.1. Research Questions

With a descriptive approach, this literature evaluation focused on developing only one research question to achieve its purpose, which is to examine whether cloud computing architectures are sufficient to maintain the records life cycle process and their provenance and original order with the question: Are the existing cloud software architectures sufficient in maintaining the records life cycle process and the provenance and original order of electronic records and archives?

3.2. Search Strategies

In order to conduct a rigorous systematic literature review, this research utilized the electronic resources available in the digital library, such as ACM, IEEE Xplore, SCOPUS, Springer, and Web of Science, which were used in the search strategy. These resources were instrumental in identifying suitable and pertinent sources of articles that aligned with the study objectives. Only relevant journal articles and conferences were consulted. Keywords, synonyms, and alternatives from electronic records and archives literature associated with cloud computing were used to address the research question. A total of 3,840 citations were identified using search strings #1 and #2. After the screening process, only a total of 713 non-duplicate citations were screened.

Based on the inclusion and exclusion criteria, only 14 articles from the open-access data sources precisely matched the study's objective and questions were selected. Since this study aims to explore cloud computing architecture for maintaining electronic records' life cycle process, provenance, and original order, only papers pertaining to the study of cloud architecture on electronic records and archives are selected. Those explicitly related to the government and electronic medical, health records architecture or other fields were discarded as they would not achieve the study objective and may not answer the research question. Table 4 shows the search keywords and search string used to identify the initial citations on electronic records and archives in the cloud.

3.3. Quality Assessment Criteria (QAC)

Performing a thorough QAC is crucial for a successful systematic literature review (SLR), as the reliability of the conclusions drawn from the selected literature relies entirely on the quality of the literature itself. The techniques used by (Kitchenham and Charters, 2007) and (Y. Xiao and Watson, 2019) for the QAC were adopted to determine the essential studies for evidence pertaining to electronic records and archives in cloud computing. Analyses are grounded on the questions that are put forth.; if the answer is 'Yes', 2 points will be awarded to that study. If the answer is 'No', zero points are given. Finally, if the answer is partial, 1 point is given. Table 5 shows the number of total articles per data source. Following a thorough calculation of points, a total of 14 articles have been deemed suitable for further review pertaining to cloud computing in archives and records management. As this review involves a descriptive review, it assesses existing literature only regarding the specific research question of the study. Thus, all selected articles were related to digital records management and the challenges for archives and records management professionals to coexist with cloud computing and manage it in a digital environment.

Table 4. Search keyword and search string

Search string 1#: ("electronic records" or "digital archives" or "SaaS" or "laaS" or PaaS") AND (Cloud computing) AND architecture AND software
Search string 2#: ("electronic records management systems" or "electronic record-keeping systems" or "archives long-term preservation") AND (Cloud computing) AND architecture AND software

Table 5. The total number of articles per data source

Source	Total article found	Related articles	Selected articles	Total selected articles
ACM	132	1	1	1
IEEE Xplore	237	3	2	2
SCOPUS	19	5	4	4
Emerald insight	307	6	6	6
Web of Science	18	1	1	1
TOTAL				**14**

4. Findings of Studies

The following review comprehensively analyses archives and records management literature in a cloud computing setting. This examination solely focuses on articles that address the particular research query.

4.1. Descriptive Overview of Selected Papers

The final selected papers comprised 14 papers on cloud computing in electronic records and archives, with primary studies on records and archival concepts and cloud computing titles appearing from 2011 to 2023. The analyses found that there is a lack of significant increase in efforts for publication and work produced on electronic records and archives cloud application architecture since 2011 to the time of writing from the records and archival practitioners' community, even though new technologies such as loT, big data, cyber-physical systems, edge, fog and cloud computing take centre stage in international research projects.

It is noticeable that insufficient attention has been given to the subject of cloud architecture in relation to records and archives across different application domains. This lack of focus has resulted in an inadequate understanding of the ways in which cloud architecture can be utilized to improve records and archives management. As such, there is a pressing need to increase awareness and understanding of this topic in order to facilitate the development of effective cloud-based solutions for managing records and archives.

Table 6 displays the comprehensive list of publications that have been selected for review. Table 6 summarizes the studies of cloud records and archives architectures from 14 articles using a comparison format developed by (Baheer et al., 2020).

Table 7 compares records and archives architecture design investigated against the cloud computing services models (e.g., SaaS, PaaS, laaS, STaaS, G-Cloud); application architecture design (e.g., Layered structure, SOA); standards (e.g., ASCII, PDI, RIR, PREMIS, API, REST, XML, HTML, SITA etc.); and technologies (e.g., blockchain, Amazon 3, Google Doc etc.). The proposed architectures are in the form of new frameworks, records life cycle models, developmentof policies and codes of practice, new models based on Open Archival Information Standard (OAIS), preservation strategies, reconstruction of records storage models based on common cloud computing models as the foundation of most of the studies. In many cases, these architectures are presented in the shape of informal diagrams, as most of them are in the form of proposals for new or advanced existing records and archives cloud architecture.

Table 6. Publications selected for review

Authors	Types of paper	Finding of the articles
P1 (Pillen & Eckard, 2023)	Journal article	This article emphasizes that issues surrounding cloud computing go beyond technology and complicate the process of archiving digital information in the modern era.
P2 (Shibambu, 2022)	Journal article	The study has uncovered some noteworthy findings. For instance, Physical host attacks, cross-border jurisdiction, bankruptcy, information access, sovereignty, and data loss are among the security concerns that appear to prevent the government from adopting privately owned cloud services. Even more significantly problematic is the lack of legislation pertaining to cloud storage.
P3 (Shibambu & Marutha, 2021)	Journal article	This study indicates that Governments are now facing difficulties in managing manual paper-based record-keeping systems, as they have not yet implemented a government-owned cloud infrastructure to handle and eliminate documents, despite the advent of cloud computing technology.
P4 (Han et al., 2021)	Journal article	With the specific architecture of an electronic file management system, records management can attain unified, dependable, and secure file management through the utilization of cloud storage, security, and computing technologies.
P5 (Sun, 2021)	Conference paper	A comprehensive security assessment of cloud-based digital archives is essential to identify and mitigate potential security vulnerabilities.
P6 (Q. Wang et al., 2020)	Journal article	A specific security model (blockchain, coding theory, and reliable technology) needs to be established to guarantee the provenance of electronic records, ensuring the authenticity, integrity, confidentiality, and reliability of the provenance information is maintained.

P7 (Mosweu et al., 2019)	Journal article	The utilization of cloud computing services in records management is projected to offer substantial benefits to the African continent. However, the continent is currently unprepared to embrace these technologies and derive the advantages they offer fully.
P8 (Leng et al., 2019)	Journal article	The electronic record system's success hinges on the portal's development and enhancement. However, electronic record centres have low connectivity, which leads to a shortage of interoperability and data exchange. Therefore, it is strongly suggested that cloud computing technology be integrated to enhance the efficiency and versatility of electronic records.
P9 (Y. Wang, 2019)	Conference paper	The analysis indicates that the Hadoop-based cloud computing platform meets electronic archive data preprocessing, storage, information exchange, and business collaboration requirements.
P10 (Wu et al., 2019)	Journal article	The research suggests that an XML archive management system that employs encrypted data can improve query performance without compromising data security, resulting in better system availability.
P11 (Guo et al., 2016)	Journal article	Ensuring the reliability and authenticity of digital records in a cloud environment is paramount. Thus, the archive's role as a neutral and impartial third party highlights the cloud environment's challenges.
P12 (Lee & Lee, 2017)	Conference paper	The findings revealed that many businesses have reservations about adopting cloud-based electronic records management due to the involvement of third-party services and their inherent risks.
P13 (Xue, 2017)	Conference paper	The 'double layer data storage model' proposal presents a viable solution for the entire life cycle of electronic documents, ensuring digital documents' authenticity, evidential quality, and integrity.
P14 (Askhoj et al., 2011)	Journal article	It has been concluded that there are certain areas where Integration issues exist between the OAIS reference model and cloud computing systems. A new layered model for a cloud archiving system has been established in accordance with the discoveries. This model incorporates the concepts and information types from the OAIS reference model, which assists in maintaining archive functionality and simplifying record transfer.

Table 7. Summary of electronic records and archives architecture in the cloud

Authors	Context	CC services model	Architecture design or pattern	Standards, Technologies, and Recommendations
P1 (Pillen & Eckard, 2023)	USA	PaaS	Layered SOA	SOA
P2 (Shibambu, 2022)	South African	G-cloud	Layered	SITA
P3 (Shibambu & Marutha, 2021)	South African	G-cloud	Layered	SITA
P4 (Han et al., 2021)	General	SaaS, PaaS, IaaS	Layered SOA	DNS, XACML, SML, DDOS
P5 (Sun, 2021)	General	Iaas	Hierarchical SOA	ISO27001-2013.AHP
P6 (Q. Wang et al., 2020)	General	SaaS, PaaS, laaS	Layered (GEA)	PREMIS, METS, OAIS, XACML, SAML, Blockchain
P7 (Mosweu et al., 2019)	Africa	SaaS, PaaS, laaS, DaaS	Layered	SOA
P8 (Leng et al., 2019)	General	IaaS	Multi-layered	HBase Apache Hadoop
P9 (Y. Wang, 2019)	General	IaaS	Middleware layer	XML, GUI, HBase Apache Hadoop
P10 (Wu et al., 2019)	General	SaaS, PaaS, IaaS	Encrypted data	XML
P11 (Guo et al., 2016)	China	PaaS	Layered model	Open Archival Information System (OAIS)
P12 (Lee & Lee, 2017)	General	SORMA SaaS, PaaS, IaaS	Layered structure SOA	SOA

P13 (Xue, 2017)	China	IaaS	Double-layered	CDC, PDF, XML, Dublin Core Metadata
P14 (Askhoj et al., 2011)	General	SaaS, PaaS	Layered model	OAIS, Google Docs, RIR, AmazonS3, ASCII, PDI, PREMIS, REST, XML, HTML

** Service Oriented Architecture (SOA),*

4.2. Findings of the Research Question

RQ: Are the existing cloud software architectures sufficient to maintain the life cycle process, the principles of provenance, and the original order of electronic records and archives?

The "moment of risk" is the primary problem facing e-government systems when they fail to capture the decision-making process of organizational functions in the system workflow, which is the basic evidence of governance integrity and transparency (Matlala & Maphoto, 2020). The study highlights six specific "moments of risk" that occur throughout important transitions in the life cycle of records: collection, maintenance, ingestion, access, disposal, and preservation. The life cycle process is threatened whenever the workflow is transmitted across space. There is a growing consensus that electronic records are most vulnerable to losing their essential characteristics as records when they remain in cyberspace. The issue of trust in cloud providers becomes the primary concern.

After providing context in the area and discussing the relevant literature, it was found that cloud-based productivity and collaboration tools, along with storage solutions, present a range of promising opportunities for records managers and archivists. "Archiving-as-a-service" models can significantly enhance collaboration, streamline record management processes, and potentially reduce costs, which can greatly benefit organizations. The research conducted by Pillen and Eckard (2023) [P1] explored the utilization of SOA-based architecture and collaboration tools in cloud computing for record-keeping activities across a standard life-cycle model for managing records.

However, ensuring the long-term accessibility of identified records in the cloud remains uncertain (Pillen and Eckard, 2023). In a study of cloud storage in public service, creating a government cloud service could reduce concerns about privately owned data management. Shibambu (2022) [P2] and Shibambu and Marutha (2021) [P3] have confirmed that the formation of a G-cloud would alleviate concerns among record practitioners regarding privately owned services, and SITA should be used for benchmarking due to its expertise in the cloud. Intending to investigate whether the public sector is willing to entrust their records to cloud computing technology, Shibambu (2022) [P2] and Shibambu & Marutha (2021) [P3] found that it is necessary to ensure the security of records stored in the cloud by implementing appropriate cyber security measures which end up with the propose of potential strategies of cloud storage of digital records. Han et al. (2021) [P4] developed a new three diagrammatic architectural design for electronic file management using DNS, XACMAL, SAML, and DDOS standards and technologies with three new security levels: secure cloud infrastructure services, security infrastructure services and cloud security application services to ensure direct replacement of traditional systems, simultaneously operating on new and old systems life cycle workflow processes, thus protecting the consistency, accuracy, authenticity, integrity, reliability of the files through multiple electronic file management subsystems.

By using OAIS, Preservation Metadata: Implementation Strategies (PREMIS) and Meta Data Encoding and Transmission Standard (METS) OAIS, XACML, SAML and blockchain. While Q. Wang et al. (2020) [P6] proposed a protection architectural model and integrated safeguard technology of electronic records constructed based on PREMIS and METS with the primary purpose of protecting the records provenance and authenticity of records.

With cloud storage, digital files are kept in a remote server for an extended period, providing ample time for the records creators to lose physical control of their records. Sun (2021) [P5] found that cloud computing technology applications in digital archives provide powerful data storage and network services; however, the cloud environment may integrate all kinds of risks. Thus, Sun (2021) proposed a fuzzy comprehensive evaluation of a set of security assessment systems suitable for cloud digital archives. The organization may be unable to retrieve electronic documents in the event that complications arise with the cloud service provider and the tendency to lose their records as completely as possible, as experienced by the international CodeSpace cloud company in 2014 when it was hacked. All the records in the Apache Subversion and Elastic Block collections on the company's cloud service platform were permanently deleted and could not be recovered (Li et al., 2018). At the same time, Mosweu et al. (2019) [P7] emphasized that cloud computing streamlines records management and promotes collaboration and faster data processing, a vital tool for operational efficiency and business growth. The study highlighted that overcoming challenges such as records storage, jurisdiction, privacy, security, and the digital divide is necessary for Africa to benefit fully from cloud-based records management services. Thus, cloud service solutions (SaaS, PaaS, or IaaS) should be assessed to assess whether the services fulfil the necessary criteria for records management capabilities. In addition, Leng et al. (2019) [P8]

built a reliable electronic records preservation system architecture based on coding theory.

By using the laaS model, layered SOA with Minimum Bandwidth of Regenerating Code (MBRC), they developed a new system using the existing cloud model that guarantees the reliability of record storage when the electronic record is damaged. The original electronic record can be restored by redundant coding, which maintains the original documents without producing new data, thus ensuring the reliable storage of electronic records in their original provenance and original order. This MBRC method could replace the existing cloud replication method to restore electronic records, which are difficult to judge and provide evidence of the authenticity and trustworthiness of the records replicated. At the same time, Y. Wang, (2019) [P9] designed a Hadoop cloud platform architecture to design the archival functional modules with Hbase storage to ensure the trustworthiness of records within their respective provenance. In the meantime, Wu et al. (2019) [P10] addressed the security of archival privacy data in the cloud, which has become the main obstacle to cloud computing applications in archives management.

To this end, aiming at XML archives, Wu et al. (2019) suggested a privacy protection strategy that guarantees the authenticity and reliability of private data security in an untrusted cloud environment while maintaining system availability. On the other hand, the study by Guo et al. (2016) [P11] found that as records reside in the cloud either by design or default, studies have been carried out to identify whether third-party cloud service providers can protect the traditional records life cycle process workflow in the cloud from creation until they become archives. Guo et al. (2016) highlighted that redefining the concept of archives as a reliable third party is crucial. Therefore, the nature of cloud providers' third parties depends on the nature of electronic records and the intrinsic risks inherent in the cloud. To counter this problem, Lee and Lee (2017) [P12] developed a new model architecture called Service Oriented Records Management Architecture (SORMA) reference architecture that combines SOA and RMS, which enables organizations or companies to refer to the development of explicitly cloud-based for the records management system. SORMA SaaS, SORMA PaaS, and SORMA laaS are the extensions of the fundamental cloud models but specifically for records aimed at establishing and Cloud services are utilized to safeguard the activity, management domain, metadata, and function of associated processes throughout the life-cycle workflow of electronic records, including creation, distribution, storage, preservation, and disposition.

Besides, the design principles and implementation mechanisms of the electronic records storage model in cloud data centres were studied by Xue (2017) [P13]. This study has proven that, to a certain extent, the existing cloud computing architecture laaS model SOA for archival storage does not cater for recording the original form of an electronic document from its creation stage, which is the fundamental requirement to maintain the provenance and original order of documents within their distinct series.

In this study, Xue has created a double-layer data storage model solution with the capability of capturing and preserving the whole workflow process of the electronic document life cycle to guarantee the authenticity, evidential quality and integrity of electronic records and archives. At the same time, the new architecture could provide methods and solutions for the retention of the provenance chain of custody of an organization's digital assets. Finally, Askhoj et al. (2011) [P14] concluded that there are several areas where the Open Archival Information System (OAIS) does not integrate well with cloud computing systems.

Utilizing the information categories and concepts from the OAIS reference model, they develop a new layered model for a cloud archiving system in accordance with their findings. The suggested model enables the exchange of functionality and information items by providing them as services to higher levels. The model encompasses the complete document life-cycle, enabling the implementation of archive features, such as preservation planning, at an early stage and facilitating the streamlining of records transfer.

Their model provides a simple, OAIS-compatible approach to representing how digital objects and necessary metadata can be transferred from content creation systems to archives systems. This study also found that most studies emphasized the SOA-based layered architecture with suitable standards and technologies to support the adequate separation between the traditional records' life cycle components. Finally, based on the study, the cloud computing architecture of the records and archives management system could be illustrated in Figure 1 as follows: The subsequent section of this article will delve into the discussions derived from the analysis of the 14 reviewed articles.

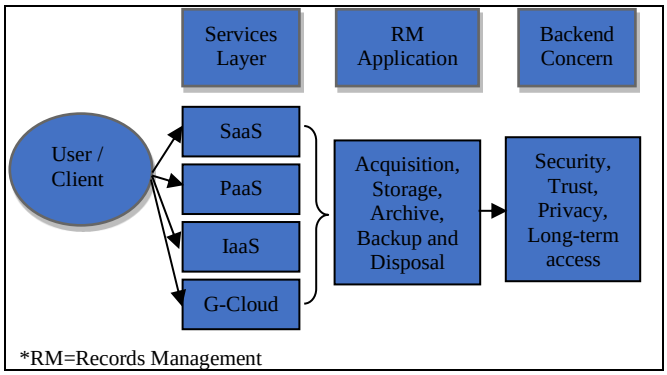

Fig. 1 Cloud architecture with RM functions.

5. Discussion of Findings

This literature review identified 4 forms (G-Cloud, SaaS, PaaS, IaaS) of cloud computing architecture developed and proposed specifically for electronic records and archives. Data in Table 7 shows that the majority of the studies used SOA cloud architecture as a service platform. Even though SOA is found to be suitable for Digital Government according to studies carried out by (Baheer et al., 2020; Han et al., 2021), functions essential for electronic records management may not be provided in SOA, associated risk due to distributed processing, risk of loss of metadata due to changes in configuration management, access risk due to network virtualization, and multi-tenancy environment of laaS, PaaS, and SaaS (Lee & Lee, 2017). Thus, to overcome SOA's inherent risks, most studies have developed a new architecture framework suitable for the management of records and archives in the cloud.

Baheer et al. (2020) and Mosweu et al. (2019) believe that web services are suitable for implementing SOA. Web service architecture is deemed suitable for implementing records and archives in the cloud because web services software systems design supports interoperable machine-to-machine interaction over a network. This interoperability is gained through a set of XML-based open standards. In this way, SOA allows for the reuse of existing assets, and records and archives services can be created from an existing system infrastructure [P1, P6, P10, P13, and P14]. On the other hand, P2 and P3 confirmed that a government cloud (G Cloud) in Africa is in SITA and under SITA control, which is used to manage digital records. However, both P2 and P3 studies agreed that cloud computing can eliminate challenges such as missing files, damaged records, and long turnaround times for retrieving records, which calls for further studies. Even though Governance Enterprise Architecture (GEA) is an important factor for the success of all types, scales, and intensity of government programs (Baheer et al., 2020; Sun, 2021; Shibambu, 2022; and Shibambu & Marutha, 2021), only one study carried out by Q. Wang et al. (2020) [P6] who found GEA suitable to be used with the blockchain technology to secure the provenance of electronic records. Addressing the issue of trust is the concern of [P6] by proposing permissions for blockchain to perform data invoking and data storage and avoid data tampering from inner-side users and external attackers. In this new framework, blockchain technology adds a security layer to the data transactions on distributed cloud storage. In addition, layered architecture could support the adequate separation between records and archives components in the electronic document management system in the cloud to protect the key attributes of electronic records and archives.

The reviewed studies proposed layered architecture designs to achieve interoperability, compatibility, and integration of cloud computing architecture with records and archives functions in the legacy system. The aim is to operate the new system in the cloud while gradually replacing the traditional systems in stages, depending on the organization's business needs, technical environment, and budget [P4, P12, and P13]. In the context of software architecture, most of the studies provided detailed architectural descriptions even though they are not formal. Only one of the proposed products has been practically tested and implemented by some banks and insurance companies in China with promising results [P13]. Cloud architecture was not explicitly designed for records and archives, resulting in difficulties in applying records and archival standards in the cloud computing architecture. Archival standard ISO 14721:2012, Reference Model for an Open Archival Information System (OAIS) and ISO 16363:2012, Trustworthy Digital Repository Certification in practice, were not designed for cloud-based services (Duranti, 2015; Yao, 2016; and McLeod & Gormly, 2017).

Difficulty in applying the OAIS model to a cloud environment was cited by Askhoj et al. (2011). In response, they suggested a cloud archive domain ontology built on a layered computing model. In this approach, lower layers provide shared services to higher layers so that content-creating applications and the services that supply preservation metadata can exchange metadata more effectively [P14]. Interestingly, addressing the associated risks of data stored in the cloud becomes central to most studies on records, archives, and other areas because of the risks whereby insiders and third parties can access the data. In the context of security issues, (Alouffi et al., 2021) believe that cloud users mistakenly assume that their public laaS providers have responsibility for securing their data, operating system, and application without realizing that some cloud providers, such as AWS and Microsoft Azure policies clearly stated that customers need to address the security of their data, identity, applications, operating system, and their configuration, and access management in shared responsibility.

AWS only considers the security of hardware, software, and networking facilities, and to ensure the security of user data, AWS resources require security credentials for access (Alouffi et al., 2021). If this is the case, it is the records managers and archivists' responsibility to determine whether it is wise to outsource their records and archives directly to a public cloud without scrutinizing the detailed nature of services rendered by the cloud providers. Studies in P5, P7, P8, P9, P10, P11, P12, P13, and P14 proposed new solutions to the issue of data security in commercial cloud-based storage on "secure by design" as suggested by Alouffi et al. (2021). Remarkably, the adoption of "secure by design" architecture in the US government is based on the application of Agile methodology to support the records life cycle process in the cloud from creation to archives. Their new "secure by design" architecture proposes a use-based approach to cloud records and archives management rather

than a store-based one, as mentioned in P4, P5, P8, P10, P12, P13, and P14. Therefore, providing relevant literature and exploring the layered architectural designs in records and archives functions in this study provides a thorough understanding of the evolution of cloud computing to effectively manage records and archives to meet the expanding requirements of electronic records storage and administration.

6. Conclusion

This study identifies records and archives architecture design in cloud computing proposed by researchers and writers of selected primary articles. Even though initially, 3,840 citations were identified, only 14 papers were finally selected through the QAC process, which is highly relevant specifically to records and archives cloud architecture. Descriptive in nature, this literature review focused on existing cloud service models and architecture designs being studied for their suitability and conformity with the conceptual requirements that underpin records and archives management. The findings of the review suggest common cloud service models and architecture designs. In some cases, new architecture models were developed based on existing cloud service-oriented models and layered architecture using different standards and relevant technologies. As a result, each study attempts to tackle the complexity of electronic records and archives in the cloud from a different perspective, and it is evident that there is no consistent consensus on records and archives architecture concepts to accomplish the theoretical basis of archival and records management. However, 14 studies reviewed are in unison with one common goal: protecting the key attributes of records and archives based on the life cycle process and ensuring the security of their provenance and original order in cloud storage. The specified architectural characteristics in the papers reviewed are vital for the development of cloud-based records and archive architecture, even though most studies have not been implemented in the real world. It is essential to recognize that the integration of cloud computing for electronic records and archives has greatly enhanced the ability to disseminate information. However, the lack of clarity and standardization in the service platform, meeting the archives management standard, may lead to inappropriate data utilization and jeopardize data storage (sufficient security and privacy protection). Perhaps there are limitations in this literature review. However, it is hoped that in the future, more studies will be conducted on electronic records and archives cloud architecture by records and archives practitioners.

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