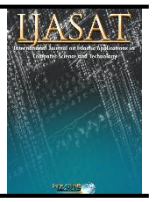

Digital Preservation in Indonesia Institutional Repositories for Future Community: A Literature Review

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ABSTRACT
In this digital age, academic libraries and repositories have the expertise and the knowledge to manage digital assets. Their digital preservation program will determine the challenge to ensure future access to institutional scientific products. This research uses a literature review to determine the status and the difficulties of having a digital preservation program in Indonesian repositories, emphasising academic/university libraries. This research includes a bibliometric analysis for the preliminary findings. The study is based on Scopus as the primary database and uses the Biblioshiny application as the bibliometric analysis tool. A custom database of open-access journals for Library and Information Science was also built to support the literature review of the topics. The finding showed a lack of comprehensible data to definite conclusions about digital preservation practices due to limited publications. While aiming for the mission and achieving the objectives, the repositories were challenged mainly by technical aspects, the organisation and policy, and the sustainability of the resources for future communities.

***Keywords*: digital preservation, academic library, institutional repository**

1. Introduction
Within university environments, open access and institutional repositories are integral hubs supporting scholarly communication, facilitating storage, learning, and research utilisation, fostering scientific advancement and safeguarding institutional knowledge (A. Miller, 2017). As the keepers of information, the libraries had to adapt to the evolving needs of the research community while navigating the changes in technology and the information landscape at large (Palmer et al., 2008, p.142) to enable visibility, preservation, and accessibility of intellectual resources. Academic and university libraries have actively contributed to establishing institutional repositories to preserve scholars' intellectual output and embrace open-access trends (Palmer et al., 2008). Adopting open access and institutional repositories plays a significant role in granting access to scholarly resources to developing nations that they might lack the means to obtain. Moreover, these repositories offer developing nations an invaluable opportunity to showcase their research capabilities to their collaborators (Liauw & Genoni, 2017).

These innovative applications of library science allow community engagement to be appropriately valued as the central organising component of diverse academic activities (W. A. Miller & Billings, 2012). An institution repository program's permanency, authenticity, and trustworthiness enable institutions to provide resources for citizens who might not otherwise have access to traditional scholarly communication channels (Moore et al., 2020). It democratises content for all. In this digital era, repositories provide access to and enable the use of digital data, requiring trust and reliability to manage data effectively (Lin et al., 2020). A trustworthy digital repository can prevent the digital dark ages by establishing a data interoperability layer and integrating it with other repositories to make it accessible (Wittenburg et al., 2022).

The earliest recorded publication using the term "digital dark ages" was at the IFLA conference in 1997. It refers to conditions where digital materials are inaccessible due to technological advancement and obsolete media storage ("Google's Vint Cerf Warns of 'Digital Dark Age,'" 2015; Kuny, 1997). Digital preservations, which refer to the series of managed activities necessary to ensure continued access to digital materials for as long as necessary (*Home - Digital Preservation Handbook*, 2021), offer the solution to prevent the phenomena. The repositories must start their digital preservation program in their digital information life cycle as soon as possible. The program does not merely consist of technological factors but combines policies, strategies, and actions to ensure access to digital content over time, regardless of technological changes (American Library Association, 2007).

Based on Scopus database collections, searching the phrases "digital preservation" and "library or institutional repository" from the title, abstract, and author keywords shows how these terms are connected. The search for 2013-2023 resulted in 362 records (executed on 3 July 2023). Using VOSviewer, a network visualisation tool, illustrates the connections among various nodes within a network using Scopus bibliographic data in Figure 1. It generates visual maps of keywords, highlights their interrelationships, and demonstrates the degree of association between each node (van Eck & Waltman, 2023). The visualisation of the term's connection in the last ten years indicates that the term "institutional repositories" is the third highest link strength after the keywords "digital libraries" and "digital storage" with the term "digital preservation."

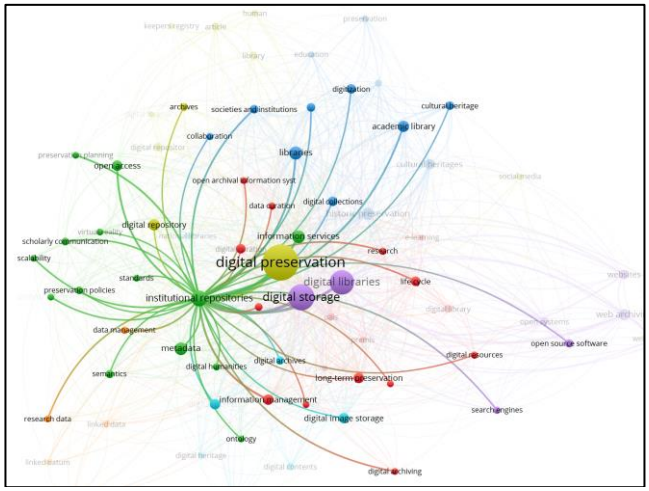

Figure 1. VOSviewer network map on Scopus data for digital preservation and library/institutional repository articles in the last ten years

The year 2019 was an important milestone for digital data in Indonesia. Three significant occasions occurred: Law No.11/2019 on National Scientific and Research Information, Circular Letter from Ristekdikti, Ministry of Education (MoE) on digital repositories in Universities and Higher Education Institutions (HEI), and acceleration program on Indonesia scientific journal publications. With 3.107 HEIs in Indonesia (BPS – Indonesia Statistics 2022, accessed 13 June 2023), only 176 institutions (5,7%) register their repositories in OpenDOAR (https://v2.sherpa.ac.uk/view/repository_by_*country*/Indonesia.html, accessed 13 June 2023). There is a vast number of unknown Indonesian repositories that host Indonesian scientific research digital resources for future knowledge discovery.

This paper investigates the Indonesia HEIs with their repositories in establishing digital preservation to support a research community. Every HEI were expected to maintain their scientific works in a digital repository. Later, the Ministry of Education will harvest the repository data into a single database that reflects all Indonesian research works and their publications. The study explores institution repository readiness levels on digital preservation programs, their practices, and their obstacles to establishing the program. A bibliometric analysis based on the Scopus database was used for the background information, followed by a literature review.

2. Research Method

2.1. Bibliometric Analysis

Using the previous search result from Scopus for the primary database and Biblimetrix (Aria & Cuccurullo, 2017), the bibliometric method prioritises the author keywords for quick literature analysis and visualisation. In the last ten years (2013-2023), the number of publications on digital preservation topics tended to decrease by -17.88% (Fig. 2), and the latest trend documents topics based on author keywords are scholarly communications, open access, CLOCKSS (Controlled Lots of Copies Keep Stuff Save), academic libraries, and institutional repositories (Fig. 3).

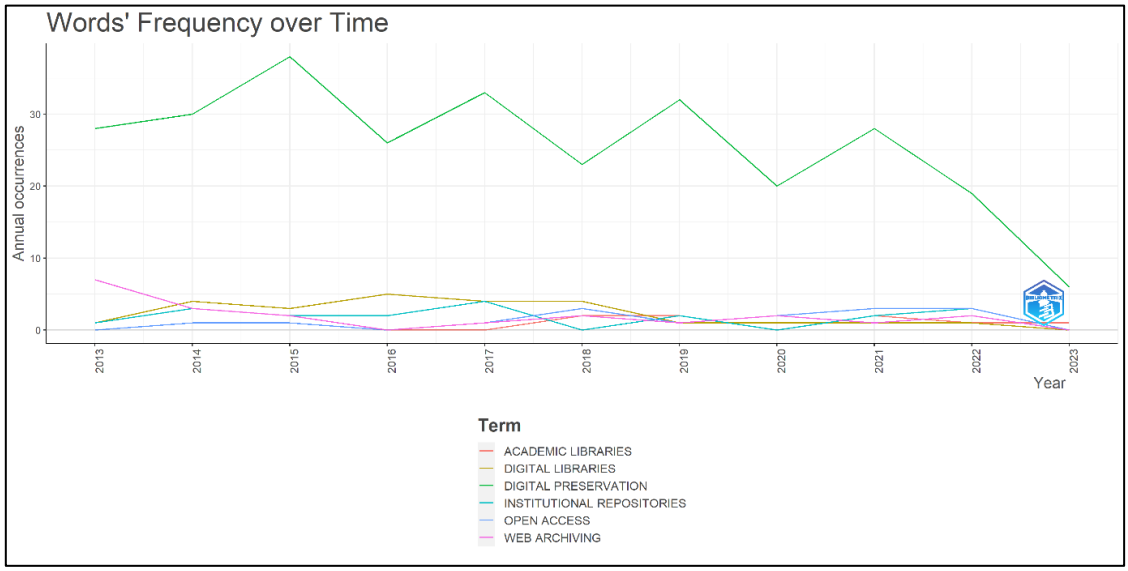

Figure 2 Frequency of author keywords in the documents for the last ten years

For the country of author affiliations, Indonesia has seven documents (1,93%) that were published between 2016 and 2020. As the world leader in open-access publishing (Irawan et al., 2020), this number is too small to reflect the publication number of the topics published in

Indonesia. According to the ISSN portal database (https://portal.issn.org/), there are 13.899 journal titles for Indonesia (accessed June 2023). The number of these titles found in commercial databases is unknown, which may be the reason for the limited results found on Indonesian country affiliations. Regarding the term "digital preservations" on government regulation, the National Archives of the Republic of Indonesia is the first institution to use it in its Regulation No.6/2021.

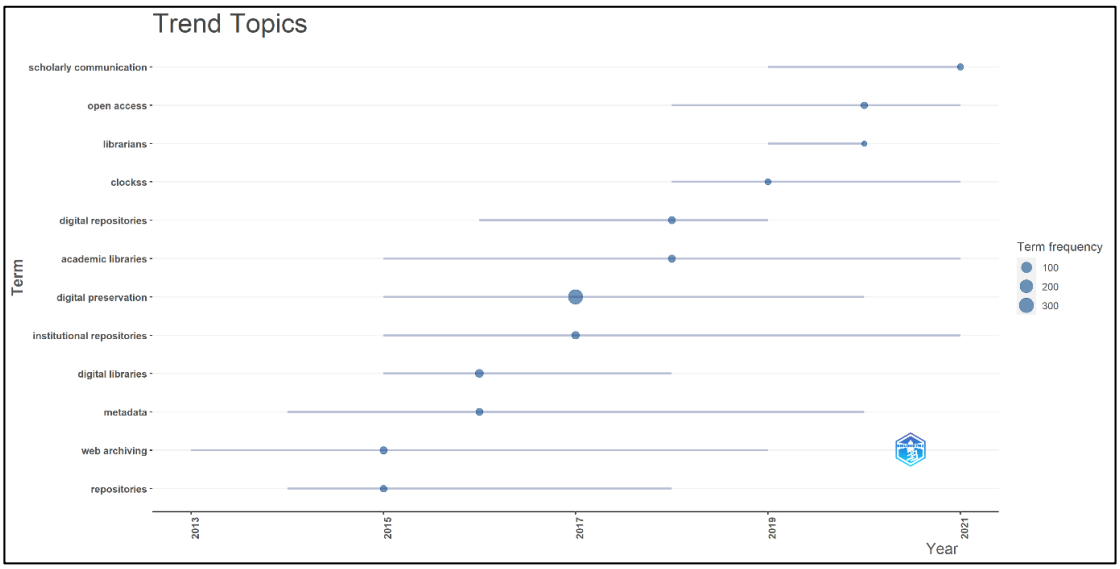

Figure 3 Document trend topics based on author keywords

2.2. Literature Review on Digital Preservation and Academic Repository in Indonesia

With limited published resources on commercial databases in mind, the study created a custom database of open journal articles published in Indonesia for the literature review steps. The custom database was developed using the Open Harvester System (OHS) written by the Public Knowledge Project (https://pkp.sfu.ca/software/retired/). The database comprises 55 journal titles published primarily by Library and Information Science (LIS) schools in Indonesia, with 12.025 articles (accessed June 2023). Since the OHS depends on MySQL search capabilities, a broad approach is deployed in the database to acquire exhaustive results and not miss relevant titles. It is preferred to deal with non-relevant titles in the output rather than missing relevant ones due to a narrower search strategy.

Four search terms were combined from this custom journal database at the identification stage to get the total output. After eliminating the same data, there are 55 records (N1=55) in total. The search terms deployed in the custom database are:

1. digital AND preserv* AND (repositor* OR librar* OR perpustakaan) with 7 records;
2. "digital preserv*" with 10 records;
3. repositor* AND preserv* with 24 records;
4. digital AND preserve* with 35 records.

With more advanced retrieval capability, Scopus allows the use of term truncation, exact phrases, and parenthesis. Similar steps in this stage were also deployed for the Scopus database to get a thorough result using general terms instead of the exact phrase "digital preservation" used in the initial phase. These are the search terms:

- TITLE-ABS-KEY (digital AND preservation) AND TITLE-ABS-KEY (library* OR repositor*) AND AFFILCOUNTRY (Indonesia) with 16 records;
- TITLE-ABS-KEY (digital AND preservation) AND AFFILCOUNTRY (Indonesia) with 40 records.

The total number of records found in the Scopus after eliminating the same and similar data is 47 (N2=47).

Two questions for this literature review aim to provide an initial condition of digital preservations in libraries and repositories in Indonesia HEI:

Q1 – what are the conditions, status, and practices of digital preservation that the library/institutional repository has done?
Q2 – what challenges do library/institutional repositories face in their digital preservation activities?

Screening criteria to include and exclude the articles are as follows:

1. Inclusion criteria:
   a) Library and repository in Academic, University, and other HEI having digital assets
   b) Conducting digital preservation activity and mentioning its status, practices, and obstacles in their program
2. Exclusion criteria
   a) Any other digital preservation practices outside Academic, University, and other HEI
   b) Preservation practices that are not related to digital resources
   c) Digitization of resources

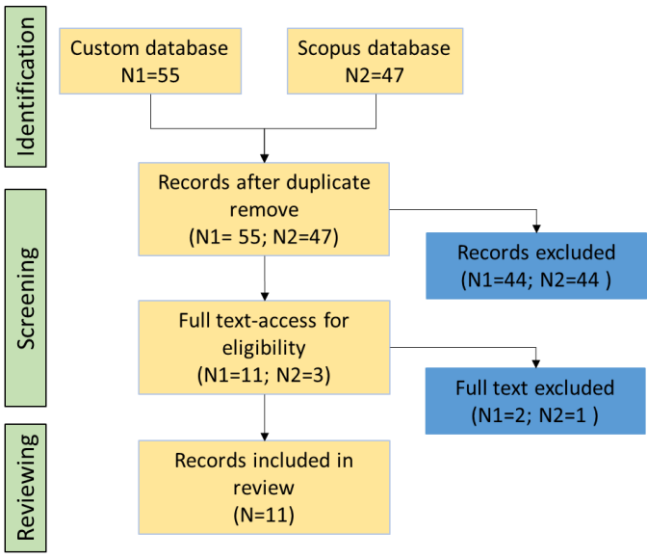

Figure 4 PRISMA model for literature review

At the screening stage, 86% (88 records) were excluded. The top three reasons for exclusion are not with an academic or HEI context, topics on culture preservation/cultural heritage, and too broad or general discussion. In 14 records, another three were excluded, with no full articles available. The final stage is left with 11 full-text records available to review. The reviewing steps classified articles within the context of the three-legged stool (McGovern, 2007).

3. Findings and Results

McGovern (2007) inferred that we can measure the coalescing and maturing of the digital preservation community by taking the organisational, technology, and resources infrastructure together. These three leg stools include the objectives, the mandate, the scope, the staffing of an organisation for engaging in digital preservation; the strategies, staff, tools, equipment, and other means for achieving the objectives; and the resources that deal with "how much" needed to produce the desired output. Table 1 shows the concise result of the literature review.

Table 1. List of Literature reviewed on digital preservation and institutional repository (IR)

No.	Author	Methodology	Digital Preservation status		Practices	Challenges
L1	(Rachman, 2019)	Qualitative, case study: interviews	N/A	2 Respondents; Made efforts for DP	O: - T: Backup data R: -	O: Not specific for DP T: - R: Fund not allocated, limited HR
L2	(Srirahayu et al., 2020)	Quantitative Cornell Survey	3rd level (consolidate)	100 Respondents; 5 levels of DP (Kenney & McGovern, 2003)	O: Available T: Backup on media R: Special HR, Professional technician, long-term technology support	O: - T: No file format, complaint with OAIS R: -
L3	(Hadna, 2014)	Qualitative, descriptive: Case study	N/A	Digital Library as Institutional Repository (IR)	O: - T: - R: -	O: Faculties cooperations T: Undigitized sources R: Promotion
L4	(Santoso, 2019)	Quantitative, Descriptive: Webometrics indicators	N/A	5 Islamic HEIs level based on Visibility; Size; Rich File; and Google Scholar	O: - T: - R: -	O: - T: Web SEO R: -
L5	(Irawati et al., 2015)	Quantitative, Descriptive: Questionnaire, observation	Not Ready for DP	Respondents: 35 IR from Webometric list (2014). Only 12 IR claims had a policy but not comprehensive	O: Repository has a policy T: Standard Format, metadata R: -	O: No specific policy, mainly for access; no coordination T: Not adopt pdf/A R: Human Resources Competency, Promotion
L6	(Setiawan & Mas'ud, 2019)	Qualitative, descriptive: Case study	N/A	Finding problems in building IR	O: T: Backup R: Expert, training	O: IR policy for DP T: Conversion R: HR Competency

L7	(Rizkyantha et al., 2022)	Qualitative, descriptive: Case study	N/A	IR and Scholarly Communication, with DP	O: T: Repository Software R: -	O: No specific policy, no coordination T: - R: Promotion/socialisation
L8	(Ahwan, 2020)	Qualitative, Descriptive: Case study: OAIS reference model (CCDS, 2012)	Ready for DP	Based on OAIS compliant with notes	O: Only partial T: Compliant R: Compliant	O: DP plan T: Migrating, Packaging R: -
L9	(Pramudyo & Sp, 2022)	Qualitative: Literature review (Google Scholar 2014-2019)	N/A	Explain methods, policy, challenges, and role of librarians in DP	O: - T: Software CMS and support system R: -	O: No clear policy T: Standard format, Vulnerability R: Lack of Technical skill
L10	(Safri, 2020)	Qualitative, Descriptive: Case study	N/A	Practical DP	O: - T: Technology preservation, backup, migration, refreshing R: -	O: No policy T: - R: Lack of Human Resources
L11	(Musrifah, 2017)	Qualitative, Descriptive: Case study	N/A	Sporadic policy	O: Partially, i.e., Intellectual Property Right T: Technology preservation, migration, refreshing R: -	O: - T: Obsolescence, security, lack of hardware R: Lack of Human Resources

Notes: O – Organization infrastructure; T – Technology infrastructure; R – Resources, DP – Digital Preservation

The final interpretations from the articles:

- The Q1 and Q2 responses lack comprehensiveness. The representation of Indonesia's condition in research is notably limited. Among eleven studies, eight utilise qualitative and case study approaches. Comparing aggregate results incorporating quantitative and survey methods proves challenging due to the tool, measurement, and sample selection variations. Consequently, these studies fail to provide conclusive insights or a definitive overview of digital preservation practices in Indonesia (Q1). While three studies (L2, L5, L8) discuss digital preservation, two employ quantitative surveys (L2, L5) conducted five years apart, yielding differing results. Interestingly, L2 and L8, published in 2020, share similar findings. The studies highlight digital preservation practices, primarily focusing on technical and digital item-related issues. Correspondingly, discussions on repository barriers and challenges (Q2) predominantly concentrate on technical aspects. However,

organisational or policy-related concerns emerge as secondary problems, followed by resources and sustainability issues.

- The condition and status (Q1) of digital preservation cannot be comparable due to different measurements and tools deployed in the published research.
    - In 2015, Irawati (L5) concluded that the institutional repository was not ready since no policy was in place. If there was any, it did not execute accordingly. The report used descriptive quantitative research with a sample of 35 institutional repositories listed in Webometric 2014 (Irawati et al., 2015)
    - Santoso (L4), in 2019, used descriptive quantitative methods to rank 5 Islamic HEIs using webometric analysis (Santoso, 2019). The studies did not indicate the readiness level for digital preservation.
    - Using a case study in 2020 at UIN Sunan Kalijaga, Ahwan (L8) found out that the institutional repository is ready to adopt the OAIS reference model. He also notes that there are still challenges to overcome in some policy and technology infrastructures (Ahwan, 2020).
    - The late report 2020 came from Srirahayu (L2) involving 100 random sampling respondents from Indonesian university libraries listed in Webometric with descriptive quantitative method (Srirahayu et al., 2020). Adopting the Cornell survey (Kenney & Buckley, 2005) and five levels of digital preservation readiness (Kenney & McGovern, 2003), Indonesia's institutional repository was on 3rd level of readiness.

    Addressing the Srirahayu report, the article did not mention other ways to verify her research responses. This could be misleading since Keeney mentions caveats on the Cornell survey:
    "First, although the participants represented those charged with some level of digital preservation responsibility at their respective institutions, individual assessments do not necessarily represent official responses."
    And
    "…the survey instrument was not intended to capture all information reflecting an institution's commitment to digital preservation, only indicators of efforts…" (Kenney & Buckley, 2005).

- Digital preservation practices (Q1) and challenges (Q2) using "three-legged stool" infrastructure (McGovern, 2007) show:
    - Organizational infrastructure, such as mission statements and policies addressing digital preservation, is limited if not available.
      Only four studies have shown that the repository has practices on policies or statements addressing digital preservation, although not all policies are comprehensive. Partial or sporadic policies include intellectual property rights, access rights, and digital asset standard operational procedures (SOP). Practises of organisation infrastructure involved participation and agreement from multi-stakeholders. This task will be difficult when the organisation considers the library/repository unimportant.
    - Technology infrastructure includes specific digital preservation strategies, tools, and equipment.
      Research from the articles is likely to discuss this infrastructure more than others. Eight research mention technology infrastructure, including traditional data and media backup, standard file format, metadata, content management and support

software, migration, refreshing, and technology preservation. This condition will likely conform to the Ruusalepp opinion cited by Runardotter in her thesis: "… people around the world are involved in ambitious research projects on long-term digital preservation, with most of them focusing on technical solutions." (Runardotter, 2007, p.3)

- Resources infrastructure, represented by relevant cost, occurs in all parts of the digital life cycle.
  Articles discussing practices for this infrastructure are two out of eleven (Srirahayu, 2020; Ahwan, 2020). Setiawan and Mas'ud's (2019) study briefly mentioned the availability of experts and training. Practice for this infrastructure is not a fancy topic compared to the other two.

4. Conclusions

In response to the literature review result, the research gives us a view of the limitation on primary data of digital preservation in libraries/repositories in academic institutions in Indonesia. The qualitative method is dominant, with half of the articles using case studies for this topic. The current level of digital preservation practices, in general, is unclear, with the primary practices being on the technology infrastructure. The identification of practices in policy and resource infrastructure is also minimal. Should the practices be considered the best? This is another gap that should be addressed before discussing the future of Indonesian scientific communities in the digital era.

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