

Paper Persistence in Organizations amid Digitization: A Bibliometric Analysis

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Abstract

This study investigates the persistence of paper in organizational workflows amid ongoing digital transformation, exploring how emerging technologies influence information management, workflow efficiency, and document governance. The study aims to identify dominant conceptual themes, key contributors, and the temporal evolution of digital technologies in the literature. A bibliometric and thematic analysis was conducted on 327 Scopus-indexed publications from 2000 to 2025. Keyword co-occurrence networks, cluster analysis, trend topics and citation metrics were employed to examine research evolution, institutional and author contributions, thematic foci, and the representation of technologies such as AI, automation, cloud ECM and blockchain. Results reveal a steady growth in research output, accelerating from 2017 and peaking in 2025. Four conceptual clusters were identified: (i) digital transformation and organizational information management, (ii) information security and decentralized record governance, (iii) scalable data infrastructure and distributed records handling, and (iv) cloud-enabled storage systems and redundant archiving practices. Temporal analysis shows a shift from early, low-technology discussions (2008–2012) to a focus on AI, automation, digital storage, blockchain and interoperability in 2020–2024, highlighting the integration of paper into increasingly intelligent, secure and cloud-based organizational ecosystems. This study offers a comprehensive bibliometric perspective on paper persistence amid digitization, linking conceptual themes, technological trends, and global contributions. It highlights underexplored areas for future research, including cross-platform workflow integration, human-technology interactions and organizational policy approaches.

Keywords — Paper persistence, digital transformation, AI, blockchain, cloud computing, bibliometric analysis, organizational information management, workflow automation.

1. Introduction

Rapid advances in digital technologies have significantly reshaped organizational information practices, accelerating the adoption of AI-enabled document processing, cloud-based workflows and automated records-management systems. Contemporary research consistently demonstrates that digitization enhances operational efficiency, improves information accessibility and reduces costs associated with storage, labor and manual processing [1]. Across sectors—including government, healthcare, finance and higher education—organizations increasingly deploy machine-learning optical character recognition (OCR), intelligent document processing (IDP) and robotic process automation (RPA) to manage historically paper-intensive workflows [2]. These tools are often embedded within cloud-based enterprise content management (ECM) platforms such as Microsoft SharePoint, Box, DocuWare and Adobe Acrobat Sign. Complementary innovations, including blockchain-supported audit trails, legally recognized e-signature and e-notarization systems, AI-enabled compliance monitoring and mobile real-time scanning infrastructures, have further consolidated digital document ecosystems [3], [4]. These developments have strengthened transparency, standardization and data security across multiple organizational domains [1].

Despite these technological advancements, paper remains deeply embedded in organizational information ecosystems. Recent studies attribute the persistence of paper to its intuitive affordances during collaborative review, its perceived reliability in verification-intensive tasks, and its cultural legitimacy within long-standing professional routines [5], [6]. Organizational risk aversion, legal documentation norms and entrenched workflow practices further reinforce continued reliance on paper even when digital alternatives are fully operational [3]. As a result, many organizations operate within hybrid information environments where digital and physical records coexist, often redundantly, complicating long-term information governance and undermining the efficiency gains promised by digital-transformation initiatives [2].

Although the literature on organizational digitization is extensive (spanning systematic reviews of digital transformation, sector-specific analyses of records-management systems and evaluations of ECM adoption) several unresolved questions persist. Much of the existing scholarship emphasizes technological capability and implementation outcomes, while devoting comparatively less attention to how organizational routines, information cultures and documentation practices are conceptualized within the literature [1]. Regulatory and compliance pressures are frequently cited

as drivers of documentation practices, yet cross-sectoral comparative analyses remain limited [7]. Moreover, relatively little research systematically examines why organizations continue to retain paper backups despite substantial investments in automation, cloud platforms and AI-supported document infrastructures, leaving institutional risk framing and continuity assumptions underexplored [2]. Similarly, few studies trace how scholarly understandings of information culture, resistance to digital workflows, and hybrid documentation practices have evolved over time [1]. These gaps underscore the need for an integrative, longitudinal analysis that synthesizes how paper persistence has been conceptualized across disciplines and over time. Accordingly, the present study is guided by four central research questions that frame the scope of inquiry:

- How has research on paper persistence in organizations evolved from 2000 to 2025?
- Which academic disciplines, sectors, institutions, and authors contribute most to this field?
- What are the dominant conceptual frameworks explaining why paper continues to persist in organizational workflows?
- How have digital technologies—such as AI, OCR, RPA, and cloud-based ECM—been represented in the literature over time?

To address these questions, the study employs a structured bibliometric and thematic analysis of publications spanning 25 years. This approach allows for a comprehensive examination of temporal trends, institutional and disciplinary contributions, conceptual developments and the evolving representation of digital technologies in scholarly discourse.

2. Research methodology

This study systematically investigates the scientific literature on paper persistence in organizational information practices amid digitization from 2000 to 2025. A bibliometric approach was adopted to map trends in research output, uncover key conceptual themes and explore collaboration patterns across authors, institutions and disciplines. To ensure transparency, rigor and reproducibility, the review followed the PRISMA framework, providing a structured process

for the identification, screening and selection of relevant publications [1]. PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) is a widely adopted reporting guideline that enhances methodological transparency by clearly documenting search procedures, inclusion criteria and study selection decisions; it was selected to ensure a systematic and replicable literature identification process suitable for bibliometric analysis. The search was conducted in Scopus, chosen for its comprehensive multidisciplinary coverage and robust bibliometric indicators [2]. To capture studies specifically addressing the persistence of paper in organizations alongside digital transformation, the following search string was applied to titles, abstracts, and keywords:

("paper" AND ("persist*" OR "retain*" OR "backup*" OR "hard copy" OR "physical record*" OR "analog record*" OR "print record*")) AND ("digital transformation" OR digitization OR "electronic record*" OR "enterprise content management" OR automation OR AI OR cloud OR OCR OR "blockchain") AND ("records management" OR "information management" OR "document management" OR "record retention" OR archive* OR workflow*) AND NOT (pulp OR "paper manufacturing" OR "paper industry" OR "pulp and paper" OR "paper recycling" OR "3D print*" OR "printer hardware" OR "printer design" OR "printing press" OR "paper material*" OR "paper-making" OR "paper production" OR "paper mill*" OR "chemical process*" OR "paper sensor*" OR "paper electronics"). Following the initial retrieval of 720 publications, records were screened based on language, publication type and relevance. Non-English articles and non-peer-reviewed outputs were removed, along with papers outside the scope of organizational information practices and digital transformation. To ensure relevance to ASEE and interdisciplinary coverage, the dataset was further filtered by subject area, retaining publications in Engineering, Social Sciences, Business/Management, Decision Sciences, and Environmental Science. The final curated dataset comprised 327 publications for bibliometric analysis. The PRISMA workflow, detailing identification, screening, and inclusion of records, is presented in Figure 1. Metadata for all 327 publications were exported in CSV format for analysis. The bibliometric evaluation included publication trends, authorship patterns, subject area distributions, institutional contributions and citation metrics. Conceptual and collaboration networks were visualized using VOSviewer, which generated co-authorship, co-citation and keyword co- occurrence maps [3], [4]. For detailed analyses of citation patterns, thematic evolution and discipline-level contributions, Biblioshiny™ in R was employed [5], [6]. Additional text-mining procedures on

titles, abstracts and keywords were conducted in R Studio to identify evolving themes, emerging research directions and the interplay of organizational, cultural and technological factors sustaining paper persistence.

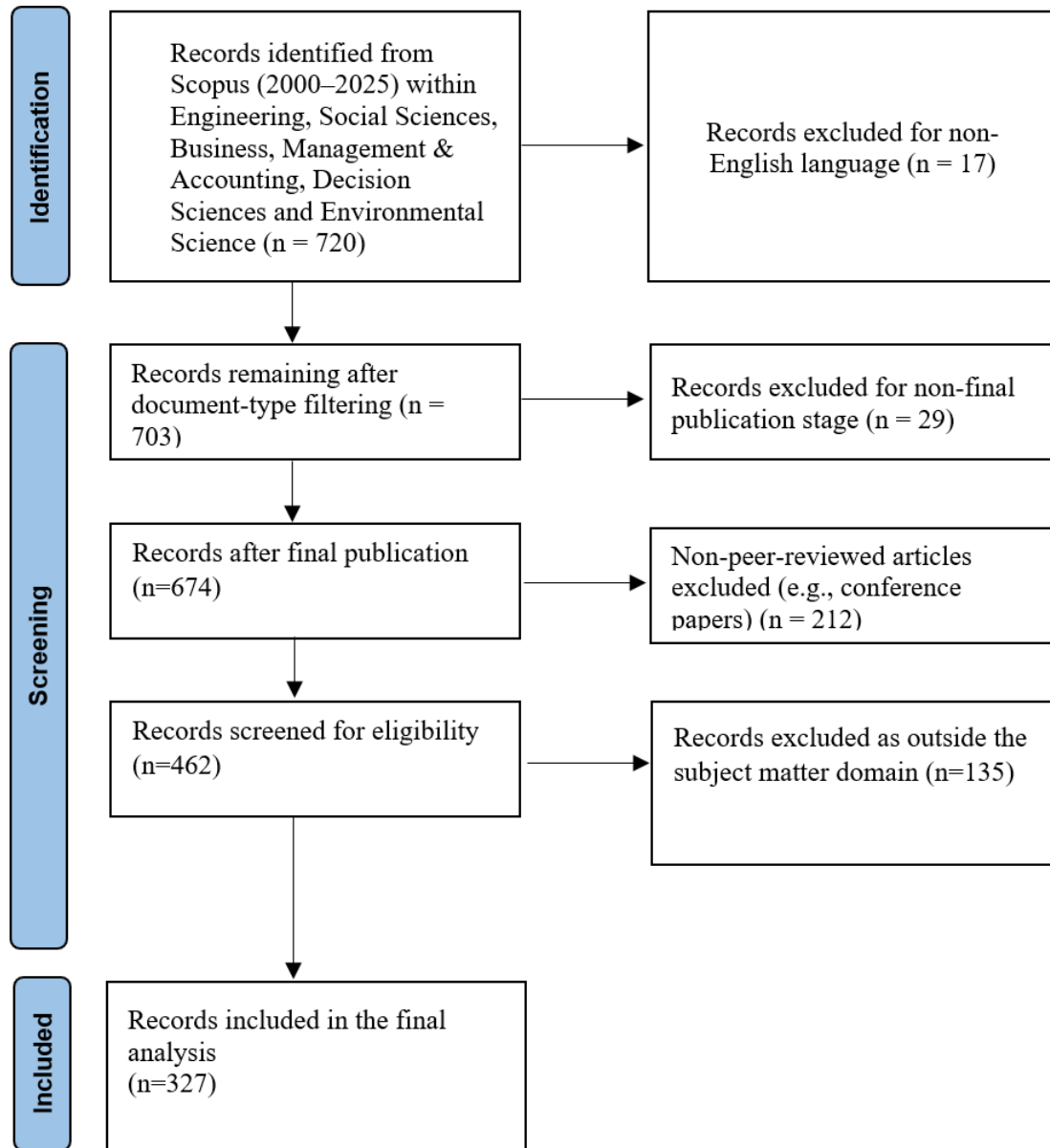


Figure 1: PRISMA flow diagram for publication selection of paper persistence in organizational information practices (2010–2025)

3. Results and discussion

3.1. Annual publication trends

Figure 2 illustrates the annual number of publications on paper persistence in organizations amid digitization from 2000 to 2025. The data show that research output was very limited in the early 2000s, with only a few articles published each year and several years (2000, 2001, 2003, 2004, 2007) reporting no publications. A gradual increase is observed from 2005 onward, with small but consistent contributions through 2016. From 2017, the field shows a notable acceleration, reflecting growing scholarly interest in organizational information practices, hybrid workflows, and the role of digital technologies in record management. Significant growth occurs between 2019 and 2025, peaking in 2025 with 76 publications, indicating a surge of research attention in recent years. This trend suggests that the persistence of paper in organizations is increasingly recognized as an important area of study, particularly in the context of digital transformation, AI, cloud ECM, and automation technologies.

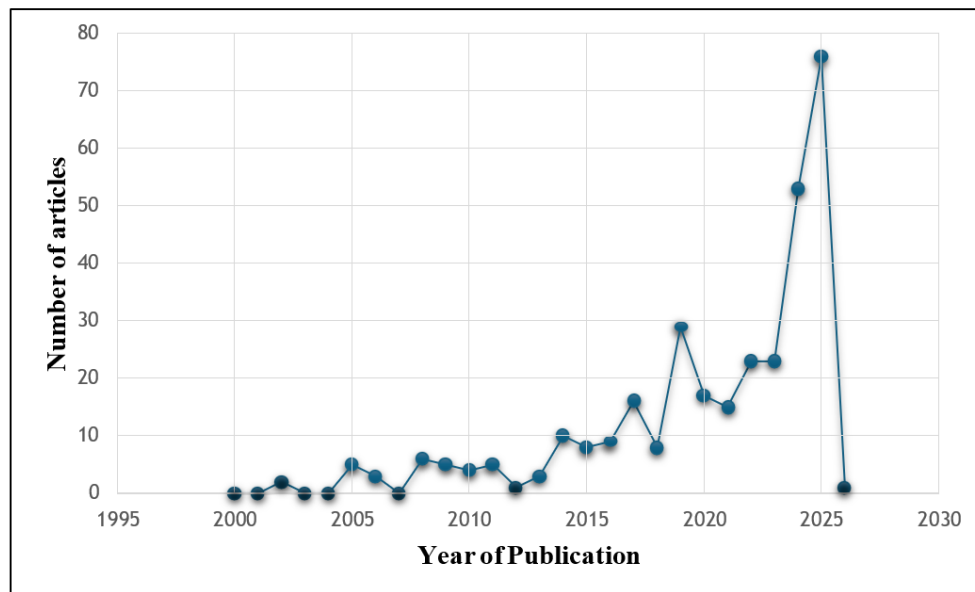


Figure 2: Annual number of publications on paper persistence in organizations amid digitization (2000–2025)

3.2. Documents per country

Table 1 presents the geographical distribution of the top 10 countries contributing publications on paper persistence in organizations from 2000 to 2025. China leads with 45 publications, followed by the United States (19) and India (18), highlighting strong research activity in both Asian and

Western contexts. The table also shows collaboration patterns, indicated by the number of single-country publications (SCP) and multiple-country publications (MCP). For example, Pakistan has a high MCP ratio (0.600), suggesting a larger proportion of its research is conducted through international collaboration, while the United Kingdom and Germany have all publications as SCPs. Citation analysis provides additional insight into impact: although China has the highest number of publications, the mean article citations are lower (5.70) compared to countries such as Korea (19.40) and Australia (17.80), indicating that smaller publication outputs can still achieve high scholarly influence.

Table 1: Distribution of publications on paper persistence in organizations by country (2000–2025)

Country	n	SCP	MCP	MCP ratio	TC	Mean Article Citations
China	45	40	5	0.111	256	5.70
USA	19	16	3	0.158	251	13.20
India	18	15	3	0.167	41	2.30
Canada	7	6	1	0.143	93	13.30
United Kingdom	6	6	0	0.000	67	11.20
Germany	5	5	0	0.000	7	1.40
Iraq	5	4	1	0.200	61	12.20
Korea	5	4	1	0.200	97	19.40
Pakistan	5	2	3	0.600	9	1.80
Australia	4	3	1	0.250	71	17.80

Note: n = number of publications; SCP = single country of publication; MCP = multiple countries publication; TC = total citation

3.3. Contributions of authors

Figure 3 presents a three-field plot illustrating the relationships between the most productive countries, influential authors and dominant research keywords, providing a comprehensive view of how geographical and individual contributions shape research on paper persistence in organizations. This visualization highlights both the global distribution of expertise and the thematic focus of key contributors. Several authors emerge as particularly influential. Borrmann, André and Braun, Alexander (2 articles each; fractional contributions 0.58) form a strong institutional cluster in Germany, with work focused on digital integration, blockchain technology, and workflow optimization. Other prominent contributors include Chen, Hui (2 articles; 0.50), Han, Yan (2 articles; 2.00), Kbidy, Gilles (2 articles; 2.00), Mehranfar, Mansour (2 articles; 0.58), Stein, Sebastian (2 articles; 0.67), and Yao, Guangshun (2 articles; 0.58), all of whom significantly contribute to thematic development in areas such as AI, cloud computing, and hybrid workflows. In addition, Alabdeli, Haider Mohmmmed (2 articles; 0.29) from Iraq and A, Subaveerapandiyani (1

article; 0.20) represent contributions from regions outside the primary publication hubs, reflecting the global diversity of researchers engaged in this topic. The keyword field demonstrates a clear

technological shift from traditional digitization to advanced tools. Central nodes such as Artificial Intelligence, Deep Learning, Cloud Computing and IoT indicate that the persistence of paper is increasingly studied in the context of high-tech adoption and intelligent automation. Flow lines in the plot also reveal interdisciplinary linkages, showing how authors from countries like Canada and China bridge local expertise with global research trends.

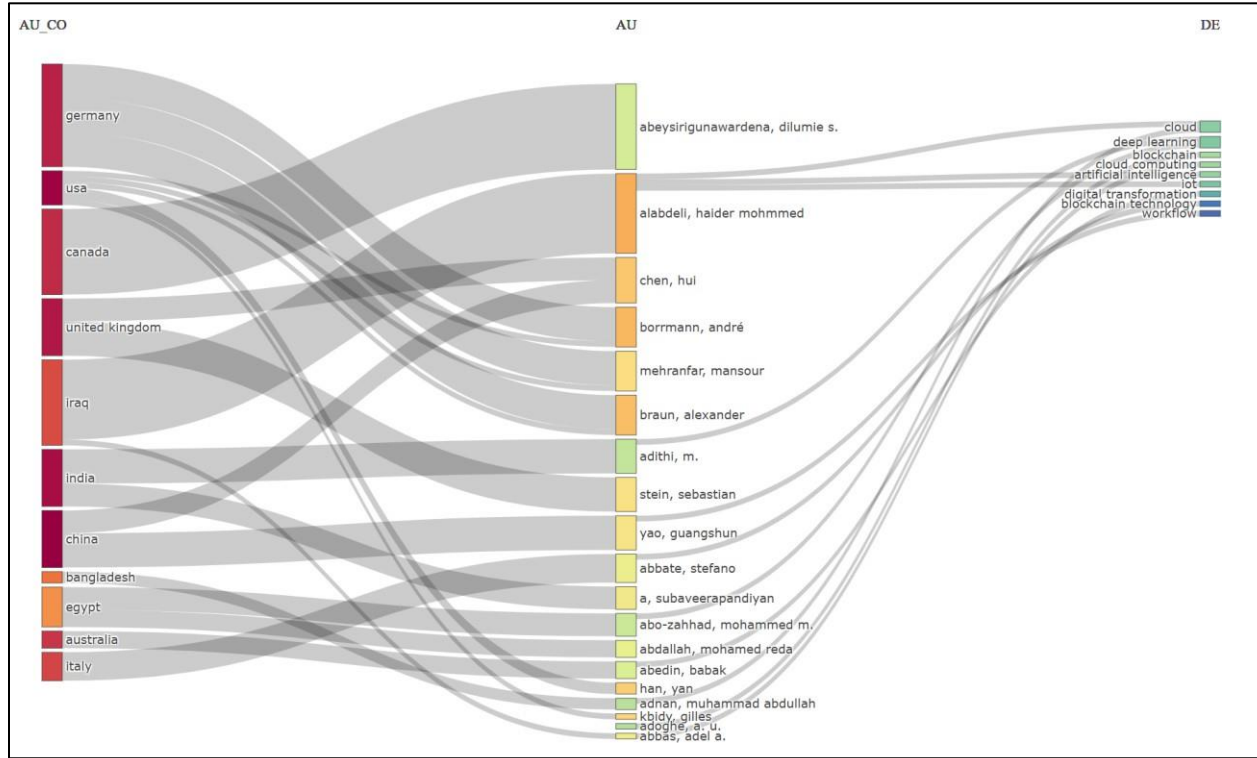


Figure 3: Three-field plot of countries, authors and key research terms in paper persistence research

3.4. Publications per source

Table 2 presents the distribution of publications on paper persistence in organizations across journals and other scholarly sources, along with citation impact indicators. *IEEE Access* leads with 12 publications, accumulating 168 citations and an h-index of 6, reflecting both productivity and influence within the field. Other notable sources include the *Proceedings of SPIE – The International Society for Optical Engineering* (7 publications, 13 citations, h-index = 2), *IEEE Transactions on Services Computing* (4 publications, 75 citations, h-index = 4) and *Records Management Journal* (4 publications, 46 citations, h-index = 4). Several journals with smaller publication counts demonstrate high citation impact relative to their output. For example, *Archival*

Science (2 publications) accumulated 56 citations, highlighting the influence of select contributions on the field. Collectively, these results indicate that while research on paper persistence is dispersed across multiple sources, a few key journals play a central role in shaping scholarly discourse.

Table 2: Number of publications and citation impact by source/journal

Sources	n	TC	h-index	m-index
IEEE Access	12	168	6	1.357
Proceedings of SPIE - The International Society For Optical Engineering	7	13	2	1.333
IEEE Transactions on Services Computing	4	75	4	2.143
Records Management Journal	4	46	4	1.133
Library Hi Tech	3	65	2	1.273
International Archives of The Photogrammetry, Remote Sensing and Spatial Information Sciences - ISPRS Archives	3	2	1	1.600
Archival Science	2	56	2	0.950
Automation In Construction	2	117	2	1.250
Electronics (Switzerland)	2	25	2	1.050
Expert Systems with Applications	2	10	2	1.353

Note: TC = total citation; h-index = Hirsch index; m-index = normalized h-index.

3.5. *Institutional contributions*

Table 3 presents the top 10 institutional affiliations contributing to research on paper persistence in organizations from 2000 to 2025. The University of Victoria leads with 15 publications, followed by institutions such as Oak Ridge National Laboratory and Hong Kong University of Science and Technology, reflecting both research productivity and thematic focus on digital workflows, records management, and organizational information practices. Other notable contributors include the China Electric Power Research Institute and Khulna University of Engineering and Technology, each with 7 publications, as well as Chulalongkorn University, Jilin University, the National Centre for Scientific Research “Demokritos”, and Politecnico Di Torino, each producing 6 publications. The presence of institutions from multiple regions—including North America, Europe, and Asia—highlights the global distribution of research activity in this field.

Table 3: Most relevant institutional affiliations in research on paper persistence in organizations (2000–2025)

Rank	Affiliation	Articles
1	University of Victoria	15
2	Notreported	10
3	Oak Ridge National Laboratory	10
4	Hong Kong University of Science and Technology	9
5	China Electric Power Research Institute	7
6	Khulna University of Engineering and Technology	7

7	Chulalongkorn University	6
8	Jilin University	6
9	National Centre For Scientific Research “Demokritos”	6
10	Politecnico Di Torino	6

3.6. *Publications with the highest citations*

Building on established evidence that citation indicators provide a robust measure of scholarly influence, this study employed a scientific mapping approach to identify the most impactful publications on paper persistence in organizations. Citation analysis of the retrieved dataset indicates that a substantial number of documents have received scholarly attention, reflecting the growing relevance of research examining the intersection of paper workflows and digital transformation. Table 4 presents the most highly cited publications, highlighting works that have shaped academic discourse on organizational paper persistence, workflow automation and digital document management. Among the top-cited studies, Viriyasitavat and Hoonsopon [7] emerges as the most influential, with 389 total citations, a high annual citation rate, and a normalized citation score of 16.07. This study provides foundational insights into blockchain characteristics and consensus in business processes, establishing a conceptual link between emerging technologies and organizational information management. Closely following is Broich et al. [8], whose work on blockchain applications in Earth observation and geoinformation systems has informed research on secure and verifiable document workflows. Other highly cited publications, including Ursini et al. [9] on scan-to-BIM conversion in built heritage, Kang et al. [10] on digitization tools for intelligent P&ID diagrams and Islam et al. [11] on deep learning and computer vision for quality control, highlight the evolution of the field toward integrating advanced AI and digital technologies into traditionally paper-dependent workflows. Additional influential contributions include Shakor et al. [12] on AES encryption and blockchain key management, Ding et al. [13] on fault-tolerant scheduling in cloud workflows and Sicilia and Visvizi [14] on blockchain and OECD data repositories. These studies collectively emphasize technological innovation, risk management and digital transformation as central drivers of research on paper persistence. Citation patterns underscore both foundational work and emerging directions, illustrating how scholarly attention has evolved from basic workflow automation to the implementation of intelligent, technology-enabled document management systems.

Table 4: Most highly cited publications on paper persistence in organizations (2000–2025)

Document	Title	Source	TC	TC per Year	Normalized TC
Viriyasitavat and Hoonsopon (2019)	Blockchain characteristics and consensus in modern business processes	Journal of Industrial Information Integration	389	48.63	16.07
Broich <i>et al.</i> , (2011)	Blockchain characteristics and consensus in modern business processes	International Journal of Applied Earth Observation and Geoinformation	172	10.75	3.21
Ursini <i>et al.</i> , (2022)	From scan-to-BIM to a structural finite elements model of built heritage for dynamic simulation	Automation in Construction	82	16.40	7.67
Kang <i>et al.</i> , (2019)	A digitization and conversion tool for imaged drawings to intelligent piping and instrumentation diagrams (P&ID)	Energies	74	9.25	3.06
Islam <i>et al.</i> , (2024)	Deep learning and computer vision techniques for enhanced quality control in manufacturing processes	IEEE Access	70	23.33	16.86
Ding <i>et al.</i> , (2017)	Fault-tolerant elastic scheduling algorithm for workflow in cloud systems	Information Sciences	57	5.70	6.20
Shakor <i>et al.</i> , (2024)	Dynamic AES encryption and blockchain key management: a novel solution for cloud data security	IEEE Access	54	18.00	13.01
Sicilia and Visvizi (2019)	Blockchain and OECD data repositories: opportunities and policymaking implications	Library Hi Tech	54	6.75	2.23
Weder <i>et al.</i> , (2020)	December. Integrating quantum computing into workflow modeling and execution	IEEE	46	6.57	6.63
Heinis <i>et al.</i> , (2005)	Design and Evaluation of an Autonomic Workflow Engine	International Conference on Autonomic Computing	46	2.09	3.11

3.7. Visualization of research focus areas

Figure 4 presents a word cloud illustrating the most frequently occurring keywords in research on paper persistence in organizations from 2000 to 2025. Analysis of keyword frequency reveals that “information management” (180 occurrences) is the dominant theme, reflecting the centrality of managing organizational knowledge and documentation in studies of paper persistence. Other prominent terms include “digital storage” (59), “block-chain” and “blockchain” (47 each), highlighting the growing interest in secure, distributed technologies as part of digital transformation initiatives. Additional frequently occurring keywords such as “automation” (26), “network security” (24), “cloud computing” (21), “records management” (21), “internet of things” (20) and “decision making” (19) indicate that research has increasingly focused on integrating technological solutions, enhancing workflow efficiency and supporting organizational decision-making processes. The visualization underscores how studies on paper persistence are not limited

to traditional record-keeping but also engage with broader digital transformation trends, reflecting the convergence of organizational behavior, information systems and emerging technologies.

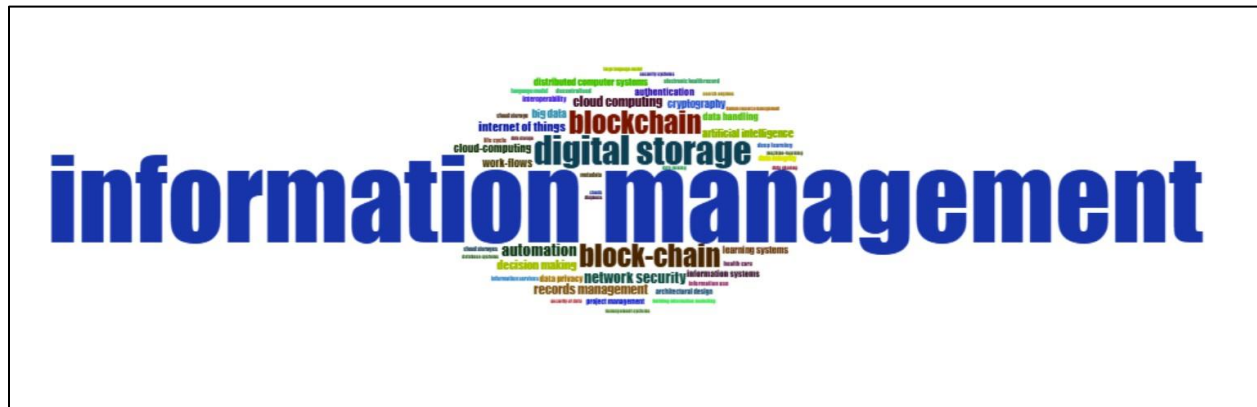


Figure 4: Word cloud illustrating the most frequently occurring keywords in research on paper persistence in organizations (2000–2025)

To visualize the research focus of past studies on paper persistence, VOSviewer was used to analyze keyword co-occurrence [1]. From the 327 retrieved documents, 3,518 keywords were extracted from author and journal indexing. A minimum co-occurrence threshold of 7 was applied to highlight the most influential terms while reducing visual clutter. This process resulted in 32 keywords organized into four major clusters, with 311 links and a Total Link Strength (TLS) of 1,220, as shown in Figure 5.

Cluster 1 is represented by the red nodes on the visualization map and comprises 15 keywords that collectively reflect a central thematic focus in research on paper persistence in organizations. Information management (LS = 441) is the most central keyword, highlighting its dominant role in shaping organizational knowledge handling, workflow efficiency and documentation practices. This is followed by terms such as automation, artificial intelligence and decision making, illustrating the interconnected influence of technological adoption, process optimization and managerial oversight in sustaining hybrid or paper-based workflows. The cluster includes the following co-occurring keywords: architectural design, deep learning, information systems, internet of things, interoperability, learning systems, life cycle, metadata, project management and workflows, further emphasizing the integration of advanced technologies with organizational routines. These terms reflect how digital transformation intersects with operational, structural and managerial processes, highlighting research on workflow optimization, system interoperability,

and intelligent management of paper and digital records. The frequent co-occurrence of *workflows*, project management and decision-making keywords underscores scholarly attention to improving efficiency, standardization and governance in organizational information practices. Based on the conceptual coherence and prominence of these keywords, this cluster is thematically labeled “Digital Transformation and Organizational Information Management.” It captures the literature’s focus on how emerging technologies, management practices and workflow innovations influence the persistence of paper in organizational contexts, balancing both traditional and digital information systems.

Cluster 2 is represented by the green nodes on the visualization map and includes 10 keywords that collectively reflect a security-centric research stream within the paper persistence literature. Blockchain (LS = 56) is the most central term, underscoring the increasing scholarly focus on decentralized record verification and tamper-resistant documentation systems. This is closely followed by authentication, network security and data integrity, which highlight concerns around verifying records, protecting information flows and ensuring reliability in both physical and digital document ecosystems. The cluster includes the co-occurring keywords cryptography, data privacy, decentralized, records management and healthcare, emphasizing technical mechanisms for safeguarding records alongside governance practices aimed at maintaining trust in documentation systems. Sector-specific terms, particularly healthcare, indicate that paper persistence is often studied in environments where verification, privacy and record continuity carry high regulatory stakes. The co-occurrence of authentication, integrity, privacy and blockchain keywords reveals a dominant scholarly interest in understanding how organizations sustain paper records alongside digitally secured systems to mitigate perceived documentation risks. Given the conceptual coherence and prominence of these terms, this cluster is thematically labeled “Information Security, Verification, and Decentralized Records Governance.” It captures the literature’s emphasis on securing organizational records and ensuring trust, integrity and verifiability in hybrid environments where paper continues to coexist with advanced digital infrastructures.

Cluster 3 is represented by the blue nodes on the visualization map and consists of four keywords reflecting a data-systems perspective in the study of paper persistence. Digital storage (LS = 177)

is the central term, highlighting sustained academic attention to how organizations structure, migrate and preserve records as digital repositories expand. This is followed by big data and data handling, which signal a focus on large-scale information processing, record organization and challenges of managing parallel physical and digital data streams. The cluster further includes distributed computer systems, emphasizing the technical infrastructure underpinning modern document ecosystems, where information is stored and processed across decentralized networks rather than local paper archives. The co-occurrence of digital storage with terms linked to data handling and distributed systems indicates that paper persistence is increasingly examined within the context of scalable data environments, where organizations face governance and redundancy challenges despite strong digital capacity. Based on the conceptual alignment and prominence of these terms, this cluster is thematically labeled “Scalable Data Infrastructure and Distributed Records Handling.” It captures the literature’s emphasis on understanding how expanding digital storage systems and distributed computing environments frame ongoing reliance on paper records within complex organizational information architectures.

Cluster 4 is represented by the yellow nodes on the visualization map and includes three closely linked keywords that reflect a cloud-centric dimension of the paper persistence literature. Cloud computing (LS = 100) is the most central term, underscoring strong scholarly focus on cloud-hosted information systems and their role in reshaping organizational storage models. This is followed by cloud storage, which reinforces attention on remote, scalable repositories designed to replace localized physical archiving. The co-occurrence of these terms suggests that paper persistence is frequently examined in organizations undergoing migration to cloud-based enterprise content and document management environments, where storage capacity is no longer a limiting factor. Despite this, the cluster highlights that research continues to frame cloud systems not as full displacements of paper, but as infrastructures that coexist with physical documentation due to organizational continuity expectations and redundant storage behaviors. Based on the conceptual coherence of these terms, this cluster is thematically labeled “Cloud-Enabled Storage Ecosystems and Redundant Archiving Practices.” It captures the literature’s emphasis on understanding how cloud infrastructures influence—but do not fully eliminate—paper dependence in organizations transitioning to distributed digital records environments.

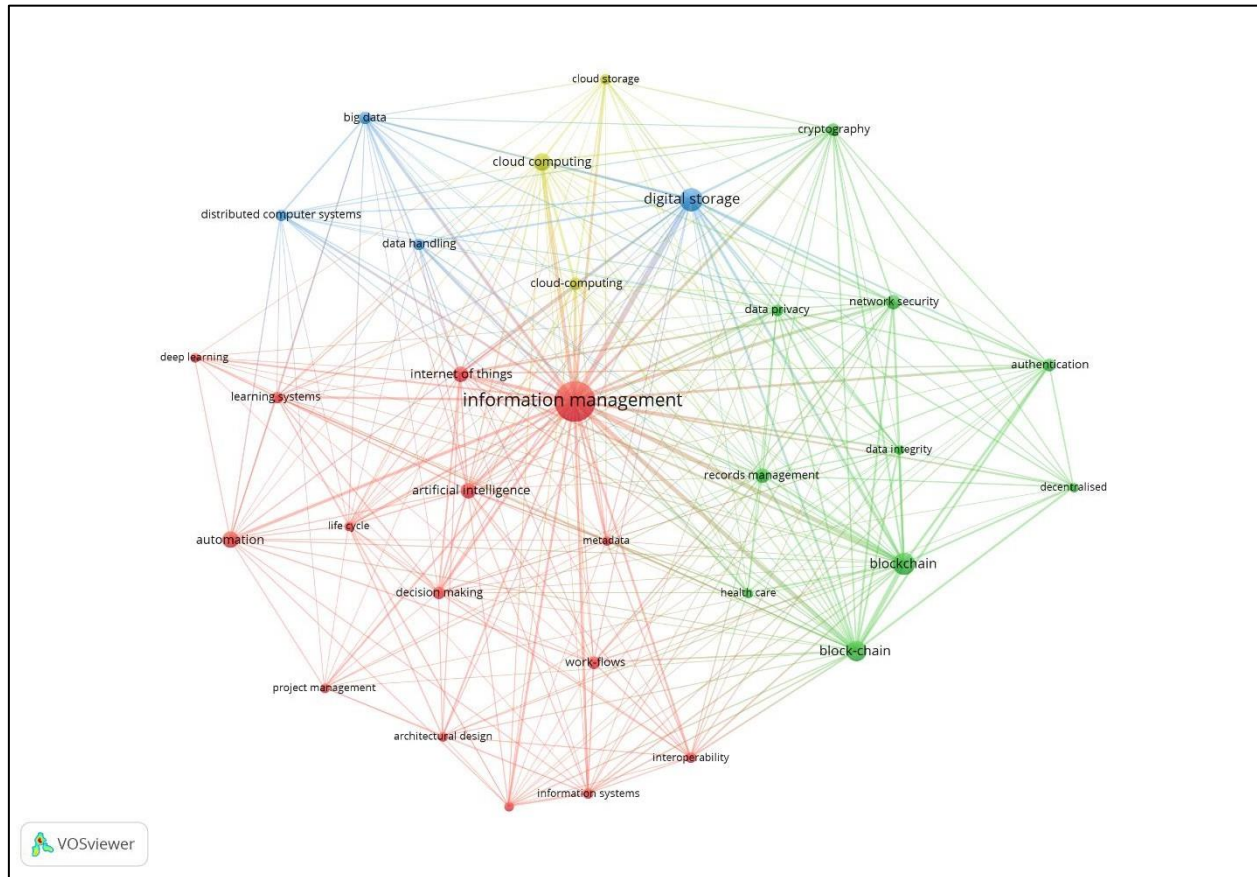


Figure 5: Keyword co-occurrence network in studies on paper persistence

3.8. *Temporal representation of digital technologies in paper persistence research*

Figure 6 reveals the temporal visibility of digital technologies in paper persistence literature from 2008 to 2024, showing how intelligent systems, security architectures, data infrastructures and cloud services have been represented over time. The early period (2008–2012) is characterized by low-frequency digital terms, dominated by foundational or observational topics such as remote sensing and clouds, signaling a nascent scholarly engagement with digitalization in organizational paper workflows. From 2014 to 2018, the literature entered a growth phase, marked by the appearance of enabling infrastructure terms including distributed computer systems, cloud computing, middleware, and fault tolerance. This period reflects a shift from conceptual discussion of paper persistence to investigations of digital backbone technologies that support document processing, enterprise content management (ECM) and systems integration. The most notable peaks occur between 2020 and 2022, where large bubbles indicate sharp increases in terms directly linked to digital transformation — particularly information management, automation and digital

storage (the largest recorded frequency at 177). This suggests that recent research places significant emphasis on digitally mediated organizational efficiency, while still acknowledging paper as an embedded workflow artifact. From 2023 onward, the field shows a renewed surge of advanced digital technologies, including learning systems, interoperability, decision making, data handling, block-chain and blockchain (highest security-related frequency at 56). The rise of deep learning, AI, records management and distributed ledger security terms demonstrates that digital technologies are increasingly framed not only as tools for efficiency (OCR, RPA, RPA-like automation), but also as governance, security, and intelligence infrastructures that attempt to explain paper's persistence despite accelerating digitization. The dominant representation of AI-driven management systems (Cluster 1), blockchain-enabled security systems (Cluster 2), big data infrastructures (Cluster 3) and cloud services (Cluster 4) confirms that digital technologies in paper persistence research have evolved from peripheral mentions to central explanatory constructs, reflecting a field that now interrogates paper not as a technological failure, but as a socio-technical persistence occurring alongside increasingly intelligent, secure, distributed and cloud-based document ecosystems.

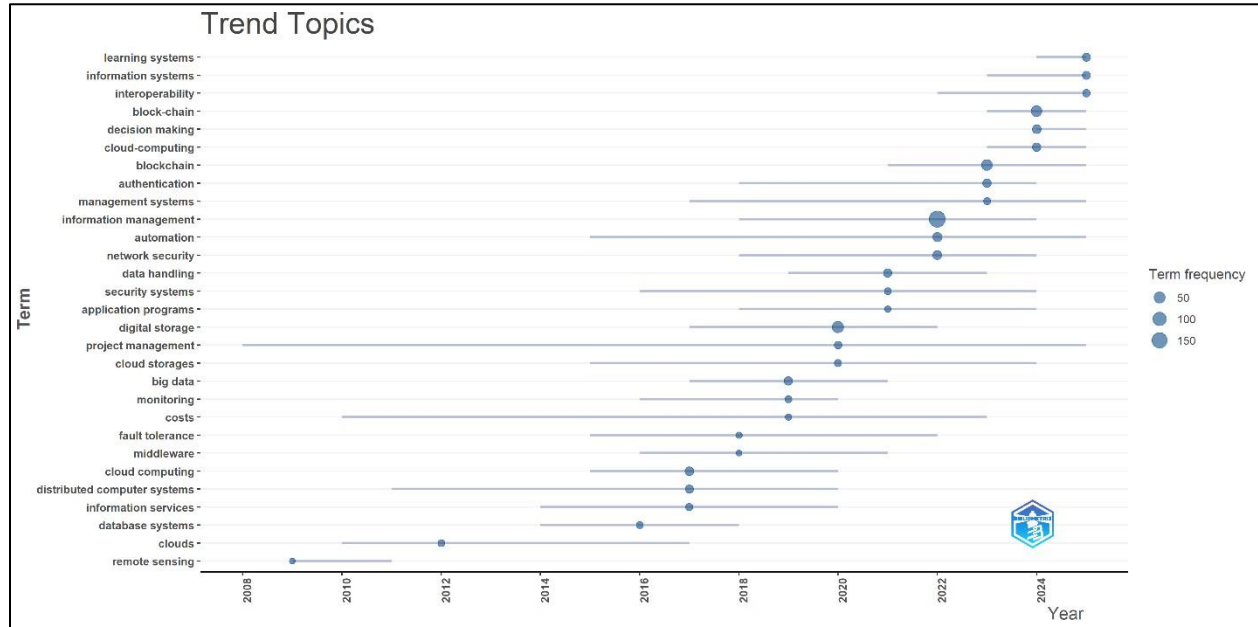


Figure 5: Evolution of research trend topics and term frequency (2008–2024)

4. Conclusion

Paper persistence in organizations remains a critical issue in the era of digital transformation, reflecting the complex interaction between technological advancement, organizational workflow and governance structures. This study conducted a comprehensive bibliometric and thematic analysis of 327 publications published between 2000 and 2025 to examine how scholarship on paper persistence has evolved, identify leading contributors and institutional actors, uncover dominant conceptual themes and trace how digital technologies have been represented across time. The findings collectively provide direct answers to the study's research questions by clarifying the temporal development of the field, identifying key knowledge producers, explaining the conceptual foundations of paper persistence and demonstrating how digital technologies have reshaped scholarly understanding of organizational documentation practices.

First, the analysis shows a sustained growth in research output over the past two decades, with a notable acceleration after 2017 and a peak in 2025. This trend indicates increasing scholarly recognition that paper persistence remains relevant despite rapid digitalization. The expansion of research aligns with growing interest in hybrid information systems, digital workflow integration and emerging technologies such as artificial intelligence, automation, cloud-based enterprise content management and blockchain. In addressing the research question concerning the evolution and geographic distribution of scholarship, the findings reveal that China, the United States, and India are leading contributors, while institutions including the University of Victoria, Oak Ridge National Laboratory, and Hong Kong University of Science and Technology play central roles in knowledge production. The participation of smaller contributors and emerging regions further highlights the importance of international collaboration in advancing understanding of organizational information practices.

Second, thematic analysis demonstrates that the literature converges around four interrelated conceptual clusters, directly answering the research question regarding dominant explanatory themes. The first cluster emphasizes digital transformation and organizational information management, highlighting AI-enabled workflows, project management systems, and hybrid documentation environments. The second cluster focuses on information security and decentralized governance, where blockchain, cryptography, and authentication mechanisms address trust, verification, and record integrity. The third cluster centers on scalable data infrastructure and distributed record handling, reflecting the increasing role of digital storage, big

data, and distributed computing systems. The fourth cluster highlights cloud-enabled storage and archiving systems that support remote accessibility while paper persists as a complementary safeguard. Together, these clusters reveal that paper persistence is fundamentally socio-technical in nature. Rather than indicating resistance to innovation, continued paper use represents an adaptive organizational response shaped by risk management, regulatory compliance, interoperability challenges, workflow flexibility and institutional routines. Paper therefore functions as a stabilizing mechanism that supports coordination, accountability, and operational continuity within increasingly complex digital ecosystems.

Third, the temporal analysis of digital technologies addresses the research question concerning how technological discourse has evolved within the literature. Early studies between 2008 and 2012 contained limited engagement with digital infrastructures, whereas the period from 2014 to 2018 marked the emergence of distributed computing, middleware systems, and early cloud applications. From 2020 onward, research increasingly emphasizes artificial intelligence, automation, digital storage, and interoperability, reflecting a shift toward examining paper persistence within intelligent and highly integrated digital environments. This progression demonstrates that paper is no longer conceptualized as a legacy artifact but as an enduring component embedded within technologically advanced workflows.

Finally, the study identifies influential authors, publications, and journals that shape the intellectual structure of the field, thereby addressing the research question concerning scholarly leadership and knowledge diffusion. High-impact studies emphasizing blockchain-enabled governance and digital management systems illustrate how technological innovation has reframed debates around documentation practices, while leading journals demonstrate the interdisciplinary nature of the topic across information systems, construction and organizational research domains. These insights provide a foundation for future research, particularly in underexplored areas such as interoperability constraints, cross-platform workflow integration, and the socio-organizational implications of hybrid record environments.

From a practical perspective, the findings carry important implications for organizations navigating simultaneous paper-based and digital systems. Digital transformation initiatives should move beyond assumptions of complete paper elimination and instead adopt strategies that intentionally accommodate hybrid information environments. Paper persistence reflects enduring

organizational needs for trust, redundancy, verification, and regulatory assurance, suggesting that successful transformation depends on aligning technological systems with human practices and governance requirements. Organizations that recognize paper as a complementary component of an adaptive information ecosystem are better positioned to achieve resilient, secure, and sustainable operational outcomes.

Despite these contributions, the study has limitations. The analysis relies exclusively on English-language publications indexed in Scopus, which may exclude relevant research available in other databases or languages. Future studies could expand coverage to include Web of Science and non-English literature, as well as examine sector-specific dynamics, regulatory influences, and human behavioral factors shaping documentation practices. Such work would deepen understanding of why paper continues to coexist with advanced digital technologies across organizational contexts. Overall, the study demonstrates that paper persistence should not be interpreted as a temporary delay in digital adoption but as an enduring organizational strategy through which institutions balance innovation, reliability, and accountability within evolving socio-technical systems. By reframing paper persistence as an adaptive feature of digital transformation rather than a failure of it, this research opens new avenues for examining governance, trust, and institutional adaptation in contemporary digital workplaces..

Data availability statement

All data or codes generated or used during the study are available from the corresponding author upon request.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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