Beyond Technology Adoption: A Systematic Review of Institutional, Human Capital, and Governance Barriers to Sustainable Digital Transformation in Academic Libraries

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ABSTRACT

This systematic literature review explores the digital transformation (DT) landscape in university libraries between 2016 and 2026. It shows a shift in focus from technology to more important socio-institutional factors. A global review of 31 studies suggests that despite the widespread introduction of technologies such as artificial intelligence (AI), the Internet of Things (IoT), and cloud computing, the successful implementation of these technologies is still hampered by financial constraints, low digital competencies of staff and deficiencies in the institutional policy framework. It was also found that there are significant differences between developed and developing countries. For example, basic infrastructure such as power supplies that are not reliable and broadband access are problems for developing countries. The findings show that the whole sociotechnical context is important in the digital transition, including adaptive leadership, continuous professional development, and more legal and moral oversight to ensure long-term success.

Keywords: Digital Transformation, Academic Libraries, Barriers, Institutional Readiness, Human Capital, Governance, Systematic Literature Review, PRISMA

INTRODUCTION

Background and Context

In the past 10 years, there has been a rapid evolution of information and communication technology (ICT) which has caused major changes for higher education institutions (Trivedi & Trivedi, 2025). Academic libraries have been repositories of physical resources and should be transformed into centres to help users navigate the increasingly complex world of digital information sources (Subaveerapandiyan & Sinha, 2024). The transition has been gradual from manual systems before the ’70s to automation and integrated systems and now to digital transformation driven by technology such as artificial intelligence (AI) and the broad use of data (Trivedi & Trivedi, 2025).

“Digital transformation, in this sense, means not only the digitisation of materials or the introduction of new systems, but also a radical change in the way that libraries function, including internal processes and customer service delivery with increased speed and flexibility" (Deja et al., 2021; Nakaziba & Ngulube, 2024). The increasing significance of digital transformation stems from modern customers’ need for fast, easily accessible, and customised information services, regardless of time and place (Bawack, 2019, cited in Nakaziba & Ngulube, 2025; Martínez-Camacho et al., 2025). The COVID-19 pandemic has accelerated this change, revealing the flaws of traditional approaches and forcing libraries to ramp up their digital capabilities more quickly (Adarkwah et al., 2024; Deja et al., 2021).

Problem Statement

Trivedi & Trivedi (2025) expressed that in 2025, 92% of the world's libraries will adopt automated systems, but there are still many challenges in sustainable digital transformation efforts. There is a significant gap between the pace of technological acquisition and the willingness of organisational frameworks and human resources to handle it (Deja et al., 2021). Many libraries, especially in the poor countries, tend to adopt technology without proper and comprehensive planning. This causes chaotic execution to lead to resource waste and inefficient services (Mosha & Ngulube, 2026; Nakaziba & Ngulube, 2024).

These are not just technological problems. Human factors and governance also play a key role, along with issues like poor infrastructure, erratic power supplies, and high maintenance costs (Dei, 2026; Mesagan & Hossana, 2025). Leadership gaps, like the inability to be agile in the face of change, can prevent organisations from responding rapidly to digital developments (Hongo et al., 2026).

Moreover, some staff still lack digital skills, especially in comprehending new technologies like the metaverse, thus underutilising their potential (Subaveerapandiyan & Sinha, 2024). Lack of understanding of legal issues such as copyright and no specific data management laws are some of the significant barriers to the full implementation of digital innovation (Seitimbetova et al., 2026).

Significant and Objectives

Therefore, this systematic literature review (SLR) is important, as the previous research has largely focused on technology dimensions and often ignored other important aspects such as institutional preparedness, leadership and human resource competencies (Trivedi & Trivedi, 2025). This paper reviews 31 studies published from 2016 to 2026 to clarify the real issues of digital transformation (DT) implementation and to understand the reasons for some initiatives' failure to attain long-term sustainability.

The study seeks to address the following questions:

- RQ1: What are the most common types of barriers (financial, human capital, governance, technical, etc.) to the implementation of digital transformation in academic libraries?
- RQ2: What is the impact of the institution's preparedness level, adaptive leadership, and governance structure on the success or failure of digital transformation?
- RQ3: How do contextual factors (geographical location, size of the institution, level of economic development) impact the nature and complexity of the difficulties?
- RQ4: What theories and models are used to understand the problems of digital transformation, e.g., TAM and UTAUT, and what is missing in the current theoretical framework?

This study tries to provide better guidance to library managers and policymakers in developing strategies, strengthening leadership and designing more effective policies and training them for a sustainable digital transformation.

METHODOLOGY: SYSTEMATIC LITERATURE REVIEW APPROACH

This section presents the systematic approach used to identify, select, and synthesise relevant literature concerning institutional, human capital, and governance barriers to digital transformation in academic library services. The review will follow the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA 2020) standards to ensure transparency, reproducibility, and rigour in the study selection and reporting processes. Content analysis was selected as the primary method for data synthesis, as it aligns with approaches commonly employed in the field of library and information science, facilitating a systematic analysis of qualitative data from studies with diverse research designs.

The thematic synthesis, based on the approach proposed by Thomas and Harden (2008), was conducted through three distinct stages: a detailed line-by-line coding process to examine findings, the clustering of these codes into descriptive themes, and the final interpretation of these themes into analytical frameworks that directly address the core research questions. By collecting, examining, and organising the findings from individual studies into specific themes, this process enables a more comprehensive understanding of the multilayered issues and challenges associated with digital transformation in academic environments.

Collection of Past Works and Database Selection

To ensure full coverage of the relevant literature, publications were obtained from four large academic databases, namely, Scopus (Elsevier), Web of Science, Emerald Insight, and IEEE Xplore. These databases were selected because they provide comprehensive, authoritative coverage of the literature in the areas of library and information science, information systems, educational technology, and organisational management. Access was provided by Perpustakaan Tun Abdul Razak (PTAR). My knowledge management portal is in the Library and Information Science category to provide full-text retrievability of selected items.

Search Terms

Boolean search strings were meticulously constructed for all specified databases to allow comprehensive, targeted searches. The search terms utilised were:

- The search phrases used included "digital transformation", "digitali*", "digital adoption", "technology adoption", "digital innovation", and "digital maturity".
- barrier* OR challenge* OR constraint* OR obstacle* OR limitation* OR impediment*. This search includes terms related to OR readiness, resistance, and "change management."
- institutional OR organization* OR governance OR policy OR leadership OR "human capital" OR skill* OR competenc* OR capacity OR training OR workforce OR staff OR librarian*
- "academic library" The search criteria included terms such as "academic library", "university library", "libraries", "librarians", "library service*", and "library management".

The search criteria were developed to ensure broad conceptual coverage and precision on the issues by capturing studies that address the technical, human capital, governance, and institutional dimensions of digital transformation challenges across many disciplines.

Selection of Papers: Inclusion and Exclusion Criteria

A rigorous set of inclusion and exclusion criteria was used to ensure quality and relevance of the selected studies.

Table 1: Inclusion and Exclusion Criteria

Criterion	Inclusion Criteria	Exclusion Criteria
Publication Date	Published between 2016 and 2026	Published before 2016
Language	Articles published in English	Articles published in languages other than English
Article Type	Peer-reviewed journal articles	Conference papers, book chapters, books, theses, dissertations, grey literature, unpublished reports, editorials, and review papers
Research Focus	Studies focusing on digital transformation in academic or university libraries, including digital services, digital technologies, AI, automation, digital repositories, smart libraries, and digital innovation	Studies focusing solely on public, school, special, or national libraries without an academic/university context

Availability	Full-text articles accessible through databases or institutional subscriptions	Articles with restricted or unavailable full text
Research Relevance	Studies directly addressing digital transformation, digitalization, or technology adoption in academic libraries	Studies unrelated to digital transformation or not involving academic libraries
Study Quality	Studies with a clear research methodology and empirical or conceptual contribution	Opinion articles, commentaries, news articles, and studies lacking methodological rigor

Data Analysis

Content analysis was chosen for this study because it is compatible with library and information science. This approach is particularly useful for the systematic analysis of qualitative data, especially in the case of studies with different research designs. This approach aggregates, analyses and categorises findings from separate studies into specific themes. This process facilitates a better understanding of the issues and challenges of digital transformation in academic libraries.

In this study, thematic synthesis was conducted based on the approach proposed by Thomas and Harden (2008) through three main stages: The findings of the selected studies were analysed in detail by means of a line-by-line coding process at the beginning. Second, the codes were clustered into descriptive themes. Finally, the themes were further interpreted to produce analytical themes that directly address the research questions.

PRISMA Flow Diagram

The PRISMA flow diagram below illustrates the systematic screening process for the inclusion and exclusion of articles.

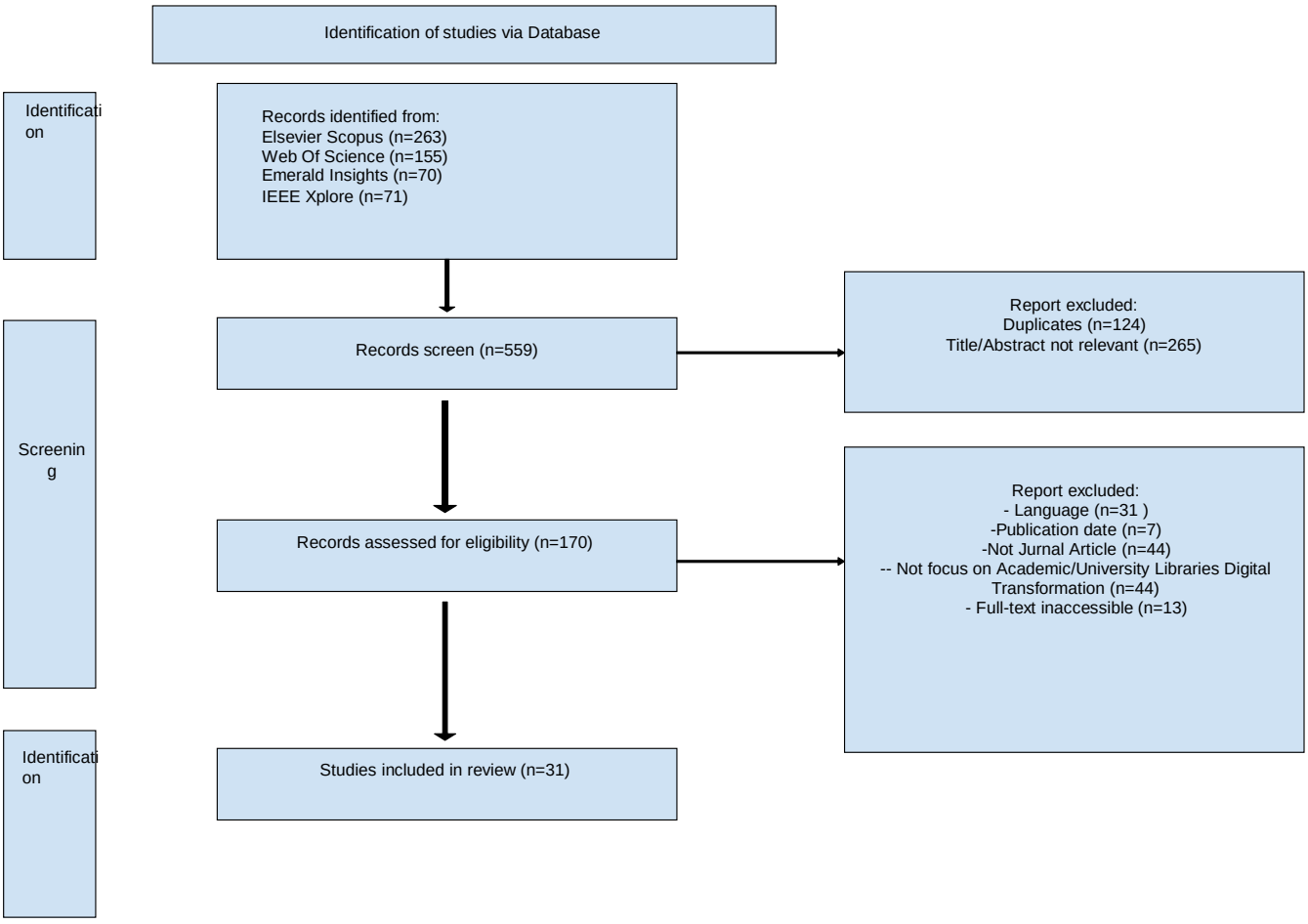

Figure 1: PRISMA flow diagram

RESULTS

Overview of Included Studies

The systematic review approach identified a total of 559 records from the four selected databases. Among these, only 31 research studies met all the set criteria and were selected for further investigation. The selected papers deal with diverse study methods, geographic areas, and topics. The diversity indicates that the research on digital transformation in academic libraries is from many contexts and not limited to one.

Table 2: Database Search Results Summary

Database	Search String	Records Retrieved
Scopus (Elsevier)	TITLE-ABS-KEY("digital transformation" OR "digital adoption" OR "digital innovation" OR "digital maturity" OR digitali*) AND (barrier* OR challenge*) OR constraint* OR obstacle* OR impediment* OR readiness OR resistance OR "change management") AND (institution OR organisation*) OR governance OR policy OR leadership OR "human capital" OR skill* OR competenc* OR capacity OR training OR workforce OR staff OR librarian*) AND ("academic library" OR "university library" OR libraries OR librarians OR "library service*" OR "library management")	263
Web of Science	TS("digital transformation" OR digital* OR "digital adoption" OR "digital innovation" OR "digital maturity") AND (barrier* OR challenge* OR constraint* OR obstacle* OR impediment* OR readiness OR resistance OR "change management") AND (institutional OR organization* OR governance OR policy OR leadership OR "human capital" OR skill* OR competence* OR capacity OR training OR workforce OR staff OR librarian*) AND ("academic library" OR "university library" OR libraries OR librarians OR "library service*" OR "library management")	155
Emerald Insight	("digital transformation" OR "digital innovation") AND (barrier* OR challenge* OR constraint* OR readiness OR resistance OR "change management") AND ("academic library" OR "university library" OR libraries OR librarians OR "library service*" OR "library management") AND (institutional OR organization* OR governance OR policy OR leadership OR "human capital" OR skill* OR competence* OR capacity OR training OR workforce OR staff OR librarian*)	70
IEEE Xplore	("digital transformation" OR digitali* OR "digital	71

	adoption" OR "digital innovation" OR "digital maturity") AND (barrier* OR challenge* OR constrain* OR obstacle* OR impediment* OR readiness OR resistance OR "change management") AND (institutional OR organization* OR governance OR policy OR leadership OR "human capital" OR skill* OR competence* OR capacity OR training OR workforce OR staff OR librarian*) AND ("academic library" OR "university library" OR libraries OR librarians OR "library service*" OR "library management")	

Research Design of Included Studies

It is based on 31 selected literature sources and reveals the diversity of methodological approaches used to study the phenomenon of digital transformation in university libraries. These methods can be classified into three main categories: qualitative, quantitative and mixed methods. Further analysis of all these sources reveals variations in utilisation rates for each methodological technique used in the studies.

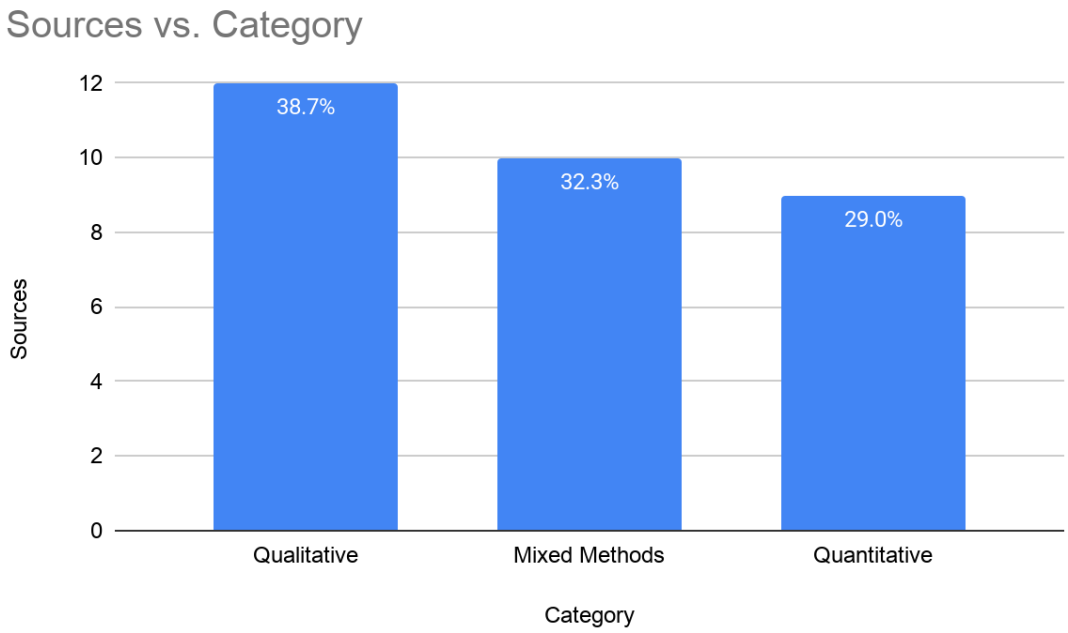

Figure 2 Research Design

The breadth of the analytical methods used in this study indicates that the digital revolution in academic libraries is not just a technical problem but also a complex social and organisational issue.

The main approach is the qualitative approach (38.7%), which makes use of techniques such as systematic literature review (SLR), meta-synthesis, and case studies to generate comprehensive understanding and theoretical frameworks. Adarkwah et al. (2024), Hu et al. (2024), Mosha & Ngulube (2025), & Nakaziba & Ngulube (2025a) incorporate global trends and professional development. Horstmann (2018) and McKenzie et al. (2022) talk about leadership and organisational strategies. Khoeini et al. (2024a, 2024b) introduced a digital transformation model based on Delphi and metasynthesis. Research has also been carried out in different contexts, such as open-source software (Ahammad et al., 2024), artificial intelligence (Martínez-Camacho et al., 2025), conflict situations (Muthanna and Sang, 2019) and the pandemic (Singh, 2020).

Mixed methods (32.3%) are becoming more prominent due to their ability to combine quantitative data with user experience. This design typically uses both surveys and interviews to achieve more comprehensive results. This method is the approach adopted in the studies by Nakaziba et al. (Ngulube, 2024a, 2024b, 2025b) on Digital Technology (DT) and Continuous Professional Development (CPD) preparedness in Uganda; and Hongo et al. (2026) on adaptive leadership in Kenya. Also, research on legal literacy studies (Seitimbetova et al., 2026) and AI implementation in Ghana (Dei, 2026). Other studies on sustainable transformation (Dube and Keita, 2024), leadership (Mirza and Jabeen, 2025), system planning (Cevher and Soydal, 2026) and automation development (Trivedi and Trivedi, 2025).

The quantitative approach (29.0%) provides empirical evidence with measurable data, especially in evaluating the link between institutional readiness and the use of technology. Asim and Arif (2026) and Deja et al. (2021) discuss the use of SEM/CBSEM. Survey techniques assess skills, infrastructure, and technology adoption (Mesagan and Hossana, 2025; Subaveerapandiyan and Sinha, 2024; Gundur and Kumar, 2026). Other studies are AI metadata readiness (Mabawonku and Buraimo, 2025), user perception (Inyang and Umoh, 2020), skill gaps (Ashiq et al., 2021) and intelligent service model development (Liu, 2026).

The combination of the three approaches will provide a strong and equitable evidence base. Quantitative methods will help us to quantify the extent of the problem; qualitative and mixed methods will help us understand why and in what context. The findings confirm the multidimensional socio-technical nature of digital transformation and provide a solid basis for identifying the main impediments to be discussed in the following analysis.

RQ1: Dominant Barriers and Challenges Hindering Digital Transformation (DT) in Academic Library Services (2016–2026).

Table 3: Key Sources for Dominant Barrier Categories

Author, Year	Title	Summary of Findings
Subaveerapandiyan & Sinha (2024)	From Books to Bytes and Custodians to Navigators: Exploring Metaverse Literacy for Library Professionals	Recognise human capital challenges, including lack of "metaverse literacy" and digital agility, as major skill gaps that inhibit librarians from effectively navigating the contemporary digital landscape.
Dei (2026)	Library and information Service delivery in the age of artificial intelligence faces impediments, with persistent financing deficiencies and insufficient ICT resources being the primary challenges to the sustainable integration of AI.	The main challenges in the sustainable integration of artificial intelligence (AI) are the persistent financing deficiencies Additionally, there is a lack of ICT resources, particularly in terms of financial and infrastructural support.
Mabawonku & Buraimo (2025)	Preparedness of Librarians for AI-Generated Metadata Management: A Case Study of University Librarians in South–West, Nigeria	The study finds that a significant proportion of librarians remain under-skilled in technical aspects of AI integration and digital metadata resolution.
Mesagan & Hossana (2025)	Deployment of information communication technology (ICT) in Nnamdi Azikiwe	Highlighting the significant infrastructural issues in developing regions, such as erratic power supply and slow internet speed, which hamper the efficiency of

	library, University of Nigeria, Nsukka: Availability, utilization, challenges, and strategies for improvement	digital solutions
Mosha & Ngulube (2025)	Systematic analysis of emerging trends in smart libraries is conducted. The review focuses on university needs, sustainability, and challenges.	The review provides a detailed classification of barriers including legal restrictions (such as copyright), data privacy issues and resistance from employees to organisational changes in the context of a smart library.

The literature review revealed that there are many factors that hinder the implementation of digital transformation in academic libraries. On the other hand, it is a combination of several interrelated components, including technology, finance and human issues. Generally we may state these problems as follows:

1. Financial constraints are one of the most common problems across all countries. The costs of subscribing to digital databases, purchasing software, such as AI, and maintaining automation systems are expensive, often beyond the financial capacity of libraries, especially in countries with economic difficulties.

2. This gap in the skills and competencies of the staff is a huge challenge. The digital revolution has pushed librarians into new roles that go beyond managing materials to helping users navigate digital information. However, challenges remain, including lack of digital skills, lack of confidence in technology, lack of motivation to engage in continuing professional development (CPD) and difficulties in adapting to changes in work methodologies.

3. Technical infrastructure issues, particularly in developing countries, pose major obstacles to digital transformation efforts. The biggest challenges are unreliable electrical supplies, slow internet speeds, and outdated hardware not being able to handle modern technology.

4. The governance, policy, and legislative elements are also important. Many organisations do not have a digital transformation strategy in place. A lack of understanding of legal issues such as copyright and data protection is holding back digital innovation and growing concerns.

RQ2: Institutional Readiness, Leadership, And Governance Structure Function as Structural Barriers to Sustainable Digital Transformation in Academic Libraries.

RQ1 provides a broad overview of categories of barriers. The findings from RQ2 show that failures in digital projects are often the result of deficits within the organisation. structure internal. The literature constantly emphasises that, however advanced it is, the use of technology will remain unstable and difficult to sustain over time without responsive leadership and clear rules.

Table 4: Key Sources for Leadership and Institutional Governance

Author, Year	**Title**	**Summary of Findings**
Hongo et al. (2026)	Adaptive Leadership Strategies for Advancing Digital Transformation and Innovation in Academic	The primary obstacle is the lack of adaptive leadership; leaders who cannot master the challenges of change and develop a shared vision will prevent innovation.

	Libraries in Kenya	
Horstmann (2018)	Are Academic Libraries Changing Fast Enough?	Recognising the institution's budget and "appointment capacity" as structural constraints which determine the pace of a library's transformation,
McKenzie et al. (2022)	A vision for change. The Leadership at the University of Wollongong Library focuses on trust, transparency, and accountability.	There is no open culture of leadership and this is a barrier to progress. Sustainable change requires "change leadership" that engages employees.
Seitimbetova et al. (2026)	Legal Literacy and Institutional Barriers to the Digital Transformation of Libraries in Kazakhstan: A Comparative Study of Academic and Public Libraries	This study shows "partial institutionalisation" as the absence of internal constraints on copyright and open access leads to precarious digital activities.
Nakaziba & Ngulube (2024)	A model is proposed for enhancing digital transformation through technology-related continuing professional development activities in academic libraries.	The lack of adequate management support for the development of strategic goals and staff development strategies was reported as a major barrier to organisational readiness.

The analysis of the sources reveals three interrelated main dimensions that allow us to understand the structural barriers to digital transformation.

1. Traditional leadership models, which many libraries adhere to, lack flexibility in adapting to digital changes from a leadership perspective. This situation limits an organization's ability to respond quickly to technological advances. Organisations need enhanced adaptive leadership to manage change successfully, particularly by reducing workers' stress and anxiety. Moreover, research shows that a longer work experience can sometimes be linked to a lower motivation to improve digital skills, which can hamper the transition process.

2. One key governance challenge is the absence of clear policies and structures to facilitate digital transformation. Many companies don't do digital transformations properly and don't formally integrate them into their management structures. Therefore, digital services are more reliant on personal initiatives than institutional support. Moreover, lack of knowledge of legal issues such as data management and digital copyright prevents libraries from managing digital resources effectively and in a sustainable manner.

3. The issue of institutional readiness is not only about the availability of technology but also about the competence of the organisation in terms of personnel and financial resources. Digital tasks often multiply without a reduction of the existing workload, so workers are overwhelmed in many cases. At the same time, the recruitment of new specialists is limited, and management support often emphasises the provision of technology without investing in training and continuing professional development (CPD). This means personnel do not have the required competencies to effectively manage the digital system.

4. The answers to RQ2 show that the main barriers to digital transformation are not only technological but also derived from the organisational structure's shortcomings. Unless institutions improve their leadership, governance and capacity development and move away from the traditional management approach, efforts towards a sustainable digital transformation will continue to be challenged.

RQ3: To What Extent Do Geographic Location, Institutional Size, and Economic Development Shape the Type and Severity of Digital Transformation Challenges in Academic Libraries?

The results of the investigation show that the difficulties associated with digital transformation are significantly reliant on the context in which libraries function rather than occurring consistently across all of them. Contextual factors function as external influences that establish the initial level of a digital effort, whereas leadership and governance (RQ2) are inside variables. There are undoubtedly inequalities in the adoption and sustainability of digital services due to the disparities between developed and developing nations as well as regional economic circumstances.

Table 5: Key Sources for Contextual Factors (Geography, Economy, and Institutional Size)

Author, Year	Title	Summary of Findings
Adarkwah et al. (2024)	The study explores the transformative journey of academic libraries in Africa, focusing on changes before and after COVID-19. Generative AI Era	Africa's geographical environment and how the COVID-19 pandemic has served as a regional impetus for the transition from analogue to digital storage.
Muthanna & Sang (2019)	State of University Library: Challenges and Solutions for Yemen	Shows how the library has become a 'antiquarian bookshop' with no digital resources due to the political and economic conditions of the conflict zone.
Martínez-Camac,Ho et al. (2025)	Generative artificial intelligence and university libraries in Latin America	Problems exposed in economic stability in Latin America: universities in crisis-hit countries unable to start AI projects because of budget emergencies
Cevher & Soydal (2026)	User priorities and emerging trends: A mixed-method study in a Turkish university library	The user priority context in Turkey, which is still based on physical collections, limits the ability of institutions to achieve strategic transformation.
Gundur & Sampath Kumar (2026)	Internet of Things in Indian Information Resource Centres: An Empirical Study of Institutions of National Importance	The study found that large, mature institutions in South India have a fundamental advantage but also face similar IoT cost barriers.

In the literature, contextual variables affect digital transformation in three main dimensions:

1. Geographic factors are crucial in determining a country's readiness to adopt a digital transformation, especially when it comes to fundamental infrastructure. In Sub-Saharan Africa, digital transformation is often a response to crises, such as the COVID-19 pandemic, which required a rapid shift from analogue to digital infrastructure. Obstacles remain because there is a lack of funding for training and targeted programmes for staff skill development.

2. The level of economic development and political stability determines the intensity of the obstacles encountered. In Yemen, economic and political instability leads to a shortage of essential resources, including up-to-date databases in university libraries, with budgets allocated to basic necessities like staff salaries. A similar situation is seen in Latin America, where universities in countries that are facing economic difficulties do not yet make use of technologies such as generative AI, in contrast to more stable governments which have already started to develop laws in this area.

3. The size, stage of maturation and classification of an institution are also factors that influence its capacity for digital transformation. A study in South India shows that larger, more established institutions such as IIT Madras have a larger user base and more sophisticated digital services. The type of library affects the level of preparation. Academic libraries in Kazakhstan have a higher level of legal literacy and institutional status than public libraries due to their close ties with research activities.

4. The findings of RQ3 indicate that a universal approach to digital transformation is ineffective. In low- and middle-income countries (LMICs), barriers are mostly basic, such as infrastructure and resources, whereas in high-income countries, challenges tend to be higher-level, such as ethics, privacy and incorporating technologies such as artificial intelligence and the Internet of Things.

RQ4: Theories and Models Are Used To Explain Digital Transformation Challenges in Academic Libraries, and Gaps Remain.

The findings for RQ4 examine the theoretical frameworks employed by scholars to comprehend this issue, following the preceding inquiry into the categories of challenges (RQ1), organisational causes (RQ2), and environmental factors (RQ3). The study indicates a transition from models that exclusively emphasise individual acceptance, such as the technology acceptance model. (TAM), a more holistic framework that incorporates organisational variables, environmental influences, and data management considerations.

This is an overview of the five principal papers that provide the most substantial theoretical contributions in this domain:

Table 6: Key Sources for Theoretical Frameworks and Models

Author, Year	Title	Summary of Findings
Asim & Arif (2026)	Investigating factors influencing the Internet of Things adoption and uses among Pakistani university librarians	The intention to use IoT was examined by applying the UTAUT model, augmented with the personal innovation and environmental consciousness components.
Deja et al. (2021)	Digital transformation readiness: perspectives on academia and library outcomes in information literacy	Developing a Digital Transformation Readiness (DTR) model using CBSEM: Link between information culture and digital readiness
Trivedi & Trivedi (2025)	Digital transformation in higher education and libraries is the focus of this study. The study focuses on automation: an analytical examination of its evolution, barriers, and future	This study employs Rogers' Diffusion of Innovations (DoI) theory to conceptualise digital transformation in higher education and libraries. Digital transformation (DT) is defined as a socio-technical evolution that involves policy and culture change.

	trajectories.	
Nakaziba & Ngulube (2024)	A model is proposed to enhance digital transformation by implementing technology-related continuing professional development activities specifically designed for academic libraries.	Integration of Technology-Organization-Environment (TOE) framework with the learning organization model to enhance the effectiveness of Continuous Professional Development (CPD) on Digital Transformation (DT)
Liu (2026)	The study presents a knowledge graph-based intelligent data management and information innovation service model specifically designed for university library systems.	A Five-Tier Hierarchical Model (Data, Processing, Knowledge Graph, smart services, and Applications) is proposed as a solution to the data silo problem

The theoretical framework of library digital transformation, based on the analysis of 31 sources, can be grouped into the following main clusters:

1. Individual acceptance models like the Technology Acceptance Model (TAM) and Unified Theory of Acceptance and Use of Technology (UTAUT) are still widely used, especially in studies of attitudes and personnel technology adoption. This paradigm explains technophobia, the resistance to change and other phenomena. It is, however, frequently criticised for placing too much emphasis on the human variables and for neglecting the challenges at the organisational level.

2. More attention is paid to frameworks like Technology-Organization-Environment (TOE) and Socio-Technical Theory (STS) because they offer a more holistic perspective. This approach studies the interrelated effect of external factors such as government legislation and internal factors such as managerial support on technology use. The Diffusion of Innovations (DoI) concept can help explain why some libraries are quicker adopters of improvements than others.

3. Moreover, modern models, like Digital Transformation Readiness (DTR), focus on the digital readiness of organisations by incorporating the competencies and capacities of their personnel. Technology-based models like knowledge graphs are a step towards more sophisticated automation systems and improved personalisation of services.

Despite the development of the theory, significant gaps persist in the current research. First, researchers primarily conduct their studies on short-term (cross-sectional) data, raising doubts about the model's long-term effectiveness. The institutional preparation models do not sufficiently consider the legal and ethical aspects of data, which are becoming increasingly relevant in the digital environment. Thirdly, there are still no appropriate models for the developing countries, especially those that consider the infrastructure problems and resource constraints.

DISCUSSION

The literature consistently characterises academic libraries as being in a phase of digital transformation . Digital transformation is defined as a complex process that is more than the adoption of technology . It is not all technical, but it is the result of a complex interaction of technological and human factors. Indeed, the secret to success is rarely the technology itself. Even the most powerful systems, such as artificial intelligence (AI),

the Internet of Things (IoT) or knowledge graphs, will not help if the library staff members do not have the necessary digital competencies to integrate and use them in their daily work practices.

The COVID-19 pandemic has accelerated the move to digital service delivery but also revealed structural weaknesses in traditional library models. However, much of the work during this period involved reactive improvisation rather than strategic planning. As a result, technologies were deployed in isolation, with no clear connection to the core functions of teaching and research in universities. This is often referred to as fragmented or uncoordinated implementation.

The sustainability of digital transformations in academic libraries demands the development of comprehensive organisational systems. This involves a change not just in the level of technology but in the institutional policies that govern the roles of the staff and the governing structures. For institutional repositories and open access initiatives to succeed, there needs to be not only a robust technological infrastructure but also a sound understanding of laws (copyright, licensing, and data management). Lack of a robust legal framework is blocking digital innovation for fear of ethical and legal risks.

From a leadership perspective, the literature points out the need to move away from traditional management styles towards more adaptive leadership models. People often perceive digital transformation as a technological challenge, but it actually represents a significant organisational and cultural shift. Therefore, effective leadership needs to articulate a common vision, deal with staff concerns around automation, and support ongoing change processes. Financial models also need to move to long-term investment, away from short-term funding, for continuing professional development (CPD) and staff digital skills training.

And finally, the challenges of digital transformation are very much dependent on geography. Libraries in the Global South, including Sub-Saharan Africa, Pakistan, and Yemen, still face basic infrastructure constraints, such as unreliable electricity and high internet costs. The challenges are quite different from those of the developed countries (the Global North), where the focus has moved to issues such as ethics, privacy, and sophisticated use of technology. Such a situation suggests that digital transformation strategies require contextualisation based on local resources, constraints, and institutional priorities.

CONCLUSION

In conclusion, successful digital transformation in academic libraries requires a move from a narrow technology-centric approach to a more strategic and integrated one. implemented in a sustainable way. This process requires adaptive and transparent leadership, sustained investment in the development of staff capability through sustained professional development (CPD) and the strengthening of policies and governance for technology and data management. At the same time, there is a need to strengthen sustainable financing models and strategic partnerships in order to support the increasingly complex needs of digital infrastructure. Future work should address long-term effects and models that can address the diverse needs of different institutions. context. Ultimately, the success of digital transformation is not determined by the sophistication of technology alone but by the institution’s ability to align people, policies and technologies into a cohesive, sustainable and resilient ecosystem.

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