

***The impact of digital transformation on university library  
services: A field study at the Central Library of the  
University of Babylon***

**أثر التحول الرقمي على خدمات المكتبات الجامعية: دراسة  
ميدانية في المكتبة المركزية لجامعة بابل**

مجلة الأكاديمية الدولية للعلوم  
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**Extract**

This study examines digital transformation and its significant impact on the services and resources provided by university libraries today. The research aims to explore how libraries are transitioning from traditional paper-based models to interactive digital environments, and the accompanying fundamental changes in research methodologies and user needs. The study also highlights the technical, human, and financial challenges hindering digital transformation, as well as the opportunities offered by modern technologies, particularly regarding improved open access to information. The study employed a descriptive-analytical approach to assess the current state of university libraries, and the results demonstrate that digital transformation has become indispensable for ensuring the continued role of libraries as centers of knowledge. The study emphasizes the necessity of investing in developing digital infrastructure and training human resources..

**the introduction :**

The past few decades have witnessed a technological and information revolution that has significantly impacted various aspects of life, and higher education institutions and their facilities have not been immune to these changes. University libraries are considered a cornerstone of any educational institution, given their fundamental role in supporting research and enhancing

education. With the continuous increase in the volume of creative thought and the diversity of information sources, the need to adopt new technologies capable of efficiently and quickly absorbing, organizing, and delivering this vast amount of data to users has become increasingly urgent. This has given rise to the concept of digital transformation, which is not limited to digitizing resources but also includes redesigning processes and creating new services based on modern technology..

### **Importance of the research**

The importance of this research stems from the fact that it addresses a contemporary topic that combines technology and library and information science, thus contributing to enrichment. Libraries on studyIn this field, from a scientific standpoint, the research provides a theoretical and analytical framework for understanding digital transformation and its modern trends, while its practical importance lies in providing applicable insights and recommendations that help decision-makers in universities and library directors adopt effective strategies for digital transformation and overcome the challenges they face in this field.

### **Research problem**

crystallizesproblemThis research examines the gap between the rapid advancements in information and communication technology and the responsiveness of university libraries to these advancements. Despite academic leaders recognizing the importance of digitization, many libraries still face significant challenges in fully transitioning to a digital environment, whether due to insufficient funding, a lack of strategic vision, or resistance to change from some staff members. Therefore, the central question revolves around how to overcome these obstacles to achieve an effective digital transformation that positively impacts the services provided..

### **Research questions: This research seeks to answer the following questions.:**

1. What is the precise concept of digital transformation in the context of university libraries and what are its most prominent characteristics?
2. What are the essential technical, human, and financial requirements for successfully implementing digital transformation?
3. What are the main challenges and obstacles facing the digitization of university libraries?
4. What is the impact of digital transformation on the quality of services and information resources available to users?

### **Study objectives**

To achieve the research objectives and answer its questions, the descriptive-analytical method was adopted. The phenomenon under study—the digital transformation of libraries—is described by collecting data and information from primary and secondary sources, then analyzing this data to draw conclusions. This method is also used to compare traditional and digital services and analyze the impact of this transformation on the academic environment..

### **First topic**

#### **What is the nature of digital transformation in university libraries?**

#### **The concept, origins, and historical development of digital transformation**

The current era is witnessing rapid technological advancements that have clearly impacted higher education institutions, particularly university libraries, which are a cornerstone in supporting scientific research. With the increasing volume of information and the diversity of its sources, it has become essential to move from traditional methods to adopting digital transformation as a strategic option that ensures efficient performance and the continued scientific role of libraries. <sup>(1)</sup>

Digital transformation involves employing modern technologies to reorganize office work and convert it into an interactive digital environment that allows easy access to information at any time. Despite the challenges related to cost, training, and information security, it offers significant advantages, such as overcoming temporal and spatial limitations and improving access to knowledge. <sup>(2)</sup>

This transformation has evolved gradually through historical stages, beginning in the 1960s and 70s with the automation of library procedures and the emergence of automated cataloging, which facilitated information exchange between libraries. The 1990s witnessed a qualitative leap with the advent of the internet, which enabled remote access to catalogs and paved the way for the digitization of resources. With the dawn of the third millennium, the transformation process accelerated thanks to interactive technologies, enabling libraries to provide extensive databases and electronic resources that serve researchers with high efficiency. <sup>(3)</sup>

**Table 1: Historical Stages of Digital Transformation in University Libraries**

| <b>Its impact on university library services</b>                                 | <b>The most prominent technological development</b>            | <b>Time period</b>               |
|----------------------------------------------------------------------------------|----------------------------------------------------------------|----------------------------------|
| <b>Automating indexes and the beginning of bibliographic record exchange</b>     | <b>The emergence of MARC format and mainframe computers</b>    | <b>The sixties and seventies</b> |
| <b>Facilitating the search process within the library and reducing time</b>      | <b>The spread of automated indexes available to the public</b> | <b>1980s</b>                     |
| <b>Making catalogs available remotely and initiating collection digitization</b> | <b>The emergence of the Internet and the World Wide</b>        | <b>1990s</b>                     |

<sup>1</sup>Abdel-Hadi, Mohamed Fathi, Digital Libraries: Foundations and Applications, Dar Al-Thaqafa Al-Ilmiya, Cairo, 2010, p. 45.

<sup>2</sup>Qasim, Hussein Muhammad, Information Technology and the Development of University Libraries, Dar Al-Masirah, Amman, 2015, p. 78.

<sup>3</sup>Hassan, Ali Abdullah, Digital Transformation in Libraries and Information Centers, University Knowledge House, Alexandria, 2020, p. 56.

| <b>Its impact on university library services</b> | <b>The most prominent technological development</b> | <b>Time period</b> |
|--------------------------------------------------|-----------------------------------------------------|--------------------|
| <b>initiatives</b>                               | <b>Web</b>                                          |                    |

### **Dimensions of digital transformation in university libraries**

Digital transformation in academic and administrative environments is not merely the use of technology; it is an integrated system built upon three interconnected pillars. The first pillar is the technological aspect, which includes providing a sophisticated infrastructure of servers, networks, and modern technologies that ensure secure and rapid data storage and access. The second pillar is the human element, where the success of digital transformation depends on the competence of staff capable of managing modern technologies. This necessitates continuous training and skills development to keep pace with the digital environment. The third pillar is the organizational and administrative aspect, which includes updating policies and procedures to align with the nature of digital resources, regulating intellectual property issues, and managing electronic subscriptions.<sup>(4)</sup>

Thus, the success of digital transformation is achieved through the integration of these three dimensions, which contributes to building a modern knowledge environment that supports scientific research and efficiently meets the needs of beneficiaries.

### **Strategic goals of digital transformation in university libraries:**

Digital transformation in academic and office environments is not merely the use of technology, but rather an integrated system based on three main, interconnected dimensions. The first dimension is the technological aspect, which includes providing a sophisticated infrastructure of servers, networks, and modern technologies that ensure secure and rapid data storage and access.<sup>(5)</sup>

The second dimension is the human dimension, as the success of digital transformation depends on the efficiency of personnel capable of managing modern technologies, which requires continuous training and development of workers' skills to keep pace with the digital environment.

The third dimension is the organizational and administrative aspect, which includes updating policies and procedures to suit the nature of digital resources, regulating intellectual property issues, and managing electronic subscriptions.

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<sup>4</sup>Al-Salem, Ahmed bin Mohammed, Knowledge Management in Academic Institutions, King Fahd National Library, Riyadh, 2018, p. 102.

<sup>5</sup>Hassan, Ali Abdullah, Digital Transformation in Libraries and Information Centers, University Knowledge House, Alexandria, 2020, p. 61.

Thus, the success of digital transformation is achieved through the integration of these three dimensions, which contributes to building a modern knowledge environment that supports scientific research and efficiently meets the needs of beneficiaries.

### **Requirements, stages, and challenges of implementing digital transformation in university libraries**

Building a sophisticated technological infrastructure is fundamental to the successful digital transformation of university libraries. This requires providing modern equipment, powerful servers, and ample storage capacity capable of handling diverse data types. It also necessitates leveraging cloud computing for its flexibility, cost reduction, and data protection. Software and library management systems are crucial to this transformation, contributing to the organization of technical processes and the provision of advanced search services based on modern technologies. Furthermore, they support digital repositories that preserve scholarly output and enhance its dissemination. This infrastructure is incomplete without fast and secure communication networks that enable seamless access to digital resources, along with the implementation of cybersecurity measures to protect information. Thus, the integration of these elements ensures the delivery of effective digital information services that efficiently meet the needs of researchers. <sup>(6)</sup>

### **Human and organizational requirements in the digital environment**

The human and organizational requirements for digital transformation in university libraries underscore that technology alone is insufficient for success. A qualified workforce capable of managing and utilizing digital technologies to serve users is essential. The role of librarians has evolved from traditional tasks such as cataloging and circulation to more advanced roles including knowledge management, providing information consultations, and assisting students and researchers in accessing accurate information. Therefore, university libraries need ongoing training programs to develop staff skills in database use, digital content management, online research, and other fundamental technical skills.

Digital transformation also requires developing organizational and administrative aspects within libraries, by moving from traditional, centralized structures to more flexible ones that rely on specialized teams for managing digital content, providing technical support, and offering remote user services. Furthermore, acquisition and collection building policies must be updated to include not only the purchase of physical books but also subscriptions to databases and electronic journals, adhering to quality and reliability standards. <sup>(7)</sup>

The importance of establishing clear policies to protect intellectual property rights and regulate the use of electronic resources is also highlighted, given the ease with which digital information can be copied and circulated. Libraries should also promote academic integrity, combat plagiarism, and educate students and researchers on proper citation practices. Thus, the

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<sup>6</sup>Qasim, Hussein Muhammad, *Information Technology and the Development of University Libraries*, Dar Al-Masira, Amman, 2015, p. 85.

<sup>7</sup>Abdel-Hadi, Mohamed Fathi, *Digital Libraries: Foundations and Applications*, Dar Al-Thaqafa Al-Ilmiya, Cairo, 2010, p. 92.

success of digital transformation depends on the integration of human resources. Qualified with Clear administrative organization and policies Legal The occasion.<sup>(8)</sup>

### **Stages and steps for implementing the digital transformation project in libraries**

Transitioning a university library from its traditional reliance on physical resources to a fully integrated digital environment is not a spontaneous or overnight event. Rather, it is a long-term strategic project requiring meticulous and systematic planning, unfolding through a series of carefully considered and sequential phases. The first of these phases begins with strategic planning, a feasibility study, and a comprehensive assessment of the library's current state. During this crucial stage, specialized committees are formed, comprising experts in library science, information technology, and project management. These committees conduct a precise inventory of the library's holdings and identify priority materials for digitization, such as rare manuscripts, university theses, and historical documents that are susceptible to deterioration over time. This phase also includes a detailed evaluation of the existing technological infrastructure, identifying gaps and future needs in hardware, software, and personnel. Furthermore, a comprehensive project budget is developed, along with a specific and precise timeline for implementing all steps, taking into account all potential risks and developing contingency plans to ensure the project's smooth progress.<sup>(9)</sup>

Next comes the practical implementation and direct digitization phase, which consumes the largest share of time, effort, and financial resources. This phase involves the actual conversion of pre-selected paper information sources into digital formats using high-resolution, high-speed scanners capable of handling various document types and sizes. The scanning process is accompanied by optical character recognition (OCR) software, which converts scanned images into editable and searchable text, thus facilitating researchers' access to precise information within the digitized material. In parallel with the local digitization process, the library administration begins implementing subscription plans for international databases and electronic journals, securing the necessary usage licenses to connect the university community to external information resources. Descriptive and subject cataloging of digital materials and the creation of their metadata are among the most important steps in this phase, as this metadata ensures efficient information retrieval and prevents its loss in the vast sea of digital information. growing.<sup>(10)</sup>

The third and final phase involves integration, testing, and the actual launch of digital services. In this phase, all disparate technical components and digital resources are linked within a unified electronic portal and a single user interface. This allows users to simultaneously search all local library resources and shared databases through a single search box, thus simplifying the user experience. Before the official public launch, the portal and digital systems undergo

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<sup>8</sup>Hassan, Ali Abdullah, Digital Transformation in Libraries and Information Centers, University Knowledge House, Alexandria, 2020, p. 74.

<sup>9</sup>Al-Salem, Ahmed bin Mohammed, Knowledge Management in Academic Institutions, King Fahd National Library, Riyadh, 2018, p. 115.

<sup>10</sup>Abdel-Hadi, Mohamed Fathi, Digital Libraries: Foundations and Applications, Dar Al-Thaqafa Al-Ilmiya, Cairo, 2010, p. 110.

rigorous and intensive testing by technical support teams and a random sample of users to ensure they are free of bugs, responsive, and capable of handling high traffic during peak times.<sup>(11)</sup>

### **Challenges of implementing digital transformation in university libraries**

University libraries face a number of challenges in implementing digital transformation, despite its importance in developing services and meeting the needs of researchers and students. Among the most prominent of these challenges is insufficient funding, as digital transformation requires substantial budgets to provide modern equipment, servers, software, scanners, and subscriptions to databases and electronic journals, in addition to the costs of ongoing maintenance and updates. Weak technological infrastructure also presents a significant obstacle, as successful digital transformation requires high-speed internet networks, secure servers, ample storage capacity, and advanced security systems. Libraries also face human resource challenges, including a shortage of technically qualified staff and the need for ongoing training for existing employees in managing digital systems, electronic repositories, and advanced search capabilities.<sup>(12)</sup>

Other challenges include resistance to change from some employees or beneficiaries due to adherence to traditional methods or fear of technology, as well as legal and ethical challenges related to intellectual property rights and the fair use of digital resources. Information security challenges and data protection against hacking or loss also present challenges, along with the difficulty of digitizing older paper-based resources, which requires significant time, effort, and meticulous indexing.

Finally, ensuring the continuity and updating of digital services presents a key challenge, as digital transformation doesn't end with the creation of a website or digital repository; it requires ongoing monitoring, evaluation, and development. Therefore, successful digital transformation necessitates securing funding, developing infrastructure, training personnel, establishing appropriate policies, enhancing information security, and fostering a digital culture within the university.<sup>(13)</sup>

### **Indicators and criteria for measuring the success of digital transformation processes**

The evaluation of digital transformation projects in university libraries becomes increasingly important as the financial investments allocated to them grow. It is now essential to rely on precise scientific indicators rather than personal impressions. Among the most important of these indicators are usage rates, which measure the number of times users access the online portal, the number of searches conducted, and the number of files and articles downloaded or

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<sup>11</sup>Hassan, Ali Abdullah, *Digital Transformation in Libraries and Information Centers*, University Knowledge House, Alexandria, 2020, p. 88.

<sup>12</sup>Abeer Al-Tawil Muhammad, "Digital Transformation in University Libraries: Assiut University Libraries as a Model", *Scientific Journal of the Faculty of Arts - Assiut University*, Volume 27, Issue 82, 2022, pp. 985–1042.

<sup>13</sup>) Muhammad Hadi Jassim and Ahmed Kazem Hantoush, "Digital Transformation of Information Services in University Libraries in Light of the Digital Environment", *University of Babylon Journal of Human Sciences*, Volume 33, Issue 8, 2025.

printed. High usage rates indicate the library's success in providing suitable digital resources and user-friendly interfaces that meet the needs of researchers and students.<sup>(14)</sup>

Qualitative indicators are also essential for understanding user satisfaction with digital services and the extent to which they benefit from them. This is achieved through online surveys, interviews, and focus groups that identify challenges and suggestions for service improvement. These indicators help libraries enhance their performance and avoid spending on services that do not provide clear benefits.<sup>(15)</sup>

The economic evaluation focuses on measuring the return on investment by comparing the cost of database subscriptions with the number of times they are used, thus determining the cost per use. This helps identify valuable databases worth renewing subscriptions with and those used infrequently and which can be canceled. Digital transformation also reveals savings in printing, binding, shipping, and physical storage space for paper collections. Therefore, integrating quantitative, qualitative, and economic indicators provides university management with a clear view of the success and efficiency of the digital transformation.<sup>(16)</sup>

### **The spatial and geometric transformation of the university library in the digital age**

The impact of digital transformation in university libraries has not been limited to changing the nature of information sources and methods of accessing them, but has extended to a radical shift in the philosophical and architectural concept of spatial organization within the library building. In the traditional paper-based era, the majority of library space was necessarily dedicated to arranging shelves crowded with books and volumes, leaving limited and restricted areas for readers to sit in an atmosphere characterized by silence, rigidity, and isolation. Today, however, with millions of titles migrating to cloud servers that occupy minimal physical space, university libraries have found themselves facing vast geographical areas that can be redesigned and utilized in innovative ways that align with modern educational approaches. As a result, new architectural concepts have emerged, such as information commons and learning commons. These are open and flexible spaces specifically designed to encourage collaborative work and social interaction among students and researchers. These spaces are equipped with modern, movable, and reconfigurable furniture, interactive displays, smart boards, and power outlets distributed throughout to facilitate the use of laptops and tablets, transforming the library from a mere quiet repository of books into a vibrant hub of collaborative academic activity..<sup>(17)</sup>

Alongside open spaces, digital library architecture has seen the introduction of dedicated areas for technological innovation and creativity, known as makerspaces or innovation labs. These spaces represent a natural evolution of the library's mission to support the production of

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<sup>14</sup>Name, Hussein Muhammad, *Information Technology and the Development of University Libraries*, Dar Al-Masirah, Amman, 2015, p. 160.

<sup>15</sup>Hassan, Ali Abdullah, *Digital Transformation in Libraries and Information Centers*, University Knowledge House, Alexandria, 2020, p. 102.

<sup>16</sup>Al-Salem, Ahmed bin Mohammed, *Knowledge Management in Academic Institutions*, King Fahd National Library, Riyadh, 2018, p. 178.

<sup>17</sup>) Abdel-Hadi, Mohamed Fathi, *Digital Libraries: Foundations and Applications*, Dar Al-Thaqafa Al-Ilmiya, Cairo, 2010, p. 190.

knowledge, not just its consumption. They are equipped with advanced technologies such as 3D printers, stereoscopic scanners, laser cutters, and sophisticated engineering design software. These labs allow students in engineering, science, and medical colleges to apply the theoretical aspects of their studies and transform their research ideas into tangible, physical models within the library environment. Simultaneously, they provide students with immediate access to scientific references that support their projects. Integrating these advanced technologies into the library's physical spaces enhances its role as a key partner in the educational process and as a hub for student innovation and the development of practical skills required by the modern job market. This spatial transformation also contributes to changing the traditional image of the library, making it a preferred destination for students to spend their free time in a stimulating environment that combines learning with purposeful recreation..<sup>(18)</sup>

The digital transformation also necessitated a redesign of spaces for staff and information specialists to align with their evolving roles. Large offices dedicated to manual cataloging and bookbinding were replaced by digital labs equipped with high-performance scanners and advanced computers for big data processing and portal management. Soundproof rooms were established to provide remote reference services via video calls and instant chat, minimizing disruption to other library users. Furthermore, many universities have dedicated spaces for training users on how to utilize specialized databases and advanced search tools. These spaces are equipped with state-of-the-art presentation and communication technologies to host regular workshops and training courses that enhance information literacy and digital culture within the academic community..<sup>(19)</sup>

## **Section Two: Digital services and resource management in university libraries**

Building and developing library collections has been one of the most fundamental functions of university libraries throughout history. These collections reflect the library's ability to support academic curricula and meet the diverse research needs of faculty and students. In the traditional paper-based environment, acquisition strategies relied almost entirely on the principle of physical ownership of information resources. The library purchased printed books and volumes and permanently stored them on its shelves as fixed physical assets, adding to the university's holdings. However, the emergence of information and communication technologies and the accompanying comprehensive digital transformation have revolutionized the philosophy of collection building, shifting the focus from permanent ownership to availability and immediate access. In the age of digital information flow, it is no longer logical, economically feasible, or geographically feasible for any university library, regardless of its budget, to acquire every book and periodical published worldwide across all fields of knowledge. Therefore, library administrations have turned to alternative strategies that rely on providing electronic access points via the internet to massive databases and global digital libraries that host millions of

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<sup>18)</sup> Abdel-Hadi, Mohamed Fathi, *Digital Libraries: Foundations and Applications*, Dar Al-Thaqafa Al-Ilmiya, Cairo, 2010, p. 205.

<sup>19)</sup> Hassan, Ali Abdullah, *Digital Transformation in Libraries and Information Centers*, University Knowledge House, Alexandria, 2020, p. 118.

articles and full texts on their dedicated servers off-campus. This strategic shift has forced acquisitions departments in university libraries to reformulate their policies and change their technical and financial procedures to suit the nature of intangible resources, which are often obtained through annual subscription contracts that grant the university temporary use rights rather than absolute ownership. This creates new administrative challenges that require advanced negotiation and legal skills from information specialists..<sup>(20)</sup>

This conceptual shift is accompanied by a radical change in the nature of the resources focused on in acquisition processes. Whereas textbooks and printed references once consumed the lion's share of the library budget, today peer-reviewed electronic journals and specialized databases form the backbone of academic research and consume the largest portion of allocated funds. This change stems from the nature of contemporary scientific research, characterized by rapid pace and a pressing need for the latest and most accurate information—a feature readily available in electronic journals, which are updated daily or weekly. This contrasts sharply with printed books, whose writing and publication processes can take years, leading to rapid scientific obsolescence, particularly in applied, medical, and technological fields. Furthermore, digital resources offer interactive features unavailable in print environments, such as advanced full-text search, hyperlinks between citations and their original sources, and the integration of multimedia, including interactive tables and explanatory videos, within scientific articles. This enriches the researcher's experience and facilitates the comprehension of complex concepts..<sup>(21)</sup>

With the increasing reliance on digital resources, the importance of collaborative acquisition policies has emerged as an effective mechanism to counter the ever-increasing subscription fees imposed by global commercial publishers. University libraries have realized that operating independently in the electronic publishing market weakens their negotiating position and limits their ability to provide comprehensive information resources to their users.

### **Office conglomerates, licensing management, and intellectual property rights**

As a continuation of collaborative resource provisioning policies, the concept of library consortia has emerged as one of the most important administrative and organizational outcomes of digital transformation in higher education institutions. A library consortium is a strategic alliance comprising a group of university and research libraries that agree to pool their efforts and financial resources to negotiate collectively with database publishers and electronic information providers. This concept is based on the principle of strength in unity, as negotiating on behalf of dozens of universities gives it a much stronger negotiating position than each library negotiating individually. This consortium aims to secure the best possible prices and flexible licensing terms, enabling the largest possible number of users to access digital resources without arbitrary restrictions. The benefits of library consortia are not limited to financial aspects and cost reduction, but extend to include the exchange of technical expertise among staff working in

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<sup>20</sup>Qasim, Hussein Muhammad, *Information Technology and the Development of University Libraries*, Dar Al-Masira, Amman, 2015, p. 175.

<sup>21</sup>Al-Salem, Ahmed bin Mohammed, *Knowledge Management in Academic Institutions*, King Fahd National Library, Riyadh, 2018, p. 190.

member libraries, the standardization of cataloging and accessibility criteria, as well as the possibility of sharing the costs of technological infrastructure such as renting cloud servers or developing unified search portals that serve all researchers in universities affiliated with the consortium, thus contributing to bridging the digital divide between major universities and those with less advanced capabilities. Potential      Limited.<sup>(22)</sup>

Alongside budget management and negotiation, managing usage licenses stands out as one of the most complex tasks facing digital collection development officers in university libraries. Unlike printed books, which, once purchased, become the property of the library and are managed according to its internal regulations, electronic resources are governed by strict legal contracts and licenses. These contracts precisely define what is permitted, who is authorized to access the database, and how access is granted, whether from within the university campus or from outside via secure communication protocols. Managing these licenses requires extensive legal expertise to ensure that the terms of the contract with publishers are not violated, which could expose the university to legal repercussions, hefty fines, or immediate subscription cancellation. Library management must carefully review the contract terms to ensure they guarantee users' rights to print excerpts of articles for research and personal use, permit the use of digital materials in preparing e-learning packages and courses uploaded to the university's distance learning platforms, and guarantee continued access to the digital archive for the years for which subscriptions were paid, should the library decide not to renew the contract in the future..<sup>(23)</sup>

The issue of licensing is closely intertwined with intellectual property rights and copyright in the digital environment, which are among the complex challenges brought about by digital transformation. The ease with which digital content can be copied, pasted, and distributed across the internet and social media platforms makes protecting the rights of authors and publishers extremely difficult. University libraries find themselves in a delicate position, requiring them to balance their mission of providing information to researchers and facilitating the flow of knowledge with their ethical and legal obligation to protect intellectual property rights.<sup>(24)</sup>

### **The role of corporate digital repositories and open access initiatives**

Faced with the growing financial challenges posed by the exorbitant rise in subscription fees for commercial scientific journals, which have become a heavy burden on university library budgets, global movements and initiatives have emerged advocating for the liberation of scientific knowledge and its free access to all—a movement known as the Open Access Movement. These initiatives aim to break the monopoly of major commercial publishers who reap enormous profits by selling research often funded by public money or government grants to universities. University libraries have enthusiastically embraced this philosophy, viewing it as a

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<sup>23</sup>Al-Salem, Ahmed bin Mohammed, Knowledge Management in Academic Institutions, King Fahd National Library, Riyadh, 2018, p. 210.

<sup>24</sup>Hassan, Ali Abdullah, Digital Transformation in Libraries and Information Centers, University Knowledge House, Alexandria, 2020, p. 135.

lifeline to escape the pricing crisis and to strengthen the university's role as a producer and free distributor of knowledge, rather than merely a consumer. Within this movement, two main paths for publishing research have emerged. The first, the "gold path," involves researchers publishing their articles in peer-reviewed scientific journals that offer open access to all readers immediately upon publication, with the researcher or their institution paying a processing fee. The second, the "green path," involves researchers publishing their articles in closed commercial journals while retaining the right to deposit a copy of the article—either the pre- or final version—in an open digital repository belonging to their university. This is the path that university libraries have focused on most intensively..<sup>(25)</sup>

Hence, the importance of institutional digital repositories as a crucial strategic tool for managing the digital resources of university libraries has emerged. An institutional repository is defined as a comprehensive electronic archive established and managed by the university to collect, preserve, and make available the intellectual and scientific output produced by its faculty, researchers, and graduate students. This output encompasses a wide range of resources, such as published scholarly articles, conference papers, master's and doctoral theses, technical reports, research datasets, as well as educational materials and open online courses. The university library's management of this repository ensures accurate descriptive and subject indexing of these works using international metadata standards, making them easily retrievable through global academic search engines like Google Scholar. The repository's role extends beyond mere accessibility; it plays a pivotal role in documenting the university's history and scientific achievements and serves as a digital showcase reflecting its academic standing. This directly contributes to improving the university's ranking in global indices that rely heavily on the volume of electronically available scientific output and its citation rates..<sup>(26)</sup>

However, building institutional digital repositories faces significant challenges, perhaps the most prominent being the cultural challenge of convincing faculty members of the importance of depositing their research in these open platforms. Some researchers fear copyright infringement of the commercial journals in which they have previously published, while others believe that publishing in open repositories may diminish the academic value of their work. To overcome these obstacles, library administrations are implementing intensive awareness campaigns to explain copyright policies and clarify that most international publishers now allow researchers to self-deposit under certain conditions. University leaders are also working to enact legislation and internal regulations that require researchers to deposit a digital copy of any university-funded research in the institutional repository as a condition for academic promotion or receiving research excellence awards. The success of these repositories depends on the combined efforts of university senior management, the library, and faculty members to create an organizational

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<sup>25)</sup> Abdel-Hadi, Mohamed Fathi, *Digital Libraries: Foundations and Applications*, Dar Al-Thaqafa Al-Ilmiya, Cairo, 2010, p. 225.

<sup>26)</sup> Qasim, Hussein Muhammad, *Information Technology and the Development of University Libraries*, Dar Al-Masira, Amman, 2015, p. 200.

culture that believes in the importance of knowledge sharing and maximizing the societal and scientific impact of research produced within the university campus..<sup>(27)</sup>

### **Evaluating electronic information sources and digital preservation strategies**

With the majority of university library budgets allocated to database subscriptions and electronic resources, it has become essential to have precise and rigorous mechanisms for evaluating these resources before deciding to acquire them or renew subscriptions. The evaluation process in a digital environment differs radically from that of printed books, as it relies on a complex set of quantitative and qualitative criteria. Among the most important qualitative criteria are the alignment of the database content with the university's academic programs and curricula, the recency of the information, its temporal and geographical coverage, and the publisher's reliability and academic standing. The evaluation also encompasses technical aspects such as the ease of use of the search interface, the availability of advanced filtering tools, the system's compatibility with mobile devices, the speed of loading full texts, and the availability of automated alerts. Quantitatively, libraries rely heavily on analyzing usage statistics provided by automated systems and applying a cost-per-use metric to calculate the economic viability of each database individually. Databases with low usage statistics but high subscription costs are likely to be canceled or excluded, necessitating periodic reviews of library subscriptions to ensure the optimal allocation of financial resources to the most beneficial resources for the academic community..<sup>(28)</sup>

Alongside the evaluation and elimination process, the challenge of long-term digital preservation stands out as one of the most pressing and complex issues in digital resource management. In the paper environment, preservation meant providing a suitable physical environment for books, protecting them from moisture and insects to preserve the paper for centuries. In the digital environment, however, the greatest risk comes not from physical damage but from rapid technological obsolescence. The accelerating development of computers, operating systems, and software leads to the emergence of new file formats and the disappearance of older ones, rendering digital files stored today unreadable or unretrievable within a few years if not addressed proactively. A digital preservation strategy requires periodic data migrations—that is, transferring information from older to newer storage media and converting files to open-source standard formats that ensure future readability. Preservation processes also include creating multiple backups and distributing them geographically across different cloud servers to ensure that the university's digital archive is not lost in the event of natural disasters or devastating cyberattacks targeting the central library's servers..<sup>(29)</sup>

Digital preservation efforts in university libraries also include digitizing the university's rare and heritage paper resources, such as ancient manuscripts, early printed materials, historical

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<sup>27</sup>Al-Salem, Ahmed bin Mohammed, *Knowledge Management in Academic Institutions*, King Fahd National Library, Riyadh, 2018, p. 235.

<sup>28</sup>Hassan, Ali Abdullah, *Digital Transformation in Libraries and Information Centers*, University Knowledge House, Alexandria, 2020, p. 150.

<sup>29</sup>Abdel-Hadi, Mohamed Fathi, *Digital Libraries: Foundations and Applications*, Dar Al-Thaqafa Al-Ilmiya, Cairo, 2010, p. 245.

documents, and photographs that document the university's origins and development. This digitization process aims to achieve two objectives: first, to protect fragile physical assets from damage caused by frequent use and handling; and second, to make these intellectual treasures accessible to a wide audience of researchers worldwide without endangering the original copies. Implementing digitization projects requires specialized scanning equipment that does not damage the materials and employing technical teams trained in digital image processing and adding accurate metadata to facilitate retrieval.<sup>(30)</sup>

### **The concept of quality and user experience in the digital library environment**

The digital transformation of university libraries extends far beyond simply providing technological infrastructure or building massive electronic collections. It reaches the very core of the service process: the quality of what is offered to users and how they interact with these services. In the traditional library environment, quality standards were often measured by purely quantitative indicators such as the size of the physical collection, the number of staff, the building's size, and the number of seats available for readers. With the shift to the digital and virtual environment, evaluation concepts have changed radically, now centered on the concept of the user experience, or what is commonly known as the user interface. This concept reflects the overall impression formed by the researcher or student from the moment they enter the library's online portal until they complete their search and download the required information. A complex or slow user interface can create a psychological and technical barrier, preventing users from benefiting from databases that cost the university millions of dollars annually. Therefore, studying user behavior and designing platforms that align with their abilities and expectations is crucial to ensuring the success of any digital transformation project..<sup>(31)</sup>

Quality management in digital libraries requires adopting a comprehensive perspective that focuses on meeting the implicit and explicit needs of the academic community. This includes evaluating the efficiency of the library's integrated search engines and their ability to retrieve accurate and relevant results without overwhelming researchers with thousands of random and distracting results. The evaluation also encompasses the availability of technical support and immediate reference assistance while browsing databases, as modern digital users expect quick responses and immediate solutions to any technical problems they may encounter. From this perspective, university library administrations have begun implementing Total Quality Management (TQM) principles, which focus on the continuous improvement of administrative and technical processes based on ongoing feedback from users themselves. In the digital environment, users have become key partners in service design and evaluation, no longer passive recipients of library decisions. This shift in power dynamics necessitates that librarians develop exceptional communication and digital marketing skills to understand the aspirations of the new

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<sup>30</sup>Qasim, Hussein Muhammad, *Information Technology and the Development of University Libraries*, Dar Al-Masira, Amman, 2015, p. 220.

<sup>31</sup>Al-Salem, Ahmed bin Mohammed, *Knowledge Management in Academic Institutions*, King Fahd National Library, Riyadh, 2018, p. 210.

generation of students who have grown up in a technologically advanced environment and hold very high expectations regarding the speed and ease of access to information..<sup>(32)</sup>

To achieve high levels of digital quality, leading university libraries conduct regular and intensive usability tests before launching any new online service or making significant updates to their websites. These tests involve inviting random samples of students and faculty members to perform specific research tasks on the new platform, observing and recording their interaction with the user interface, and identifying any points of difficulty or confusion. These practical tests help detect software bugs and design flaws early on, before the service is widely rolled out, saving considerable time and money and ensuring a user-friendly and intuitive information platform..<sup>(33)</sup>

### **Tools and metrics for evaluating the quality of electronic information services**

With the increasing complexity and diversity of digital services, the need arose to find and develop scientific metrics and standardized evaluation tools capable of accurately and objectively measuring the quality of these services. One of the most well-known and important of these tools globally is the LeapQual measurement tool, developed in collaboration between the American Research Library Association and the University of Texas. This sophisticated survey tool measures the gap between users' expectations of the ideal service and what they actually receive from the library. This metric was later adapted to suit the purely digital environment, resulting in the eQual metric, which focuses specifically on the quality of electronic services, databases, and digital portals. This model measures vital dimensions such as the quality, comprehensiveness, and up-to-dateness of available digital content, ease of use (related to website design, link structure, and page navigation), and reliability (measuring the dependability of the technical system and its ability to operate efficiently without unexpected software errors). Applying such standardized measures allows the university library the opportunity to compare its performance with its counterparts from local, regional and international libraries, which contributes to determining its competitive position and discovering shortcomings that require urgent administrative intervention..<sup>(34)</sup>

In addition to survey-based measurement tools that rely on user feedback, the digital environment offers the exceptional advantage of automated collection of accurate and continuous statistical data through website analytics software and central server logs. These technological tools enable library management to track user movements within the online portal, identify the most visited pages and the most common search terms among students, and determine the amount of time each researcher spends browsing a particular database before exiting. By analyzing the bounce rate—the percentage of visitors who leave the site after viewing only one

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<sup>32)</sup>Abdel-Hadi, Mohamed Fathi, *Digital Libraries: Foundations and Applications*, Dar Al-Thaqafa Al-Ilmiya, Cairo, 2010, p. 178.

<sup>33)</sup>Qasim, Hussein Muhammad, *Information Systems in Modern Libraries*, Dar Al-Masira, Amman, 2015, p. 120.

<sup>34)</sup>Al-Salem, Ahmed bin Mohammed, *Knowledge Management in Academic Institutions*, King Fahd National Library, Riyadh, 2018, p. 210.

page—librarians can infer whether the search interface is complex and intrusive or whether the content fails to meet the researcher's initial expectations. These silent statistical indicators provide objective and unbiased feedback that complements the picture offered by traditional surveys, giving decision-makers in the university library a comprehensive panoramic view. This allows them to restructure digital services and allocate budgets toward the resources and databases that actually experience the highest usage and academic value..<sup>(35)</sup>

However, the application of these standards in the Arab academic environment faces some methodological and practical challenges that cannot be overlooked. The most prominent challenge is the weak culture of self-assessment and institutional evaluation in some universities, where evaluation processes are viewed as routine or inspection procedures rather than tools for continuous development and improvement. Furthermore, some libraries suffer from users' reluctance to actively participate in completing electronic questionnaires due to their length or the complexity of their questions, which reduces the accuracy and reliability of the resulting data. To overcome these obstacles, modern administrations tend to simplify measurement tools and use very short, real-time surveys that appear to the user immediately after downloading a digital file or after completing a reference chat session to evaluate that specific experience. only.<sup>(36)</sup>

### **Inclusivity, accessibility, and inclusive design in the digital environment**

Achieving comprehensive quality in the digital services offered by university libraries is only possible by ensuring that all members of the academic community have access to these vast resources without discrimination or exception. This is expressed through the concept of accessibility and universal information design. This concept becomes paramount when we consider students and researchers with special needs, who constitute a significant segment of library users. In the traditional paper-based environment, the challenges faced by this group were primarily architectural and physical barriers, such as the lack of elevators or narrow aisles between bookshelves. In the digital environment, however, these barriers have transformed into software and design barriers that prevent blind, visually impaired, or mobility-impaired students from browsing the library's online portal or reading uploaded scholarly articles. Therefore, leading university libraries are committed to implementing international standards for web accessibility, which stipulate the necessity of designing user interfaces that are fully compatible with assistive software, such as screen readers that convert written text into audible speech, and providing alternative text for images and explanatory tables within digital articles to facilitate their comprehension by visually impaired individuals..<sup>(37)</sup>

In addition to physical disabilities, the concept of inclusive design encompasses providing a flexible digital environment that adapts to the diverse cognitive styles and technical needs of all

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<sup>35)</sup>Abdel-Hadi, Mohamed Fathi, *Digital Libraries: Foundations and Applications*, Dar Al-Thaqafa Al-Ilmiya, Cairo, 2010, p. 178.

<sup>36)</sup>Qasim, Hussein Muhammad, *Information Systems in Modern Libraries*, Dar Al-Masira, Amman, 2015, p. 120.

<sup>37)</sup>Hassan, Ali Abdullah, *Digital Transformation in Libraries and Information Centers*, University Knowledge House, Alexandria, 2020, p. 95.

users. This underscores the imperative of adopting responsive design technologies for library websites and portals. With the widespread use of mobile devices such as smartphones and tablets, it is no longer acceptable for library services to be limited to traditional desktop computer screens. A library's digital portal must be able to automatically adapt to different screen sizes, adjusting font sizes and menu display to provide a smooth and comfortable browsing experience for users who wish to read a scholarly article on their mobile phones while commuting on the university bus. A library's failure to provide this technological flexibility inevitably leads to user frustration and drives them to rely on commercial search engines that offer highly flexible and adaptive interfaces. Inclusive design also extends to considering color contrast in search interfaces and avoiding cluttered designs that might distract users with concentration or attention difficulties, thus ensuring a supportive and inclusive digital learning environment for all..<sup>(38)</sup>

Library management plays a pivotal role in negotiating with publishers and global database providers to ensure they offer platforms that comply with international accessibility standards. University libraries do not always have complete control over the software design of the commercial databases they subscribe to, placing them under a legal and ethical responsibility to select providers who respect the rights of people with disabilities to independent access to information. Specialized acquisition committees test publishing platforms before subscription contracts are signed to ensure the availability of text magnification tools, keyboard-only navigation (without mouse), and machine-readable text file formats instead of unprocessed scanned images. University libraries' commitment to the principles of digital inclusion is not merely a response to anti-discrimination legislation; it embodies their overarching mission of achieving equal educational and research opportunities and empowering every member of the academic community to reach their full scientific and intellectual potential, regardless of their physical abilities or the technological tools they use..<sup>(39)</sup>

### **The impact of digital transformation on user behavior and the development of their research skills**

Studying the impact of digital transformation on university libraries is incomplete without highlighting the most important variable in this equation: the user, whether an undergraduate student, a graduate researcher, or a faculty member. The technological revolution and the pervasive influence of the internet on all aspects of daily life have fundamentally altered the demographic and psychological makeup of the library community. In past decades, the traditional user adapted to the library's services within the constraints of available time and space, accepting the idea of waiting days or weeks for a specific reference through interlibrary loan or for printed copies of academic journals to arrive by mail. Today, however, university

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<sup>38)</sup>Al-Salem, Ahmed bin Mohammed, Knowledge Management in Academic Institutions, King Fahd National Library, Riyadh, 2018, p. 210.

<sup>39)</sup>Abdel-Hadi, Mohamed Fathi, Digital Libraries: Foundations and Applications, Dar Al-Thaqafa Al-Ilmiya, Cairo, 2010, p. 178.

libraries deal with a new generation that sociologists and information specialists call "digital citizens"—individuals born and raised in the age of the internet, smart devices, and social networks. This generation is characterized by unique traits that pose enormous challenges to traditional information institutions. They have very high expectations regarding the speed of access to information and the ease of using search interfaces, preferring immediate and direct answers to their academic inquiries without the need for extensive and complex manual research..<sup>(40)</sup>

This shift in expectations has led to a radical change in how users perceive the role and status of the university library. For the modern student, the library is no longer merely a silent repository of printed books, but rather a comprehensive electronic gateway that should be available 24/7 to provide knowledge and research support. The digital user expects to find all the information resources they need—from full-text articles and e-books to educational videos—available on a single platform accessible via their smartphone or laptop from anywhere, whether in their dorm room, a café, or even while commuting. Consequently, any delay in providing information or any complexity in the user interface will drive these users away from library services and toward immediate recourse to commercial search engines like Google, which meet their need for speed and ease, despite the risks associated with the potentially weak academic reliability of some retrieved results.<sup>(41)</sup>

## **Conclusion, Recommendations, Suggestions, and Sources**

### **Conclusion**

This research examines and analyzes the phenomenon of digital transformation and its comprehensive impact on the services and functions offered by contemporary university libraries. The study, through its three chapters, demonstrates that digitization has created a cognitive and organizational break with traditional library management models, shifting libraries from the concept of individual ownership of information resources to one of open and universal access. The research concludes that the adoption of modern technologies such as cloud computing and big data has had a direct and positive impact on accelerating the pace of scientific research, broadening users' horizons, developing academic communication channels, and transforming the library into an interactive hub that supports innovation and knowledge production.

### **Recommendations**

The results of the study show that digital transformation in university libraries represents a crucial strategic variable in reshaping the information services system. Accordingly, the study recommends the necessity of adopting comprehensive institutional digital transformation plans based on a long-term strategic vision that is directly linked to the university's educational and

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<sup>40)</sup>Al-Salem, Ahmed bin Mohammed, Knowledge Management in Academic Institutions, King Fahd National Library, Riyadh, 2018, p. 210.

<sup>41)</sup>Abdel-Hadi, Mohamed Fathi, Digital Libraries: Foundations and Applications, Dar Al-Thaqafa Al-Ilmiya, Cairo, 2010, p. 178.

research goals, with the inclusion of measurable performance indicators and continuous evaluation.

It is evident that the efficiency of the technological infrastructure constitutes one of the essential pillars for the success of digital transformation. Therefore, the study recommends the necessity of sustainable investment in the development of digital networks, integrated library management systems, and cloud computing, in order to ensure the reliability of services and the speed of access to electronic resources without interruption or fluctuation in performance.

We also conclude that the human element is the main driver of the success of digital transformation processes, and accordingly the study recommends the establishment of specialized and continuous training programs aimed at developing advanced digital skills for library staff, with a focus on data analysis skills, database management, and interaction with artificial intelligence systems in modern information environments.

It is clear that the quality of user experience is a governing criterion in evaluating digital services; therefore, the study recommends adopting user-centric design methodologies (User-Centered Design), and conducting periodic usability testing with active participation from users, to ensure the development of user-friendly, highly efficient, and compatible interactive interfaces across different devices and platforms.

It is also evident that the challenges related to intellectual property rights and the licensing of digital databases require careful regulatory handling. Therefore, the study recommends the need to develop clear legal and administrative frameworks that regulate digital subscription processes, while strengthening institutional negotiation with database providers to ensure the availability of digital content that complies with universal access standards.

Given the increasing reliance of users on modern digital technologies, the study recommends the need to enhance the integration between library services, e-learning platforms, and education management systems, in order to provide integrated information services that support the educational and research process immediately and effectively.

The study also recommends activating mechanisms for continuous evaluation of the performance of digital services by adopting comprehensive quality indicators that combine quantitative and qualitative analysis, such as usage rates, satisfaction levels, and information retrieval effectiveness, while employing data analysis tools to support decision-making and improve services.

Finally, the study emphasizes the importance of establishing the principle of digital inclusion as a core value in the design of university library services, and therefore recommends adherence to international accessibility standards (Accessibility Standards), and providing digital environments that take into account the needs of all categories of beneficiaries, including people with disabilities, to ensure knowledge equity and equal educational opportunities.

### **Proposals for future studies**

1. Conducting an evaluation study on the impact of using "generative artificial intelligence" techniques on the quality of reference services in Arab university libraries.

2. An analytical study of the impact of "Metaverse" and virtual worlds on the future of the spatial environment of academic libraries.
3. A specialized study on the legal and ethical aspects of managing intellectual property rights in open digital repositories.

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