Reconceptualizing University Libraries as Knowledge Ecosystems: Rethinking the Roles and Management of Academic Libraries

Article

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Abstract

University libraries are undergoing profound transformation in response to digitalization, open science, and evolving academic practices. Traditional perspectives primarily conceptualize libraries as collection-centered repositories or information service institutions. While these views have shaped professional development, they insufficiently capture the dynamic and systemic nature of contemporary academic libraries. This study reconceptualizes the university library as a knowledge ecosystem. Drawing upon knowledge ecosystem theory, knowledge sharing theory, and learning environment perspectives, the paper proposes a four-component model consisting of knowledge resources, human participants, learning environments, and knowledge interaction. The model emphasizes interdependence, co-evolution, and collaborative knowledge creation within the academic context. Based on this framework, the study derives managerial implications that reposition libraries as knowledge hubs, librarians as facilitators, and libraries as academic communities. By integrating theoretical analysis with practical insights, this research provides a comprehensive framework for understanding and guiding the future development of university libraries.

Introduction

The digital transformation of higher education has profoundly reshaped the environment in which university libraries operate. Advances in information technology, the expansion of digital collections, and the growth of networked infrastructures have altered how knowledge is produced, accessed, and disseminated (Borgman 2007; Lankes 2011). No longer confined to physical collections, academic libraries increasingly provide access to electronic journals, institutional repositories, research data services, and digital scholarship platforms. These changes challenge the traditional conception of the library as a static repository of printed materials and instead position it within a dynamic and interconnected knowledge landscape.

The rise of the open access movement has further transformed scholarly communication. By promoting unrestricted access to research outputs, open access initiatives have shifted the economic and institutional structures of academic publishing (Suber 2012). University libraries now play central roles in supporting open repositories, managing article processing charges, and facilitating compliance with funder mandates. In this context, libraries are not merely intermediaries between publishers and users but active participants in shaping the scholarly communication ecosystem.

Simultaneously, patterns of academic communication have evolved. Digital platforms, collaborative research networks, and interdisciplinary projects have expanded the ways scholars exchange knowledge (Borgman 2007). Research practices increasingly rely on shared datasets, collaborative tools, and cross-institutional partnerships. Libraries have responded by offering research data management, digital humanities support, and scholarly communication services. These developments suggest that libraries function within broader systems of knowledge interaction rather than as isolated service units.

Changes in learning behaviors also contribute to the transformation of university libraries. Contemporary students engage in blended learning, online collaboration, and project-based inquiry. Learning spaces within libraries have shifted from silent reading rooms to flexible, technology-enhanced environments designed to foster interaction and co-creation (Lankes 2011). In this evolving educational landscape, libraries serve as social and intellectual spaces that support both individual study and collective knowledge construction.

Despite these significant transformations, much of the existing literature continues to conceptualize university libraries primarily as information service institutions. Research often emphasizes collection development, user services, and information literacy instruction as core functions. While these perspectives remain valuable, they may insufficiently capture the systemic and relational dimensions of modern academic libraries. Specifically, there

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has been limited effort to analyze university libraries holistically as integrated systems composed of multiple actors, resources, environments, and knowledge flows.

This gap leads to a central research question: Can university libraries still be understood merely as information repositories? To address this question, this study reconceptualizes the university library as a knowledge ecosystem. Drawing upon knowledge ecosystem theory and related perspectives on knowledge sharing and learning environments, the paper proposes a conceptual model that frames the library as a dynamic system characterized by interdependent components: knowledge resources, human participants, learning environments, and knowledge interaction processes. Rather than viewing the library as a passive provider of access, this approach positions it as an active hub within a network of knowledge creation and exchange.

The objectives of this study are threefold. First, it introduces the concept of the university library as a knowledge ecosystem. Second, it develops a conceptual framework that integrates multiple theoretical perspectives to explain the systemic nature of library functions. Third, it derives managerial implications for academic library leadership, emphasizing the transformation from collection-centered management to ecosystem-oriented governance. By offering a systemic reinterpretation of university libraries, this paper aims to contribute to ongoing discussions about their evolving roles in the digital age.

Traditional Perspectives of University Libraries

Library as Collection Center

Historically, university libraries have been conceptualized primarily as collection-centered institutions. Their core mission was to acquire, organize, preserve, and provide access to scholarly materials. Collection development policies, cataloguing systems, classification standards, and archival preservation constituted the backbone of professional library practice. In this traditional view, the value of a library was largely measured by the size, depth, and quality of its holdings (Borgman 2007).

The emphasis on collection building was closely linked to the material conditions of scholarship in the print era. Access to knowledge depended on physical proximity to books and journals, and libraries functioned as custodians of scarce intellectual resources. Technical services such as acquisitions, cataloguing, and metadata organization were therefore central professional activities. Even as digital resources expanded, collection management remained a dominant paradigm, with attention shifting toward licensing electronic journals and managing digital repositories rather than rethinking the underlying conceptual model (Corrall 2010).

Within this framework, the library was primarily understood as a repository: a stable, organized storehouse of information resources. The professional identity of librarians was closely associated with stewardship—ensuring bibliographic control, preservation, and systematic access. Although this model ensured reliability and scholarly continuity, it positioned the library as a relatively static institution whose main responsibility was maintaining collections rather than actively participating in knowledge production.

Library as Information Service Institution

In the late twentieth century, the professional discourse shifted toward viewing the library as an information service institution. This perspective emphasized user needs, service quality, and access facilitation. Reference services, information literacy instruction, and user education programs became increasingly central functions (Lankes 2011).

The rise of digital databases and online search systems strengthened this service-oriented model. Libraries began to focus on helping users navigate complex information environments, evaluate sources, and develop research skills. Information literacy programs, in particular, became a defining feature of academic library practice, positioning librarians as educators who support student learning and research competencies (Julien and Genuis 2011).

Moreover, as scholarly communication evolved, libraries expanded into areas such as institutional repositories, copyright support, and research data management. These developments reinforced the idea that libraries are service providers embedded within the academic support infrastructure. Their primary value lay in facilitating access to information and enhancing user capabilities.

While the service-oriented approach represented progress beyond purely collection-centered thinking, it still largely conceptualized the library in functional terms. The focus remained on delivering services efficiently and meeting user demands. Users were often viewed as recipients of services rather than active participants in collaborative knowledge processes. As a result, this perspective continued to frame the library as an intermediary institution rather than as a dynamic system of knowledge interaction.

Limitations of Traditional Views

Although the collection-centered and service-oriented perspectives have shaped library development for decades, both exhibit important limitations in the contemporary academic environment.

First, traditional models tend to be static. They conceptualize the library as either a repository of materials or a provider of services, emphasizing stability and institutional continuity. However, digital scholarship, interdisciplinary collaboration, and networked research practices require more dynamic and adaptive frameworks (Borgman 2007).

Second, these perspectives are resource-centered. Even in service-oriented approaches, the underlying assumption is that the primary function of the library is to facilitate access to information resources. This focus risks underestimating the relational and interactive dimensions of knowledge production, where meaning emerges through dialogue, collaboration, and shared inquiry (Lankes 2011).

Third, traditional views often overlook knowledge creation processes. By concentrating on access and support, they implicitly separate libraries from the core activities of research and innovation. Yet contemporary academic work increasingly involves collaborative data analysis, digital humanities projects, and interdisciplinary research networks—activities in which libraries frequently participate

but which are not fully captured by repository or service metaphors (Corrall 2010).

Finally, conventional models insufficiently address the spatial and community dimensions of libraries. Physical and digital library spaces have evolved into learning commons, makerspaces, and collaborative environments that foster interaction and community building. These developments suggest that libraries function as social and intellectual ecosystems rather than merely as storage facilities or service desks.

Taken together, these limitations indicate the need for a more comprehensive conceptual framework—one that accounts for resources, actors, environments, and knowledge flows as interdependent elements. The following table summarizes the contrast between traditional perspectives and the proposed knowledge ecosystem approach, which will be developed in subsequent sections.

The Concept of Knowledge Ecosystem

Defining the Knowledge Ecosystem

The concept of a knowledge ecosystem originates from the broader ecological metaphor applied to organizational and innovation studies. Rather than viewing knowledge as a static asset stored within institutions, the ecosystem perspective conceptualizes knowledge as emerging from dynamic interactions among multiple actors, technologies, and environments (Adner 2006). In this sense, a knowledge ecosystem is a networked system composed of interdependent participants who collaboratively create, share, and transform knowledge.

A central feature of a knowledge ecosystem is multi-actor participation. Knowledge does not reside solely within individuals or organizations but is distributed across diverse participants, including producers, intermediaries, and users. These actors interact through formal and informal mechanisms, contributing complementary capabilities and perspectives. Such distributed participation enhances collective intelligence and enables innovation through collaboration (Järvi et al. 2018).

Dynamic interaction is another defining element. Unlike hierarchical or linear models of knowledge transfer, ecosystem approaches emphasize reciprocal and evolving relationships. Knowledge flows are continuous rather than episodic, shaped by technological infrastructures, institutional norms, and social practices. This perspective highlights that knowledge systems are adaptive and constantly reconfigured in response to environmental changes (Clarysse et al. 2014).

Knowledge flow constitutes the operational mechanism of the ecosystem. Information, expertise, and ideas circulate among participants, generating new insights through recombination and reinterpretation. These flows are facilitated by digital platforms, communication channels, and collaborative spaces. As knowledge moves across boundaries, it gains new meanings and applications, thereby contributing to collective learning (Järvi et al. 2018).

Finally, collaborative knowledge creation is fundamental to the ecosystem model. Rather than merely transmitting existing information, ecosystems enable co-creation processes in which participants jointly develop new knowledge. Innovation emerges from the interaction of diverse competencies and perspectives. This co-creative dimension distinguishes knowledge ecosystems from traditional organizational structures centered on unilateral knowledge provision (Adner 2006).

Taken together, a knowledge ecosystem can be defined as a dynamic and adaptive network of interdependent actors who engage in continuous knowledge exchange and co-creation within a shared environment. This definition provides a theoretical foundation for reinterpreting institutional settings, including university libraries, as systemic rather than isolated entities.

Core Characteristics of Knowledge Ecosystems

Building on the above definition, four core characteristics define knowledge ecosystems: interdependence, co-evolution, knowledge flow, and innovation.

Interdependence refers to the mutual reliance among participants. Actors contribute specialized resources or capabilities that complement one another. The value generated by the ecosystem depends not on isolated performance but on coordinated interaction. Ecosystem theory emphasizes that no single actor can independently create the full range of outcomes; instead, value emerges through collaboration (Clarysse et al. 2014).

Co-evolution describes the process by which participants adapt in response to one another and to environmental shifts. As technological, institutional, or social conditions change, actors adjust their roles and strategies. This adaptive capacity enables resilience and long-term sustainability. In knowledge ecosystems, organizations evolve together, shaping and being shaped by collective learning processes (Järvi et al. 2018).

Knowledge flow highlights the circulation of information and expertise across boundaries. Effective ecosystems facilitate transparent and efficient exchanges, reducing barriers to communication and collaboration. Digital infrastructures, open platforms, and shared standards play critical roles in enabling these flows. Without sustained knowledge exchange, the ecosystem becomes fragmented and loses innovative capacity (Adner 2006).

Innovation represents the emergent outcome of ecosystem interactions. When diverse actors combine complementary knowledge, novel ideas and solutions arise. Innovation in this context is not solely technological but also organizational and social. Ecosystems foster experimentation, learning, and iterative development, thereby enhancing creative potential (Clarysse et al. 2014).

These four characteristics together underscore the systemic and relational nature of knowledge ecosystems. They provide analytical dimensions that can be applied to understand how institutions support or constrain knowledge creation.

Theoretical Integration: Knowledge Sharing and Learning Environment Perspectives

To operationalize the knowledge ecosystem concept in the context of university libraries, it is useful to integrate insights from knowledge sharing theory and learning environment theory.

Table 1. raditional vs. Knowledge Ecosystem Perspective of University Libraries

Dimension	Traditional Perspective	Knowledge Ecosystem Perspective
Core Role	Information repository	Knowledge hub
Focus	Access to information	Knowledge interaction & creation
Actors	Librarians & users	Multi-actor network
Space	Physical collection space	Dynamic learning environment
Value Creation	Service provision	Collaborative knowledge generation

Note. The table highlights the conceptual shift from a static, resource-centered model to a dynamic, ecosystem-oriented understanding of university libraries.

Knowledge sharing theory emphasizes that knowledge is socially constructed and disseminated through interaction. Organizational learning depends on communication, trust, and shared practices that enable individuals to exchange tacit and explicit knowledge (Nonaka 1994). The well-known SECI model (socialization, externalization, combination, internalization) illustrates how knowledge is continuously transformed through interaction. This perspective reinforces the ecosystem view by highlighting that knowledge creation is fundamentally collaborative rather than individual.

Furthermore, knowledge sharing is influenced by environmental and structural conditions. Incentives, culture, and technological infrastructures shape the willingness and capacity of actors to exchange knowledge. Ecosystem thinking aligns with this perspective by focusing on relational networks and supportive contexts that enable continuous interaction (Nonaka 1994).

Learning environment theory provides an additional dimension. Contemporary educational research emphasizes that learning occurs within complex environments composed of physical spaces, digital tools, social relationships, and cultural norms. Effective learning environments promote collaboration, engagement, and active knowledge construction. Rather than serving merely as background settings, environments actively shape cognitive and social processes.

By integrating knowledge sharing theory and learning environment theory, the knowledge ecosystem framework becomes both socially and spatially grounded. It acknowledges that knowledge creation depends on interactive processes among participants and on supportive environments that facilitate these processes. This theoretical synthesis provides a robust foundation for reconceptualizing university libraries as dynamic knowledge ecosystems in subsequent sections.

University Libraries as Knowledge Ecosystems

Building upon the theoretical foundations outlined in the previous section, this study proposes the University Library Knowledge Ecosystem Model, which reconceptualizes the academic library as a dynamic system composed of interdependent elements. Rather than functioning merely as a repository or service unit, the university library operates as a knowledge ecosystem in which resources, actors, environments, and interactions continuously shape and reinforce one another. This systemic view aligns with contemporary understandings of knowledge production as distributed, collaborative, and context-dependent (Powell et al. 1996).

The proposed model positions the University Library at the center of four mutually reinforcing components: knowledge resources, human participants, learning environment, and knowledge interaction. These elements are not hierarchical; instead, they are connected through bidirectional relationships characterized by continuous knowledge flow and adaptive evolution.

Knowledge Resources

Knowledge resources constitute the foundational energy of the ecosystem. Traditionally associated with printed collections, resources now encompass electronic journals, digital databases, institutional repositories, research data archives, and multimedia materials. In the digital age, access to high-quality and interoperable resources enables scholarly communication, interdisciplinary research, and evidence-based learning (Tenopir et al. 2012).

However, within an ecosystem perspective, resources are not passive assets. Their value emerges through use, recombination, and reinterpretation by participants. Digital repositories and data services, for example, facilitate the integration of datasets into new research contexts, supporting innovation beyond initial publication. As open science practices expand, libraries increasingly curate not only publications but also research data and metadata infrastructures (Pinfield et al. 2014). Thus, knowledge resources function as dynamic inputs that fuel interaction and collaborative creation.

Human Participants

The second component of the model is human partici- pants. The university library ecosystem includes students, researchers, librarians, faculty members, and broader academic communities. Each actor contributes distinct expertise and perspectives, creating a multi-actor network consistent with contemporary models of collaborative scholarship (Wuchty et al. 2007).

Students engage with resources for learning and inquiry, researchers generate new knowledge, and librarians facilitate discovery, data management, and scholarly communication. Importantly, librarians' roles have expanded beyond custodianship to include digital scholarship support, bibliometric analysis, and research data services. This evolution reflects a shift toward partnership-based engagement in the research lifecycle (Auckland 2012).

In an ecosystem framework, participants are co-creators rather than isolated users. Their interactions generate collective intelligence, and their collaborative activities sustain the vitality of the system. Knowledge production

becomes a shared endeavor shaped by dialogue and cooperation rather than unidirectional service delivery.

Learning Environment

The learning environment represents the spatial and technological context in which knowledge exchange occurs. Contemporary university libraries provide hybrid environments that integrate physical and digital spaces. Learning commons, makerspaces, collaborative study rooms, and technology-rich facilities coexist with online platforms, virtual research environments, and digital repositories (Bennett 2009).

From an ecosystem perspective, space is not merely a container but an active facilitator of interaction. Physical design influences communication patterns, collaboration, and intellectual engagement. Flexible furniture, shared workstations, and interdisciplinary hubs encourage dialogue and spontaneous exchange. Similarly, digital platforms enable remote collaboration and asynchronous knowledge sharing across institutional boundaries.

Research on learning spaces suggests that well-designed environments enhance engagement, creativity, and problem-solving (Bennett 2009). Therefore, the library's learning environment operates as the habitat of the ecosystem—supporting, shaping, and sustaining knowledge processes.

Knowledge Interaction

At the core of the ecosystem lies knowledge interaction. Interaction encompasses academic communication, research collaboration, workshops, data sharing, peer learning, and co-authorship. Knowledge does not merely circulate; it is transformed through dialogue and collective inquiry (Powell et al. 1996).

Digital infrastructures amplify these interactions by connecting scholars globally and enabling real-time exchange. Institutional repositories, research data services, and open access platforms facilitate visibility and reuse of scholarly outputs (Pinfield et al. 2014). Meanwhile, in-person seminars, interdisciplinary forums, and collaborative learning sessions foster intellectual community within the library space.

Knowledge interaction is both the process and outcome of ecosystem functioning. It links resources with participants within enabling environments, generating innovation and shared understanding. Without sustained interaction, the ecosystem loses coherence and creative capacity.

The four components described above are integrated in the figure 1. This model illustrates that: (a) The University Library serves as the central hub. (b) Knowledge resources provide foundational inputs. (c) Human participants activate and transform these resources. (d) The learning environment enables and shapes interactions. (e) Knowledge interaction connects all elements through dynamic exchange.

Bidirectional arrows signify continuous feedback loops. For instance, participant collaboration generates new knowledge resources (e.g., datasets, publications), which are then curated and reintegrated into the system. Similarly, evolving learning environments influence patterns of

interaction, while emerging research needs reshape resource development.

By framing the university library as a knowledge ecosystem, this model moves beyond static metaphors of storage and service provision. It emphasizes systemic interdependence, adaptive evolution, and collaborative knowledge generation. The model thus provides the theoretical foundation for rethinking academic library management and governance in the subsequent section.

Implications for Library Management

The University Library Knowledge Ecosystem Model (Figure 1) provides not only a conceptual reinterpretation but also a strategic framework for management transformation. If university libraries are understood as dynamic ecosystems composed of resources, participants, environments, and interactions, then managerial practices must shift from collection-centered administration to ecosystem-oriented governance. This section derives three major managerial implications: positioning the library as a knowledge hub, redefining librarians as knowledge facilitators, and cultivating libraries as academic communities.

Library as Knowledge Hub

Within the ecosystem model, the university library functions as a central knowledge hub that connects diverse actors, resources, and disciplines. Unlike traditional repositories that primarily store and provide access to materials, a knowledge hub actively coordinates and integrates flows of information and expertise. This shift requires libraries to adopt network-oriented strategies that support interdisciplinary collaboration and cross-boundary knowledge exchange (Bryson et al. 2006).

As research becomes increasingly collaborative and interdisciplinary, libraries are uniquely positioned to bridge departmental silos. By hosting research forums, supporting digital scholarship initiatives, and managing institutional repositories, libraries can enhance visibility and connectivity across academic communities. Evidence suggests that networked collaboration significantly increases innovative outcomes and research impact (Wuchty et al. 2007). Therefore, management should prioritize initiatives that strengthen the library's integrative capacity—such as cross-disciplinary data services and shared digital infrastructures.

In practical terms, ecosystem-oriented management implies reallocating resources toward coordination functions rather than solely collection expansion. Strategic planning should emphasize partnerships with research offices, IT departments, and academic faculties. Through such integrative roles, the library evolves from a passive service unit into a central node within the institutional knowledge network.

Librarians as Knowledge Facilitators

The ecosystem perspective also reshapes professional roles. In a dynamic knowledge environment, librarians move beyond custodial and transactional service functions to become knowledge facilitators embedded in the research and learning lifecycle. This transformation reflects broader
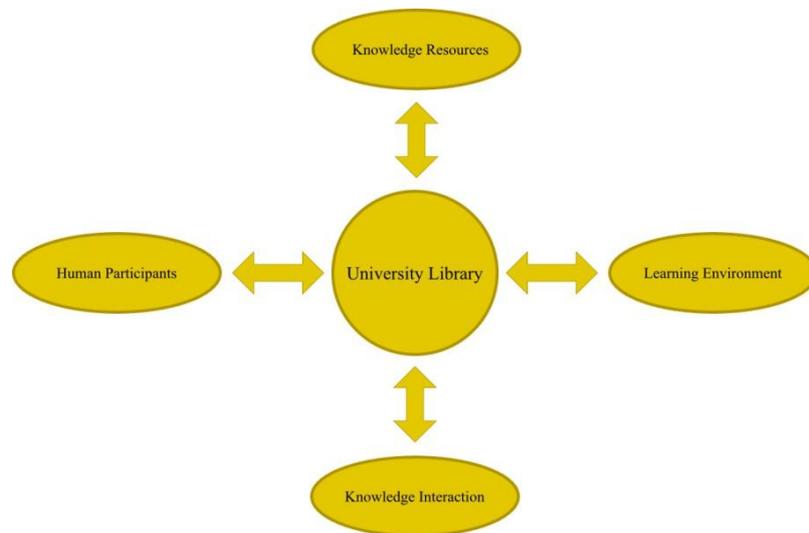
Figure 1. University Library Knowledge Ecosystem Model

shifts in scholarly communication and data-intensive research (Auckland 2012).

Data support has become a critical domain of library activity. Research data management, metadata curation, and compliance with open science mandates require specialized expertise. Studies indicate that libraries increasingly contribute to data stewardship and digital scholarship support, positioning librarians as partners in research processes (Pinfield et al. 2014). Consequently, management strategies should invest in upskilling staff, developing competencies in data analytics, digital preservation, and scholarly communication.

In addition to technical expertise, librarians facilitate academic dissemination. Support for open access publishing, bibliometric analysis, and research visibility enhances institutional impact. By advising researchers on publication strategies and copyright issues, librarians actively contribute to knowledge circulation and institutional reputation.

Moreover, librarians can foster research collaboration by organizing workshops, training sessions, and networking events. In this role, they act as connectors within the ecosystem—linking scholars, resources, and technologies. Effective management must therefore recognize facilitation and partnership-building as core professional competencies, supported by continuous professional development and organizational flexibility.

Libraries as Academic Communities

The ecosystem model further highlights the social dimension of university libraries. Beyond providing access and services, libraries can function as academic communities that cultivate learning, belonging, and shared intellectual culture. Research on learning spaces demonstrates that collaborative environments enhance engagement, creativity, and collective problem-solving (Bennett 2009).

As physical and digital learning spaces converge, library management should prioritize community-building initiatives. Flexible learning commons, makerspaces, and hybrid collaboration platforms create opportunities for peer learning and interdisciplinary interaction. Such environments foster a sense of academic belonging and intellectual identity,

particularly important in increasingly digital and dispersed campuses.

Cultivating a knowledge-sharing culture is equally critical. Organizational research emphasizes that trust, openness, and shared norms significantly influence knowledge exchange (Foss et al. 2010). Library leaders can promote such a culture by encouraging collaborative programming, recognizing community contributions, and supporting inclusive participation.

Importantly, viewing libraries as academic communities reinforces their role in promoting equity and access. By offering open learning spaces, inclusive programming, and accessible digital services, libraries contribute to social and intellectual inclusion within higher education institutions.

Future Development of University Libraries

Building upon the knowledge ecosystem framework proposed in this study, the future development of university libraries can be understood as an evolutionary process toward greater intelligence, connectivity, and openness. As higher education continues to transform under digital and global pressures, the university library ecosystem will not remain static; rather, it will become increasingly adaptive and technology-enabled.

AI Integration: Toward Intelligent Ecosystems

Artificial intelligence (AI) is poised to significantly reshape library ecosystems. AI-driven tools can enhance knowledge discovery, automate metadata generation, support semantic search, and provide personalized learning recommendations. Instead of merely improving efficiency, AI has the potential to deepen knowledge interaction by identifying connections across disciplines, uncovering hidden research patterns, and facilitating data-intensive scholarship.

Within the ecosystem model, AI functions as an enabling infrastructure that strengthens knowledge flows between resources and participants. Intelligent systems can analyze usage data to optimize resource allocation, predict emerging research trends, and enhance decision-making processes. Chatbots, research assistants, and automated data curation

tools may support both students and researchers, allowing librarians to focus more on high-level facilitation and strategic engagement.

However, AI integration also requires careful governance. Ethical considerations, data privacy, algorithmic transparency, and digital equity must be addressed to ensure that technological advancement strengthens rather than disrupts the knowledge ecosystem. Thus, future library development will involve not only technological adoption but also responsible innovation management.

Smart Learning Spaces

As learning environments evolve, university libraries will increasingly function as smart learning spaces. These spaces integrate physical design, digital infrastructure, and user analytics to create responsive and adaptive environments. Flexible furniture, immersive technologies, collaborative hubs, and real-time digital access systems will support interdisciplinary and project-based learning.

In ecosystem terms, smart learning spaces enhance the environmental dimension by fostering dynamic interac- tion. Sensors and analytics can monitor space utiliza- tion and inform redesign strategies, ensuring that environ- ments align with changing academic practices. Hybrid mod- els— combining on-site collaboration with virtual participa- tion—will enable inclusive and global engagement.

The concept of space will extend beyond physical boundaries. Virtual research environments, cloud-based collaboration platforms, and digital scholarship centers will complement physical facilities. This hybridization reinforces the idea that the library ecosystem is not confined to a building but exists as an interconnected network of physical and digital habitats.

Open Science and Networked Collaboration

Open science represents another major direction of ecosystem evolution. As research practices increasingly emphasize transparency, data sharing, and collaborative publication, libraries will play central roles in supporting open infrastructures. Institutional repositories, open data platforms, and open educational resources expand the accessibility and reuse of knowledge.

Within the ecosystem framework, open science strengthens interdependence and knowledge flow across institutional boundaries. Libraries act as connectors in global knowledge networks, facilitating interoperability and standardization. By supporting open access publishing, data stewardship, and research transparency, libraries contribute to a more inclusive and democratized academic landscape.

Moreover, networked collaboration will redefine institutional boundaries. University libraries may form alliances to share resources, co-develop digital platforms, and collectively manage research data. Such cross-institutional ecosystems enhance resilience and reduce duplication, further reinforcing systemic integration.

Digital Scholarship and Innovation

The rise of digital scholarship—encompassing digital humanities, computational social sciences, and data-intensive research—will further transform library ecosystems. Libraries increasingly provide digital labs, data visualization tools, and specialized expertise that support innovative research methodologies.

In this evolving context, the library ecosystem becomes a platform for experimentation and innovation. Librarians collaborate with faculty and students on grant-funded projects, digital exhibits, and interdisciplinary research initiatives. The boundaries between support and participation blur, as libraries actively contribute to the production of new knowledge.

Overall, the future university library ecosystem will be characterized by three interrelated qualities: intelligence, connectivity, and openness. AI enhances intelligence, networked collaboration strengthens connectivity, and open science expands openness. Together, these forces will drive the continued evolution of libraries as adaptive and innovation-oriented knowledge ecosystems.

Conclusion

This study has reconceptualized the university library from a traditional institutional model to a dynamic knowledge ecosystem. Historically, university libraries have been understood primarily as collection centers or information service institutions. While these perspectives have contributed to professional development, they present limitations in a rapidly evolving digital and collaborative academic environment.

In response, this paper introduced the knowledge ecosystem perspective as a comprehensive framework for understanding the systemic nature of university libraries. By integrating insights from ecosystem theory, knowledge sharing theory, and learning environment theory, the study proposed a four-component model consisting of knowledge resources, human participants, learning environments, and knowledge interaction. This model emphasizes interdependence, co-evolution, and collaborative knowledge creation.

The theoretical contribution of this research lies in offering an integrated and systemic framework that transcends static metaphors of storage and service. Rather than treating libraries as isolated units, the ecosystem model situates them within dynamic networks of actors, technologies, and practices. This conceptual shift provides a more accurate and forward-looking interpretation of contemporary academic libraries.

Furthermore, the model bridges theory and practice by deriving concrete managerial implications. It reframes libraries as knowledge hubs, redefines librarians as knowledge facilitators, and highlights the importance of fostering academic communities. These transformations align library governance with emerging trends in digital scholarship, open science, and intelligent learning environments.

Looking ahead, the university library ecosystem will continue to evolve toward greater intelligence, connectivity, and openness. By embracing ecosystem-oriented thinking, libraries can enhance their resilience, relevance, and capacity

for innovation in higher education. Ultimately, understanding university libraries as knowledge ecosystems not only clarifies their current transformation but also provides strategic guidance for their future development.

References

Adner, R. (2006). Match your innovation strategy to your innovation ecosystem. *Harvard Business Review*, 84(4):98–107.

Auckland, M. (2012).

Bennett, S. (2009).

Borgman, C. L. (2007).

Bryson, J. M., Crosby, B. C., and Stone, M. M. (2006). The design and implementation of cross-sector collaborations. *Public Administration Review*, 66(s1):44–55.

Clarysse, B., Wright, M., Bruneel, J., and Mahajan, A. (2014). Creating value in ecosystems: Crossing the chasm between knowledge and business ecosystems. *Research Policy*, 43(7):1164–1176.

Corrall, S. (2010). Educating the academic librarian as a blended professional: A review and case study. *Library Management*, (8/9):567–584.

Foss, N. J., Husted, K., and Michailova, S. (2010). Governing knowledge sharing in organizations: Levels of analysis, governance mechanisms, and research directions. *Journal of Management studies*, 47(3):455–482.

Järvi, K., Almpanopoulou, A., and Ritala, P. (2018). Organization of knowledge ecosystems: Prefigurative and partial forms. *Research Policy*, 47(8):1523–1537.

Julien, H. and Genuis, S. K. (2011). Librarians' experiences of the teaching role: A national survey of librarians. *Library & Information Science Research*, 33(2):103–111.

Lankes, R. D. (2011).

Nonaka, I. (1994). A dynamic theory of organizational knowledge creation. *Organization Science*, 5(1):14–37.

Pinfield, S., Cox, A. M., and Smith, J. (2014). Research data management and libraries: Relationships, activities, drivers and influences. *PLOS ONE*, 9(12).

Powell, W. W., Koput, K. W., and Smith-Doerr, L. (1996). Interorganizational collaboration and the locus of innovation. *Administrative Science Quarterly*, 41(1):116–145.

Suber, P. (2012).

Tenopir, C., Birch, B., and Allard, S. (2012).

Wuchty, S., Jones, B. F., and Uzzi, B. (2007). The increasing dominance of teams in knowledge production. *Science*, (5827):1036–1039.