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# Functional Reconstruction and Service Innovation of University Libraries under Industry-Education Integration

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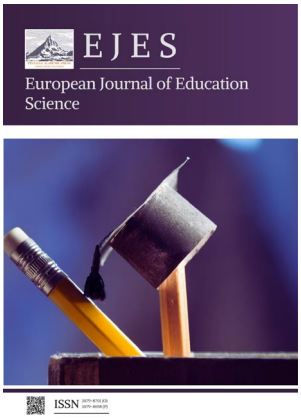


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**Abstract:** In response to national strategies for high-quality talent cultivation and industrial development, industry-education integration (IEI) has emerged as a crucial mechanism connecting education, talent, industry, and innovation. University libraries, particularly in engineering-oriented institutions, face a necessary transformation from "resource assurance" to "knowledge collaboration". Here, knowledge collaboration is defined as the active co-production, sharing, and integration of information and expertise among libraries, faculty, students, and external partners, enabling the co-creation of knowledge across academic and industrial boundaries. This paper constructs a systematic framework consisting of four interrelated dimensions: specialized resources, embedded services, intelligent platforms, and collaborative mechanisms. Based on a comprehensive literature review, this study examines the necessity and feasibility of library functional reconstruction under IEI, and proposes innovative service models. It argues that libraries must embed themselves into teaching, research, and industrial collaboration, transitioning from passive providers to active partners. This transformation enhances support for technical talent cultivation, strengthens regional industry-academia cooperation, and contributes to sustainable development. Future research directions include empirical evaluations of innovative practices and models of inter-institutional collaboration.

**Keywords:** university library; industry-education integration; knowledge services; functional reconstruction; service innovation; engineering education

## 1. Introduction

The rapid advancement of technological innovation and industrial transformation has heightened the demands placed on higher education systems to serve economic and social development. Policy frameworks, such as Several Opinions on Deepening the Integration of Industry and Education, underscore the growing importance of universities in supporting regional industry and contributing to innovation ecosystems [1]. Within this landscape, university libraries are expected to evolve from traditional support units into strategic hubs for knowledge collaboration.

Traditionally, libraries have focused on lending services, resource provision, and basic academic assistance. However, these functions no longer meet the complex demands of IEI.

The shift toward IEI presents both significant opportunities and challenges for university libraries. On one hand, it provides an impetus for libraries to break free from traditional roles and become central to the education and innovation value chain. On the other hand, it challenges libraries to redefine their services, expand their user base, and

build new cooperative mechanisms. Existing studies reveal a notable gap between international and domestic research. While international research has highlighted user-centered and data-driven library services, domestic studies, despite emphasizing alignment with national policies, often lack a comprehensive framework to guide this transformation. This paper addresses this gap by presenting an integrated framework that connects resource development, service embedding, platform construction, and feedback mechanisms into a coherent progression. A comprehensive understanding of the current research landscape is essential to effectively address this gap. The following section provides a critical review of both international and domestic scholarly discourse on library services, identifying key trends, existing models, and persistent challenges. By synthesizing these findings, this paper establishes the theoretical foundation for its proposed framework of library functional reconstruction.

## 2. Literature Review

Internationally, Internationally, academic libraries are shifting toward user-centered, data-driven, and collaborative knowledge services. Libraries in the United States and Europe are increasingly embedded in research workflows, offering services such as research data management and digital scholarship support. These experiences provide valuable reference points for Chinese university libraries seeking to strengthen their engagement in IEI.

For instance, the development of "digital scholarship centers" or "innovation labs" within libraries provides a physical and virtual space for interdisciplinary collaboration, offering access to advanced software, data visualization tools, and expert consultations. This model moves the library from a repository of finished knowledge to an incubator for new discoveries. Furthermore, the concept of the ‘embedded librarian’ has matured significantly, with librarians becoming integral members of research teams and curriculum planning committees, a practice that has shown measurable improvements in student learning outcomes and research quality. These international trends underscore a movement towards proactive, integrated service delivery that is directly aligned with institutional and economic goals.

In China, research has emphasized the need for libraries to align with national strategies such as “double first-class” university development and IEI. Xu point out that libraries’ participation in IEI often remains superficial, limited to resource sharing without deeper integration into talent cultivation [2]. Chu highlights the emergence of smart libraries, emphasizing the integration of big data and intelligent platforms for precise service provision [3]. Li argues that collaborative service mechanisms are essential for embedding libraries in educational systems [4]. While recent studies also explore libraries’ roles in information literacy education and scientific data services, these discussions remain fragmented, highlighting the need for a comprehensive framework that integrates these perspectives.

## 3. Redefined Roles and Diversified Needs under IEI

Building on the identified research gaps, this section delves into the fundamental transformations required of university libraries. The discussion begins with an analysis of how library roles are being redefined, followed by an examination of the increasingly diverse needs of a broader user base in the context of IEI.

### *3.1. Redefining Library Roles*

Under the new paradigm, libraries are redefining their service boundaries. The shift toward knowledge collaboration represents a fundamental transformation, where the library acts as a dynamic partner in the university's academic mission. The university library must reimagine its role, shedding the passive identity of a 'document center' to become a proactive 'academic service hub' that actively engineers connections between

classroom theories and industrial applications. Despite this, libraries often remain positioned as auxiliary units within universities. This auxiliary status often stems from a historical path dependence and a governance structure that prioritizes traditional teaching departments, thus limiting the library's ability to independently secure funding and forge external partnerships. Overcoming these structural constraints requires strategic reforms in governance and institutional autonomy.

### *3.2. Diversified User Demands*

IEI has diversified user groups beyond students and faculty to include enterprises and research institutions. These users increasingly demand specialized, targeted information services. A joint project between Tongji University and the SAIC Motor Corporation, for example, demonstrated that industrial partners required not only scholarly articles but also patent analyses, international standards, and technical reports to support product development. Such examples illustrate the need for multi-dimensional and flexible service models.

## 4. Necessity and Feasibility of Library Functional Reconstruction

### *4.1. Necessity*

Chinese academic libraries face a development bottleneck. Homogenized services, often modeled after established foreign libraries, weaken local distinctiveness and reduce innovation capacity. Now many university libraries offer nearly identical database subscriptions and information literacy programs. IEI provides an opportunity to overcome these limitations by embedding library development in institutional strengths, regional contexts, and industrial demands, thereby enhancing strategic value in talent cultivation and innovation ecosystems.

### *4.2. Feasibility*

Service innovation is supported by favorable policy frameworks, institutional resources, and technological infrastructure. Universities possess faculty expertise, laboratories, and training platforms that create strong foundations for collaboration. Governmental support for IEI legitimizes and directs these efforts. Furthermore, advances in digital infrastructure and smart library technologies enable precise, efficient, and scalable services. However, challenges such as data security, intellectual property protection, and organizational inertia remain. Studies by Yin stress the importance of balancing innovation with these constraints [5].

## 5. Framework for Functional Reconstruction and Service Innovation

Building upon the identified necessity and feasibility, this section outlines a comprehensive framework for functional reconstruction. The framework is composed of four interconnected pillars, designed to guide university libraries toward a knowledge collaboration paradigm [6].

### *5.1. Specialized Knowledge Resource Construction*

University libraries should build a dynamically updated professional resource system guided by the needs of advantageous disciplines and key technological fields. For technology-intensive areas like integrated circuits, libraries must introduce high-quality professional databases, industry white papers, technical standards, and patent retrieval systems to serve multi-level resource needs.

The traditional collection-centric model must be transformed into a "demand-pull and dynamic adjustment" model. In terms of resource organization, a cross-disciplinary collaborative planning mechanism should be established [7]. By regularly holding re-

source development seminars and distributing needs assessment questionnaires to relevant departments, libraries can gain a comprehensive understanding of the literature requirements for fundamental research, technological development, and engineering applications.

Furthermore, the library's role must extend to the stewardship of institutional research output. This includes developing and managing institutional repositories and research data archives that not only preserve academic work but also facilitate its discovery by industry partners, thereby supporting the principles of Open Science and accelerating knowledge transfer [8].

### *5.2. Deep Integration into the Teaching and Research*

Libraries should evolve from resource providers to active participants in teaching and research. The "service-forwarding" philosophy requires libraries to proactively intervene in the entire educational process. In teaching, libraries can collaborate with faculty to develop "information literacy modules" that are integrated into course design and project training.

For instance, in courses like integrated circuit design, a literature analysis training camp based on industry standards could be offered, teaching students how to interpret process documents, retrieve cutting-edge research, and compare patents. The embedded service for scientific research should extend to all stages, from project initiation to data collection and outcome dissemination.

This involves the librarian acting as a co-investigator, providing expertise on data management planning, systematic review methodologies, and author rights, thus ensuring research integrity and maximizing its impact [9]. Libraries can provide early warnings for research topics and trend insights using knowledge graphs and data mining. During the research phase, technologies like novelty search and patent layout analysis can improve resource allocation efficiency.

### *5.3. Building a Smart Service Platform and Expanding Interaction Boundaries*

Under the wave of digital transformation, the construction of a smart library service platform presents a significant opportunity. By using emerging technologies like big data analysis and natural language processing, the library can shift from being "retrieval-responsive" to "problem-solving-oriented". To achieve precise services, libraries must first establish a multi-dimensional user profiling system. By integrating structured data (e.g., borrowing records, retrieval behavior) and unstructured data (e.g., course participation), a dynamic user model can be built using machine learning algorithms [10]. This allows for the automatic identification of research directions and the intelligent push of relevant technical manuals and patent documents for engineering students. The expansion of service boundaries goes beyond physical space; it includes seamlessly embedding knowledge services into online teaching and research management platforms.

Crucially, the implementation of such data-driven services must be balanced with strong ethical guidelines for data privacy and algorithmic transparency to maintain user trust.

### *5.4. Establishing a Feedback and Evaluation Mechanism*

To enhance service quality, it is essential to establish a comprehensive evaluation mechanism that focuses on service effectiveness rather than just traditional quantitative indicators. The new generation of evaluation systems should adopt a "process-outcome-impact" three-dimensional framework. To achieve scientific evaluation, libraries need to analyze database usage, user behavior, and other data to build a system that includes resource usage, teaching effectiveness, and research support dimensions. For instance, the effectiveness of services can be demonstrated by comparing the project success rate and citation counts before and after library intervention.

Beyond these metrics, libraries should adopt frameworks like the Value of Academic Libraries (VAL) to articulate their contribution to student success, research excellence, and institutional reputation in both qualitative and quantitative terms. This allows for a more compelling demonstration of return on investment (ROI) to university stakeholders and potential industry partners.

## 6. Conclusion

In the context of industry-education integration, the functions of university libraries are being redefined through the paradigm shift toward knowledge collaboration. Libraries are no longer confined to resource provision but are transforming into comprehensive platforms. To achieve this, libraries must actively align with industrial demands and embed themselves in collaborative education systems. The value of the proposed framework lies in the synergy of its components; weakness in one area will inevitably undermine the effectiveness of the others. A structured strategy emphasizing specialized resource construction, data-driven services, and institutionalized collaboration is essential.

This study, while comprehensive in its conceptual framework, has limitations, as it primarily lacks empirical validation. Future research should employ case studies, user surveys, and cross-institutional comparisons to evaluate the effectiveness of service innovations. Additionally, more attention should be paid to potential challenges such as data security, intellectual property, and librarian professional development. By addressing these issues, libraries can strengthen their role as knowledge hubs in supporting sustainable talent cultivation and innovation.

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