From Resource Repository to Smart Services: Construction Model and Empowerment Path of a Panoramic Data System for Excellent Traditional Chinese Culture in University Libraries

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Date: 2025-10-14T10:55:59+00:00

Abstract

Against the dual backdrop of the national cultural digitization strategy and the transformation and development of university libraries, this study aims to explore how university libraries can transcend their traditional role as "resource repositories"and transform into providers of deep "smart services"by constructing a panoramic data system for excellent traditional Chinese culture. The article first analyzes current issues in libraries' construction of traditional cultural resources, such as data silos and monolithic service models, and then proposes the core connotation of the "panoramic data system"—namely, an integrated system that fuses multimodal resources, associates knowledge ontologies, and supports panoramic research and experience. The research focuses on constructing a four-layer collaborative construction model comprising "resource layer—data layer—platform layer—service layer," and systematically elaborates four core pathways through which this system empowers scientific research innovation, education and teaching, cultural dissemination, and the public. Finally, it proposes countermeasures for challenges that may be encountered during the construction process, including standards, copyright, technology, and sustainability. This study provides a theoretical framework and practical guidelines for university libraries to revitalize traditional cultural resources, achieve service upgrades, and reshape their value in the digital age.

Full Text

From Resource Repository to Smart Services: Research on the Construction Model and Empowerment Path of a Panoramic Data System for Chinese Excellent Traditional Culture in University Libraries

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Abstract: This study explores how university libraries can transcend their traditional role as "resource repositories" and transform into providers of "smart services" by constructing a panoramic data system for Chinese excellent traditional culture. The paper first analyzes existing problems in current university library construction of traditional cultural resources, such as data silos and monolithic service models. It then proposes the core connotation of a "panoramic data system"—an integrated platform that fuses multimodal resources, associates knowledge ontologies, and supports panoramic research and experiential engagement. The study focuses on the "construction model" of this system (including collaborative construction across the resource layer, data layer, platform layer, and service layer) and the "empowerment path" (how to intelligently empower teaching, research, cultural inheritance, and public services). Finally, through case analysis and future prospects, it provides theoretical foundations and practical guidelines for the digital transformation and innovative services of university libraries.

Keywords: university library, Chinese excellent traditional culture, panoramic data system, knowledge service, smart empowerment, digital humanities. **Classification Number:** G250. **Research Methods:** Literature research method (reviewing relevant domestic and international theories and practices), case analysis method (selecting typical domestic and international cases), model construction method (proposing construction and empowerment path models for the panoramic data system).

Culture constitutes the spiritual lifeline and creative source of a nation. Chinese excellent traditional culture embodies the deepest spiritual pursuits of the Chinese people and forms the foundation upon which we stand firm amidst global cultural currents. Promoting the creative transformation and innovative development of Chinese culture has become a major national-level strategy. Simultaneously, digital technologies represented by big data, artificial intelligence, and virtual reality are profoundly reshaping the preservation, research, dissemination, and experiential engagement of cultural resources, offering unprecedented historical opportunities to "rediscover" and "reactivate" traditional cultural treasures.

In this context, university libraries, as vital hubs for cultural inheritance and knowledge innovation, are undergoing profound reconstruction of their roles and functions. For a long time, university libraries have achieved remarkable suc-

cess in collecting and preserving Chinese traditional cultural resources, playing an indispensable role as "resource repositories." However, traditional resource construction models often suffer from limitations: digital collections frequently exist as "information silos," with single resource types and low knowledge connectivity. Service models remain relatively passive, struggling to meet the urgent needs of digital-native users for immersive, interactive, and knowledge-based services. This has prevented massive quantities of precious collections from fully releasing their potential knowledge value and cultural charm, and the library' s role in smart empowerment has not been fully realized. How to break free from the "emphasis on collection over utilization" paradigm and achieve the leap from static "resource repositories" to dynamic "smart services" represents the core issue in the current transformation and development of university libraries.

The concept of "panorama" provides new insights for this challenge. It signifies that the digital reconstruction of Chinese excellent traditional culture should not stop at fragmented, isolated digital copies. Instead, it should strive to build an organic living entity that integrates multimodal resources—including text, images, audio-video, and 3D models—while deeply revealing their intrinsic knowledge associations. Constructing such a "panoramic data system for Chinese excellent traditional culture" aims to achieve full-element digitization, full-dimension correlation, and full-scenario servitization of cultural resources, thereby providing a powerful data foundation and intelligent engine for academic research, education, and cultural dissemination.

Currently, domestic academic research on the digitization of traditional cultural resources in libraries is quite extensive, but most studies focus on specific technical applications or single-database construction, lacking a full-chain, systematic exploration from "system construction" to "service empowerment." In view of this, this research focuses on core questions: How should university libraries construct a panoramic data system for Chinese excellent traditional culture? And how can this system empower teaching, research, and cultural dissemination to specifically realize the path transformation from "resource repository" to "smart service" ?

To answer these questions, this paper will first analyze the internal logic of the role evolution of university libraries from "resource repository" to "smart service." It will then systematically elaborate on the core connotation of the "panoramic data system" and propose a "four-layer collaborative" construction model comprising the resource layer, data layer, platform layer, and service layer. On this foundation, it will focus on exploring the diverse empowerment paths of this system for scientific research innovation, education and teaching, cultural dissemination, and public services. Finally, it will analyze potential challenges in practice and propose corresponding countermeasures. This study aims to provide a useful reference framework and practical guidance for university libraries to deepen service connotations and enhance cultural inheritance and innovation capabilities in the digital age.

1.1 Research Background and Significance

Policy Background: Responding to the calls of the "National Cultural Digitalization Strategy" and the "Chinese Excellent Traditional Culture Inheritance and Development Project."

Technical Background: Big data, artificial intelligence, virtual reality, and other technologies enable the deep development of cultural heritage digitalization.

Industry Background: University libraries face an internal need to transform from "knowledge treasure houses" to "intelligent brains," requiring enhanced service capabilities and influence.

Theoretical Significance: Enriching the theoretical systems of library science and digital humanities, exploring new paradigms for resource construction and knowledge services.

Practical Significance: Providing actionable solutions for university libraries to construct traditional culture data systems, enhancing their functions in cultural inheritance and innovation.

1.2.1 Foreign Research Status

European and American university libraries have formed relatively mature theoretical and practical systems in the digitalization of special collections, digital humanities project support, and open data services. Their core characteristic is the transformation from "resource custodians" to "academic partners" and "data service providers."

In terms of special collection digitalization, European and American university libraries generally view it as a core mission aimed at achieving permanent preservation and global sharing of cultural heritage. Their digitalization practices go beyond simple image scanning, emphasizing the construction of standardized metadata (such as widely adopting MODS, METS, EAD standards), meticulous handling of copyright issues, and sustainable digital preservation strategies. For example, Harvard University Library's "Digital Collections" project provides massive high-quality digitized special collections, with comprehensive metadata ensuring resource discoverability and interoperability [1].

In digital humanities (DH) project support, university libraries have transcended technical assistance roles to become key drivers of interdisciplinary research. Their service models mainly include: establishing specialized service centers (e.g., Stanford University Library's "Center for Interdisciplinary Digital Research (CIDR)" provides advanced research method consulting and technical training in GIS spatial analysis, text mining, and data visualization [2]); developing dedicated tools and platforms (e.g., Oxford University Library utilizes the IIIF (International Image Interoperability Framework) protocol, enabling scholars worldwide to compare, annotate, and reuse image resources within a unified

framework, greatly promoting academic collaboration [3]); and providing full project lifecycle management (librarians as collaborators deeply participate in the entire process of DH project conception, data acquisition, cleaning, modeling, analysis, and publication, embodying an "embedded" service concept [4]).

In open data services, European and American university libraries actively practice open science principles, leading or participating in the construction of institutional repositories and research data management (RDM) services. They not only provide guidance on writing data management plans (DMP), data storage, and publication services for faculty and students, but also strive to release special collection digital resources as open data, allowing users to freely download, reuse, and conduct computational analysis, thereby maximizing the academic value of resources [5].

Overall, foreign research and practice exhibit characteristics of deep technology integration, emphasis on open sharing, and focus on service embedding, with the ultimate goal of activating special collection resources and empowering cutting-edge humanities and social sciences research.

1.2.2 Domestic Research Status

Domestic research on university libraries and Chinese excellent traditional culture is abundant, mainly concentrated on three levels: resource construction, technology application, and service transformation, but with a tendency to "emphasize construction over application."

In traditional culture resource construction, numerous studies focus on building characteristic databases. Many university libraries have established excellent projects such as "Tsinghua University Architecture Digital Library" and "Peking University Miji Linlang" based on their collections of ancient books, local documents, and intangible cultural heritage resources. These studies discuss in detail key aspects such as resource selection, metadata standard formulation, and digital processing workflows [6]. However, many databases suffer from "information silo" phenomena, with inconsistent standards and low interoperability.

In smart library services, with the rise of new-generation information technologies, domestic scholars have begun exploring the application of artificial intelligence, big data, VR/AR, etc., in library services, including smart space reconstruction, intelligent consultation robots, and personalized recommendation services [7]. However, successful cases and systematic research that deeply integrate these technologies with traditional cultural resources to create immersive and experiential cultural services remain relatively scarce.

Current research shortcomings are evident: First, research perspectives mostly focus on the "construction" phase—namely, how to digitize and build databases—while lacking effective service models and empowerment path exploration for how resources can actually be "utilized" and truly embedded into teaching, research, and public cultural life. Second, existing practices are mostly scattered

and point-based, lacking a "panoramic" perspective that integrates resources, technology, services, and scenarios holistically. Various systems, platforms, and data fail to form an organic system, making it difficult to support macro, multidimensional, and deep cultural insights and knowledge discovery.

1.2.3 Research Review

In summary, domestic and international research provides a solid theoretical and practical foundation for this project. The deeply embedded model of foreign university libraries in digital humanities and open data services offers important references for positioning libraries as "academic empowerment centers." Domestic research has accumulated rich experience in the ontological construction of traditional cultural resources.

However, shortcomings in existing research also leave room for innovation. Neither domestic nor international practice has systematically proposed the concept of a "panoramic data system for Chinese excellent traditional culture" and its construction model. This study aims to bridge the gap between "construction" and "utilization" with two key innovations: first, a systematic perspective that breaks the isolated construction model of traditional characteristic databases, emphasizing the building of a "panoramic data" system that integrates diverse heterogeneous data (such as text, images, audio, video, and spatiotemporal information), follows unified standards and specifications, and possesses cross-database retrieval and interoperability capabilities; second, a focus on empowerment paths that not only addresses "how to construct" but more importantly investigates "how to empower" —systematically exploring how this panoramic data system can activate the value of traditional cultural resources through smart service paths (such as data-driven research support, contextualized cultural experiences, and open innovative educational empowerment), ultimately achieving the paradigm shift from "resource repository" to "smart service."

1.3 In-Depth Case Analysis: From Practical Exploration to Model Inspiration

To anchor theoretical concepts in practical foundations, this study selects two benchmark cases—one domestic and one foreign—for deep deconstruction. They respectively represent two different construction paradigms of "platform-driven" and "data-core,"jointly outlining the diverse landscape of panoramic data system construction.

1.3.1 Domestic Case: Peking University Digital Humanities Open Laboratory—Platform-Driven Integration and Empowerment

The practice of Peking University Digital Humanities Open Laboratory demonstrates the ambition of university libraries transforming from resource custo-

dians to research infrastructure providers as academic centers. Its core characteristic lies in building a unified digital scholarship platform that integrates multi-source heterogeneous resources and directly provides tool-based services for complex research needs in humanities and social sciences.

1.3.1.1 Construction Model Analysis

Resource Layer: Its foundation is no longer single collections but aggregative. It systematically digitizes various documents from Peking University Library' s treasured collections, including ancient books, maps, rubbings, and Republican-era newspapers, as well as resources obtained through cooperation with external institutions, forming a multimodal resource pool across types and carriers.

Data Layer: This is the key to its "smart" leap. The laboratory not only performs basic OCR text conversion but focuses on deep semantic annotation and data structuring. For example, in the "Complete Tang Poems Analysis Platform," it not only provides poetic texts but also extracts and associates entities such as poets, eras, place names, and official positions, preliminarily constructing a knowledge graph in the Tang poetry domain and achieving the transformation from "text database" to "knowledge base" [8].

Platform Layer: The laboratory has created an online open-source platform integrating storage, computation, visualization, and analysis. The platform provides a series of digital humanities tools such as social network analysis, geographic information systems (GIS), text mining, and visualization presentation, enabling researchers to analyze platform data online without locally installing complex software. This realizes a paradigm shift from "data follows people" to "tools follow data" [9].

Service Layer: Its empowerment path directly cuts into the core of research and teaching. On one hand, it provides data and technical support for high-level research projects (such as National Social Science Fund projects). On the other hand, through "course-embedded services," it integrates with courses like "Chinese Historical Geography" and "Ancient Chinese Literature," enabling students to complete data analysis assignments using the platform and transforming dormant resources into vibrant teaching materials that greatly stimulate students' learning interest and research capabilities.

1.3.1.2 Insights and Limitations

The Peking University Laboratory model proves that university libraries can become catalysts for academic innovation by building centralized platforms that lower the technical threshold for digital humanities. Its success hinges on the breadth of resource integration, depth of data processing, and precision of service embedding. However, this model demands extremely high professional technical teams from libraries themselves and faces long-term challenges in sustainable operation, maintenance, and updates.

1.3.2 Foreign Case: Harvard University China Biographical Database (CBDB)—Data-Centric Openness and Co-creation

Unlike the comprehensiveness of the Peking University platform, Harvard University' s CBDB project follows a "narrow but deep" path. It does not pursue full coverage of resource types but focuses on the core entity of "Chinese historical figures," constructing a global academic infrastructure through extreme data standardization and open sharing.

1.3.2.1 Construction Model Analysis

Resource Layer: Highly focused, its resources mainly consist of figure information recorded in successive dynastic histories, epitaphs, and biographical literature. It is essentially a thematic, relational database.

Data Layer: CBDB has maximized its construction model. It has established extremely rigorous and detailed data models, standardizing and encoding figures' birth and death years, native places, relatives, official careers, and social relationships. This highly structured and standardized data processing enables seemingly unrelated figure information from different documents to be interconnected and compared, forming a massive figure relationship knowledge graph [10].

Platform Layer: CBDB itself does not provide complex online analysis platforms. Its "platform" focuses more on data distribution and API services. It allows global users to freely download the complete database (supporting multiple formats) or call data through API interfaces. This extreme openness completely transfers the right to use and create data to the academic community [11].

Service Layer: Its empowerment path is "teaching people to fish." By providing pure, reliable structured data, CBDB has empowered thousands of research projects worldwide. Scholars use this data, combined with their familiar statistical analysis software (such as Python, R), social network analysis tools (such as Gephi), or GIS software, to conduct in-depth research on major historical issues such as the imperial examination system, elite networks, and regional mobility. Its services are intangible, yet its impact is ubiquitous, truly achieving data "interoperability" and "reusability."

1.3.2.2 Insights and Limitations

CBDB' s success demonstrates the construction philosophy that "data quality is superior to numerous functions." It proves that a standardized, completely open database focusing on core entities generates far greater academic energy than a flashy but loosely-structured system. It provides a model for how university libraries can achieve tremendous impact through "single-point breakthroughs" when resources are limited. Its limitation lies in indirect services that are not

user-friendly for those unfamiliar with data analysis tools, and its construction highly depends on long-term, professional academic community collaboration.

1.3.3 Comprehensive Analysis Conclusions

Through comparative analysis of the Peking University Laboratory and Harvard CBDB, we can draw the following core conclusions to provide solid support for this study' s construction model and empowerment path:

1.3.3.1 Dual-Drive Construction Models

Panoramic data system construction features two feasible models: "platform-centric" and "data-centric." The former emphasizes integration and immediate services, while the latter focuses on depth and open empowerment. University libraries can choose or blend these models based on their own resources, technical capabilities, and service objectives.

1.3.3.2 Diversified Empowerment Paths

Empowerment paths are by no means singular. The Peking University model represents "direct empowerment" by providing integrated platforms that lower usage barriers, while the CBDB model represents "indirect empowerment" by providing high-quality foundational data that stimulates the innovative vitality of global scholars. Both respectively suit different goals of embedding internal teaching and research versus expanding external academic influence.

1.3.3.3 Common Cornerstone of Sustainability

Regardless of the model, continuous data governance, clear property rights definition, and stable community maintenance are indispensable foundations for success. CBDB' s decades of accumulation and the Peking University Laboratory's continuous investment both confirm that such projects are "long-termism" endeavors rather than short-term initiatives.

In summary, these two cases validate the feasibility and diversity of moving from "resource repository" to "smart service" from different perspectives. They jointly indicate that the success of university libraries' panoramic data systems for Chinese excellent traditional culture hinges on finding precise academic entry points and, through high-quality data organization and an open service mindset, providing an indispensable "digital infrastructure" for humanities research.

2 The Evolution of University Libraries' Role: From "Resource Repository" to "Smart Services"

2.1 Traditional Role: Limitations of the "Resource Repository" Model

Centered on physical carriers with emphasis on collection over utilization; digital resources exist in "silo" states lacking correlation; services are passive, limited to consultation and circulation, with insufficient deep knowledge mining.

2.2 Transformation Drivers: Triple Impetus from Technology, Demand, and Policy

Digital technologies have eliminated boundaries between resource storage and utilization; university faculty, students, and the public increasingly demand immersive, interactive, and knowledge-based cultural services; national policies guide libraries to become important platforms for cultural inheritance and innovation.

2.3 New Positioning: Core Connotation of "Smart Services"

Datafication: Transforming resources into structured data that is computable and analyzable; **Contextualization:** Embedding services into specific scenarios of teaching, research, learning, and cultural experience; **Intelligentization:** Utilizing AI technologies to provide value-added services such as personalized recommendations, knowledge Q&A, and deep analysis; **Openness:** Adhering to FAIR principles (Findable, Accessible, Interoperable, Reusable) to promote data sharing and reuse.

3 The Connotation and Construction Model of the Panoramic Data System for Chinese Excellent Traditional Culture

3.1 Core Connotation of the "Panoramic Data System"

The "panoramic data system"is not a simple application of single technology but a modern data governance and service paradigm guided by systematic thinking, aiming to comprehensively, multidimensionally, and deeply reveal and integrate Chinese excellent traditional culture resources. Its core lies in breaking the isolated and static limitations of traditional resource repositories and, through digital technology empowerment, constructing an organic ecosystem with complete elements, tight associations, full lifecycle coverage, and rich experiences.

3.1.1 Full Elements: Deep Integration of Multimodal Resources The primary characteristic of the panoramic data system is the comprehensiveness of resource types. It transcends traditional text digitization to incorporate various

cultural carriers, forming a multimodal resource complex. This includes textual resources such as ancient books, local gazetteers, and archives; image resources like calligraphy, paintings, murals, and rubbings; audio resources including operas, folk songs, and oral histories; video resources of traditional crafts and ceremonial activities; and 3D model resources of bronze vessels, ceramics, and ancient architecture. Multimodal fusion forms the foundation for high-fidelity preservation and creative representation of cultural heritage, providing a data cornerstone for subsequent deep knowledge discovery and experiential innovation [12].

3.1.2 Full Association: Deep Construction of Knowledge Networks
"Full association" refers to utilizing modern information technology, particularly knowledge graph technology, to deeply reveal and formally express complex semantic relationships within and between cultural resources. It aims to connect originally isolated resource nodes (such as persons, events, locations, time, works, and concepts) into a semantically rich knowledge network. By defining and instantiating relational predicates such as "taught by,""occurred at,""created at," "influenced," and "inscribed," it can explicitly present spatiotemporal, social, causal, and influence associations among cultural elements, thereby supporting semantic-based intelligent retrieval, knowledge reasoning, and associative discovery [13].

3.1.3 Full Lifecycle: End-to-End Management of Data Life Cycles
The panoramic data system concerns the entire process from data "birth" to "utilization," covering the complete lifecycle of resource digital acquisition, metadata description, knowledge organization, standardized management, long-term preservation, and innovative services. This means system construction includes not only front-end digital processing but also emphasizes mid-end standard formulation, quality control, data governance and fusion, as well as back-end data persistent storage and sustainable utilization mechanisms. Full lifecycle management ensures the standardization, availability, interoperability, and long-term value of data resources [14].

3.1.4 Full Experience: Seamless Interaction for Multi-Level Users
"Full experience" emphasizes user-centricity, relying on the panoramic data system to provide differentiated and immersive cultural experiences for diverse user groups ranging from professional researchers to the general public. For scholars, it can provide precise data retrieval, associative analysis, and visualization tools for in-depth research. For the general public, it can offer immersive popular science, interactive exhibitions, and online experiences based on augmented reality (AR), virtual reality (VR), and gamified narratives, achieving popularized and entertaining dissemination of cultural knowledge and empowering social education and cultural inheritance [15].

3.2 Construction Model: Four-Layer Collaborative Model

Based on the above connotation, this study proposes a four-layer collaborative construction model comprising the resource layer, data layer, platform layer, and service layer. This model progresses layer by layer, mutually supporting each other to constitute the implementation path of the panoramic data system.

3.2.1 Resource Layer (Foundation) [16] Content Sources: Endogenous resources: Core collections of university libraries themselves, such as rare ancient books, stone rubbings, local gazetteers, Republican-era publications, and characteristic archives. **Cooperative resources:** Artifact information, archaeological data, and intangible cultural heritage project materials integrated through cooperation with museums, archives, and cultural research institutes. **Network resources:** Using web crawler technologies to selectively collect publicly available digital resources, folk art materials, and relevant research findings scattered across the internet, with copyright screening and standardization processing.

Key Technologies: High-precision scanning and non-linear reproduction technologies for non-contact digitization of precious documents; 3D laser scanning and photogrammetry for 3D modeling of artifacts and ancient architecture; OCR (Optical Character Recognition) and HTR (Handwritten Text Recognition) for converting image text into computable structured text; and audio-video digitization and restoration technologies for digital rescue and noise enhancement of old records, tapes, and films.

3.2.2 Data Layer (Core) [17] Data Processing: Metadata standard formulation: Following and extending international universal standards (such as Dublin Core, DC), domestic universal standards (such as the "Chinese Metadata Scheme"), and domain standards (such as the CADAL project' s metadata specifications) to design metadata schemes suitable for multimodal traditional culture resources. **Information extraction:** Utilizing natural language processing (NLP) technologies, particularly named entity recognition (NER), relation extraction (RE), and event extraction (EE), to automatically extract key knowledge units such as persons, place names, official positions, events, and works from textual resources. **Data cleaning and standardization:** Establishing authority control files (such as name authority files and place name authority files) to clean, normalize, and associate extracted heterogeneous data, ensuring data consistency.

Knowledge Organization: Ontology construction: Building a "Chinese Excellent Traditional Culture Ontology" that defines core concepts (such as "Person,""Work,""Event,""Location,""Concept") and their semantic relationships (such as "isCreatedBy,""happenedAt,""isPartOf,""influenced"), providing schema-level constraints for knowledge graphs. **Knowledge graph construction and storage:** Instantiating processed data into the ontology model to form large-scale knowledge graphs, using graph databases (such as Neo4j, Nebula Graph)

for efficient storage and management.

3.2.3 Platform Layer (Support) [18] **Core Functions:** Providing a technical middle platform that integrates massive data storage, high-performance computing, intelligent analysis, and multidimensional visualization to support upper-layer applications.

Key Components: Distributed storage systems (such as HDFS, Ceph) for storing massive unstructured original resources (images, videos, 3D models) and structured data; data middle platforms/computation engines providing data integration, processing, analysis, and API encapsulation capabilities (such as using Spark, Flink for batch and stream computing); unified API interfaces opening data and service capabilities to third-party systems or front-end applications through RESTful APIs; and visualization toolkits integrating or developing diverse visualization tools such as timelines, geographic information systems (GIS), social network analysis (SNA) graphs, and 3D displays to transform data into intuitive visual insights.

3.2.4 Service Layer (Objective) [19] The service layer is the ultimate embodiment of the panoramic data system' s value, aiming to provide precise and efficient smart service interfaces for different user groups.

For Research Users: Knowledge discovery systems providing complex semantic retrieval, associative path discovery, and knowledge reasoning; data analysis tools providing online research tools such as social network analysis, spatiotemporal evolution analysis, and text mining; and data open interfaces providing clean, standardized datasets and APIs for digital humanities researchers to support quantitative analysis.

For Public Users: Immersive experience applications developing VR/AR-based virtual exhibitions, cultural site reconstructions, and interactive games; personalized recommendation services intelligently recommending relevant cultural resources and activities based on user behavior profiles; and creative empowerment platforms providing resource downloads and secondary creation tools to support the development of cultural and creative products (such as digital cultural creations).

For Librarians: Data cockpits providing backend management functions such as data monitoring, resource usage statistics, and service effectiveness evaluation to support scientific decision-making.

4 Research on the Empowerment Path of the Panoramic Data System

The ultimate value of constructing a panoramic data system for Chinese excellent traditional culture (hereinafter referred to as the "panoramic data system") lies in its "empowerment" effect. This chapter systematically elaborates

from four core dimensions—scientific research innovation, education and teaching, cultural dissemination, and public services—on how the panoramic data system fundamentally changes traditional service models and achieves strategic upgrading of university library functions. The overall empowerment logic can be summarized as the evolutionary path of data resourceization, resource knowledgeization, knowledge servitization, and service intelligentization. The overall empowerment path framework of the panoramic data system is shown in "Table 4.1: Data Processing, Knowledge Graph Development, and Application Enablement with Corresponding Goals."

4.1 Table of Data Processing, Knowledge Graph Development, and Application Enablement with Corresponding Goals

Empowerment Application Direction	Data Resourceization (Underlying Data Integration)	Resource Knowledgeization (Middle-Layer Knowledge Construction)	Service Intelligentization (Upper-Layer Application Empowerment)
Key Processes	Aggregation of multi-source heterogeneous data; Data cleaning and standardization; Metadata extraction and normalization	Entity recognition and semantic indexing; Knowledge extraction and association; Construction of domain knowledge graphs	Intelligent retrieval and knowledge discovery (as foundational support for all upper-layer applications); Visualization analysis and contextual computing

Empowerment Application Direction	Data Resourceization (Underlying Data Integration)	Resource Knowledgeization (Middle-Layer Knowledge Construction)	Service Intelligentization (Upper-Layer Application Empowerment)
Empowerment Objectives	Forming trustworthy, usable, and manageable high-quality data assets (as core drivers for all smart services)	Forming semantically interconnected, inferable structured knowledge networks (as core drivers for all smart services)	Empowering scientific research innovation; Driving paradigm revolution in data-driven research; Empowering education and teaching; Creating immersive, interactive smart classrooms; Empowering cultural dissemination; Achieving precise, interactive living transmission; Empowering public society; Promoting equitable, open, and shared cultural resources

Note: This table systematically outlines the complete value realization path from underlying data to top-level empowerment in the panoramic data system for Chinese excellent traditional traditional culture. Its design philosophy draws on the Data-Information-Knowledge-Wisdom (DIKW) model' s application framework in the digital humanities domain [20][21].

4.1.1 Vertical Process Evolution

The table follows the progressive logic of "Data Resourceization → Resource Knowledgeization → Service Intelligentization." This process clearly demonstrates the entire journey from multi-source heterogeneous raw data, through processing and integration into high-quality data assets, then sublimated into

structured knowledge systems through knowledge graph technology, and finally encapsulated as smart services to empower different application scenarios, embodying the core path of library intelligent transformation from basic resources to smart services [22].

4.1.2 Clear Hierarchical Functions

Data resourceization is the foundation, focusing on solving "usability" and "trustworthiness" issues through aggregation and cleaning, forming a reliable cornerstone for subsequent knowledgeization [23]. Resource knowledgeization is the core, with the key being the construction of domain knowledge graphs to achieve semantic association and organization of knowledge, thereby transforming discrete resources into machine-understandable, inferable structured knowledge networks [24]. Service intelligentization is the objective, emphasizing the use of intelligent technologies (such as contextual computing and visualization analysis) to encapsulate knowledge into usable services that directly embed into users' research, learning, and experience scenarios, achieving the transformation from "people seeking knowledge" to "knowledge finding people" [25].

4.1.3 Clear Empowerment Paths

At the "Service Intelligentization" level, the system provides precise empowerment to four key directions through a unified smart service engine. These four paths not only respond to university libraries' core missions of serving teaching and research and inheriting innovative culture but also align with the inherent requirements of the national cultural digitalization strategy regarding promoting inclusive public services and shared cultural achievements [26].

4.2 Empowering Scientific Research Innovation: From "Data Query" to "Paradigm Revolution"

A core empowerment of the panoramic data system lies in promoting the digital transformation of humanities and social sciences research paradigms, shifting from the traditional "close reading" tradition reliant on individual reading and speculation to a new "digital humanities" paradigm combining data-driven "distant reading," quantitative analysis, and visual exploration [27].

4.2.1 Path: Providing Data-Driven Research Paradigms and Infrastructure

The role of university libraries should transform from "data providers" to "constructors and service providers of research infrastructure." Specific paths include: providing digital humanities toolsets by integrating or developing digital tools suitable for traditional culture research on the panoramic data platform, such as text mining tools (for word frequency analysis, sentiment analysis, topic modeling), social network analysis tools (for analyzing interpersonal relationships), and spatiotemporal visualization tools (GIS), providing researchers with

a "methodological toolbox" [28]; and constructing computable knowledge resources by deeply associating and semantically annotating entities such as classics, persons, events, locations, and concepts through knowledge graph technology to form structured, machine-understandable knowledge networks that lay the foundation for discovery-based research on linked data.

4.2.2 Case Demonstrations

Case 1: Discovery of Literati Social Networks Based on Knowledge Graphs
Using the "Tang and Song Literati Knowledge Graph" constructed in the panoramic data system, researchers can query the social networks of core figures like Li Bai and Du Fu. Through social network analysis algorithms, it can automatically calculate and visualize key nodes (social centers) in the network, different literati groups (community discovery), and even identify some "bridge-type" figures not prominently featured in traditional literary history who may have played crucial roles in information transmission between different groups [29].

Case 2: Geographic Imagery Distribution in Classical Poetry Through GIS Analysis
By extracting and geocoding all location-mentioned verses in the "Complete Tang Poems"and mapping them onto GIS maps, researchers can macroscopically analyze the geographic centers of Tang poets' activities, thematic differences in poetry creation across regions (such as frontier poems concentrated in the northwest and pastoral poems in the Central Plains), and the influence of important transportation routes (like the Grand Canal and Silk Road) on literary dissemination. This enables macro, quantitative research in literary geography [30].

4.3 Empowering Education and Teaching: From "Supplementary Materials" to "Immersive Classrooms"

The panoramic data system can transform static knowledge points into interactive, explorable three-dimensional teaching resources, driving the transformation of teaching models from "teacher-centered" knowledge transmission to "student-centered" inquiry-based and experiential learning.

4.3.1 Path: Developing Smart Education Resources Deeply Integrated into Teaching Processes

Thematic Teaching Resource Packages: Around specific teaching themes (such as "Song Dynasty Social Life" or "Silk Road"), relevant digital classics, images, audio-video materials, maps, and research findings are extracted from the panoramic data system and packaged into structured teaching resource bundles for direct classroom use by teachers or for student self-directed learning.

Virtual Simulation "Golden Courses" : Utilizing VR/AR technology to create high-fidelity historical scenes based on authentic historical data. For example, students can "walk into" virtual Han Dynasty Chang' an or Song Dynasty Bianjing to intuitively understand urban layouts, architectural styles, and social customs, achieving "contextualized teaching" [31].

Course-Embedded Services: Librarians collaborate with professional course teachers to incorporate the use of the panoramic data platform and its tools as part of course assignments, directly cultivating students' information literacy and digital humanities research capabilities.

4.3.2 Case Demonstration

Practice in "Ancient Chinese History" and "Tang Poetry Appreciation" Courses: In the "Ancient Chinese History" course, teachers assign tasks requiring students to use historical map base maps and GIS tools provided by the panoramic data platform to collaboratively draw territory change maps, population migration maps, or war route maps for specific historical periods (such as before and after the An Lushan Rebellion in the Tang Dynasty). In the "Tang Poetry Appreciation" course, students can select a poet and use the platform' s trajectory data, chronological poems, and GIS tools to draw their "life trajectory maps" and analyze the relationship between life experiences and poetic style evolution [31].

4.4 Empowering Cultural Dissemination: From "Static Exhibitions" to "Dynamic Experiences"

The panoramic data system is key to breaking the "aloof" image of traditional culture and achieving "circle-breaking"dissemination. Its goal is to transform cultural dissemination from one-way, static indoctrination into two-way, dynamic, and participatory experiences.

4.4.1 Path: Creating Online-Offline Integrated Immersive Cultural Experience Fields

Online Virtual Exhibition Halls: Building never-closing online 3D virtual exhibition halls based on panoramic data. Users can freely roam, click on exhibits to view high-definition details and in-depth interpretations, far exceeding the space and content limitations of physical exhibitions.

AR/VR Interactive Experiences: Developing AR applications based on mobile devices where users scanning specific images or scenes can see artifact reconstructions or historical scene overlays on screens. VR experiences can allow users to "travel"into the street markets of "Along the River During the Qingming Festival," "interacting" with people in the painting to deeply experience Song Dynasty urban life.

Social Media Light Applications: Developing fun, easily shareable lightweight applications such as "AI Ancient Poetry Matching," "Famous Painting DIY Puzzles," and "Traditional Costume Dress-up H5" to achieve fun-based and social dissemination of culture in ways that resonate with younger audiences [32].

4.4.2 Objectives

To make artifacts and classics "come alive," attract Generation Z audiences, and enhance cultural identity and pride.

4.5 Empowering Public Society: From "In-Library Services" to "Open Sharing"

As important components of the public cultural service system, university libraries have the responsibility to open precious cultural data resources to society and stimulate innovation vitality across society.

4.5.1 Path: Building Open Data Platforms and Constructing Innovation Ecosystems

Open Data Policies: Formulating clear hierarchical data opening strategies to maximize the opening of non-confidential metadata and some raw data to the public, primary and secondary schools, cultural and creative enterprises, and research institutions under the premise of protecting intellectual property rights and privacy.

Providing API Interfaces: Offering standardized application programming interfaces that allow third-party developers to call data and develop diverse applications such as educational apps, cultural and creative products, and data analysis tools. This achieves the transformation from "the public uses what libraries provide" to "the public creates what they need using data."

Hosting Data Innovation Competitions: Attracting talents from all sectors of society to use open data to solve practical problems or create cultural products through hosting "cultural data hackathons" or innovation competitions, forming an innovation ecosystem around traditional culture data.

The European Union' s "European Data Portal" and China' s National Center for Philosophy and Social Sciences Documentation provide reference examples for data opening and sharing, emphasizing the value of open data in promoting innovation and economic growth [33].

This chapter systematically discusses the empowerment paths of the panoramic data system across four dimensions. Its essence lies in breaking spatiotemporal and media limitations through the fusion of data and technology, transforming traditional cultural resources into computable, experiential, and re-creative intelligent capital, and ultimately driving university libraries to evolve from

guardians of resource repositories into smart service hubs that activate cultural vitality.

5.1 Main Challenges

Standards and Interoperability Challenges: Inconsistent metadata standards lead to data integration difficulties. **Copyright and Ethics Challenges:** Issues concerning copyrights of ancient book digitalization and personal privacy (such as historical figure data). **Technology and Talent Challenges:** Requires interdisciplinary talents proficient in both library science and IT, with high technical thresholds. **Sustainability Challenges:** High initial project investment, with continuous funding and human resources needed for later maintenance and updates.

5.2 Countermeasures

Strengthen top-level design by participating in or formulating industry-wide unified standards; establish reasonable copyright risk avoidance mechanisms and ethics review systems; enhance librarian training, introduce external technical teams, and conduct interdisciplinary projects; secure special school funding support and explore project result transformation and sustainable operation models.

6 Conclusion and Future Prospects

This section summarizes the full text, reiterating that constructing a panoramic data system for Chinese excellent traditional culture is key to university libraries' transformation from "resource repositories" to "smart services," and outlines the effectiveness and innovation of the proposed "four-layer collaborative" construction model and "four-in-one" empowerment path.

6.2.1 Deepening Technology Integration

AIGC (AI-Generated Content) for automatic indexing, content summarization, intelligent Q&A, and even creation, significantly improving efficiency.

6.2.2 Metaverse Applications

Libraries may construct a "Chinese Culture Metaverse,"providing unprecedented immersive interactions.

6.2.3 Ecosystem Co-construction

Moving from single-library construction to nationwide library consortium co-construction and sharing, forming a genuine node of the "National Cultural Big Data System."

7 Conclusion

This study systematically explores how university libraries can move from traditional "resource repositories" to innovative "smart services," constructing models and paths for a panoramic data system for Chinese excellent traditional culture. The article' s proposed "resource-data-platform-service" four-layer collaborative construction model and multi-dimensional empowerment paths oriented toward research, teaching, dissemination, and the public provide a clear theoretical framework and practical guide for this transformation.

The research confirms that the core of constructing a panoramic data system lies in achieving the sublimation from "digital resources" to "smart data." Its value does not stop at technical implementation but, more importantly, lies in the profound reshaping of humanities research paradigms, education and teaching models, and cultural dissemination forms. Through knowledge graphs, intelligent technologies, and open collaboration, dormant collection resources are activated and transformed into intelligent sources driving academic innovation and cultural inheritance.

Looking forward, with the deep integration of generative AI, metaverse, and other technologies, the connotation and extension of panoramic data systems will continue to expand. University libraries should seize opportunities, actively explore smarter and more immersive service frontiers while consolidating data foundations, and ultimately become core drivers leading the creative transformation and innovative development of Chinese excellent traditional culture in the digital age.

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