From Digital Collections to a Smart Ecosystem: An Analysis of and Insights from Australian Smart Data Projects from the Perspective of Libraries, Archives, and Museums*

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Full Text

【Overseas ·Perspectives】

From Digital Collections to a Smart Ecosystem: An Analysis of and Insights from Australian Smart Data Projects from the Perspective of Libraries, Archives, and Museums*

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Abstract This article focuses on Australian smart data projects from the perspective of libraries, archives, and museums. By comprehensively employing online surveys, literature analysis, and e-mail interviews, it systematically collects relevant materials, conducts a comprehensive review and in-depth analysis of representative cases at various stages of development, and distills four project characteristics: clear strategic positioning and significant policy-driven effectiveness; participation by diverse actors and a high degree of resource sharing; emphasis on cultural heritage protection and the highlighting of public value; and adherence to user-demand orientation with continuous optimization of the service experience. On this basis, and in light of China' s actual conditions, targeted development implications are proposed, with a view to providing reference and lessons for the construction of smart data in China.

[**Keywords**] smart data project; libraries, archives, and museums; digital collections; Australia

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Introduction

In May 2025, the General Office of the National Data Administration issued the *Action Plan for Digital China Construction 2025*, which clearly states that, with the market-oriented allocation reform of data elements as the main line, digital transformation will be driven from multiple aspects—including cultivating a nationally integrated data market, developing the digital economy, and advancing citywide digital transformation—so as to comprehensively improve the level of Digital China construction. Driven by cutting-edge technologies such as the Internet of Things, blockchain, and artificial intelligence, the value of smart data has become increasingly prominent. Especially in the field of libraries, archives, and museums (Libraries, Archives and Museums, LAM), smart data can not only effectively address such problems as the heavy pressure of preserving traditional cultural resources, limited dissemination scope, and inefficient matching of supply and demand, but can also further promote the transformation of cultural resources from traditional offline models toward digitalization and intelligentization.

In recent years, research related to smart data has shown an active trend. Internationally, Iafrate F[2] was among the first to propose the meaning of smart data from the perspective of business intelligence; Lenk A et al.[3] believe that smart data describes the process by which data is transformed from unstructured forms into intelligent, standardized, and knowledge-based forms; Duong T H et al.[4] regard smart data as an organizational approach that performs semantic compilation, operational processing, association, and analysis of data resources from different sources. In addition, the convening of conferences such as the International Semantic Web Conference (ISWC) and the European Semantic Web Conference (ESWC) has further highlighted the research value and international attention accorded to smart data.

In China, smart data has become a research hotspot in fields such as digital humanities and cultural heritage[5]. The academic community has carried out multifaceted explorations around its theoretical construction and practical application. For example, Wang Xuezhao et al.[6] proposed the concept of intelligence smart data; Chen Qing et al.[7] constructed a library digital-intelligence service platform integrating smart data; and Ye Zimeng et al.[8] reviewed research and applications related to smart data. Although smart data has already been reflected in multiple aspects of digital practice—such as the construction of knowledge bases for ancient books, corpus construction, knowledge representation of special ancient-book texts, and optimization of pre-trained models in text mining[9]—there remains broad room for improvement and promising prospects for development in this field in China. From an international perspective, Australia,

as one of the Western countries with a relatively mature digital economy, offers development pathways and practical experience in smart data projects that can provide valuable reference for China. However, at present, relevant research by Chinese scholars on Australian smart data projects remains relatively scarce. It is therefore necessary to analyze the development of Australian smart data projects, in order to make up for the shortcomings of existing research and provide an international perspective and innovative ideas for the planning of China' s smart data strategy.

1 Concepts of Smart Data and Overview of the Survey

1.1 Concept of Smart Data

Regarding the definition of the concept of smart data, scholars in China and abroad have formed diverse definitions based on different perspectives. Iafrate F[2] believes that smart data is

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Business intelligence is an extension of business intelligence, and is also the process of transforming raw, low-quality data into data forms usable for data mining or knowledge extraction[10]. Zeng Lei et al.[11] introduced the concept of smart data, regarding it as a method for realizing the last "V" of big-data characteristics—value. Wang Zhihong et al.[12] proposed that smart data is centered on specific problems or tasks: it identifies and separates key data subsets from big data, and, through standardized governance and processing, helps humans or machines form valuable capabilities for insight, judgment, and prediction when solving problems and making decisions. Under China' s strategy for market-based allocation of data elements, there is a certain connection between high-quality datasets and smart data. High-quality datasets emphasize data standardization, completeness, and compliance, among other aspects, and serve as the basic guarantee for enabling data elements to realize value; smart

data, by contrast, is a higher-order data form produced through processing—understandable, linkable, and interactive—and can fully release the deeper value of high-quality data. A synthesis of existing research shows that the core connotation of smart data includes three features: it is a high-value data element that can be efficiently processed by artificial intelligence and can support intelligent applications; it is a key method for realizing the value of big data, and also an important achievement through which humans intelligently process big data so as to better bring its functions into play; it possesses dynamic characteristics of qualitative evaluation, evolutionary development, and polymorphic composition. This paper analyzes smart data from three perspectives—value, structure, and process—emphasizing the hierarchical progression of data value, focusing on top-level refined design of data frameworks and models, and creating new value through step-by-step top-down refinement[13]. Among these, the three-level evolutionary view of "digitization—datafication—intelligentization" from the process perspective is widely recognized at the present stage (see Table 1). Based on this three-level evolutionary view from the process perspective, this paper classifies Australian smart-data projects. Specifically in the LAM field, the distinctiveness of its smart data is mainly reflected in three aspects: first, its core resources concentrate on various forms of cultural heritage, such as literature, archives, and cultural relics; second, its core mission is knowledge dissemination and public cultural services, performing cultural communication and educational functions for the public; third, its development orientation emphasizes resource preservation, open knowledge sharing, and cultural inheritance, rather than taking economic returns as the primary objective.

Table 1 Relationship of the "Three-Level Evolution" of Smart Data

Evolutionary stage	Core objective	Output value	Stage positioning
Digitization	Mapping the real world into the digital realm, enabling computability	Structured raw data assets	Underlying foundation
Datafication	Mining the connotations of data, achieving semanticization/visualization	Understandable and linkable information resources	Value transformation
Intelligentization	Deep mining and interaction, releasing the intelligent value of data	Cognizable and interactive knowledge services	Advanced application

1.2 Survey Methods

This paper conducts a survey on the development status of smart-data projects in Australia. Relevant literature was retrieved through the Web of Science database, and relevant information was also obtained through online investigation. First, the official websites of Australian national institutions were selected as the research entry point: the National Library of Australia is the core hub for domestic documentary resources and an important leading body in digital construction in the LAM field; the National Archives of Australia is the country' s largest government archive, with the core mission of systematically preserving government records of historical and administrative value; the Australian Museum is both the country' s oldest public museum and a leading natural-history specialist museum in Australia, and, with its rich collections and academic influence, ranks among the world' s top ten museums. Second, the survey objects were extended to universities and research institutes, including the Australian Research Data Commons (ARDC), formed in 2018 through the merger of the Australian National Data Service (ANDS), the National eResearch Collaboration Tools and Resources (Nectar), and Research Data Services (RDS), as well as "The Group of Eight" (Go8), which represents the highest level of Australian universities. Finally, this paper comprehensively collected smart-data projects from the official website of the Australasian Association for Digital Humanities (AADH) and the Sketchfab platform. The projects established and participated in by the above institutions have enriched research on Australian smart-data projects; they not only strengthen the research system in this field, but also provide key support for enabling smart-data resources to serve social development efficiently.

1.3 Overall Overview of Australian Smart-Data Projects

Australia has built a solid support system from two major dimensions: policy guidance and infrastructure construction. At the policy level, the introduction of a series of relevant policies has laid a solid institutional foundation for the development of smart-data projects; at the level of infrastructure construction, Australia emphasizes underlying technical support and full-coverage capability. Institutional innovation and technological investment have formed a strong synergy, promoting the construction of a smart-data ecosystem with broader coverage dimensions and providing a solid guarantee from the ground up for the deep application of data elements in diverse scenarios.

1.3.1 Policy Leadership and Strategic Layout The Australian government attaches great importance to the construction of smart-data projects, viewing them as a key driving force for enhancing national competitiveness and improving social well-being. In the policy domain, Australia has continued to advance digitalization and data-strategy deployment, creating a favorable policy environment for smart-data projects. In 2011, the National Archives of Australia issued the *Digital Transition Policy*, explicitly requiring all government

agencies to implement digital information and records management in order to improve efficiency. This means that most Australian government records will be created, stored, and managed in digital form, a move that has advanced Australian government records management into a new era of digitalization[14]. In 2023, the Australian government issued the *Data and Digital Government Strategy*, which states that world-class data and digital capabilities should be relied upon to provide the public

providing simple, secure, and interoperable public services[15]. In 2025, the National Library of Australia released *Treasures: National Library of Australia Strategic Vision 2025–2033*, which proposed enhancing the accessibility of collection resources through emerging technologies and set out the development path and implementation direction for national-level library smart-data projects[16]. A series of strategies and special policies have subsequently been introduced, providing solid institutional safeguards for the steady advancement of smart-data projects.

1.3.2 Infrastructure Development and Technological Innovation

At the level of infrastructure development, Australia has, on the basis of forward-looking strategic planning, built a solid foundation to support the development of smart-data projects. Among these, the National Computational Infrastructure (NCI) serves as the core computing-power support platform. Equipped with Australia' s leading supercomputers and high-capacity data-storage systems, it can provide comprehensive data management, infrastructure, and services, meeting the country' s needs for high-performance computing, massive data storage, and specialized data processing. At the same time, Australia' s LAM sector has continued to deepen its digital transformation, promoting the interconnection, interoperability, openness, and sharing of cultural-heritage data, and providing rich, high-quality cultural data resources for smart-data projects.

At the level of technological innovation, Australia' s Internet networks and mobile communications technologies have matured, and the deployment of 5G networks has accelerated. High-speed, stable 5G networks not only bring smooth experiences to digital services such as high-definition video and virtual reality, but also lay the foundation for the real-time transmission and immediate application of data in smart-data projects. In addition, Australia has numerous data centers and cloud-computing service providers with relatively high levels of security and reliability, which can supply data storage, management, and computing resources for smart-data projects and effectively ensure secure storage and stable operation. Likewise, the LAM field has actively used cloud infrastructure to deploy specialized digital-asset management systems, ensuring the long-term secure preservation of precious documents, cultural relics, and archival digital copies, and providing resource momentum for smart applications and innovative research.

2 Practice and Feature Analysis of Australian Smart-Data Projects

2.1 Analysis of Project Content

Viewed through the three-stage evolutionary logic of digitization, datafication, and intelligentization in smart-data projects, digitization and datafication projects constitute an important foundation for the development of intelligentization projects. Specifically, the digitization stage provides computable underlying data resources for intelligent applications; the datafication stage realizes the mining of data connotations and the transformation of value; and the three stages progress layer by layer, jointly forming the full life cycle of smart-data projects. This paper systematically reviews practical cases and research outcomes of Australian smart-data projects, combines them with major developments in relevant sectors, and, using key projects with national demonstration value as pivotal nodes, constructs an overall analytical framework for Australian smart-data projects. At the same time, it conducts analysis along the three major development dimensions of digitization, datafication, and intelligentization, selecting a group of projects that can reflect the level of Australia' s smart-data infrastructure development for discussion, in order to present a comprehensive picture of the development of Australian smart-data projects.

2.1.1 Digitization Projects Digitization is the data foundation of smart data. Its core objective is to promote the transformation of data into computable formats, so as to facilitate data use and storage and provide strong support for subsequent data analysis, mining, and intelligent applications. Key technologies in the digitization stage of smart data include data-management technologies and data-security technologies. Through an in-depth analysis of Australian smart-data digitization projects, they can be further classified into two major categories: data collection and data storage.

(1) Data collection projects. The core function of the data collection stage is to obtain raw data from reality through various technical means and convert it into signals or formats that can be recorded and transmitted. The collection link is the foundation for subsequent data-processing work; its planning, design, and technology selection directly affect the completeness, timeliness, and accuracy of data. The continuous development of technologies such as edge computing and low-power wide-area networks has driven collection toward greater intelligence and security, providing high-quality raw-data support for smart data. In terms of technical classification, data-collection methods are rich and diverse, covering web crawlers, sensor technologies, blockchain technologies, and others. For example, the National Library of Australia' s Preserving and Accessing Networked Documentary Resources of Australia project (PANDORA)[17], launched in 1996, is dedicated to systematically collecting and permanently preserving Australia' s online documentary resources. Using its self-developed PANDAS digital

archiving system, the project combines web-crawler technology to realize automated capture of web content, while also adopting a manual selection mechanism to ensure the academic value and cultural significance of the collected resources. PANDORA became one of the world' s first national-library projects to carry out web archiving, and it plays an important role that cannot be overlooked in the long-term preservation of online digital resources.

(2) Data storage projects. Data storage projects, in accordance with unified data standards and specifications, systematically organize and structurally integrate complex and disordered raw data, providing a stable and reliable storage environment for massive data and high-quality, efficient data support for subsequent data analysis, value mining, and intelligent applications. The Dutch–Australian Shared History Project[18] organized and stored records of Dutch migrants, providing precious historical materials for research on the history of Australia and the Netherlands after the Second World War and greatly enriching the two countries' socio-cultural understanding during a special historical period. The "Freeze Frame Digitisation: Preserving an Antarctic Photography Collection for Future Generations" project[19] focuses on the recording of Antarctic photographic images; staff of the National Archives of Australia completed the compilation of record lists and the digitization of collections. Through this platform, the public can conveniently access a series of Antarctic exploration records from earlier to later periods, allowing long-sealed polar memories to regain vitality in digital form. The State Library of New South Wales' digitization strategy project[20], meanwhile, has advanced the development and preservation of digital resources on a relatively large scale. Digitally storing these precious materials can effectively avoid the risks of data loss and damage, while also improving the convenience of data retrieval and opening a gateway for researchers worldwide to understand Australia.

a new window onto history and culture.

2.1.2 Datafication Projects

The core mission of datafication is to deeply uncover the intelligible meaning behind data, and it can be divided into two major directions: semanticization and visualization. Datafication projects enhance the depth of human cognition of data and provide a structured, interpretable, high-quality data foundation for intelligent applications such as artificial intelligence and intelligent decision-making. Datafication is not simply data collection; rather, through multi-level processing, it upgrades data from disorder to order, ultimately endowing it with the capacity to drive intelligent applications. This stage involves knowledge-discovery technologies, visualization technologies, and semantic technologies. Through a systematic analysis of the collected datafication projects, they can be further classified into semanticization projects, assetization projects,

and visualization projects.

(1) Semanticization projects. Semanticization is the foundation for making data understandable and interoperable. By clarifying the meanings, relationships, and rules of data, it eliminates data ambiguity, covering technologies or application scenarios such as the Semantic Web, ontologies, linked data, semantic tags, and structured data modeling. Trove, Australia' s largest digital-resource aggregation platform, integrates diverse cultural-heritage data, including books, newspapers, images, and archives, and connects the digital collections of hundreds of Australian partner institutions. The efficient aggregation of such vast and complex data is inseparable from the support of semantic technologies. Through such technologies, data from different sources and in different formats can break out of isolation and achieve cross-domain data interoperability, thereby enabling unified management and presentation and providing users with a one-stop resource-access service. For example, the Smart Archiving Metadata Project[21], by realizing "one-time creation and multiple reuse"of metadata and semantic-level interconnection across systems, breaks down data silos and gives metadata machine-understandable associative attributes. The project not only verifies the feasibility and commercial value of semantic interoperability for metadata, but also provides a practical semantic-level solution for addressing the difficulty of implementing metadata standards in the archival field and adapting them to the digital-technology environment.

(2) Assetization projects. The essence of assetization projects is to transform raw or preliminarily processed data into strategic assets that can be effectively used by organizations and can create economic or business value through standardization, rights confirmation, management, and value mining. For example, the National Archives of Australia' s *Strategy 2030: Transforming and Trusted National Archives*[22] centers on the construction of digital collections, the mining of digital-asset value, and commercial development, promoting the transformation of archival materials into reusable and open digital assets. At the same time, it is supported by four major systems—infrastructure, laws and regulations, collaborative cooperation, and professional talent—to provide user-centered digital services aligned with future development trends. The Open Digitisation Partnership Program initiated by the State Library of New South Wales[23] joins with external partners to convert collections that have not yet been digitized into digital assets, thereby reducing value loss. The project makes clear that digitization does not create new copyright and strictly implements compliant rights confirmation. On the one hand, it opens digital collections to realize social value; on the other, it allows partners to recover investment and explore commercialization, thereby releasing economic value.

Overall, the two projects systematically interpret the core logic of data asse-

tization, from governance frameworks to technical pathways and from value preservation to value release, providing a referential practical paradigm for the transformation and value reshaping of public cultural institutions in the digital era.

(3) Visualization projects. Visualization projects are both a deep extension of semanticization and assetization and a key vehicle for realizing the value of both. Against the backdrop of the market-oriented development of data elements, visualization technology has shifted from being a basic tool application to an important supporting force, becoming a core engine for promoting the realization of data value. The "Kimberley Wilderness: Virtual Reality Experience" project[24] is a typical practice in the application of visualization technology. Through virtual-reality technology, the project transforms remote and abstract resources such as the geographical landscapes of the Kimberley wilderness into intuitive, perceptible, three-dimensional immersive visual scenes. This not only helps the public understand their historical, geological, and cultural connotations, but also deepens public emotional identification and cognitive impressions.

2.1.3 Intelligentization Projects

Intelligentization projects represent an advanced stage in the development of smart data, using frontier technologies such as artificial intelligence, machine learning, and deep learning to conduct in-depth analysis and mining of massive datasets. Projects at this stage have conversational characteristics and focus on the presentation of dynamic intelligence. Data at the intelligentization stage are interactive and can fully release application value, providing strong support for intelligent development across various fields. Through analysis of the collected project content, intelligentization projects can be divided into cognitive intelligentization projects and interactive intelligentization projects.

(1) Cognitive intelligentization projects. The implementation of cognitive intelligentization projects benefits from the coordination of multiple technologies, including text understanding and processing, image/speech interpretation, and knowledge integration and generation. Their essence lies in understanding, analyzing, and interpreting complex information, rather than merely completing mechanical data computation. This core capability has been fully reflected in the strategic planning and practice of Australia' s LAM sector. In 2024, the *2024-2027 Digital Strategy* released by the National Library of Australia[25] clearly highlighted the core value of cognitive intelligentization. The strategy explicitly identifies artificial intelligence and machine learning as core cognitive technologies driving knowledge transformation: on the one hand, it focuses on advancing enhanced handwritten text recognition technology to expand the transcription scope of digitized content; on the other hand, it simultaneously upgrades the intelligent search capabilities of fully digital collections and catalogues, thereby activating the knowledge value of massive digital

resources. In addition, the *Digital Strategy 2025-2029* released by the State Library of Queensland[26] also incorporates artificial intelligence and machine learning into its core cognitive-technology system, planning to use these technologies to enhance collection access and service experience. The release of the two major strategies jointly confirms the key position of cognitive intelligentization projects in the digital upgrading of culture. Their core objective is precisely to break down knowledge barriers and transform originally static cultural resources into accessible and understandable knowledge carriers. A project released by the National Library of Australia on the application of handwritten text recognition technology on the Trove platform[27] is precisely a cognitive intelligentization

typical practice of such projects. Through handwritten text recognition technology, this project transforms originally static, non-searchable handwritten documents into searchable and editable structured text, enabling users to quickly locate the core information of documents by means of keywords.

(2) Interactive intelligent projects. Interactive intelligence refers to the use of technological means to achieve more efficient interaction between people and systems, devices, or environments. Its core lies in making the interaction process better suited to human needs and habits, and, through the system' s active perception, understanding, and response to user intent, realizing interaction that is more intelligent, natural, and efficient. For example, the State Library of Queensland' s "Virtual Veterans" project[1] relies on an artificial-intelligence chatbot ("Charlie") to build immersive historical interaction scenarios. Users can not only engage in immersive conversations with virtual veterans and obtain first-hand accounts of historical events, but can also directly access original letters and diaries in the library' s collections as well as related official historical materials from the Australian War Memorial. In addition, the research assistant tool newly added to the State Library of Queensland' s One Search platform[2] likewise demonstrates the advantages of intelligentization. This tool integrates generative artificial-intelligence technology, allowing users to ask questions in natural language. These practices have improved the accessibility of cultural resources and optimized data quality through user feedback, embodying an intelligent development path characterized by technological empowerment and user co-creation.

From the perspective of its core logic, intelligentization is not an isolated technological application; rather, it is based on the achievements of the digitization and datafication stages. By means of cutting-edge technologies such as artificial intelligence and machine learning, it conducts in-depth mining of massive data and ultimately transforms originally unitary information carriers into resources with interactive capabilities that can effectively release value, thereby providing support for intelligent development across various fields. These projects have not

[1] 28
[2] 29

only clarified the direction for technological implementation through the strategic planning of national- and state-level libraries, but have also demonstrated through concrete practice the important role of intelligentization in activating the value of cultural resources and improving the experience of public services. They provide a complete and referential path for advancing intelligent data in the cultural field, and also offer experience and ideas of reference value for China in carrying out related research and practical work on intelligent data.

2.2 Analysis of the Characteristics of Australian Intelligent Data Projects

2.2.1 Clear strategic positioning and significant policy-driven effectiveness

Australia has incorporated intelligent data projects into the overall framework of national digital development, providing coordinated guidance through a series of policy documents that are clearly tiered and progressively advanced. The 2011 *Digital Transformation Policy for Government* established the "digital first" principle for government documents, laying a solid foundation of structured raw data for intelligent data construction; the 2023 *Data and Digital Government Strategy* further promoted the integration of data into public-service scenarios, implemented "digital-first design," and enhanced the practical effectiveness of intelligent services; and the 2025 *Treasures: National Library of Australia Strategic Vision 2025–2033*, grounded in the cultural field, anchored the development direction of intelligent data and delineated implementation pathways for libraries and other cultural institutions. From the early emphasis on digitization to consolidate the foundation, to the gradual deepening of efforts to promote data circulation and release value, this series of progressive policies has established a complete institutional system, ensuring the sustainability of project development. This top-down, high-level design has enabled various types of projects to be highly aligned with national macro-level development goals, forming a virtuous development loop in which policy guides practice and practice feeds back into policy. It provides an extremely valuable reference paradigm for China in coordinating and advancing intelligent data–related projects.

2.2.2 Participation by multiple stakeholders and a high degree of resource sharing

Australia' s intelligent data projects are led by national hub platforms and actively connect the country' s libraries, archives, and museums, while extensively bringing together the strengths of universities, research institutions, and international cooperation. They have broken through institutional barriers and established a collaborative development model featuring multi-stakeholder cooperation and the co-construction and sharing of resources. Represented by Trove, the national digital-resource aggregation platform integrates the digital collections of hundreds of cultural institutions through unified interfaces, en-

abling "one-stop" cross-institutional resource discovery and access. The Smart Archiving Metadata project, meanwhile, has verified the practical value of "create metadata once, reuse it many times." This project adopts internationally used metadata standards and Semantic Web technologies, promoting automatic semantic association among archival and collection data from different institutions. Relying on this model, researchers can obtain multi-source data on the same historical event across databases in a one-stop manner, and the public can also conveniently access diverse cultural resources preserved by different institutions. This provides an important reference for the construction of intelligent data in China' s LAM field.

2.2.3 Emphasis on cultural heritage protection and the highlighting of public value

Australia' s intelligent data projects are deeply rooted in the nation' s historical memory and have consistently taken the preservation of cultural heritage and the release of public value as their core objectives. With the help of digitization, semanticization, and intelligent technologies, these projects carry out systematic rescue, preservation, activation, and utilization of endangered, scattered, and precious cultural heritage. Whether it is the National Library of Australia' s PANDORA project for the permanent archiving of web documentary resources, or the National Archives' digital preservation of precious historical materials such as Antarctic exploration images and immigration records, all are intended to prevent historical resources from being lost. More importantly, these projects have effectively promoted the inclusive sharing of knowledge. Platforms such as Trove are open free of charge to scholars worldwide, breaking down barriers of time, space, and identity; immersive applications such as the use of virtual reality to recreate the Kimberley wilderness and artificial-intelligence dialogue transform static historical materials into vivid content that can be perceived and interacted with, greatly strengthening the public' s cultural identity and historical awareness. They fully demonstrate the humanistic concern and social value of intelligent data projects beyond the technical level.

2.2.4 Adhering to user needs as the guide and continuously optimizing the service experience

Intelligent data projects have, to a certain extent, changed the mode of interaction between users and cultural-heritage resources, and thus have certain practical significance. An in-depth analysis of the collected materials is sufficient to show the importance that Australian intelligent data projects attach to user orientation and experience optimization. This concept is deeply reflected in all aspects of service design. Taking the interaction layer as an example, such projects generally adopt technologies such as natural language processing and generative artificial intelligence to lower the threshold for users. The State Library of Queensland' s sci-

The research-assistant tool allows users to obtain precise answers and resource

recommendations by asking everyday questions, directly transforming a complex search process into an intuitive conversational experience. This user-centered design not only enhances the accessibility and appeal of public cultural services, but can also continuously feed user feedback and behavioral data back into the optimization of data models and service processes, forming a virtuous cycle in which technology and user experience complement each other in both directions.

3 Implications for Smart Data Projects in China

Australia' s smart data initiatives have been able to form a complete development pathway from top-level design to scenario-based implementation. This has depended on sustained guidance from national policy, the pivotal role of cross-institutional collaboration platforms, and the deep integration of cultural institutions with technological capabilities; these are also the core supports for their steady development. By contrast, China' s smart data initiatives are still at an early stage, and shortcomings remain in such areas as strategic coordination and the activation of cultural heritage. Therefore, drawing on Australia' s practical experience in smart data development, this paper proposes reference ideas and development recommendations from the following aspects.

3.1 Building a Foundation for Cross-Institutional Data Interoperability

Through policy documents such as the *Government Digital Transformation Policy* and the *Data and Digital Government Strategy*, Australia has clarified the development path for smart data, and has used legislation and funding guarantees to support the coordinated construction of data infrastructure. In recent years, China has also attached great importance to the market-oriented development of data elements. The *Opinions on Building a Basic Data System to Better Give Play to the Role of Data Elements*, issued in 2022, clearly proposed improving basic systems such as data property rights, income distribution, and security governance, thereby laying a policy foundation for unleashing the value of data elements[30]; the *Overall Layout Plan for Digital China Construction*, released in 2023, also emphasized opening up the major arteries of digital infrastructure and smoothing the great circulation of data resources[31]. However, compared with Australia's systematic and phased promotion mechanism, China' s strategic focus in the smart data field still needs to be strengthened, and there remains room to improve cross-departmental coordination and resource integration. This is especially evident in the practice of the LAM field, where the three types of institutions differ markedly in smart data development: libraries emphasize inclusive access to knowledge and public services, with relatively high levels of standardization and openness; archives excel at reconstructing processes and maintain rigorous preservation systems; museums emphasize interactive experiences[32]. Their inconsistent standards and inadequate coordination constrain the formation of a smart data ecosystem. To promote the development of smart data projects in China' s LAM field, it is recommended that efforts proceed col-

laboratively at both the institutional and technical levels: first, drawing on the concept of "create once, reuse many times" from the smart archival preservation metadata project, detailed data management rules should be formulated, requiring digitization projects to follow unified semantic standards already at the metadata-creation stage; second, China should actively promote the establishment of smart data standards and interoperability platforms in the LAM field, explore pilot cross-institutional data alliances, address the problem of data silos, and realize semantic interconnection and sharing of cultural-heritage data.

3.2 Strengthening the Digitization of Cultural Heritage and the Orientation toward Public Services

Australian smart data projects attach great importance to the digital preservation and intelligent activation of cultural heritage. They not only provide a solid, high-quality data foundation for smart data applications, but also further enhance the social value of the projects. Projects such as PANDORA and Trove have not only accomplished the systematic rescue of cultural heritage, but have also improved the accessibility and communicative power of public cultural services through open access and immersive experiences. University libraries in China possess abundant cultural resources such as university-history archives and local documents, yet there is still considerable room for improvement in in-depth digital mining, intelligent innovation, and the transformation of these resources into public services. Drawing on Australia' s practical experience, it is recommended that domestic LAM institutions take the following measures: first, introduce handwritten-text recognition technology to intelligently identify and convert collection manuscripts, transforming static documents into searchable structured texts; second, develop immersive experience projects based on their own institutional characteristics; third, refer to the project model of the "State Library Virtual Veterans" project and build artificial-intelligence dialogue systems around figures from institutional history, so as to optimize the user service experience; fourth, encourage coordinated collaboration among the three LAM parties, jointly apply for pilot projects for the intelligent transformation of cultural heritage, and open digitized achievements to the public through online exhibitions, virtual tours, and other forms, thereby fully releasing the effectiveness of public cultural services.

3.3 Improving the Experience and Accessibility of Smart Data Services

Australian smart data projects consistently adhere to a user-oriented approach. Through natural-language interaction, intelligent recommendation, virtual assistants, and other means, they have substantially improved the usability and appeal of services. China has already carried out many fruitful practices, laying a solid foundation for service optimization. For example, Lu Yanqun[33] proposed a retrieval-augmented generation (RAG) intelligent question-answering system that integrates multi-channel retrieval. By deeply integrating multi-source data

to build a dynamic knowledge base and incorporating natural-language interaction functions, it effectively improves the quality of answer generation. When advancing smart data projects, China can further draw on Australian experience on the basis of existing practice: first, university libraries in China can use open-source RAG frameworks to set up intelligent question-answering assistants based on their electronic collection resources, supporting functions such as natural-language questioning and literature recommendation; second, libraries, archives, and other public service institutions should be encouraged to actively conduct user-behavior analysis and experience-feedback research, and to establish service-iteration mechanisms for continuous optimization; third, smart data literacy education and training should be carried out to enhance the public' s ability to understand and apply data. In addition, at the level of technical implementation, particular attention should be paid to barrier-free access design and multi-terminal adaptation, ensuring that the public can enjoy smart data services equally and conveniently, truly expanding the coverage of digital benefits for the people and promoting the construction of an inclusive digital society.

4 Conclusion

This article comprehensively analyzes the development status of Australian smart data projects. Through a categorical examination of these projects, it summarizes the characteristics of Australian smart data projects, including clear strategic positioning, participation by diverse actors, emphasis on cultural-heritage protection, and adherence to user-demand orientation. These provide useful insights for China' s LAM field in participating in smart data development, optimizing the intelligent construction of collections, and improving reader services. China should base itself on the overall layout of Digital China construction, rely on the advantages of rich cultural resources, and clarify smart data

In light of these development directions, efforts should be made to build a foundation for cross-institutional data interoperability, strengthen the orientation toward the digitization of cultural heritage and public services, and improve the experience and accessibility of smart-data services. In this way, China' s smart-data development system can be continuously improved, enabling data factors to fully empower cultural inheritance and the high-quality development of society.

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Governance Statement and Service Embedding:

A Comparative Study of AIGC Function Configuration and Optimization Paths in World-Class University Libraries

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Abstract Based on publicly available information from university library websites, this study systematically examines the configuration structure of AIGC service functions and governance statements. Using the official websites of libraries from the top 50 universities in the 2024 QS World University Rankings as the sample, an evaluation framework comprising eight functional categories was constructed and binary-coded. Data were analyzed using descriptive statistics and Fisher' s exact test. The findings reveal a pattern characterized by "governance statements taking precedence, with insufficient service embedding." The top 10 universities demonstrated a significant lead in technology-empowered functions such as intelligent retrieval and knowledge graphs. However, no significant difference was observed in governance statements between the two groups. Based on these findings, the construction of AIGC systems in university libraries should prioritize compliance governance statements as a fundamental prerequisite, steadily advance scenario-based pilot applications, implement tiered development based on collection resources, and integrate governance guidelines into smart service processes. It is recommended to promote deep integration of AIGC governance systems with library services through interlibrary collaboration and retrieval-augmented generation (RAG) technologies.

Keywords AIGC; University library; Governance statement; Service function; Risk governance

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From Digital Collections to Smart Ecology: Analysis and Implications of Australia' s Smart Data Projects from the Libraries, Archives and Museums Perspective

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Abstract The article focuses on Australia' s Smart Data projects within the Libraries, Archives, and Museums (LAM) domain. It employs a combination of web surveys, literature analysis, and email-based interviews to systematically collect information on these projects. A comprehensive review and in-depth analysis of representative cases from various development stages are conducted. It then identifies four key project characteristics: clear strategic positioning and remarkable policy-driven effectiveness; multi-stakeholder participation and efficient collaborative partnerships; an emphasis on cultural heritage preservation and highlighting public value; and a user-oriented approach with continuous service optimization. Finally, the article proposes targeted insights for development by combining the current situation in China, aiming to provide reference for Smart Data construction in China.

Keywords Smart data project; Libraries, Archives and Museums (LAM); Digital collections; Australia

Note: Figure translations are in progress. See original paper for figures.