

# A Comparative Study of Competency Requirements for Data Librarians at Home and Abroad: Postprint

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## Abstract

[Purpose/Significance] With the continuous development of digital research, scientific research is beginning to shift towards data-intensive research, making data librarians a new focal topic for libraries both domestically and internationally. By analyzing, comparing, and summarizing the competency requirements for data librarians both domestically and internationally, this study provides references and insights for the talent cultivation of data librarians in China. [Method/Process] This study investigates job postings from university libraries both domestically and internationally, adopting web survey methodology and content analysis to conduct an in-depth analysis of the professional competencies required for data librarians from five dimensions: candidate knowledge background, comprehensive qualities, job responsibilities, professional skills, and special skills. [Results/Conclusion] The study summarizes the competencies of data librarians both domestically and internationally, clarifies the role positioning of domestic data librarians, and provides reference and guidance for domestic libraries to develop data management services and cultivate data librarians.

## Full Text

### Preamble

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Comparative Study on Ability Requirements of Domestic and Foreign Data Librarians\*

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## Abstract

**[Purpose/Significance]** With the continuous development of digital scientific research, scientific research has begun to shift toward data-intensive research, and the data librarian has become a new focal topic for libraries both domestically and internationally. By analyzing, comparing, and summarizing the competency requirements for data librarians at home and abroad, this paper provides references for the training of data librarian professionals in China. **[Method/Process]** This study investigated recruitment announcements from university libraries at home and abroad, employing network investigation and content analysis methods to deeply analyze the professional competency requirements for data librarians from five aspects: candidates' knowledge background, comprehensive qualities, job responsibilities, vocational skills, and special skills. **[Result/Conclusion]** This paper summarizes the competencies of data librarians at home and abroad, clarifies the role positioning of domestic data librarians, and provides reference for domestic libraries to develop data management services and cultivate data librarians.

**Keywords:** university library; data management; data librarian; ability requirement

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The advent of the big data era has transformed data storage and analysis methods as well as traditional IT frameworks, accelerating the intelligent development and broader utilization of network information resources and digital resources. As information centers that store knowledge and provide information services, libraries have been profoundly impacted. Traditional information services now face high-standard challenges that take complex data as objects and deep mining as requirements [1]. Currently, library service models have evolved through three stages: document services, information services, and knowledge services. With continuous transformation in resource construction, libraries are no longer merely places that provide reading for readers, but knowledge institutions that take user needs as the core and provide information resources. As data continues to increase and internet technology continuously improves, the demand for professionals with data management skills has gradually increased. These professionals must have unique insights into data management and be able to handle the complex processes of scientific data. Such professionals are called data librarians.

Data librarians have evolved from an early ambiguous role to being endowed with specific job responsibilities. However, since the emergence of data librarians is relatively recent, some problems still exist. On the one hand, libraries need to adjust and reallocate relevant positions to make full use of existing human resources; on the other hand, libraries also hope to have a clear understanding of the skills and knowledge required for new employees. Focusing research on data libraries helps form a unique new library service field and propose new

digital strategies.

## 2 Current Research and Development Status of Data Librarians at Home and Abroad

We have entered the era of big data. Libraries are no exception. While building digital libraries and smart libraries, they are also continuously accumulating massive amounts of data. The main sources of library data include: self-built databases, purchased databases, network data, sensor data, RFID data, mobile internet data, etc. In addition, the large amount of scattered data generated during daily library operations—such as borrowing statistics, visitor counts, building scale, collection status, and staff information—has endowed libraries with the “big data” characteristics of the big data era.

The continuous increase in data has produced tremendous changes in data analysis methods and tools. Only by analyzing massive amounts of information can valuable information be provided to information consumers [2]. In recent years, libraries have gradually increased their demand for professionals with data management skills. These professionals must have unique insights into data management and be able to handle the complex processes of scientific data. Such professionals are called data librarians.

### 2.1 Theoretical Research Status

In 1997, American scholar J. Liscouski [3] pointed out that data librarians should be committed to solving data management problems, collecting information resources with users as the center, while ensuring the sharing, security, and accessibility of information resources. In 2007, A. Gold [4] published two articles to study the data lifecycle, analyzing the role of data librarians in data selection, acquisition, licensing, creating metadata for data discovery and description, organizing data governance, and providing data preservation support. L. David [5] et al. also pointed out that information experts have emerged with new roles in new digital research. A. Elsa [6] et al. investigated some skills and requirements in job advertisements for e-science librarians. K. Hazel [7] investigated the current state of digital information and its organization from the perspectives of librarians and publishers, and pointed out future development possibilities and existing challenges.

Domestic library data management research has progressed relatively slowly. Some scholars have studied the knowledge structure and job responsibilities of library data management personnel. Jiang Lili et al. [8] investigated the job responsibilities and ability requirements of data librarians at 61 foreign university libraries that have established data librarian positions. Guo Sang and Lin Wei [9] analyzed data librarian recruitment information released by foreign university libraries and relevant recruitment and position setting information on domestic websites such as Zhaopin.com to position the job responsibilities of data librarians and study their impact on the transformation of library func-

tions. Gao Shan and Lu Zhiguo [10] took the IASSIST website as an example, hoping to provide reference value for training data librarians in China by investigating recruitment information for foreign data librarians.

Foreign theoretical research on data management started early and covers a wide range of directions, embedding data management into data research in research institutions, libraries, publishing, and other fields. However, current domestic research on data management mostly focuses on studying recruitment information for foreign data librarians and analyzing the domestic data management status quo by drawing on foreign research methods. But there are differences in development technology, systems, status quo, and national conditions between domestic and foreign libraries. Research solely on foreign data librarians cannot completely fit the data management status quo in China. Therefore, China's data management research should be more in-depth, effectively combining data management with the development status quo of Chinese libraries. Through analyzing and comparing recruitment information for data librarians at home and abroad, this paper clarifies the specific abilities that Chinese university libraries hope data librarians possess through domestic recruitment information, then analyzes and synthesizes domestic and foreign recruitment information, thereby providing reference for the ability requirements of Chinese data librarians.

## 2.2 Practical Development Status of Data Librarians

Data management is an emerging data service generated by the strong demand of researchers and users. As data continues to increase, the original institutional and personnel settings of university libraries are difficult to meet actual work requirements. With the development of data management-related work, university libraries have made corresponding adjustments in position setting and responsibility requirements. Since the position title "data librarian" has not been unified, different schools have different names for this position. By searching recruitment information for data management positions on the IASSIST website, the author compiled relevant information such as the names, establishment times, and job responsibilities of data librarian positions at various university libraries, reflecting the current development status of foreign data librarians. Specific details are shown in Table 1 :

**Table 1 Setting of Data Librarian Positions in Foreign University Libraries**

Library	Year Established	Position Name	Job Responsibilities
Cornell University Library	2010	Metadata Librarian/Scientific Data Management	Provide consulting services; provide digital resource discovery services, participate in research

Library	Year Established	Position Name	Job Responsibilities
Columbia University Library	2012	Research Data Services Coordinator	Assist users with data management, participate in research and teaching, etc.; screen and acquire data resources; collaborate with other departments, etc.
Yale University Library	2014	Social Sciences Research Data	Provide consulting and data management services; develop and deliver data services
Griffith University Library	2014	Digital Research Librarian	Provide data support; improve user experience; collaborate with research teams
Oxford University Library	2008	Deputy Director of Digital Library Programs and Information Technology	Participate in national policy formulation; use RDM to achieve new research results and higher research impact; support researchers in building activity management data infrastructure

In 2011, Wuhan University Library launched the construction and exploration of a scientific data management and service mechanism and platform for Chinese universities [11]. It was conducted on a small scale within three faculties as a pilot project, and no specific data librarian positions were established in the project. In 2016, the Documentation and Information Center of the Chinese Academy of Sciences held the first China Data Librarian Training Program, which targeted library and information science professionals and taught a series of courses such as data policy, data management, data processing, data analysis, big data engineering, data publishing, data storage, and data resources, receiving high praise in the industry.

Most foreign university libraries have established specialized data librarian positions. Although the position titles are not uniform, the job responsibilities are clear. Moreover, data management services are generally carried out under the background of national data management projects, with corresponding detailed data management planning and policy, funding, and other support before the project implementation. However, no domestic universities have yet established specialized data librarian positions, and national data management

projects also need to be increased. Through analyzing the ability requirements of data librarians, we hope to have a positive effect on the training of professional data librarian talents, specialized position setting, and data management project research in China in the future.

### 3 Analysis of Data Librarian Position Requirements

The author selected 51 library recruitment announcements from 14 key domestic university libraries and 6 provincial libraries between 2012-2017, and 170 foreign university library recruitment announcements from the IASSIST website as research objects to analyze and summarize the job responsibilities and skill requirements of data librarian-related positions. Based on the more specific job responsibility requirements in each recruitment announcement, the study mainly focuses on five aspects: knowledge background, comprehensive qualities, job responsibilities, skill requirements, and special skills, and further analyzes the knowledge structure corresponding to each aspect.

#### 3.1 Analysis of Knowledge Background

Regarding the knowledge background of data librarians, the analysis mainly focuses on two aspects: educational qualifications and disciplinary background. In terms of educational qualifications, recruitment units' requirements from highest to lowest are postdoctoral, doctoral, master's, bachelor's, and associate degree, five levels. In domestic recruitment announcements, bachelor's degree holders account for the largest proportion at 56% of the total; followed by master's degree holders at 32%; finally, doctoral and associate degree holders each account for 6%. This shows that university libraries primarily require bachelor's and master's degrees in their recruitment process, with doctoral and associate degrees as supplements. In foreign recruitment announcements, master's degree holders dominate at 73% of the total, followed by bachelor's degree holders at 12%, doctoral degree holders at 14%, and only 1% requiring postdoctoral qualifications. From the educational requirements for data librarians in domestic and foreign university libraries, it can be seen that foreign university libraries have relatively higher educational requirements, focusing on master's degrees with bachelor's as the minimum requirement. In contrast, some domestic university libraries only require associate degree qualifications.

From the perspective of professional background, domestic university requirements for data librarians' professional backgrounds can be mainly divided into six categories: library and information science, computer science and technology, social sciences, philology, engineering, and others. Foreign requirements mainly include library and information science, statistics, computer science, social sciences, engineering, etc. It can be seen that domestic and foreign university libraries have roughly the same professional requirements, mainly concentrated in library and information science, which is also consistent with library work functions. In addition, computer science and technology, social sciences, and statistics are also knowledge backgrounds that data librarians should

possess. This shows that university libraries need comprehensive and interdisciplinary talents for scientific data services.

### 3.2 Analysis of Comprehensive Qualities

According to recruitment announcements, it is not difficult to find that data librarians should not only possess professional knowledge in their disciplinary fields, but also have good comprehensive qualities. Since comprehensive qualities involve a wide range of areas and are of various types, the top 5 categories with larger numbers were selected from domestic and foreign recruitment announcements for analysis. The specific distribution is shown in Figure 1 [Figure 1: see original paper] and Figure 2 [Figure 2: see original paper]. In domestic libraries, data librarians who are responsible and dedicated to their work are more likely to be favored. Foreign libraries, on the other hand, place more emphasis on organizational and analytical abilities, independent working capabilities, as well as initiative and flexibility. Finally, learning and research abilities, self-management abilities, environmental adaptation abilities, and analytical decision-making abilities are all important components of comprehensive qualities. From the comprehensive quality requirements for data librarians in domestic and foreign university libraries, it can be seen that domestic libraries focus more on universality, while foreign libraries focus more on integration with library work. The comprehensive qualities required are all vocational skill requirements for data management personnel and are the prerequisites and guarantees for the required professional knowledge and skills.

### 3.3 Analysis of Job Responsibilities

In the analysis of job responsibilities, the job responsibility sections in domestic and foreign recruitment announcements were visualized to reflect their relative importance in the text based on the frequency of different terms. For the job responsibility requirements in domestic recruitment announcements, they were divided into three parts: subject services, data services, and computer services. Through word segmentation processing of recruitment announcements and using Gephi software for term visualization, the specific distribution is shown in Figure 3 [Figure 3: see original paper].

- (1) **Subject services.** Including project services, subject frontier tracking, subject analysis, subject resource construction, writing subject evaluation reports, constructing subject guides, etc.
- (2) **Data services.** First, data librarians need to be responsible for academic data analysis, data maintenance, scientific and technological novelty searches, information literacy education, etc. Second, they should be proficient in operating a series of data statistical analysis tools, such as SPSS, Excel, SAS, MATLAB, etc. At the same time, recruitment units require data librarians to conduct deep mining of scientific research data based on data statistical tools and display mining results in the form of

data visualization.

- (3) **Computer services.** First, data librarians need to master digital library-related technologies and the development and construction of application platforms, as well as the management and maintenance of subject institutional repositories and data centers. Second, recruitment units require proficiency in data operation and analysis tools such as Oracle, MySQL, MSSQL, PostgreSQL, and talents with database development experience will be given priority. Finally, many recruitment units also require data librarians to have programming development capabilities and be familiar with commonly used programming languages, such as mastering Windows, Linux operating systems, etc.

Through data services, computer services, and other services, it can be seen that the requirements for data librarians in domestic and foreign university libraries differ in terms of job responsibilities, as specifically shown in Table 2 :

**Table 2 Comparison of Job Responsibilities in Domestic and Foreign Recruitment Announcements**

Responsibility Category	Domestic Focus	Foreign Focus	Common Ground
Data Services	Data analysis, data literacy, data mining	Data lifecycle, data management plan, data governance, data-intensive research	Data visualization, data processing
Computer Services	Database operation and development, programming development	Software development, system/website development, data publishing systems	Institutional repository, network guides
User Services	Subject development services, reference consulting	User data support, user experience improvement, team collaboration	-

For the job responsibility requirements of data librarians in foreign library recruitment announcements, they can be divided into three parts: data manage-

ment services, computer services, and user services. Similarly, using Gephi software for term visualization, the specific situation is shown in Figure 4 [Figure 4: see original paper].

- (1) **Data management services.** Among them, 31 recruitment announcements require the development of data management plans, 22 mention research data lifecycle (data collection, management, analysis, archiving, sharing), as well as data management policy formulation, related curriculum development, and data reuse, data governance, data-intensive research, data mining, data quality, data visualization, etc.
- (2) **Computer services.** Foreign recruitment announcements require candidates to be able to conduct software development, establish data publishing systems and information education systems, coordinate library websites, develop and maintain web pages, and maintain and operate institutional databases and data repositories.
- (3) **User services.** 42 recruitment announcements require data librarians to provide reference consulting services, and 20 require providing data support for users. This also includes improving user experience, acting as team liaisons and subject program leaders, and conducting close cooperation with researchers, teachers, and librarians.

Through Table 2 , it can be seen that there are differences in job responsibility requirements for data librarians between domestic and foreign libraries. Domestic university libraries focus on data analysis and database and programming development capabilities, while also paying attention to subject construction. Foreign university libraries have more evenly distributed job responsibilities, with a focus on data lifecycle research, data governance, software development, etc., truly achieving user-centered data services.

### 3.4 Analysis of Skill Requirements

The words reflecting skill requirements in recruitment announcements were visualized using Gephi software. A distribution map of data librarian skill requirements was formed based on the different frequencies of various skill requirements, as shown in Figure 5 [Figure 5: see original paper].

Domestic data librarian skill requirements are relatively concise, mainly including language and written comprehensive expression abilities. Foreign language proficiency requirements are mainly reflected in the need to obtain CET-4 and CET-6 certificates. In terms of network technology, domestic requirements include understanding the principles and functions of commonly used network equipment, mastering common networking technologies and network management technologies, as well as Windows and Linux operating systems. At the same time, they must have software engineering and software quality management capabilities. In terms of data processing skills, Chinese university libraries also require mastery of data management and analysis tools, strong data pro-

cessing capabilities, and reader service awareness. In addition, libraries also require data librarians to be able to analyze and evaluate subject development and proficiently use computer languages.

There are also certain differences in skill requirements between domestic and foreign university libraries, as specifically shown in Table 3 .

**Table 3 Comparison of Skill Requirements in Domestic and Foreign Recruitment Announcements**

Skill Category	Common Requirements	Domestic Specific	Foreign Specific
Technical Skills	Database technology, data repositories, network management technology, data statistical tools, common operating systems, database development languages	Software engineering, software quality management methods	Multimedia technology, digital service evaluation technology, digital library technology
Data Processing Skills	Data statistical analysis tools	-	Metadata standardization, data visualization software, data management tools
Research Skills	-	Text expression ability	Solid professional subject knowledge, attention to subject frontiers, mastery of scientific research methods
Other Skills	-	-	Project management experience, interdisciplinary learning and training

The same visualization method was applied to foreign recruitment announce-

ments. Through Figure 6 [Figure 6: see original paper], it can be seen that foreign university libraries have more detailed skill requirements, putting forward relevant ability demands on candidates from various aspects of the data management process.

- (1) **Technical tool skills.** Data librarians need to be proficient in one or several data statistical tools, including MATLAB, R, SAS, SPSS, STATA, Tableau, etc., as well as have experience in basic database development using Oracle, MySQL, MSSQL, and PostgreSQL. In addition, this includes data management tools, digital service evaluation technologies, digital library technologies, and multimedia technologies.
- (2) **Data processing skills.** Standardizing metadata standards to facilitate data preservation and reuse is an important step in data processing. Therefore, data librarians need to be familiar with metadata standards, including: MARC, Dublin Core, OAI, DDI, etc. At the same time, proficient use of data visualization software is also very important, such as Excel, Google Charts, Tableau, Google Fusion Tables, etc. Familiarity with some commonly used programming languages such as Java, Python, HTML, etc. is helpful for processing large datasets.
- (3) **Research skills.** Paying attention to subject frontier information and mastering certain scientific research methods are essential skills for data librarians. At the same time, they also need to have relevant understanding of professional knowledge such as institutional repositories, intellectual property, data description, and information ethics.

### 3.5 Analysis of Special Skills

When analyzing foreign recruitment announcements, it can be found that most libraries have certain special skill requirements for data librarians in their recruitment information, mainly emphasizing that those with these advantages will be more easily given priority in hiring. These special skills include: work experience, specific subject background, high educational qualifications, and project management skills. Specific details are shown in Figure 7 [Figure 7: see original paper].

As can be seen from Figure 7 [Figure 7: see original paper], 38% of university libraries prioritize work experience as a condition, and among them, 89% of libraries require data librarians to have more than 2 years of work experience. Additionally, 36% of libraries hope they have specific subject backgrounds, including social sciences, economics, computer science, geography, etc. At the same time, some libraries explicitly require data librarians to have project management skills or development experience. These data librarians with multidisciplinary backgrounds all serve the purpose of carrying out data management projects. Among special skill requirements, high educational qualifications do not dominate. Compared with other advantages, libraries prefer candidates with rich work experience and specific subject backgrounds. This shows that merely

mastering professional knowledge is clearly insufficient. Only talents with rich practical experience and comprehensive qualities can meet the demands for data librarians in the big data era.

## 4 Role Positioning of Data Librarians in China

Based on research on data management in domestic and foreign university libraries, as well as statistical analysis of 170 foreign university library recruitment announcements and 51 domestic university and provincial library announcements, the author found that the function of data librarians is the deepening and specialization of library work. Data librarians should possess sustainable data literacy based on data management and supported by data governance, data sharing, data management planning, and data analysis technologies. Based on the analysis of data librarian requirements at home and abroad, the author proposes a core competency framework for data librarians, as shown in Figure 8 [Figure 8: see original paper].

### 4.1 Data Governance

In the era of big data, data is increasing dramatically, facing important challenges of eliminating the false and retaining the true, and simplifying the complex. The core of data governance is to improve data management and utilization, provide support for big data application innovation and value creation, protect data privacy, and improve data quality. In foreign libraries, 39 recruitment announcements explicitly state that data librarians should master meta-data standards. Both domestic and foreign library skill requirements mention data mining technology, which is also a basic capability that data librarians should possess. Data reuse can shorten the data collection process and can be directly used by users for analysis. Data librarians with expertise in data resource searching and familiarity with the data types contained in these resource packages may be of great help to users who have difficulty locating datasets, while also helping users organize and classify datasets.

### 4.2 Data Sharing

University libraries are more likely than other types of libraries to access scientific research data in various fields, establish close contacts with researchers and teachers, and become data curation centers for universities [12]. Therefore, various university libraries are actively building data sharing platforms to better achieve effective management and sharing of scientific data. In foreign recruitment announcements, 42 mention reference consulting services, which is an important capability in library services. 22 recruitment announcements consider data management based on the data lifecycle as the main job responsibility of data librarians, and 10 hope that data librarians can conduct research on open access. It can be seen that data librarians mostly need to have awareness of knowledge sharing and master methods of how to obtain publicly available dig-

ital resources and how to properly cite others' data. Therefore, data librarians should become promoters of data sharing in university libraries.

### 4.3 Data Analysis Technology

In the data management process, data librarians need to possess data analysis capabilities, including the use of some data statistical software and the presentation of data visualization graphs. Both domestic and foreign library recruitment announcements attach great importance to the use of data analysis tools, requiring mastery of data analysis technology, and particularly favoring data librarians who can proficiently use commonly used programming languages. Data librarians with good data literacy must always pay attention to subject frontier information, track research hotspots, and maintain a sharp perspective to capture the latest data statistical software and data visualization tools, correctly understanding the great value of scientific research data. They should discover valuable information in massive amounts of information and continuously enhance the value of the library and themselves.

### 4.4 Data Management Planning

Most foreign universities are responding to national scientific data management policies and conducting data management planning. At the same time, libraries provide support for researchers who write data management plans. In foreign recruitment announcements, 31 hope that data librarians can participate in data management planning. In the data management planning process, data librarians should have certain project management experience, excellent language and written expression abilities, and need to cooperate well with research teams. However, China currently needs to improve its emphasis on this aspect. In practical work, with the surge in data quantity and types, data management has gradually become an important capability in library services. Therefore, Chinese libraries should also actively carry out data management planning.

## 5 Summary and Outlook

In an era when many libraries face funding challenges and must prove their continued vitality, expanding data services including research data management and other data science services is an effective method to provide new types of support to users [13]. In library data service functions, data librarians bear new roles and shoulder important responsibilities for the functional transformation of university libraries. Therefore, university libraries should actively conduct data management, enrich the content of scientific research services, and enhance data service capabilities to keep pace with the rapid development of the big data era and continuously move toward the direction of smart libraries.

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