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The Evolution of Library Automation Systems in Chinese Academic Libraries

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ABSTRACT

With the rapid development of information technology, automated systems in Chinese academic libraries have undergone a process from inception to maturity. This study aims to review the development history of automated systems in Chinese academic libraries and provide a forward-looking analysis of their future trends. Through the review of historical data, this paper summarizes the development characteristics of automated systems in Chinese academic libraries. By conducting a survey of automated systems in the libraries of 39 Double First-Class universities in China, the current status of automated systems in Chinese academic libraries is analyzed. The article concludes by proposing future directions for the development of automated systems in Chinese academic libraries.

INTRODUCTION

Libraries, as repositories of knowledge and crucial support for academic research, have always been at the forefront of applying new technologies. Over the years, the library industry has actively embraced and explored emerging technologies to continually optimize service processes and enhance readers' efficiency and user experience. In this process, libraries serve not only as providers of information resources but also as practitioners and promoters of technological innovation.

From card catalogs to OPACs, from federated search to discovery systems, from Integrated Library Systems (ILS) to Library Service Platforms (LSP), the introduction of these systems has transformed the service models of libraries for users. It has significantly improved the efficiency of reader services and demonstrated the important progress of libraries in exploring and applying new technologies.

Against the backdrop of continuous technological changes and the ongoing evolution of library industry products, Chinese academic libraries are facing significant challenges in selecting information systems that not only meet their own development needs but also fully satisfy user requirements. This decision is crucial as it directly impacts the service quality, user experience, and future development trajectory of libraries. It involves not only the core competitiveness of libraries but also their position and influence in the future information services field. Among all information systems, library automation systems are at the core of library operations, and their development history and future trends are of great significance to the modernization of libraries. This study aims to provide decision-making references for academic library managers and theoretical support and practical guidance for the future development of library automation systems in Chinese universities through a review and outlook of the development process of Chinese academic library automation systems.

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A HISTORICAL REVIEW OF THE DEVELOPMENT OF AUTOMATION SYSTEMS IN CHINESE ACADEMIC LIBRARIES

The library automation system is a system that automates and manages various library operations through advanced computer technology.[1] Therefore, computer technology plays a crucial role in driving the development of library automation systems.[2] However, due to technological and financial limitations, the development of library automation systems in Chinese academic libraries has been somewhat lagging compared to developed countries. In the early stages, the development of library automation systems in Chinese academic libraries mainly referenced developed countries such as the United States and the United Kingdom.[3]

Due to different classification standards, the development stages of library automation are not uniform. Sally McCallum analyzed the development of library automation in the United States from 1963/64 to 2003 from the perspective of computer technology and communication technology and subdivided it into eight stages.[4] Meanwhile, Subhajit Panda divided the development of library automation into four main stages.[5] At the same time, Zhang Shuhua and Zhang Jiuzhen proposed a five-stage classification method for the development of library automation in China.[6] Jiang Airong from Tsinghua University Library also conducted in-depth research on this topic, summarizing the development of the Chinese library system into three important stages.[7] Based on a comprehensive consideration of the above literature and Marshall Breeding's annual reports, this article outlines the development trajectory of Chinese academic library systems into four stages based on the characteristics of critical system adoption in Chinese academic libraries, aiming to comprehensively present their development history.[8]

Exploratory Phase: Standalone Systems (1978–1996)

During this stage, while library automation systems in the United States had begun preliminary development, China's exploration in the field of library automation was also gradually unfolding. Before 1978, Chinese universities had already started researching library automation, but there were no formally deployed systems. It was not until 1978 that Nanjing University developed and implemented the Western Language Book Retrieval System (NTDS-78), marking the formal commencement of library automation in China.[9] Subsequently, libraries at Wuhan University, Peking University, Tsinghua University, Shanghai Jiao Tong University, Beijing Normal University, Fudan University, and others also began experimenting with automation systems.

At this stage, library automation systems in Chinese universities mainly focused on research and experimentation, heavily borrowing from the experiences of developed countries' automation systems. Due to the relatively slow development of computer technology in China at that time and the unresolved issue of Chinese character processing, research on library automation in China mainly concentrated on the development of Western language systems. Most of these systems were in the experimental stage and had significant gaps from practical usability. For example, systems such as the Library Circulation System developed by Beijing Normal University and the Machine-Compiled Western Language Books Union Catalog Computer System developed by Peking University, while capable of being tested, still required a significant amount of manual operation throughout the process. As a result, these systems were not widely adopted.[10]

Despite the limitations in technology and practicality during this stage, the research laid the groundwork for the subsequent development of library automation systems in Chinese universities. Through learning and experimentation, the field of library automation in China gradually accumulated experience and gradually addressed technological and application

challenges. The efforts during this period laid a solid foundation for the later development of library automation systems in China.

System Construction Phase: Integrated Library Systems (ILS) (1997–2010)

Compared to standalone systems, Integrated Library Management Systems bring together multiple key library functions such as interviews, cataloging, circulation, and retrieval into one system, enhancing the efficiency of librarians in handling tasks, and thus, gaining popularity in the library community. A landmark event during this stage can be traced back to around 1997 when two of China's most renowned universities, Peking University and Tsinghua University, introduced advanced Integrated Management Systems from the United States: the Unicorn Library Automation Management System from the American company SirsiDynix and the Innopac Automation System from the American company Innovative Interface.[11] These foreign advanced library automation management systems were introduced into China and localized based on the needs of Chinese users. Subsequently, other prestigious domestic universities in China also introduced commercial products from foreign vendors. For example, in 2000, Beijing Normal University Library adopted the ALEPH 500 system from the Ex Libris company.[12]

During this period, a notable characteristic of the development of library automation systems in Chinese universities was the active development of automation systems tailored to domestic needs while introducing foreign systems. Recognizing the limitations of separate systems and understanding the superiority of foreign integrated systems, libraries aimed to develop systems with integrated systems as their goal.

One typical example is the ILAS (Integrated Library Automation System) system led by Shenzhen Library.[13] This system has addressed the heavy reliance of Chinese academic libraries on imported foreign systems, primarily serving public libraries. Additionally, the Huwen Document Information Service System led by Nanjing University Library is another successful case. Developed to cater to the needs and characteristics of Chinese academic libraries, it has gained favor among numerous prestigious universities in China, becoming a leader in domestically developed library automation systems.

Integration Development Phase: Discovery Systems (2011–2016)

With the rapid development of the internet, automated systems in academic libraries have gradually shifted towards networking and digitization. The proportion of electronic resources in library collections has been increasing steadily, leading library automation systems to enhance their support for electronic resources. Drawing from the experience of internet search engine companies, foreign automation vendors have introduced knowledge discovery systems tailored for electronic resource retrieval, enabling users to search and access all database resources in one place.

In the course of development in Chinese academic libraries, a significant milestone occurred in 2011 when Peking University and Tsinghua University introduced foreign resource discovery systems, Summon and Primo, respectively, marking a significant event in this period.[14] Influenced by these two universities, many other Chinese universities also procured these two products. However, the development of foreign-language discovery systems faced certain difficulties as foreign database vendors primarily controlled the data of foreign electronic resources. Nevertheless, with technological advancements and the standardization of Chinese electronic resource data, domestic vendors began developing Chinese discovery systems, such as the Chaoxing Chinese Discovery system.

Due to the ownership of electronic resource data by database vendors, academic libraries have had limited participation in the development of resource discovery systems, lacking autonomy and decision-making power. Database vendors typically design and update resource systems based on commercial interests, limiting the flexibility of academic libraries to adjust system functionalities and services, thereby affecting user experience and library service levels. This issue requires further exploration and resolution to promote better development of academic library automation systems.

Innovative Integration Phase: Library Service Platforms (2016–present)

In 2011, Marshall Breeding, a renowned independent consultant for library systems in the United States, introduced the concept of the Library Services Platform (LSP) to address various issues existing in library automation systems, such as the separate management of electronic, print, and digital resources, as well as the lack of system openness.[15] This concept sparked global discussions and explorations into the next generation of library automation systems.

Chinese academic libraries actively participated in discussions and research on the concept and functionality of the LSP. A significant milestone during this period occurred in 2016 when Beijing Normal University took the lead in introducing the well-known foreign library services platform Alma, ushering in a new chapter for the digital transformation and service enhancement of Chinese academic libraries. The introduction of Alma enabled Beijing Normal University Library to more efficiently manage and integrate electronic, print, and digital resources, thereby improving resource utilization and service levels. Subsequently, Tsinghua University also followed suit in 2017 by introducing the Alma system, joining the ranks of LSP adopters.[16]

After experiencing development in the previous stages, Chinese academic libraries have accumulated rich experience and gained in-depth understanding of the advantages and disadvantages of introducing foreign automation systems. In this stage, Chinese academic libraries began to focus on automation solutions that are more suitable for domestic environments and requirements. Although introducing foreign systems can provide advanced technology and expertise, it may not fully meet the specific needs and challenges of Chinese academic libraries. Therefore, Chinese academic libraries began to actively advocate for localized and customized library automation systems to better serve domestic users and practical situations.[17]

As a result, in this stage, Chinese academic libraries no longer consider introducing foreign automation systems as the optimal choice. Instead, they have started to explore the next generation of library automation systems that align with their own needs and characteristics. The next section will describe in detail the exploration and practices of Chinese academic libraries in the next generation of library automation systems.

METHODS

In order to comprehensively understand the current status of library automation systems in Chinese universities, this study conducted a survey of the library automation systems in the libraries of 39 mainland Chinese universities recognized as 985 Project institutions. The 985 Project was a higher education development and sponsorship scheme of the Chinese government for creating world-class higher education institutions, initiated in May 1998. Thirty-nine universities were selected to be part of this program. In 2017, the Chinese government launched a massive higher education initiative to develop selected universities and disciplines into global first-class universities and disciplines (abbreviated as the Double First Class initiative).[18] These 39 985 Project universities represent outstanding examples of higher education in China and are part

of China's Double First-Class initiative. Their library automation systems serve as demonstration models and hold significant reference value for other universities.

The research questions include:

- What is the Integrated Library System (ILS) in libraries?
- Has the library adopted discovery systems? If so, what discovery system products are being used?
- Has the library adopted Library Service Platforms (LSP)? If so, what LSP products are being used?

The research was primarily conducted through visits to academic library homepages, literature research, and telephone interviews.

RESULTS AND DISCUSSION

The results of the survey are shown in table 1.

Table 1. Survey of library automation systems in Chinese 985 universities

University	ILS product	LSP product	Discovery systems product
Beihang University	Huiwen	—	Foreign discovery: EBSCO Discovery Service (EDS) Chinese discovery: Chaoxing
Beijing Institute of Technology	Huiwen	—	Chaoxing
Beijing Normal University	—	Alma	Primo
Central South University	Interlib	—	Foreign discovery: Primo Chinese discovery: Chaoxing
China Agricultural University	Huiwen	—	Chaoxing
Chongqing University	—	VIPSMART System	Foreign discovery: Summon Chinese discovery: Chaoxing
Dalian University of Technology	Huiwen	—	Foreign discovery: Primo Chinese discovery: Chaoxing
East China Normal University	—	Libstar System	Foreign discovery: Summon Chinese discovery: Chaoxing
Fudan University	Aleph	—	Primo
Harbin Institute of Technology	Huiwen	—	Foreign discovery: EBSCO Discovery Service (EDS) Chinese discovery: Chaoxing

University	ILS product	LSP product	Discovery systems product
Huazhong University of Science and Technology	Innopac	—	Foreign discovery: EBSCO Discovery Service (EDS) Chinese discovery: Chaoxing
Hunan University	Interlib	—	Chaoxing
Jilin University	Symphony	—	Foreign discovery: Summon Chinese discovery: Chaoxing
Lanzhou University	—	Libstar System	Foreign discovery: Summon Chinese discovery: Chaoxing
Minzu University of China	Huiwen	—	Chaoxing
Nanjing University	—	Libstar System	Foreign discovery: Summon Chinese discovery: Chaoxing
Nankai University	Huiwen	—	EBSCO Discovery Service (EDS)
National University of Defense Technology	Other	—	Foreign discovery: EBSCO Discovery Service (EDS) Chinese discovery: Chaoxing
Northeastern University	Aleph	—	Primo
Northwest A&F University	Huiwen	—	Foreign discovery: Summon Chinese discovery: Chaoxing
Northwestern Polytechnical University	Huiwen	—	Foreign discovery: EBSCO Discovery Service (EDS) Chinese discovery: Vips
Ocean University of China	Huiwen	—	Foreign discovery: EBSCO Discovery Service (EDS) Chinese discovery: Chaoxing
Peking University	Symphony	—	Summon
Renmin University of China	Symphony	Huiwen META	Foreign discovery: EBSCO Discovery Service (EDS) Chinese discovery: Chaoxing
Shandong University	Huiwen	—	Foreign discovery: Summon Chinese discovery: Chaoxing
Shanghai Jiao Tong University	Aleph	—	Foreign discovery: Primo Chinese discovery: Chaoxing
Sichuan University	Aleph	—	Primo

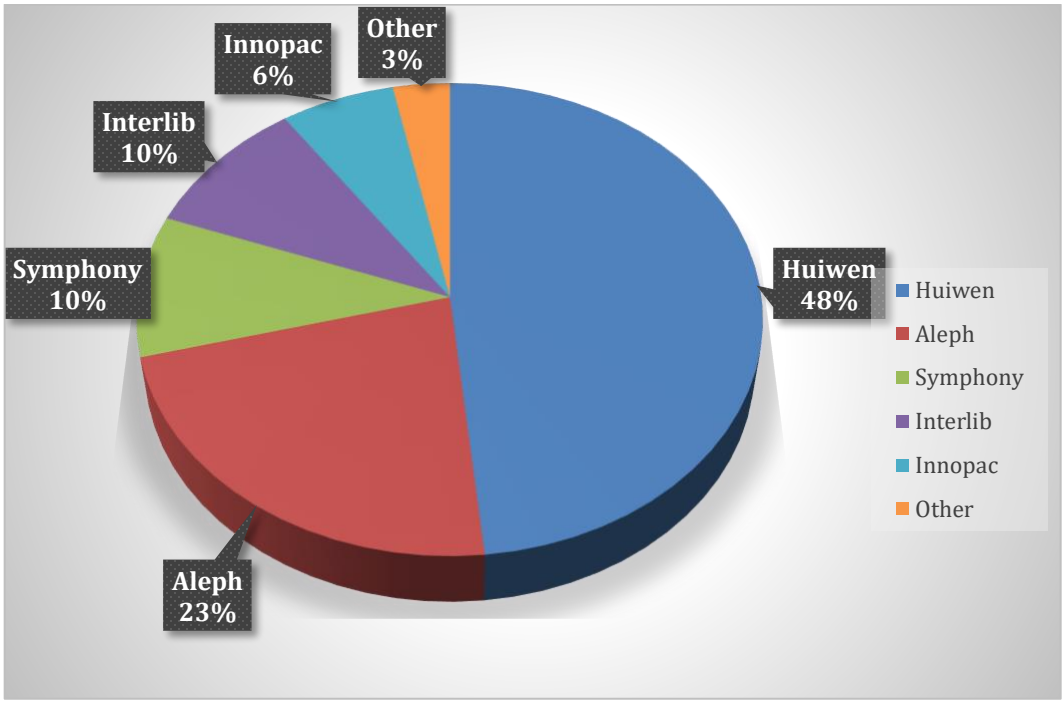
University	ILS product	LSP product	Discovery systems product
South China University of Technology	—	Libstar System	Foreign discovery: Summon Chinese discovery: Chaoxing
Southeast University	Huiwen	—	Foreign discovery: EBSCO Discovery Service (EDS) Chinese discovery: Chaoxing
Sun Yat-sen University	Aleph	—	Foreign discovery: EBSCO Discovery Service (EDS) Chinese discovery: Chaoxing
Tianjin University	Interlib	—	Chaoxing
Tongji University	Huiwen	—	Chaoxing
Tsinghua University	—	Alma	Primo
University of Electronic Science and Technology of China	—	Libstar System	Foreign discovery: Primo Chinese discovery: Chaoxing
University of Science and Technology of China	Huiwen	—	Foreign discovery: Primo Chinese discovery: Chaoxing
Wuhan University	Aleph	—	Primo
Xi'an Jiaotong University	Innopac	—	Foreign discovery: EBSCO Discovery Service (EDS) Chinese discovery: Chaoxing
Xiamen University	Huiwen	—	Foreign discovery: EBSCO Discovery Service (EDS) Chinese discovery: Chaoxing
Zhejiang University	Aleph	—	Summon

Figure 1 presents the current status of Integrated Library Systems (ILS) in Chinese 985 universities. The data reveals that currently, 31 universities (95%) utilize ILS systems. These ILS products primarily include the Huiwen system, Aleph, Symphony, Interlib, and Innopac. Among them, the Huiwen system is a library integrated management system developed by a domestic Chinese manufacturer. Due to its close alignment with the needs of Chinese users, it has been widely welcomed, adopted by nearly half (48%) of the universities. Another notable ILS system is Aleph, developed by the globally renowned company Ex Libris. With its extensive application and good reputation in the global market, Aleph has also earned the favor of 23% of Chinese 985 universities. Although Aleph is still used in libraries worldwide, Ex Libris considers it a legacy product and no longer conducts significant development on it.

Apart from these two mainstream systems, Symphony and Innopac are provided by the American companies SirsiDynix and Innovative Interfaces respectively. However, due to the development status of these companies, these two products are essentially in a maintenance state and are no

longer introducing new features. Another system named Interlib, an ILS, is also developed by a domestic Chinese manufacturer, primarily serving public libraries.

Figure 1. Statistics of ILS in Chinese 985 academic libraries.



These data highlight the preferences and trends of Chinese 985 academic libraries in ILS selection, as well as the market share and influence of different products. Overall, Chinese 985 academic libraries demonstrate a diversified approach in selecting ILS systems, showcasing the vigorous development trend of library informatization construction in China.

Resource Discovery System

Figures 2 and 3 respectively reveal the current status of foreign language resource discovery systems and Chinese resource discovery systems in Chinese 985 academic libraries. All 985 universities are equipped with resource discovery systems. Given the differences in format standards between Chinese and foreign metadata, in order to effectively showcase the characteristics of resources, 24 (61%) universities choose to use separate resource discovery systems to display Chinese and foreign language resources.

From the data, it can be observed that in the domain of foreign-language resource discovery systems, EDS, Primo, and Summon are the three predominant choices, holding market shares of 31%, 28%, and 26%, respectively. This distribution indicates a relatively balanced competitive landscape. Given the advantages of foreign systems in handling foreign language metadata, 85% of universities choose foreign language resource discovery systems from abroad.

Figure 2. Foreign discovery systems in Chinese 985 academic libraries.

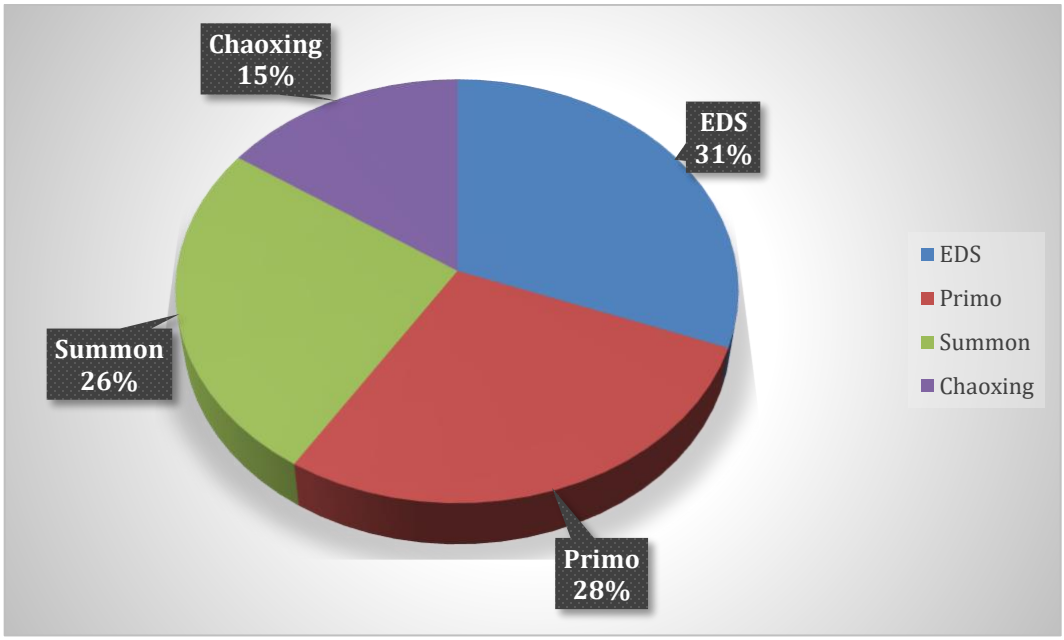
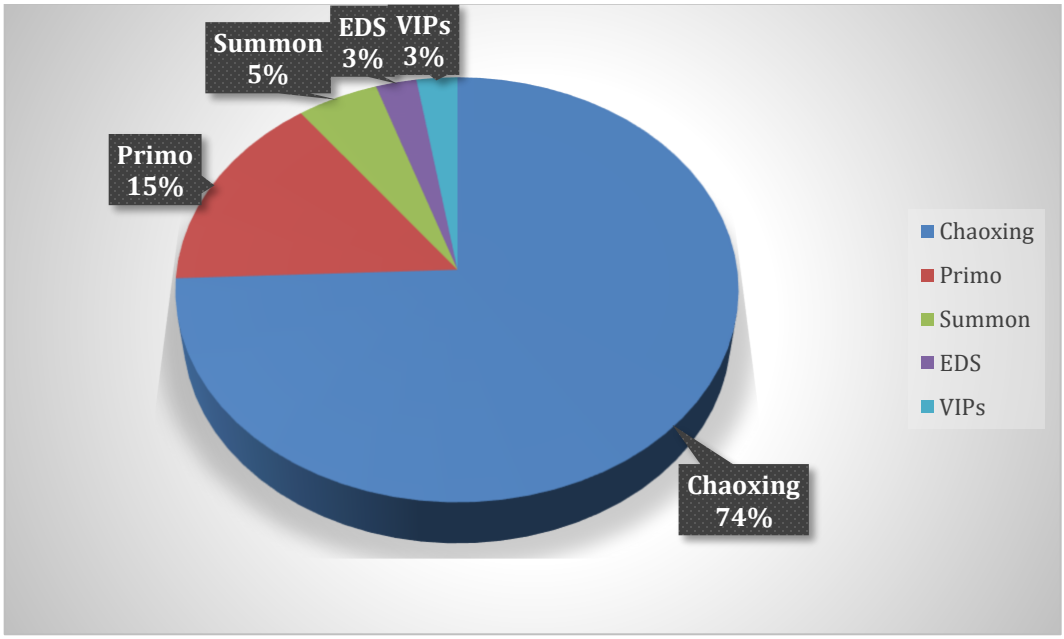


Figure 3. Chinese discovery systems in Chinese 985 academic libraries.



Chaoxing Discovery dominates among the products for Chinese resource discovery systems. Chaoxing Discovery, developed by a Chinese manufacturer, is based on a large amount of metadata and utilizes technologies such as data warehousing, resource integration, knowledge mining, data analysis, and bibliometrics models to effectively solve the integration problem of heterogeneous database clusters, achieving efficient, accurate, and unified academic resource searches. In addition, through methods such as faceted clustering, citation analysis, and knowledge association analysis, Chaoxing Discovery can realize the visualization of high-value academic literature discovery, in-depth knowledge mining, and comprehensive knowledge association.[19] Due to its

advantages in Chinese metadata processing, many universities choose Chaoxing Discovery to showcase Chinese resources. Additionally, VIPs Discovery[20] is another resource discovery system developed by a Chinese manufacturer based on Chinese metadata, which also holds a certain market share.

Library Service Platforms (LSP)

Table 1 shows that the proportion of Chinese 985 universities adopting Library Service Platforms (LSP) is relatively low, with only nine universities (23%) using them. Among them, five universities have chosen the next generation LibStar System, developed by a Chinese manufacturer. This system adopts a combination of multiple systems, including paper resource management, electronic resource management, and resource discovery services, and can be customized according to needs that meet most functional requirements of the next-generation library systems. In contrast to Alma, which has been adopted at libraries worldwide, LibStar's application is currently limited to only two universities among the Chinese 985 universities. Compared to Alma, LibStar System demonstrates more prominent features in integration, flexibility, and localization. In terms of integration, the LibStar System adopts a microservices architecture that supports unified services for print, electronic, and digital resources, enabling cohesive management of traditional print materials, electronic resources, and digital content. Alma may not match the LibStar System in the extent and ease of integration for print, electronic, and digital resources. Regarding flexibility, the LibStar System allows for the dynamic addition or adjustment of functional modules in response to the evolution and changes in its operational requirements, without the need for extensive modifications to the entire system. In contrast, configuring and adjusting Alma might necessitate more specialized knowledge and technical support, imposing higher technical demands on users. Concerning localization, the LibStar System exhibits strong adaptability for domestic users, with due consideration given to the operational characteristics and user needs of local libraries. Conversely, Alma may face challenges in this area, potentially lacking in fully supporting the specific requirements of domestic users.

During the research process, it was also found that Chinese academic libraries have adopted various strategies in embracing the changes brought by the new generation library systems. In addition to purchasing foreign software and selecting domestic software, some universities have chosen two other paths: embracing open-source software and prioritizing the adoption of electronic resource management systems.

One of the most well-known open-source software products in the library services platform domain is FOLIO. FOLIO (Future of Libraries is Open) is an open-source community project established in June 2016, funded and managed by the Open Library Foundation. The community members include libraries, developers, vendors, and service providers, aiming to provide an open-source library system, an open platform, and support for developing new application services.[21]

In September 2016, one of the key promoters of FOLIO, EBSCO, signed a cooperation agreement with China Academic Library & Information System (CALIS) to explore the feasibility of building a next-generation library system in China based on FOLIO. In March 2017, CALIS officially launched the project construction based on FOLIO and proposed the system planning for the new generation library services platform based on FOLIO microservice architecture. Due to FOLIO's ongoing development, there are currently no mature products implemented in China.[22]

Traditional Integrated Library Systems (ILS) are already very mature in handling paper resources and basically meet the needs of domestic libraries. However, with the decrease in circulation of

paper books and the increasing demand for electronic resources, the proportion of funds allocated by academic libraries for purchasing electronic resources has been gradually increasing. For example, since 2016, the electronic resource funds of Xiamen University Library have accounted for 70% of the funds for literature resource procurement.[23] Therefore, in order to better manage electronic resources, some Chinese universities have begun to develop electronic resource management systems to address the challenges in managing and using electronic resources.

THE CHARACTERISTICS OF LIBRARY AUTOMATION SYSTEMS IN CHINESE ACADEMIC LIBRARIES

Over the past 50 years, Chinese academic library automation systems have undergone an evolution from the introduction of foreign software to independent research and development, gradually forging a development path with distinctive Chinese characteristics. In the exploration and practice of the new generation library automation systems, Chinese academic libraries have begun to emphasize localization, customization, and openness, striving to provide automation solutions that better suit their own needs and development, thus promoting the enhancement of library service levels and efficiency. The development characteristics of Chinese academic library automation systems are mainly reflected in the following aspects:

Transition from Importation to Independent Development

Over the past 50 years, Chinese academic library automation systems have undergone significant evolution, transitioning from the initial importation of foreign software to gradually achieving independent development, forming a development model with Chinese characteristics.

Diversified Paths of System Selection

Academic libraries demonstrate diversity in selecting automation systems, including purchasing foreign software, opting for domestic software, embracing open-source software, and prioritizing the adoption of electronic resource management systems. This diversity reflects different universities' strategies tailored to their own circumstances.

Integration of Localization and Internationalization

In the selection of resource discovery systems, Chinese academic libraries adopt both domestically developed systems such as Chaoxing Discovery and Weipu Discovery, as well as systems used widely internationally such as EDS, Primo, and Summon, demonstrating a blend of localization and internationalization.

Distinction Between Chinese and Foreign-Language Resource Management

Due to differences in format specifications between Chinese- and foreign-language metadata, Chinese academic libraries tend to use different systems to manage Chinese and foreign language resources to achieve more effective resource management and user service.

Rise of Electronic Resource Management

With the decrease in circulation of paper resources and the increase in usage of electronic resources, Chinese academic libraries are increasingly focusing on electronic resource management. Some universities have begun developing electronic resource management systems to address challenges in managing and utilizing electronic resources, marking a new trend in the development of library automation systems.

User-Oriented

The development of library automation systems increasingly focuses on meeting user needs. Some universities strive to create more intelligent, convenient, and personalized service platforms through in-depth research and user feedback to enhance user satisfaction and usage experience.

Overall, the development of Chinese academic library automation systems demonstrates a proactive shift from dependency on imports to independent development, from a singular to diversified selection, and from traditional management to embracing new technologies and models. These characteristics not only reflect the achievements in the construction of library automation systems in Chinese academic libraries but also indicate promising prospects and challenges for future development.

CONCLUSION

Through the evolutionary history of library automation systems in China, it is evident how the rise of new technologies has driven user demand for library services and led to the emergence of a series of new automation products. With the continuous advancement and maturation of artificial intelligence (AI) technology, the library domain is witnessing a crucial opportunity for transformation and upgrading. Leveraging AI technology, libraries can significantly enhance the service quality of automation systems, providing users with more personalized and convenient reading experiences.

In China, through learning from previous stages, the library community has gained a deeper understanding of automation systems and become more confident in designing systems that meet the needs of Chinese users. To further enhance the discourse power of Chinese users in the development of automation systems, the future development of library automation systems in Chinese universities should focus on the following key breakthroughs:

- Deep exploration of localization service demands: Chinese users have a unique cultural background and service requirements. The design and development of automation systems should delve into Chinese users' reading habits, information retrieval preferences, and usage scenarios to provide services that better meet their needs.
- Innovative development of intelligent service functions: With the power of artificial intelligence technology, library automation systems can achieve more intelligent service functions, such as intelligent recommendations, automatic categorization, semantic search, etc. These functions will greatly enhance user experience and satisfaction.
- Continuous optimization of user experience: User experience is a crucial criterion for measuring the success of library automation systems. System design should focus on user-friendly interfaces, convenient operation, and response speed to ensure users' comfort and efficiency during use.
- Strict protection of data security and privacy: In the digital age, data security and user privacy protection are particularly important. Library automation systems need to adopt effective technological and managerial measures to ensure the security and privacy of user data are not compromised.
- Active promotion of open collaboration and international exchange: Closed-door development makes it difficult to achieve sustainable development. Chinese academic libraries should actively participate in international exchanges and cooperation, introduce advanced technologies and concepts, and also showcase the achievements of Chinese library automation systems to the world.

Through these efforts, Chinese academic libraries can better meet user demands, enhance service quality, strengthen their voice in the development of automation systems, and promote the advancement of intelligent library services to a higher level. This will bring more convenience and value to Chinese users.

ENDNOTES

[1] Robert M. Hayes, "Library Automation: History," in *Encyclopedia of Library and Information Sciences* (CRC Press, 2017), https://doi.org/10.1081/E-ELIS4.

[2] Michael Kaplan, "Library Automation," in *Springer Handbook of Automation*, ed. Shimon Y. Nof (Springer Berlin, 2009), 1285–98.

[3] Liu Ziheng and Lou Liping, "On 'the Western Learning Flowing Toward the East' in the Library Undertakings in China," *Library and Information Service*, no. 10 (2002): 111–115.

[4] Sally McCallum, "40 Years of Technology in Libraries: A Brief History of the IFLA Section on Information Technology, 1963/64–2003," *IFLA Publications*, July 2003, https://repository.ifla.org/handle/123456789/771.

[5] Subhajit Panda. "Library Automation: An Overview," in *Library Automation* (Lovely Professional University, 2013), 1–23.

[6] Zhang Shuhua and Zhang JiuZhen, *The Library Endeavor in China Since the 20th Century* (Peking University Press, 2008), 412–46.

[7] Jiang AiRong, "Evolution and Development of Library System," *Digital Library Forum*, no. 8 (2015): 1–7.

[8] Marshall Breeding, "2022 Library Systems Report: An Industry Disrupted," *American Libraries* 53, no. 5 (2022), https://librarytechnology.org/document/27268; Marshall Breeding, "Library Systems Report 2021: Advancing Library Technologies in Challenging Times," *American Libraries* (2021), https://librarytechnology.org/document/26215; Marshall Breeding, "Library Systems Report 2020: Fresh Opportunities amid Consolidation," *American Libraries* (2020), https://librarytechnology.org/document/25147; Marshall Breeding, "Library Systems Report 2019: Cycles of Innovation," *American Libraries* (2019), https://librarytechnology.org/document/24495.

[9] Yuan Mingdun, "The New Phase of Automation Development in University Libraries," *Journal of Academic Libraries*, no. 6 (1990): 1–5.

[10] Yuan Mingdun, Zhu Qiang, Dong Chengtai, et al., "A Decade Review and '85 Outlook on the Development of Automation in University Libraries," *Journal of Academic Libraries*, no. 5 (1992): 17–21.

[11] Nie Hua, "Overview and Features of the Unicorn System at Peking University Library," *Journal of Academic Libraries*, no. 1 (2001): 52–55; Gao Xuan, "Library: A Century in Retrospect," Tsinghua University Library, accessed May 10, 2023, https://lib.tsinghua.edu.cn/service/2008/htm/service06.htm.

[12] Feng Ruiqin, Jia Xilan, and Guo Jianfeng, "The Use of Aleph 500—An Integrated Library System," *Journal of Beijing Normal University (Natural Science Edition)*, no. 1 (2009): 104–6.

[13] Qin Tiehui and Zhang Junfang, "Integrated Library Systems and Library Automation in China," *Shanxi Library Journal*, no. 2 (1993): 32–35.

[14] Nie Hua and Zhu Ling, "Web-Scale Discovery Service: On the Way to a Deep Integration and Easy Access," *Journal of Academic Libraries*, no. 29 (2011): 5–10, 25; Dou Tianfang and Jiang Airong, "Function Analysis and Application Prospects of Resource Discovery System," *Library and Information Service*, no. 7 (2012): 38–43.

[15] Marshall Breeding, "Chapter 1. Introduction and Concepts," *Library Technology Reports* 51, no. 4 (2015), https://journals.ala.org/index.php/ltr/article/view/5686/7063.

[16] Liu Suqing, "Exploring Library Services Platform for Chinese Academic Libraries from the Perspective of Electronic Resources Management," *Journal of Academic Libraries*, no. 4 (2018): 11–17.

[17] Xu Tiancai, Yang Xinya, and Peng Xiaodong, "The Development Status and Trend of the New Generation Library Management System—Summary of the 2016 Information Technology Application Annual Meeting of the Ministry of Education Academic Library Committee," *Journal of Academic Libraries*, no. 6 (2016): 5–9.

[18] Liu Xiao, "The 'Double First Class' Initiative Under Top-level Design," *ECNU Review of Education*, no. 1 (2018): 147–52.

[19] "Chaoxing Discovery System," accessed May 1, 2023, https://www.zhizhen.com/about/about.html.

[20] "VIPs Discovery System," accessed May 1, 2023, https://lib.cufe.edu.cn/db/detail?id=263.

[21] "About FOLIO," The Open Library Foundation, accessed May 1, 2023, https://folio.org/about/.

[22] Wang WenQing, Chen Ling, Guan Tao, "Integrated Development of CALIS New-Generation Library Service Platform," *Digital Library Forum*, no. 1 (2020): 1–10.

[23] Ruiqin, Xilan, and Jianfeng, "The Use of Aleph 500."