



# Research on China Academic Library & Information System

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**How to cite this paper:** Yi, L. (2020) Research on China Academic Library & Information System. *Open Access Library Journal*, 7: e6689.

<https://doi.org/10.4236/oalib.1106689>

**Received:** August 4, 2020

**Accepted:** August 21, 2020

**Published:** August 24, 2020

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## Abstract

China Academic Library & Information System (CALIS) is the world's largest university library consortium, which is responsible for resource coordination and joint construction, document information sharing services, and staff training, application system construction, etc. It uses cloud computing (CC) technology to build a platform for cloud services and sharing, which is a model for the development of China's university library alliances (CULA) in the past 30 years, and has played an important role in promoting the CULA development, which has independently designed and developed an online cooperative cataloging system and an online public retrieval (OPAC) system for the retrieval of the joint catalogue of Chinese and foreign books and periodicals. This article mainly adopts the method of case analysis to analyze the development process, organizational structure, operation mode, and development trend of CALIS, with the purpose of revealing the general laws of the CULA construction.

## Subject Areas

Library, Intelligence and Philology

## Keywords

China Academic Library & Information System, China's University Library Alliances, Cloud Service

## 1. Introduction

China Academic Library & Information System (CALIS) which officially started construction in November 1998 is a public service infrastructure for all Chinese academic libraries invested and constructed by the Chinese Ministry of Education [1]. By 2012, the country has invested a total of 352 million yuan in con-

struction funds to build its online cataloging system, the document discovery and acquisition system, the collaborative service system and the application software cloud service platform. At present, there are more than 1800 registered member libraries, covering 31 provinces, making it the world's largest university library consortium (ULC). CALIS passed the acceptance of the third phase of the construction by the Ministry of Education in May 2012, and passed the evaluation of the construction results of the project by the China International Engineering Consulting Corporation entrusted by the National Development and Reform Commission in January 2013. Beginning in 2013, CALIS began to optimize and adjust the management structure, operating mechanism and development model, and shifted from the development phase of project construction to continuous operation and maintenance services and the development of a new generation of library service platforms (LSP).

## 2. The Development Path

From the perspective of the development of CALIS, which officially began planning in 1994, the project was established in 1996, and the management center (MC) was established in 1997. In May 1998, the original State Planning Commission approved the project proposal, marking the official establishment. The construction of CALIS is mainly divided into four phases, 1998-2001 as "Phase 1", 2004-2006 as "Phase 2", 2010-2012 as "Phase 3", and 2013-present as "Phase 4".

The first phase of construction mainly includes three aspects: First, the establishment of a joint catalogue retrieval system. Second, it created a digital resource group procurement model. CALIS is the pioneer of group procurement in the Chinese library community. CALIS adopts a flexible and changeable introduction method to coordinate and guide the construction of foreign resources in colleges and universities, alleviating the long-term shortage of foreign documents, improving the structure of foreign documents, enriching foreign digital resources, and increasing the document guarantee rate. In order to strengthen the overall planning and practical ability of resource introduction, and enhance coordination and cooperation with other organizations, CALIS established a special resource introduction working group to formulate principles and strategies for resource procurement and promote work. Third, a three-level document guarantee system has been established between the national center, regional center, and member libraries.

The second phase of construction includes four major aspects: First, the establishment of a digital library standard specification system. As a shared and public service infrastructure for university libraries (UL), CALIS has built an open, distributed, and multi-library collaboration platform, which involved the interconnection of many participating libraries and the integration of many application systems. Therefore, the standardization of technical specifications, data and application interfaces is essential. The CALIS MC presided over the compilation

of the “Technical Standards and Norms for Digital Libraries of Higher Education in China” and applied them to all sub-projects of CALIS during the Tenth Five-Year Plan. The specific work of digital library standards and specifications includes the preparation of CADLIS technical standards and specifications and the certification of software product compatibility of the CALIS system. Second, build a distributed document delivery network. “CALIS Document Delivery Service Network” officially launched its service in June 2004. Since then, university readers can obtain the rich collections of other UL in a convenient and quick way [2]. Third, in September 2003, CALIS launched the online specification control system project. In August 2004, it established a test database and an experimental retrieval system including a bibliographic database and a specification database for the experiment of the online specification control mechanism. Fourth, start the construction of a provincial center. Considering that all provinces, autonomous regions, and municipalities directly under the Central Government have increased their support for the construction of public service systems for colleges and universities in their provinces (regions and cities), and the role of some leading schools in promoting the co-construction and sharing of local literature resources, the CALISMC during the “10th Five-Year Plan” Establishing 15 provincial centers (PC) in provinces and cities without national centers (NC) and regional centers (RC), and incorporating local construction into the CALIS system, has greatly strengthened the integrity of CALIS services and the nationwide radiation [3].

The “Phase 3” construction includes three aspects: Firstly, the establishment of a “universal service (US)” system “on the cloud”. In the “third phases” construction, CALIS takes US as the guiding principle, “cloud computing (CC)” as the technical means, and “multi-levels guarantee system” as the service backbone team, and builds a library information service collaboration network covering various universities throughout the country. Secondly, build a collaborative service network (SN) unified three-level certification system [4]. CALIS takes the distributed unified authentication system (UAS) as the core, adopts a two-level distributed architecture based on CC, and integrates with the local authentication system of member libraries to form. The unified identity authentication system for the three-levels readers of universities across the country realizes the cross-domain single sign-on between the CALIS cloud platform and the local system of the member libraries. CALIS takes resource scheduling and service scheduling as the core, relying on the document delivery (DD) network, through the integration of DD, interlibrary book borrowing, article ordering PPV, e-book rental, and electronic original text links to form a complete set of distributed. The original text acquisition system with multi-library collaboration and multi-resource Cloud Platform, aims to help readers quickly, accurately and conveniently obtain the original text, thereby achieving “one account, nationwide access” University joint resource ordering system. CALIS Phase III is based on a joint resource ordering platform, based on a CC model, through integration with

book importers and exporters (referred to as booksellers) and library OPAC, to provide member libraries with independent procurement and coordinated procurement services for books, papers and other resources, Optimize and balance the resource procurement configuration of each library, avoid repeated procurement, improve the efficiency of fund use, and realize the complementation and sharing of related resources of each library. Thirdly, start cross-system and cross-border DD cooperation. CALIS and the Shanghai Library formally launched the Shanghai Library's interlibrary loan (ILL) service for universities across the country in November 2011. In March 2012, CALIS and the National Science and Technology Library (NSTL) signed a service cooperation agreement, and the "NSTL Document Delivery Service (University Edition)" was opened at the same time. In terms of international cooperation, in November 2009, CALIS and KERIS of South Korea officially opened the ILL service. In March 2012, the two-way DD service was officially launched with OCLC. After the third phase of the project, CALIS continued to expand cross-system and cross-border cooperation, and successively opened ILL and DD services with the National Library of China, Hong Kong JULAC and other institutions. Fourthly, the construction of shared domains starts to be built on the basis of all PC [5].

### 3. The Operating Mechanism

CALIS is operated and managed by the CALIS MC at Peking University. The backbone service system consists of 4 NC, 7 RC, 31 PC and more than 500 service centers. The various literature resources, human resources and service capabilities of these backbone libraries are integrated to support shared services for all colleges and universities across the country [6].

#### 3.1. CALIS Management Center

The CALIS MC is located at Peking University and is responsible for the implementation and management of the thematic projects. The MC consists of five intelligence and management departments: business support center, information service center, data center, technology center, career development center, and an online cataloging center. The technology center is responsible for technology development and technical services [7]. Its main business is to formulate the CALIS technology development plan, plan and design the overall framework and organize the cooperative development of various standards; undertake online cataloging centers, NC, and RC, PC and digital library base related business technical support; select product and technical partners, organize and undertake project design, development, testing, maintenance, training, promotion, service, outsourcing and management, etc., provide a full range of technical solutions and technical services. The Online Cataloging Center is responsible for advancing the construction of a multi-language and multi-material type joint catalog database and an online cooperative cataloging resource sharing (RS) system, and provides online public inquiry of literature resources for the teaching and re-

searching. The Online Alliance Center is based on the joint catalog database, with universities as its main service objects, and conducts online cooperative cataloging, cataloging data batch provision, cataloging consultation and system training. The information in the form (**Table 1**) is from <http://www.calis.edu.cn>.

The CALIS MC has four working departments including the resource introduction work group and the R&D department, the system operation department, the business development department and the office. The resource introduction working group is responsible for participating in the formulation of resource introduction plans, jointly negotiating the introduction of various resources; reporting on the introduction of resources; carrying out the work of introducing resource evaluation guidelines and database training. The Research and Development Department is responsible for the research and development and commissioned development management of the public service system. The Research

**Table 1.** Organizations under the MC.

Business department	Departmental responsibilities
	Business macro management
Business Support Center	Administrative Affairs Management
	Personnel financial management
	CALIS Technical Management
Technology Center	Product design and system development
	Technical support and operation and maintenance
	Data construction and service overall planning design and management
Data center	Resource service data construction and management
	Non-resource service data construction and management
	Scientific research data construction and management
	CALIS service design and management
Information Service Center	Periodical Service
	Literature access
	Subject Service
	Service product system planning and design
	Service promotion
Career Development Center	Cooperation project negotiation and organization management
	Undertake engineering projects
	Financing

and Development Department forms an implementation plan and carries out project construction based on the medium and long-term development plan and the annual development plan given by the expert committee. The construction of the projects is carried out by themselves or by entrusting other member libraries to be responsible and contracting with partner companies. The department implements project management. The Business Development Department is responsible for the operation of external publicity, resources and assets. The system operation department is specifically responsible for or instructing the operation and maintenance of the shared system. The office is responsible for the management of NC, RC and PC, and is responsible for publicity, administrative management, and foreign exchanges and cooperation [7].

### 3.2. Four National Centers

CALIS has established four national literature information centers in Beijing, including arts and sciences, engineering, agronomy, and medicine, which form the core of the three-tier structure and mainly serve as a base for document information assurance. Among them, the two NC for liberal arts and engineering are located at Peking University and Tsinghua University. The other two NC of agronomy and medicine are located in China Agricultural University and Peking University Medical Department re, serving as the connection point between CALIS and the National Agricultural Information Network and the National Medical Information Network, expanding the scope of document RS. At the same time, as the leading unit of collaboration for libraries of similar colleges and universities, it carries out corresponding resource co-construction and sharing activities. The information in the form (Table 2) is from <http://www.calis.edu.cn>.

CALIS National Information Center in Medicine (NICM) which is one of the four NC of liberal arts, engineering, medicine, and agriculture established by CALIS according to the disciplines, and was formally established in 1998, established in Peking University Medical Library. The main task is to coordinate the rich literature resources and human resources of the medical libraries of the universities through the cooperation and exchanges with the medical libraries of various universities and colleges, and with the close cooperation and support of the libraries, to jointly build a joint guarantee system for the medical literature of

**Table 2.** CALIS national Center.

CALIS National Center	Center's institution
CALIS Arts and Science Center	Peking University Library
CALIS Engineering Center	Tsinghua University Library
CALIS Medical Center	Peking University Health Science Library
CALIS Agronomy Center	China Agricultural University Library

the universities. At the same time, the NICM establish an efficient and fast connection with the National Medical Information Network, provide powerful online retrieval services and DD services, and realize the joint construction, mutual knowledge and sharing of resources among medical libraries in universities across the country. The specific construction content of the NICM includes: construction of guarantee resources, according to the funding of the project, focus on introducing a batch of high-quality biomedical databases, and providing services for universities across the country through ILL and DD [8].

CALIS National Agricultural Literature Information Center (NALIC) is based on the original literature resources and network conditions of China Agricultural University. The NALIC focuses on the following aspects: introducing a batch of domestic and foreign agricultural, forestry and water-related literature databases to provide services to alliance users through ILL and DD; the alliance information sharing platform construction; establishing a network system connecting the libraries of agricultural, forestry, water and agricultural colleges and vocational technical colleges to carry out RS and information consulting services; information resource organization and development and utilization; cooperating with the CALIS National MC to develop the collection of literature resources, establish a database of agricultural, forest, and water characteristic resources to serve the teaching and scientific research.

### 3.3. Regional Center and Provincial Center

CALIS has established a SN with a three-levels document information guarantee model of “National Center—Regional Center—University Library”, which is responsible for resource coordination and joint construction, document information sharing services, staff training and reader training, application system construction, etc. The tasks of the national center and regional center include the construction of various center organizations and the installation of application servers and application software systems running in each center. [9] The information in the forms (Table 3 and Table 4) is from <http://www.calis.edu.cn>.

**Table 3.** Regional Center that has signed a contract with CALIS.

CALIS Regional Center	Center's institution
Northeast Regional Center	Jilin University Library
East China Regional Center	Nanjing University Library
Southeast China Regional Center	Shanghai Jiao Tong University Library
South China Regional Center	Sun Yat-sen University Library
Central China Regional Center	Wuhan University Library
Northwest Regional Center	Xi'an Jiaotong University Library
Southwest Regional Center	Sichuan University Library

**Table 4.** Province or City Center that has signed a contract with CALIS.

CALIS Provincial Or City Center	Center's institution
Anhui Province	University of Science and Technology of China Library
Beijing	Library of Renmin University of China
Fujian Province	Xiamen University Library
Chongqing	Chongqing University Library
Gansu province	Lanzhou University Library
Guangxi Zhuang Autonomous Region	Guangxi University Library
Guizhou Province	Guizhou Normal University Library
Hainan	Hainan University Library
Hebei Province	Yanshan University Library
Henan Province	Zhengzhou University Library
Heilongjiang Province	Harbin Institute of Technology Library
Hunan Province	Hunan Normal University Library
Jiangxi Province	Nanchang University Library
Liaoning Province	Liaoning University Library
Inner Mongolia Autonomous Region	Inner Mongolia University Library
Ningxia Hui Autonomous Region	Ningxia University Library
Qinghai Province	Qinghai Normal University Library
Shandong Province	Shandong University Library
Shanxi Province	Shanxi University Library
Tianjin City	Tianjin Polytechnic University Library
Tibet Autonomous Region	Tibet University Library
Xinjiang Uygur Autonomous Region	Xinjiang University Library
Yunnan Province	Yunnan Normal University Library
Zhejiang Province	Zhejiang University Library

#### 4. The Development Trend

With the continuous enrichment of library collection resources and the continuous expansion of service content and extension, the traditional integrated management system designed with paper resource management as the core can no longer meet the needs of the continuous development of libraries, and develop a library platform facing the future it is inevitable. In this situation, CALIS has launched a new generation LSP based on FOLIO microservice architecture. The LSP adopts the FOLIO microservice architecture and is in line with the in-



ternational FOLIO platform, which can make full use of the latest research and development results of the FOLIO community. On this basis, it can build its own application basic platform and application store, develop corresponding application systems, and realize application customization and localization. Wang Wenqing, the chief engineer of CALIS MC, believes that the core elements of CALIS New Generation LSP are: 5 openness (open and unified microservice architecture, open central knowledge base, open multi-levels platform services, open and inclusive ecology, Open and diversified applications) + 5 standards (platform standardization, data standardization, service standardization, APP development standardization, community management standardization) [10]. The goal of new LSP is to establish a powerful platform as a service (PaaS), open platform, and on this basis, develop an open library system suitable for the needs of domestic libraries. CALIS will deepen the connotation and expand the boundaries on the basis of the established higher education document guarantee system, and build it into a national-level, guaranteed public infrastructure that supports the wider daily business operation and interlibrary collaboration of UL.

## 5. Conclusion

CALIS is the largest university library alliance in China, which represents the development level of the CULA. By studying CALIS, we can see the organization, operation mechanism, service characteristics and development trend of the CULA. CALIS will build a cloud platform in the future to provide readers with cloud services (CS), which is also the development direction of the CULA. CALIS plays a role as a benchmark and an example in the application of emerging information technology in China's academic libraries, whose development direction often indicates the mainstream direction of the development of the CULA. The development of CS is undoubtedly the general direction of the future development of the ULA. CALIS needs to continue to strengthen the interaction with readers to meet readers' literature needs more quickly and efficiently. At the same time, strengthening the construction of its own resources and continuously launching distinctive services are also issues that CALIS should consider. Therefore, CALIS should change its development thought. The long-term solution is to shift from focusing on network construction to focusing on readers and resource.

## Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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