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Shanghai Library, China

ABSTRACT

The official opening of Shanghai Library East on September 28, 2022 marked the full implementation of FOLIO platform in the Shanghai Library. The Shanghai Library has developed and implemented applications for library traditional and smart services based on the FOLIO technical framework. This paper mainly introduces the process, difficulties, and solutions during the FOLIO implementation in the Shanghai Library, and provides a summary of the various activities of a Chinese library network (the Yunhan Alliance) established in 2021.

Keywords: Shanghai Library, FOLIO, Smart Libraries, Yunhan Alliance

BACKGROUND

Shanghai is a mega-city with a population of more than 24 million in China. The Shanghai Library is one of the largest public libraries supporting scientific research in China. It boasts 57 million volumes in its collections in various languages, more than 1,000 full-time staff members, and a total area of nearly 200,000 square meters. In 1996 a new branch, the Huaihai Road Library, opened with an area of 80,000 square meters. In 2022 another branch, Shanghai Library East, opened with an area of 115,000 square meters, which has made it the largest single library in China.

In the last 10 years, Shanghai Library has been faced with many challenges in the construction of IT architecture and applications.(1) When the Huaihai Road Library opened in 1996, Horizon Integrated Library Management System was used to provide traditional services such as acquisition, cataloguing, serials and circulation, but it could not meet the needs of today's operation. (2) In 2000, a Shanghai libraries service alliance, named the "One Card Library Alliance," brought many libraries together into one alliance: the Shanghai Library, the Shanghai Children's Library, 16 district library systems, and some research libraries. The Alliance adopted a unified circulation policy and its annual circulation reached 50 million in 2015. The average annual circulation was about 63 million between 2017 and 2019. In 2022, there were an estimated

460 service points, more than 38 million volumes and more than 6 million readers in the Alliance. Due to the limitation of the Horizon System in function and performance, the Alliance was not able to accept more members to guarantee the equal rights of citizens to library services. (3) The Shanghai Library assumed multiple roles, including but not limited to, those of a public library, a scientific research library, and a library alliance. Many IT applications were developed a long time ago. Their architecture was too old to connect with each other, and thus some application and data silos appeared.

FOLIO, an acronym based on “the future of the library is open”, was developed in 2016. FOLIO is an open-source software supported by a community, and a library services platform, and a software development project. FOLIO community is composed of platform providers, system developers, software service providers, technical service companies and libraries. So far there are 31 library members from various countries, including the Shanghai Library, and more than 40 platform providers, software, and technical service companies. FOLIO is one of a kind system built upon the new modular application environment, with cloud native and micro service architecture, support all kinds of application interface access, follow the agile development mode driven by a community. FOLIO supports full media management, full process management and unified discovery for the fundamental requirement of Hybrid Library, flexibly supports the wisdom library and various business of future library. FOLIO represents the trend of library services platform.

SHANGHAI LIBRARY CHOSE FOLIO

Since the late 2010s, the Shanghai Library had investigated various library services platform solutions. Combined with the demand of Shanghai public library service system and the vision for smart services by the new Shanghai Library East that was still under construction, the Shanghai Library had put forward some key requirements for the new generation of library services platform: (1) A multi-tenant platform for the consortium environment that comprises the Shanghai Library, tens of branch libraries, and their sub-library branches; (2) it supports up to 100 million circulation transactions a year; (3) it can manage activities of over 15 million registered users; (4) it should provide collection management solutions for all kinds of culture heritage resources; (5) it should provide SaaS ecology with extension modules (e.g. SoLoMo services, data analytics, etc.) by various local vendors; (6) it can help libraries to redefine itself and re-engineer its workflow to meet new requirements.

The open, extendible, library-led FOLIO solution matched the vision of the Shanghai Library. Since 2018 the Shanghai Library started exploring FOLIO and its applications, its open-source community, and its micro service architecture. In 2019, the Shanghai Library formed the FOLIO project team, with about 50 people from multiple institutions. In 2020, the team participated in the WOLFcon conference in Texas A&M University. Several members of the project team joined the FOLIO community later.

FOLIO IMPLEMENTATION IN SHANGHAI LIBRARY

In 2019, Shanghai Library FOLIO project team developed the first new application based on the FOLIO technology framework as an experiment to learn the FOLIO development technology and to test FOLIO functions and performance. The Shanghai Library is a research-based public library, with various collections of books, bound edition of newspapers and periodicals, rare books, genealogies, manuscripts, records, standards, new year paintings, inscriptions and so on, for which the Shanghai Library hopes to conduct asset management. FOLIO project team evaluated the FOLIO technology framework and decided to develop collection management app based on the FOLIO Daisy in 2019. After more than a year of development and implementation, the collection management app went alive in September 2020 as the first FOLIO app in Shanghai Library. The app has achieved the delicacy management of the whole life cycle of the physical literature, from new book acceptance, registration, moving and removal, optimized and reconstructed the relevant processes. The change of location and status can be tracked, and the asset management can be documented. With the management of more than 10 million volumes, 920,000 copies were accepted, 450,000 copies shelved in 2022. Through the development of collection management app, the FOLIO project team has basically mastered the FOLIO technology and development mode, which has laid a solid foundation for the subsequent development and implementation of other modules.

In 2020, Shanghai Library would set up related groups of FOLIO project team, such as project management group, metadata management group, data migration group, circulation app group, user app group, VuFind app group, support group, and organize the development and implementation of circulation and discovery. FOLIO circulation apps include user, inventory, checkout, checkin, feefine, request and other apps; VuFind serves as a unified discovery entrance. The project team improved the functionality and performance of circulation and VuFind, and develop localized enhancement, for example, (1) support all SIP2 messages, compatible with SIP2 message of Horizon system, support more than 500 self-check machines concurrent access (2) support CNMARC in Marc import, Inventory, VuFind (3) support circulation in alliance (4) VuFind support the integrated retrieval for printed and electric resource, localization of facet and book cover, display collection by alliance structure (5) support a reader with multiple card, with existing OAuth authentication services.(6) performance optimization to support 100 million annual circulation in local environment, which can meet the circulation scale of the "One Card Library Alliance".

Due to the huge scale of the "One Card Library Alliance," the project team planned phased implementation of the FOLIO circulation for the alliance members starting from 2021. In March 2021, the project team transferred all the circulation polices, bibliographies, items, and loans to the new circulation system. The circulation service of Huaihai Road library was the first to be migrated. According to the different circulation scenarios, in April 2021 closed stack circulation was moved to FOLIO and Portal retrieval was moved to VuFind in Huaihai Road library; in July 2021 open stack circulation was moved to FOLIO. FOLIO inventory contains nearly 40 million collections of the Shanghai Library and the "One Card Library Alliance". By January 2023, the maximum number of daily loan is more than 16,000 in FOLIO, and the maximum monthly retrieval is 2.8 million in VuFind. FOLIO provides strong support for the smart service scene of Shanghai Library East and Huaihai Road library. For example, offline services include: 24-hour book return booth, automatic sorting system, self-check machine, appointment pickup bookcase, smart bookshelf, service robot, inventory robot, and mobile phone borrowing; online services include: navigation, network borrowing, and full reservation. FOLIO circulation serves all the registered readers of the Shanghai Library and will provide circulation services for all the members

of "One Card Library Alliance." At present, the two-way synchronization of circulation data was running between the FOLIO and the Horizon system. The members of the "One Card Library Alliance" use the Horizon system until they moved to FOLIO.

In September 2022, with the opening of Shanghai Library East, several smart service applications went alive, such as full reservation, space management, network borrowing, closed stack request, navigation, and robots. Just like the collection management and circulation, these modules are developed by different vendors, which are based on the FOLIO platform and they interact with other applications through the microservice gateway. FOLIO is self-hosted, deployed within Docker on local virtual machines cluster in the Shanghai Library. Prometheus and ELK are built to ensure the observability of FOLIO platform and applications. Prometheus pulled the metrics from FOLIO OKAPI, the operating system, and other software, and showed the health of the operation through Grafana, and timely warned the maintenance team through the Wechat when the system is abnormal.

The Shanghai Library and its development team will continue to promote the development of related modules of smart library in the future, and it has planned to launch the business modules such as acquisitions, ERM, cataloguing, inter-library lending, information processing, data center and smart intelligence in 2023.

FORMATION OF CHINESE FOLIO COMMUNITY

To promote all kinds of applications and development based on FOLIO , facilitate the transition to the next generation library services platform for Chinese libraries, and accelerate the wisdom library application ecological construction, in July 2021 the Shanghai Library joined Shanghai Jiaotong University Library and Jiangsu Jiayu Network Technology Co., LTD. And together they established Smart library technology and application alliance (Yunhan Alliance), that is, FOLIO Chinese library community.

Wei Liu, the Duty Director of the Shanghai Library, described the Yunhan: it inherited FOLIO's vision and its target tasks include not only building a new next generation library services platform but also developing a set of application components that can meet the functional needs of the library's current operations and future development as well as constructing a well-functioning and healthy community. (Wei, 2021)

The Yunhan Alliance mainly consists of an expert committee, an application committee, a development committee, and the alliance secretariat. For more than a year, Yunhan Alliance has developed vigorously and achieved fruitful results. The Yunhan Alliance released Yunhan logo, established the governance model, formulated the product technology and roadmap, released Yunhan DEMO site, started the development of product core suite, and monthly launched "Seminar of Smart library technology and application" and "Newsletters of Smart library technology and application." At present, 18 libraries and 18 companies have joined the Yunnan Alliance, and many visionary experts participated in the work of the Alliance. After FOLIO successful went alive in the Shanghai Library, Changshu Library, a member of the Yunnan Alliance, also successfully launched the FOLIO platform in November 2022.

The influence of the Yunhan Alliance is growing. On July 15, 2022, the Alliance held the "New Era, New Power-2022 World Open Library Foundation Asia Pacific conference and China Yunhan Community Conference." Many international and domestic scholars shared their research results and practical cases at the conference. More than 2,200 people attended the conference. The conference promoted the mutual exchange, further promoted FOLIO and the Yunhan Alliance,

and laid a foundation for the further implementation of FOLIO. At the 2022 World Open Library Foundation Conference in Hamburg, Germany, a special session was arranged for the representatives of the Yunhan Alliance. Tiewei Liu from the Yunhan Alliance, Gang Zhou from the Shanghai Library, Lei Zhou and Sha Jiang from Jiangsu Jiayu, introduced the progress of Chinese FOLIO community and the application practice of FOLIO in the Shanghai Library through online meetings, which attracted a large on-site audience as well as online interest around the world. Tom Cramer, the president of the Open Library Foundation, and Paula Sullenger, a member of FOLIO Community Council, were present at the meeting. At the invitation of FOLIO Product Council, Chinese FOLIO community and FOLIO community exchanged Chinese experience at the FOLIO Products Council meeting on October 20, 2022, with a heated discussion about the navigation module, smart bookshelf, robot service, full reservation system, development documents, API layer and app store in the Shanghai Library FOLIO.

EXPERIENCE

Shanghai Library is an ultra-large library with a huge number of collections and millions of users, serving two main functions of scientific research and public service. It boasts huge volume of circulation, and rich bibliographic data. One can imagine that such a big library needs complex system requirements. The Shanghai Library considered all aspects of the implementation and made careful plans before and after the migration in order to deal with the unexpected problems. The Shanghai Library hopes to inspire and share with its peers its implement experience.

Our experience shows the importance of library participation. The Shanghai Library participated in the whole implementation process from investigation, development, testing, training, and online process of FOLIO project so that the project team acquired a comprehensive understanding of the characteristics of FOLIO architecture and applications as well as a deeply understanding about the openness and flexibility of FOLIO solution. Based on the different scenarios and native app functions, the Shanghai Library adopts different application development methods: use native app functions; expand some localized functions based on native apps and develop new apps to meet new localized services. In addition, the apps of the Shanghai Library are developed by many developers, which requires the Shanghai Library to coordinate the project progress and confirm the apps boundary.

The user and developer community is the core of FOLIO. The Shanghai Library actively participates in the FOLIO community and Chinese library community, which are the platforms for the information exchange and cooperation among libraries, developers, and integrators. Many Chinese libraries and developers converge in Chinese library community. The Shanghai Library has benefited a lot from the community interactions including open meetings, regular seminars, newsletters and special interest groups. The Shanghai Library has learned about the latest information of FOLIO and its implementation experience and applied it to the project. Shanghai Library worked with community members to sort out the needs of Chinese applications and put forward constructive suggestions for FOLIO technology architecture.

The Shanghai Library has created some new applications for FOLIO, and the scale of the FOLIO is constantly expanding after the release is upgraded. The Shanghai Library hopes to explore the FOLIO extension mechanism to ensure the continuity of FOLIO. (1) Libraries will need more apps in the future, but the FOLIO project cannot expand indefinitely. The FOLIO community has some ideas, such as platform-minimal, and core apps & optional apps. Chinese library community suggests the idea of "Platform + App + App Store" and expects that FOLIO

community pays more attention to the platform, core apps and fundamental components; other apps developed outside the community are non-core apps that managed by the App Store. (2) FOLIO development is under the control of the FOLIO community. It does not consider developing "compatible" apps outside the community and lacks a series of specifications like the smartphone app ecosystem. The Shanghai Library and Chinese library community hopes that FOLIO community will discuss and formulate app development specifications, data specifications, interface specifications, deployment specifications, etc., to clarify FOLIO development, operation, and maintenance standards for developers.

Adequate training and testing can reduce the implementation risks. FOLIO has relatively complete documentation and wiki. The Shanghai Library has prepared training documents, training videos, brief manuals, and arranged online and on-site training sessions, to help librarians get familiar with FOLIO circulation as soon as possible. Before FOLIO went alive in Shanghai Library East, the public beta testing enables the circulation service department and the IT department to jointly examine the gap between FOLIO circulation and the actual service scene, timely improve the business process and adjust FOLIO functions so that FOLIO can meet the demand of library services in a limited time.

It is important that the maintenance is reliable to guarantee the normal operation of FOLIO. The Shanghai Library is improving the responsibilities and service level agreements of the support team. Librarians raise issues through instant messaging tools and hotlines, and the support team quickly locate issues and solve problems with the help of the monitoring system. The support team has basically provided the 24/7 hours technical service for the Shanghai Library.

The dual-system parallel circulation under specific conditions has certain reference significance for the migration mode of super-large public libraries or an alliance. The Shanghai Library adopts the dual-system parallel circulation between the members of the "One Card Library Alliance," which increases the development and maintenance work, but reduces the risks during the implementation.

The Shanghai Library faces great challenges in data migration. After evaluating the data in Horizon System, the metadata group and the data migration group found that the data amount was huge, the quality of earlier data was poor, and there were many errors in the data of the alliance members. The data migration group and circulation development group jointly conducted data analysis, data cleaning, conversion, import, conversion rules and circulation parameter adjustment. A total of five test migrations were conducted to improve the data quality and estimate the migration time. The final formal data migration lasted around one week. Even if all parties cooperated closely, there were still a small number of errors in bibliographic records, items, and circulation data. FOLIO circulation cannot work with wrong data under some scenarios. The support team sorted out the types of errors, improved the quality of technical service, and reduced the impact of wrong data for circulation service.

CONCLUSIONS AND PROSPECTS

The first implementation in China, FOLIO is successful online in a super-large research and public library, the Shanghai Library. It fulfilled all the functional and service requirements as initially desired by the project team in spite of the fact that the implementation procedure was tortuous. It shows that the FOLIO can adapt to Chinese libraries and the consortium needs of the library alliance, and it indicates FOLIO's open cooperation concepts are recognized by Chinese

libraries and developers. It has the potential to expand its adoption in Chinese library community.

The journey has just started for Yunhan. Many challenges will exist in the future. Shanghai Library is organizing and coordinating all members to prepare and implement the FOLIO circulation in "One Card Library Alliance." Chinese library community will soon announce the core suite of Yunhan products for free trial and experience. Chinese library community is also actively planning the product roadmap of Yunhan, promoting and researching various development specifications and interface specifications, and releasing a series of standard specifications, white papers and manuals when the time is ripe. To fully promote the enthusiasm and initiative for the members, Chinese library community will continue to optimize the organization and collaboration, explore the decentralized autonomous organization, to actively impact on the governance, motivation, and decision-make among its community members. Finally, Yunhan community and Chinese FOLIO community, sincerely invite libraries at home and abroad to strengthen the exchange, discuss strategies, share experience, engage in collaborative cooperation, foster breakthrough and innovation, and work together to create a better future of an open library service platform.

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About the authors

ZHOU Gang is the engineer of Shanghai library, the member of FOLIO product council and the member of Yunhan alliance (namely FOLIO China community). He works as the FOLIO project manager since 2019, and is responsible for the project management, product management and implementation in Shanghai library FOLIO.

ZHANG Chunjing is the researcher of Shanghai Library and the Secretary-General of Yunhan alliance.

JI Ting is the researcher of system network center at Shanghai Library.

ZHOU Jiangchun is the researcher of system network center at Shanghai Library.

ZHANG Zheyu is the researcher of system network center at Shanghai Library.