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ABSTRACT

This analysis compares how the traditional integrated library system (ILS) and the next-generation ILS may impact system and technical services staffing models at academic libraries. The method used in this analysis is to select two categories of ILSs—two well-established traditional ILSs and three leading next-generation ILSs—and compare them by focusing on two aspects: (1) software architecture and (2) workflows and functionality. The results of the analysis suggest that the next-generation ILS could have substantial implications for library systems and technical staffing models in particular, suggesting that library staffing models could be redesigned and key librarian and staff positions redefined to meet the opportunities and challenges brought on by the next-generation ILS.

INTRODUCTION

Today, many academic libraries are using well-established traditional integrated library systems (ILSs) built on the client-server computing model. The client-server model aims to distribute applications that partition tasks or workloads between the central server of a library automation system and all the personal computers throughout the library that access the system. The client applications are installed on the personal computers and provide a user-friendly interface to library staff. However, this model may not significantly reduce workload for the central servers and may increase overall operating costs because of the need to maintain and update the client software across a large number of personal computers throughout the library. [1]

Since the global financial crisis, libraries have been facing severe budget cuts, while hardware maintenance, software maintenance, and software licensing costs continue to rise. The technology adopted by the traditional ILS was developed more than ten years ago and is evidently outdated. The traditional ILS does not have sufficient capacity to provide efficient processing for meeting the changing needs and challenges of today's libraries, such as managing a wide variety of licensed electronic resources and collaborating, cooperating, and sharing resources with different libraries.[2]

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Today's libraries manage a wide range of licensed electronic resource subscriptions and purchases. The traditional ILS is able to maintain the subscription records and payment histories but is unable to manage details about trial subscriptions, license negotiations, license terms, and use restrictions. Some vendors have developed electronic resources management system (ERMS) products as standalone products or as fully integrated components of an ILS. However, it would be more efficient to manage print and electronic resources using a single, unified workflow and interface.

To reduce costs, today's libraries not only band together in consortia for cooperative resource purchasing and sharing, but often also want to operate one "shared ILS" for managing, building, and sharing the combined collections of members.[3] Such consortia are seeking a new ILS that exceeds traditional ILS capabilities and uses new methods to deliver improved services. The new ILS should be more cost effective, should provide prospects for cooperative collection development, and should facilitate collaborative approaches to technical services and resource sharing. One example of a consortium seeking a new ILS is the Orbis Cascade Alliance, which includes thirty-seven universities, colleges, and community colleges in Oregon, Washington, and Idaho.

As a response to this need, many vendors have started to reintegrate or reinvent their ILSs. Library communities have expressed interest in the new characteristics of these next-generation ILSs; their ability to manage print materials, electronic resources, and digital materials within a *unified* system and a *cloud-computing* environment is particularly welcome.[4] However, one big question remains for libraries and librarians, and that is what implications the next-generation ILS will have on libraries' staffing models. Little on this topic has been presented in the library literature. This comparative analysis intends to answer this question by comparing the next-generation ILS with the traditional ILS from two perspectives: (1) software architecture, and (2) workflows and functionality, including the capacity to facilitate collaboration between libraries and engage users.

SCOPE AND PURPOSE

The purpose of the analysis is to determine what potential effect the next-generation ILS will have on library systems and technical services staffing models in general. Two categories of ILSs were chosen and compared. The first category consists of two major traditional ILSs: Ex Libris's Voyager and Innovative Interfaces' Millennium. The second category includes three next-generation ILSs: Ex Libris's Alma, OCLC's WorldShare Management Services (WMS), and Innovative Interfaces' Sierra. Voyager and Millennium were chosen because they hold a large portion of current market shares and because the authors have experience with these systems. Yale University Library is currently using Voyager, while Central Washington University Library is using Millennium. Alma, WMS, and Sierra were chosen because these three next-generation ILSs are produced by market leaders in the library automation industry. The authors have learned about these new products by reading and analyzing literature and vendors' proposals, as well as

attending vendors' webinars and product demonstrations. In the long run, Yale University Library must look for a new library service platform to replace Voyager, Verde, MetaLib, SFX, and other add-ons. Central Washington University Library is affiliated with the Orbis Cascade Alliance mentioned above. The Alliance is implementing a new library management service to be shared by all thirty-seven members of the consortium. Ex Libris, Innovative Interfaces, OCLC, and Serials Solutions all bid for the Alliance's shared ILS. After an extensive RFP process, in July 2012 the Orbis Cascade Alliance decided to choose Ex Libris's Alma and Primo as their shared library services platform. The system will be implemented in four cohorts of approximately nine member libraries each over a two-year period, beginning in January 2013. The Central Washington University Library is in the forth migration cohort, and their new system will be live in December 2014.

It is important to emphasize that the next-generation ILS has no local Online Public Access Catalog (OPAC) interface. Vendors use additional discovery products as the discovery-layer interfaces for their next-generation ILSs. Specifically, Ex Libris uses Primo as the OPAC for Alma, while OCLC's WorldCat Local provides the front-end interface for WMS. Innovative Interfaces offers Encore as the discovery layer for Sierra. As front-end systems, these discovery platforms provide library users with one-stop access to their library resources, including print materials, electronic resources, and digital materials. While these discovery platforms will also impact library organization and librarianship, they will have more impact on the way that end-users, rather than library staff, discover and interact with library collections. In this analysis, we focus on the effects that back-end systems such as Alma, WMS, and Sierra will have on library organizational structure and staffing, rather than the end-user experience.

As our sample only includes five ILSs, the scope of the analysis is limited, and the findings cannot be universal or extended to all academic libraries. However, readers will gain some insight into what challenges any library may face when migrating to a next-generation ILS.

LITERATURE REVIEW

A few studies have been published on library staffing models. Patricia Ingersoll and John Culshaw's 2004 book about systems librarianship describes vital roles that systems librarians play, with responsibilities in the areas of planning, staffing, communication, development, service and support, training, physical space, and daily operations.[5] Systems librarians are the experts who understand both library and information technology and can put the two fields together to context. They point out that system librarians are the key players who ensure that a library stays current with new information technology. The daily and periodic operations for systems librarians include ILS administration, server management, workstation maintenance, software and applications maintenance and upgrades, configuration, patch management, data backup, printing issues, security, and inventory. All of these duties together constitute the workloads of systems librarians. Ingersoll and Culshaw also emphasize that systems librarians must be proactive in facing constant changes and keep abreast of emerging library technologies.

Edward Iglesias et al., based on their own experiences and observations at their respective institutions, studied the impact of information technology on systems staff.[6] Their book covers concepts such as the client-server computing model, Web 2.0, electronic resource management, open-source, and emerging information technologies. Their 2004 studies show that, tough there are many challenges inherent in the position, there are also many ways for system staff to improve their knowledge, skills, and abilities to adapt to the changing information technologies.

Janet Guinea has also studied the roles of systems librarians at an academic library.[7] Her 2003 study shows that systems librarians act as bridge-builders between the library and other university units in the development of library-initiated projects and in the promotion of information technology-based applications across campus.

Another relevant study was conducted by Marshall Breeding at Vanderbilt University in an investigation of the library automation market. His 2012 study compares the well-established, traditional ILSs that dominate the current market (and are based on client-server computing architecture developed more than a decade ago) to the next-generation ILSs deployed through multitenant Software-as-a-Service (SaaS) models, which are based on service-oriented architecture (SOA).[8] Through this comparison, Breeding indicates that next-generation ILSs will differ substantially from existing traditional ILSs and will eliminate many hardware and maintenance investments for libraries. The next-generation ILS will bring traditional ILS functions, ERMS, digital asset management, link resolvers, discovery layers, and other add-on products together into one unified service platform, he argues.[9] He gave the next-generation ILS a new term, *library services platform.*[10] This term signifies that a conceptual and technical shift is happening: the next-generation ILS is designed to realign traditional library functions and simplify library operations through a more inclusive platform designed to handle different forms of content within a unified single interface. Breeding's findings conclude that the next-generation ILS provides significant innovations, including

> *management of print and electronic library materials, reliance on global knowledge bases instead of localized databases, deployment through multitenant SaaS based on a service-oriented architecture, and the provision of a suite of application programming interfaces (APIs) that enable greater interoperability and extensibility.*[11]

He also predicts that the next-generation ILS will trigger a new round of ILS migration.[12]

METHOD

Our method narrowed down the analysis for the implications of ILSs on library systems and technical services staffing models to two major aspects: (1) software architecture, and (2) workflows and functionality, including facilitation of collaborations between libraries and user engagement. First, we analyzed two traditional ILSs, Voyager and Millennium, which are built on a client-server computing model, deliver modular workflow functionality, and are implemented in our institutions. Through the analysis, we determined how these two aspects affect library organizational structure and librarian positions designed for managing these modular tasks. Then,

based on information we collected and grouped from vendors' documents, RFP responses, product demonstrations, and webinars, we examined the next-generation ILSs Alma, WMS, and Sierra—which are based on SOA and intended to realign traditional library functions and simplify library operations—to evaluate how these two factors will impact staffing models.

To provide a more in-depth analysis, particularly for systems staffing models, we also gathered and analyzed online systems librarian job postings, particularly for managing the Voyager or Millennium system, for the past five years. The purpose of this compilation is to cull a list of typical responsibilities of systems librarians and then determine what changes may occur when they must manage a next-generation ILS such as Alma, WMS, or Sierra. Data on job postings were gathered from online job banks that keep an archive of past listings, including code4lib jobs, ALA JobLIST, and various university job listing sites. Duplicates and reposts were removed. The responsibilities and duties described in the job descriptions were examined for similarities to determine a typical list. The data from all sources were gathered together in a single database to facilitate its organization and manipulation. Specific responsibilities, such as administering an ILS, were listed individually, while more general responsibilities for which descriptions may vary from one posting to another were grouped under an appropriate heading. To ensure complete coverage, all postings were examined a second time after all categories had been determined. We also used our own institutions as examples to support the analysis.

The Implications of ILS Software Architecture on Staffing Models

Voyager and Millennium are built on client-server architecture. Libraries that use these ILSs also use add-ons, such as ERMS and link resolvers, to manage their print materials and licensed electronic resources. The installation, configuration, and updates of the client software require a significant amount of work for library IT staff. Many libraries must allocate substantial staff effort and resources to coordinating the installation of the new software on all computers throughout the library that access the system. Those libraries that allow staff to work remotely have experienced additional costs and IT challenges. In addition, server maintenance, backups, upgrades, and disaster recovery also require excessive time and effort of library IT staff. Administering ILSs, ERMS, and other library hardware, software, and applications is one of the primary responsibilities for a library systems department. Positions such as systems librarian, electronic resource librarian, and library IT specialist were created to handle this complicated work.

At a very large library, such as Yale University Library, the systems group of library IT is only responsible for Voyager's configuration, operation, maintenance, and troubleshooting. Two other IT support groups—a library server support group and a workstation support group—are responsible for installation, maintenance, and upgrade of the servers and workstations. Specifically, the library server support group deals with the maintenance and upgrade of ILS servers and the software and relational database running on the servers, while the workstation support group takes care of the installation and upgrade of the client software on hundreds of

workstations throughout twenty physical libraries. At a smaller library, such as Central Washington University Library, on the other hand, one systems librarian is responsible for the administration of Millennium, including configuration, maintenance, backup, and upgrade on the server. Another library IT staff member helps install and upgrade the Millennium client on about forty-five staff computers throughout its main library and two center campus libraries.

Comparatively, the next-generation ILSs Alma, WMS, and Sierra have a SaaS model designed by SOA principles and deployed through a cloud-based infrastructure. OCLC defines this model as "Web-scale Management Services."[13] Using this innovation, service providers are able to deliver services to their participating member institutions on a single, highly scalable platform, where all updates and enhancements can be done automatically through the Internet. The different participating member institutions using the service can configure and customize their views of the application with their own brandings, color themes, and navigational controls. The participating member institutions are able to set functional preferences and policies according to their local needs. Web-scale services reduce the total cost of ownership by spreading infrastructure costs across all the participating member institutions. The service providers have complete control over hardware and software for all participating member institutions, dramatically eliminating capital investments on local hardware, software, and other peripheral services. Service providers can centrally implement applications and upgrades, integration across services, and system-wide infrastructure requirements such as performance reliability, security, privacy, and redundancy. Thus participating member institutions are relieved from this burdensome responsibility that has traditionally been undertaken by their IT staff.[14]

From this perspective, the next-generation ILS will have a huge impact on library organizational structure, staffing, and librarianship. Since the next-generation ILS is implemented through the cloud-computing model, there is no requirement for local staff to perform the functions traditionally defined as "systems" staff activities, such as server and storage administration, backup and recovery administration, and server-side network administration. For example, the entire interfaces of Alma and WMS are served via web browser; there is no need for local staff to install and maintain clients on local workstations. Therefore, if an institution decided to migrate to a next-generation ILS, the responsibilities and roles of systems staff within the institution would need to be readdressed or redefined. We have learned from attending OCLC's webinars and product demonstrations that library systems staff would be required to prepare and extract data from their local systems during new systems implementation. They also would be required to configure their own settings such as circulation policies. However, after the migration, a systems staff member would likely serve as a liaison with the vendor. This would require, according to OCLC's proposal, only *10 percent* of the systems staff's time on an ongoing basis. Through attending Ex Libris's webinars and product demonstrations, we have learned that a local system administrator may be required to take on basic management processes, such as record-loading or integrating data from other campus systems. Similarly, we have learned from Innovative Interfaces' webinars and product demonstrations that Sierra would still need local systems

expertise to perform the installations of the client software on staff workstations. Sierra would require library IT staff to perform administrative tasks like the user account administration and to support Sierra in interfacing with local institution-specific resources.

In general, as shown in table 1, local systems staff could be freed from the burdensome responsibility of administering the traditional ILS because of the software architecture of the next-generation ILS.

Systems Librarian Responsibilities	Workload Percentage	Traditional ILS	Next-gen ILS
Managing ILS Applications, including modules and the OPAC	10	X	
Managing associated products such as discovery systems, ERMs, link resolver, etc.	10	X	
Day-to-day operations including management maintenance, troubleshooting, and user support	10	X	X
Server maintenance, database maintenance and backup	10	X	
Customizations and integrations	5	X	X
Configurations	5	X	X
Upgrades and enhancements	5	X	
Patches or other fixes	5	X	
Design and coordination of statistical and managerial reports	5	X	X
Overall staff training	5	X	X
Primary representative and contact to the designated library system vendors	5	X	X
Keeping abreast of developments in library technologies to maintain current awareness of information tools	5	X	X
Engaging in scholarly pursuit and other professional activities	10	X	X
Serving on various teams and committees	5	X	X
Reference and instruction	5	X	X
Total	**100**	**100%**	**60%**

Table 1. Systems librarian responsibilities comparison for traditional ILS and next-generation ILS.

Note: The systems librarian responsibilities and the approximate percentage of time devoted to each function are slightly readjusted based on the compiled descriptions of the systems librarian job postings we collected and analyzed from the Internet and from vendors' claims. A total of 47 position

descriptions were gathered. The workload percentage is adopted from the job description of the systems librarian position at one of our institutions.

Our analysis shows that systems staff might reduce their workload by approximately *40 percent*. Therefore library systems staff could use their time to focus on local applications development and other library priority projects. However, it is important to emphasize that library systems staff should reengineer themselves by learning how to use APIs provided by the next-generation ILS so that they will be able to support the customization of their institutions' discovery interfaces and the integration of the ILS with other local enterprise systems, such as financial management systems, learning management systems, and other local applications.

The Implications of ILS Workflows and Functionality on Staffing Models

The typical workflow and functionality of both Voyager and Millennium are built on a *modular* structure. Major function modules, called *client modules*, include Systems Administration, Cataloging, Acquisitions, Serials, Circulation, and Statistics and Reports. Additionally, the traditional ILS provides an OPAC interface for library patrons to access library materials and manage their accounts. Millennium has an ERMS module built in as a component of their ILS while Ex Libris has developed an independent ERMS as an add-on to Voyager. The Systems Administration module is used to add system users and to set up locations, patron types, material types, and other library policies. The Cataloging module supports the functions of cataloging resources, managing the authority files, tagging and categorizing content, and importing and exporting bibliographic records. The sophistication of the Cataloging module depends primarily on the ILS. The Acquisitions module helps in the tracking of purchases and acquisition of materials for a library by facilitating ordering, invoicing, and data exchange with serial, book, and media vendors through *electronic data interchange* (EDI). The Circulation module is used to set up rules for circulating materials and for tracking those materials, allowing the library to add patrons, issue borrowing cards, and form loan rules. It also automates the placing of holds, interlibrary loan (ILL), and course reserves. Self-checkout functionality can be integrated as well. The Serials module is essentially a cataloging module for serials. Libraries are often dependent on the Serials module to help them track and check-in serials. The Statistics and Reports module is used to generate reports such as circulation statistics, age of collection, collection development, and other customized statistical reports. A typical traditional ILS comprises a relational database, software to interact with that database, and two graphical user interfaces—one for patrons and one for staff. It usually separates software functions into discrete modules, each of them integrated with a unified interface.

The traditional ILS's modular design was a perfect fit for a traditional library organizational structure. The staff at Central Washington University library, for example, under the library administration, are organized into the following three major groups: public services, including the Reference and Circulation Departments; technical and technology services, including the Cataloging, Collection Development, Serials & Electronic Resource, and Systems Departments; and

other library services and centers, including the Government Documents Department, the Music Library, two center campus libraries, the Academic and Research Commons, and the Rare Book Collection & Archive. Each department has at least one professional librarian and other library staff members responsible for their daily operations. For example, the collection development librarian is responsible for the acquisition of print monographs and serials, while the electronic resource librarian is responsible for purchasing and managing licensed databases or e-journals.

However, the next-generation ILS significantly enhances and reintegrates the workflow of traditional ILS functions. The functionality is quite different from the traditional ILS's modular structure. The design of the functionality stresses two principles: *modularity* and *extensibility*. It brings together the selection, acquisition, management, and distribution of the *entire* library collection. It provides a centralized data-services environment to its unified workflows for all types of library assets.

One of the big enhancements of the next-generation ILS is the Acquisitions module, which enables the management of both print and electronic materials within a single unified interface, with no need to move between modules or multiple systems for different formats and related activities. For example, according to OCLC, WMS streamlines selection and acquisition processes via built-in access to WorldCat records and publisher data. Vendor, local, consortium, and global library data share the same workflows. WMS automatically creates holdings for both physical and electronic resources. The WorldCat knowledge-base simplifies electronic resource management and delivery. Order data from external systems can be automatically uploaded. For consortium users, WMS's unified workflow and interface fosters efficient resource-sharing between different institutions whose holdings share a common format. Similarly, Ex Libris's Alma has an integrated Central Knowledge Base (CKB) that describes available electronic resources and packages, so there is no need to load additional descriptive records when acquiring electronic resources based on the CKB. The purchasing workflow manages orders for both print and electronic resources in a very similar way and handles some aspects unique to electronic resources, such as license management and the identification of an access provider. Staff users can start the ordering process by searching the CKB directly and ordering from there. This search is integrated into the repository search, allowing a staff user to perform searches both in his or her institution as well as in the Community Zone, which holds the CKB. The next-generation ILS provides unified data services and workflows, and a single interface to manage all physical, electronic, and digital materials. This will require libraries to rethink their acquisitions staffing models. For example, in small libraries could merge the acquisition librarian position and the electronic resource librarian position or reorganize the two departments.

Another functionality enhancement of the next-generation ILS provides the authoritative ability for consortia users to manage local holdings and collections as well as shared resources. For example, WMS's single shared knowledge base eliminates the need for each library to maintain a copy of a knowledge base locally, because all consortia members can easily see what is licensed by other members of the consortia. Cataloging records are shared at the consortium and global levels

in real time. Each institution immediately benefits from original cataloging records added to the system and from enhancements to existing records. Authority control is built into WorldCat, so there is no need to do authority processing against local bibliographic databases. With real-time circulation between libraries' collections, there is no need to re-create bibliographic and item data in separate local systems. Similarly, Sierra enhances the traditional technical services workflows by providing a shared bibliographic database. Whenever a member library performs selection or ordering, the library is able to determine if other consortia members have already selected, ordered, and cataloged the title. This may impact a local selection, allowing consortia members to more collectively develop their individual collections and reduce duplication. Alma's centralized Metadata Management Service (MMS) takes a very similar approach to WMS and Sierra, allowing several options for local control and shared cataloging, depending on an institution's needs, while Ex Libris maintains authority files. Very large institutions, for example, might manage some records in the local catalog and most records in a shared bibliographic database, while smaller institutions might manage all of their records in the shared bibliographic database. All these approaches require more collaboration and cooperation between consortia members. According to vendors' claims on their proposals to the Orbis Cascade Alliance, small institutions might not need to have a professional cataloger, since the cataloging process is simplified and it is therefore easier for paraprofessional staff to operate and copy bibliographic records from the knowledgebases of these ILSs.

In addition, the next-generation ILS also allows library users to actively engage with ILS software development. For example, by adding OpenSocial containers to the product, WMS allows library developers to use API to build social applications called *gadgets* and add these gadgets to WMS. One example highlighted by OCLC is a gadget in the Acquisitions area of WMS that will show the latest *New York Times* Best Sellers and how many copies the library has available for each of those titles. Similarly, Sierra's Open Developer Community will allow library developers to share ideas, reference code samples, and build a wide range of applications using Sierra's web services. Also, Sierra will provide a centralized online resource called Sierra Developer Sandbox to offer a comprehensive library of documented APIs for library-developed applications.

All these enhancements provide library staff with new opportunities to redefine their roles in a library.

CONCLUSIONS AND ARGUMENTS

In summary**,** compared to the client-server architecture and modular design of the traditional ILS, the next-generation ILS has an open architecture and is more flexible and unified in its workflow and interface, which will have a huge impact on library staffing models. The traditional ILS specifies clear boundaries between staff modules and workflows while the next-generation ILS has blurred these boundaries. The integration and enhancement of the functionality of the next-generation ILS will help libraries streamline and automate workflows and processes for managing both print and electronic resources. It will increase libraries' operational efficiency, reduce the

total cost of ownership, and improve services for users. Particularly, it will free approximately *40 percent* of library systems staff time from managing servers, software upgrades, client application upgrades, and data backups. Moreover, the next-generation ILS provides a new way for consortial libraries to collaborate, cooperate, and share resources. In addition, the web-scale services provided by the next-generation ILS allow libraries to access an infrastructure and platforms that enable them to reach a broad, geographically diverse community while simultaneously focusing their services on meeting the specific needs of their end-users. Thus the more integrated workflows and functionality allow library staff to work with more modules, play multiple roles, and back up each other, which will bring changes to traditional staffing models.

However, the next-generation ILS also brings libraries new challenges along with its clear advantages. Librarians and library staff might have concerns pertaining to their job security and can be fearful of new technologies. They may feel anxious about how to reengineer their business processes, how to get training, how to improve their technological skills, and how to prepare for a transition. We argue here that library directors might think about these staff frustrations and find ways to address their concerns. Libraries should provide staff more opportunities and training to help them to improve their knowledge and skills. Redefining job descriptions and reorganizing library organizational structures might be necessary to better adapt to the changes brought about by the next-generation ILS. Systems staff might invest more time in local application developments, other digital initiatives, website maintenance, and other library priority projects. Technical staff might reconsider their workflows and cross-train themselves to expand their knowledge and improve their work efficiency. They might spend more time on data quality control and special collection development or interact more with faculty on book and e-resource selections.

We hope this analysis will provide some useful information and insights for those libraries planning to move to the next-generation ILS. The shift will require academic libraries to reconsider their organizational structures and rethink their manpower distribution and staffing optimization to better focus on library priorities, projects, and services critical to their users.

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