Strategic Technology strengthens the Capacity of Libraries to serve their Communities

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Abstract:

In this era where libraries face enormous pressures in terms of inadequate funding and increasing demands for their services, technology plays a large factor in their success. The stakes for libraries to deploy the most appropriate technology platforms for resource management and discovery have never been higher. Academic, research, and national libraries experience more complexity than ever in managing collections of large scale and diverse formats. Public libraries need systems optimized as much for lending e-books or other digital materials in addition to their longstanding print offerings. Marshall Breeding, an expert in library resource management and discovery services will provide an overview of the technology products now available and how they have been received by libraries globally and explore some the major trends currently underway. The presentation will cover the major proprietary and open source options and will address their adoption across geographic and economic sectors. The presentation is based on Breeding's ongoing research published in the annual Library Systems Report, the International Perceptions Survey of Library Automation, and from other data managed in Library Technology Guides (librarytechnology.org).

Keywords: technology**,** integrated library systems, library services platforms, discovery services

1 GENERAL INTRODUCTION

Libraries of different types and in different global regions each have distinctive characteristics in the types of materials that comprise their collections and in the services they provide to their patrons. These differing categories of libraries likewise require technology well suited to their needs and within the reach of their economic resources and manageable by the level of expertise available within their organizations.

This paper explores some of the trends seen in the global library technology arena related to the resource management systems and discovery services adopted. These patterns are based on data collected in Library Technology Guides and the libraries.org global directory of libraries, the annual Library Systems Report, and other resources.

2 ACADEMIC LIBRARY TRENDS

Libraries serving higher educational institutions such as colleges and universities work to provide resources in support of their faculty and students. Within the range of post-secondary education,

libraries differ considerably, but there are many areas of commonality. These libraries have seen a dramatic transformation in their collections away from printed materials to ever larger proportions of electronic resources. While many maintain print collections which have been amassed in previous eras, the numbers of new print monographs added each year have seen sharp declines. Serials and periodicals have shifted to mostly electronic publication, with only a small number of issues that continue to be received in print.

2.1 Library Services Platforms

Larger academics are moving toward the adoption of library services platforms. These new products, implemented since about 2011, provide a comprehensive set of tools able to manage library resources in multiple formats, including electronic resources, print and other physical materials, and digital objects. Library services platforms rely on web-based interfaces and are deployed via multi-tenant infrastructure able to provide shared access to knowledge bases and bibliographic resources as core services. The two products which most clearly fit the model of library services platform include Alma from Ex Libris and WorldShare Management Services from OCLC. Innovative's Sierra product embodies a sub-set of the characteristics of a library services platform. ProQuest had announced its development of a library services platform branded as Intota, but this effort ended when it acquired Ex Libris.

2.2 Transition in Large Academic Libraries

The transition from integrated library systems to library services platforms can be considered to be in a relatively early phase. The vast majority of academic libraries still rely on integrated library systems, though most procurements of new systems in academic libraries result in the selection of a library services platform, with Ex Libris Alma currently seeing strong popularity. Even among the group of academic libraries in North America represented by members of the Association of Research Libraries, only 29 out of the 125 have implemented a library services platform, with 26 having committed to Alma and 3 to WorldShare Management Services. Integrated library systems represented among ARL members include Aleph (16), Voyager (27), Symphony (17), Sierra (15), Millennium (15), Horizon (2), and Kuali OLE (1). The automation patterns seen among the ARL members are roughly representative of the libraries serving the largest universities in the United States, Canada, Australia/New Zealand, and the countries of Western Europe.

2.3 Patterns in other International Regions

Large academic libraries outside this group would see a somewhat different pattern, with more using traditional integrated library systems, with less penetration of library services platforms. The integrated library systems provided by the international companies such as SirsiDynix, Innovative, and Ex Libris are represented in almost all global regions, with varying degrees of dominance. Some products are represented only in specific countries or regions, such as TOTALS in China and Taiwan, or Capita Alto in the United Kingdom. Japan remains dominated by automation systems provided by local companies, with only a small number of academic libraries using products from the international suppliers.

2.4 Patterns in Developing Nations

Academic libraries in developing nations generally have collections with large proportions of print and more have more limited numbers of subscriptions to electronic resources. These libraries tend to implement integrated library systems rather than library services platforms. Open source ILS products, especially Koha, are widely implemented.

2.5 Vulnerability of the ILS for Academic Libraries

If the trend continues where most new procurements select library services platforms, the number of traditional ILS deployments will decrease over time among large academic libraries. Integrated library systems created during the era when print materials dominated academic libraries and for all types of libraries face significant challenges when competing against a new genre of products developed specifically for the needs of academic libraries. Unless companies such as SirsiDynix and Innovative make massive investments to strengthen their products for academic libraries, they will likely see their customer base drift to larger proportions of public and other types of libraries.

2.6 Trend toward Shared Technology Infrastructure

Many academic libraries are implementing technology infrastructure shared by large groups of institutions, either though large multi-campus systems or through consortia. By sharing an automation system, participants are able to provide a much larger collective collection for the benefit of their users and to reduce technology costs. Some of these projects include:
- **Orbis Cascade Alliance**: 37 institutions (Ex Libris Alma)
- **Wales Higher Education Libraries Forum**: All major academic libraries and the national library in Wales (Alma)
- **California State University**, with its 23 campuses previously automated independently are implementing Aleph jointly.
- **University System of Georgia**, 31 campuses implementing Alma, migrating from Voyager
- **Florida Academic Library Services Cooperative**, representing all the public universities and community colleges in Florida will implement Sierra and Encore from Innovative Interfaces, integrated with EBSCO Discovery Service
- **BIBSYS**: 105 libraries in Norway, including the national library, major academics, and research libraries
- **JULAC**: All 9 public universities in Hong Kong, implementing a shared Alma ILS, migrating from separate Millennium implementations.

2.7 Index-based Discovery in Academic Libraries

The genre of index-based discovery services has become well established among large academic libraries across most global regions. These products include central indexes generated from citations and full text at the article level for most of the body of scholarly communications. An index-based discovery service is configured with the profile of a library's active subscriptions so that patrons will receive results only from the resources for which they have access. These indexes also include the bibliographic records harvested from a library's resource management system. Configured in this way, these discovery services are able to present a single search box which addresses the full range of resources available from the library. Although some gaps remain in coverage, index-based discover services provide a very powerful search capability and have been implemented by a large portion of academic libraries.

2.8 Major Discovery Products

Organizations offering index-based discovery services make massive investments in the technical platforms able to ingest, index, and search multiple billions of content items and to make arrangements with hundreds of publishers to provide content. Largely due this high threshold of expense and difficulty, only a limited number of these discovery services have been developed. The current slate of index-based discovery services includes:
- **EBSCO Discovery Service** from EBSCO Information Services. This product is designed to work with any integrated library system or library services platform. EBSCO reports that it has formed partnerships with as many as 60 companies offering ILS products.

- **WorldCat Discovery Service** from OCLC. The successor to WorldCat Local, this product extends the massive WorldCat database of bibliographic records with article citations from the major publishers of scholarly content. WorldCat Discovery Service operates with any of the major ILS products and is the primary patron interface for WorldShare Management Services.
- **Summon**, is the index-based discovery service created by ProQuest in 2009 as the first product in this genre. Summon can be implemented in conjunction with all of the major ILS products used by academic libraries.
- **Primo** from Ex Libris was launched by Ex Libris in 2006 as an advanced search interface and was enhanced with Primo Central in 2009, giving it the capability for immediate article-level search. Primo was created to operate with any of the ILS products used in academic libraries and is the primary interface for Alma.

2.9 ProQuest acquisition of Ex Libris

The December 2015 acquisition of Ex Libris by ProQuest has implications for the overlapping index-based discovery services of the two companies. Summon and Primo will continue to be supported and developed as distinct products. Summon's more streamlined interface appeals to a different set of libraries than Primo's more complex and configurable interface. Although both interfaces will be preserved, the underlying indexes will be consolidated. This strategy results in better content coverage than either had separately and provides significant savings for the company since it will only have to maintain one central index.

2.10 A new Open Source Library Services Platform for Academic Libraries

An initiative to create an open source resource management platform for academic libraries began in 2008, funded by a series of grants from the Andrew W. Mellon Foundation. This project, afterward known as Kuali OLE operated under the governance of the Kuali Foundation and was built using the Kuali Rice middleware for its technical foundation. The libraries involved in the project included Indiana University, Pennsylvania University, the University of Maryland, Lehigh University, the University of Chicago, Duke University, and North Carolina State University. The Kuali OLE project ran into complications due both to the growing obsolesce of the Kuali Rice middleware and a major upheaval of the Kuali Foundation as it moved to a more commercialized model of software development and support.

A new project to create an open source library services platform for academic libraries was launched in late 2015, backed with major funding from EBSCO Information Services. This initiative will make a concerted effort to design and develop new software quickly through a combination of commercial development and community participation. This new system will be based on a microservices architecture and modular components. The idea lies in enabling functional modules can be created and replaced independently rather than creating a complex system with tightly interwoven functionality. One of the fundamental expectations of this initiative focuses on enabling libraries to choose discovery services apart from resource management systems. EBSCO has opted to support this open source project rather than acquiring a company with an integrated library system or to build its own. As the provider of the leading discovery service, EBSCO has a strategic interest in disrupting the current trend where resource management systems come bundled with discovery services. The Kuali OLE project voted in February 2016 to shift from forward development of its own software to participation in this new initiative. While this project remains in its very early phase, it brings the potential to alter the dynamics of the academic library technology arena.

3 PUBLIC LIBRARY TRENDS

Public libraries devote much of their energies to the circulation of physical materials. While involvement for e-books and audiobooks continues to rise, most public libraries have not seen declines in the circulation of physical materials. Larger public libraries will also maintain a limited number of subscriptions to electronic resources, mostly generalized databases of articles rather than the specialized resources oriented to academic and research libraries.

3.1 Reliance on Integrated Library Systems

Public libraries rely primarily on integrated library systems as their strategic technology infrastructure. The model of library automation embodied in the ILS continues to work well for libraries mostly oriented to physical materials. The functional modules of cataloguing, circulation, acquisitions provide automation support for library personnel to acquire and manage collection materials. Built-in online catalogs serves as the primary tool which patrons use to search the collection, select materials, and perform self-service options.

3.2 Evolutionary development

The automation systems used by public libraries have followed a more evolutionary development path, compared to the academic sector where the most successful products are those recently created from scratch. The radical transformation of academic library collection to a preponderance of electronic resources demanded a fresh start for resource management. Public libraries, however, have seen more continuity in the nature of their collections. Print and other physical resources form foundation of public library collections and the circulation of these materials continues at vigorous levels.

3.3 Emphasis on digital lending services

Public libraries extend their offerings of print materials with digital lending services for e-books and audiobooks. Some also offer streaming services for audio and video content. The provision of these digital and lending services for most libraries represents new activity that does not necessarily diminish the numbers of physical items circulated.

Most libraries engage with commercial providers to deliver e-book lending services. In North America, OverDrive is well established as the dominant provider of e-book lending services to libraries. Others providers include Bibliotheca with the Cloud Library service, acquired from 3M in November 2015, and the Axis 360 service from Baker & Taylor. ODILO, based in Madrid, has seen growing interest in its e-book lending service.

3.4 Reliance on external providers

These providers provide technology platforms which manage the process of lending e-books, which requires the use of digital rights management to enforce compliance with the rules required by the publisher. The DRM technology, provided through the Adobe Content Server, ensures that digital items checked out from the library cannot be shared or re-distributed and that materials are returned or deactivated within the stated loan period. These platforms also require the use of an app or web-based reader for patrons to view the materials. These providers populate their platforms with content by making distribution agreements with publishers.

3.5 Technical and Business Challenges

Challenges for e-book lending include both technical and business concerns. Public libraries have a strong interest to preserve their identity and branding as their patrons take advantage of the e-book

lending services they sponsor. The basic service of e-book lending can be accomplished by the library contracting with one or more of the commercial services and licensing a collection of titles. The library can then simply place a button or link on their web site which connects patrons to the platform of the e-book lending service, which then enables them to search for and download available titles. Access to this service would be controlled through authentication based on the patron's account within the ILS. This basic model provides a valuable service, but in a way that disjointed from the library's own virtual environment.

One of the major areas of technical development for public libraries has been through creating a more integrated approach for e-book lending. Rather than simply jettisoning patrons from the library's web site or catalog, techniques are being developed to contain the e-book lending process within the interfaces provided by the library. The initial level of integration consists of loading bibliographic records for e-book collections within the ILS so that patrons will see both printed and electronic versions of titles in search results. Patrons selecting an e-book would then be taken directly to that resource in the external platform to complete the transaction. A deeper level of integration enables the library to perform the entire process from within their own online catalog of discovery interface. This approach enables the library's ILS to make use of APIs (application programming interfaces) exposed by the e-book platforms to execute the loan. This approach enables libraries to provide a more user-friendly e-book lending experience with more opportunities to engage their patrons with their collections and services.

Libraries also seek more favourable business terms. Publishers, concerned that library lending might erode consumer sales, not only require strict protection of their content through digital rights management, but also impose business terms that many libraries find problematic. These terms include pricing that may be as much as ten times higher for libraries than the standard retail cost. Some require that libraries re-license a title after it has been lent beyond a stated number of times.

3.6 Technology Providers

A set of international and regional companies provide integrated library systems and related technologies to public libraries. Many of these libraries also take advantage of open source products. A variety of different trends and patterns can be seen in the technologies implemented in public libraries.

The international companies have a large and growing presence in public libraries in almost all regions. Some of these companies include:

- **SirsiDynix**, offering its Symphony and Horizon ILS products designed for libraries of all types, though more widely implemented in public libraries. Based in the United States, SirsiDynix holds significant market share in Australia / New Zealand, the United Kingdom and other parts of Europe, South Africa, parts of Asia, Latin America, with smaller representation in other countries and regions. SirsiDynix has focused its development in recent years on its BLUEcloud suite of interfaces and products which operate in conjunction with Symphony or Horizon to provide modern web-based interfaces and new areas of functionality.
- **Innovative Interfaces**, based in the United States also has wide international involvement. The company has followed an evolutionary development strategy, with Sierra positioned as its latest product, bringing forward mature functionality into a more modern architecture. Innovative's customers are currently in transition, with many continuing to use Millennium. Sierra and Millennium have been implemented in almost all international regions. Innovative acquired the Polaris ILS in March 2014. Polaris was created specifically for public libraries and is used almost exclusively within the United States and Canada.
- **The Library Corporation** provides its Library.Solution for small to mid-sized public libraries and Carl.X for large libraries and consortia. With only a few exceptions almost all of The Library Corporation's customers are in the United States.

- **Auto-Graphics** offers the VERSO integrated library system, which is implemented almost exclusively in the United States. The company also offers interlibrary loan and resource sharing products.
- **Civica,** an international firm based in Australia and the United Kingdom, serves local government agencies with a wide variety of technology products and services. The company's library division offers the Spydus family of library automation products which have been implemented in public libraries in many global regions including Australia, New Zealand, the United Kingdom, Singapore, Taiwan, and other parts of Asia. Only a handful of libraries in the United States have implemented Spydus.
- **Infor Library and Information Solutions,** is a small division with Infor which ranks as one of the major global information technology services companies. Infor offers the V-smart and Vubis family of integrated library systems which are widely used in the United Kingdom, Belgium, France, The Netherlands, and Canada. A small number of libraries in the United States have implement Vubis Smart or v-Smart.
- **Baratz**, based in Spain, offers its Absys.net family of integrated library systems which widely used in public libraries in Spain, Portugal, France, and in some countries in Latin America.
- **Axiell**, based in Sweden, offers a variety of integrated library systems which are used in public libraries in Sweden, Finland, and the United Kingdom. In recent years the company has seen some diminishment in its library business and has expanded into technology products for archives, museums, and other cultural organizations.

In addition to these companies, dozens of others are active in specific countries or other geographic regions. As a general trend, these smaller local companies see some attrition to systems provided by the international companies since they often do not have the resources to support development through multiple cycles of technology architectures.

3.7 Public library discovery strategies

Most public libraries rely on the online catalog or discovery service provided with their integrated library systems. The online catalog comes as a module of the integrated library system and provides patrons with a variety of features related to searching the library collection as well as to enable them to perform self-service features such as viewing their account, placing requests for materials, renewing items, paying fines or fees, and other tasks. Online catalogs face the challenge of keeping up with very high expectations for user interfaces relative to others to which library patrons have become acclimated on the Web and social networks. Some public libraries have turned to discovery interfaces to supplement or replace the online catalog module of their ILS.

Some of the current discovery interfaces used by public libraries include:
- **BiblioCore**, developed by BiblioCommons a company based in Toronto, Canada. BiblioCore supplements basic search and retrieval capabilities with a variety of social features aimed to increase patron engagement with the library, its collection, and with their peers. BiblioCore is designed to work with any integrated library system. The company also recently developed **BiblioCMS** as a full replacement for the library's website. BiblioCommons targets large and mid-sized public library systems or consortia.
- **Iguana**, developed by Infor, provides capabilities both as a discovery interface and a content management system for a public library. Iguana is used primarily, if not exclusively by libraries that have implemented its V-smart of Vubis Smart integrated library systems.
- **Arena**, developed by Axiell, is a discovery interface and content management system which can be used with any of the company's integrated library systems or with its archival or museum management systems.
- **Enterprise** is a premium discovery interface available from SirsiDynix for use with its Symphony or Horizon ILS products. Enterprise includes relevancy-based search and retrieval, faceted navigation, and other features not available in its basic online catalog products. An extended version of the product, called Portfolio, provides the capability to manage digital

collections. SirsiDynix has also partnered with EBSCO to offer integration between Enterprise and EBSCO Discovery Service.

- **Encore** is the premium discovery interface from Innovative Interfaces for Sierra and Millennium, including capabilities for relevancy-based search, faceted navigation, and other features. Innovative also offers Encore Duet, integrating search results from the ILS with those from EBSCO Discovery Service.

4 OPEN SOURCE LIBRARY TECHNOLOGY PRODUCTS

In addition to proprietary products, open source versions of resource management and discovery interfaces are well established. As open source software, all libraries are able to download and install these products without any licence fee, can make modifications for local customizations. These open source products have been adopted in many different types of libraries, in differing geographic regions, and with different models of development and support. While some libraries are able to use these open source products entirely on their own, there are also many commercial or non-profit organizations which offer services for migration, installation, support, and hosting.

Some of the major open source library products include:
- **Koha**, an open source integrated library system originally created for a small public library system in New Zealand in 1999. The product has seen continuous development since that time and has been implemented in libraries in all parts of the world. Koha is probably the most implemented integrated library system in the world, though the exact number of sites has never been comprehensively tallied. Koha currently has features quite competitive with the major proprietary integrated library systems and has been implemented in all types and sizes of libraries. Koha has become almost the de facto integrated library system for libraries in developing nations. It is widely implemented in India, throughout Latin America, in the Philippines, Turkey, and throughout Africa. Koha is often implemented through services provided through commercial companies. In the developed world, Koha competes alongside proprietary integrated library systems, usually through commercial support arrangements. A few of the major Koha support provides include:
    - **ByWater Solutions** (United States): over 1,000 libraries.
    - **Equinox Software** (United States)
    - **BibLibre** (France)
    - **Catalyst** (New Zealand, Australia)
    - **LibLime** (United States): supports and develops software based on a fork of Koha
- **Evergreen** was developed as an open source integrated library system for consortia of public libraries. The software was originally created for the PINES consortia of public libraries throughout the state of Georgia in the United States. Equinox Software, which includes some of the original Evergreen development team, is the primary support company. Evergreen finds use primarily among consortia of public libraries within the United States.
- **Kuali OLE** is an open source resource management system for public libraries created through a series of grants from the Andrew W. Mellon Foundation beginning in 2008. In 2014 the University of Chicago and Lehigh University placed an early version of Kuali OLE into production to replace their incumbent integrated library systems for print resource management. The library of the School of Oriental and African Studies of the University of London likewise implemented Kuali OLE in 2015. As noted above, the Kuali OLE project has opted to not continue the development of its own software but to collaborate in a new initiative backed by EBSCO Information Services to create a new open source library services platform for academic libraries.
- **VuFind** is an open source discovery interface originally created by Villanova University. Based on the Apache SOLR indexing technology and an interface programmed in PHP, VuFind has seen continuous development since its initial release in 2006. VuFind has been implemented by many different types of libraries and in several international regions. Notable

implementations include its use by all of the public libraries in Chile, by the Consortium of Academic and Research Libraries in Illinois, as the basis of the Pika interface used by the Marmot Library Consortia in Colorado, and many other individual and consortial projects.

- **Blacklight** is a discovery interface using Apache SOLR with a Ruby on Rails programing framework. This discovery interface is associated with the Hydra repository platform and can be used with any integrated library system. Blacklight is implemented mostly in larger academic libraries.

5 GENERAL OBSERVATIONS AND CONCLUSIONS

In these times when libraries face immense pressures to fulfil their work with ever more inadequate financial support, it is essential for them to make use of the technologies best able to support them. Libraries face challenges of ever more complex collections spanning multiple types of media and formats, ever higher expectations by users which expect similar capabilities from their libraries as they see elsewhere on the web, and the need to acquire and manage collections with shrinking numbers of personnel. The characteristics of the different types of libraries are becoming more distinct over time, making it increasingly more difficult for the same technology products to provide ideal support for all.

The industry of companies involved in creating or supporting library technology products has seen dramatic consolidation. In stark contrast to the fragmented business environment of a decade or two ago where dozens of companies competed with overlapping and less differentiated products, the numbers of companies and products seem uncomfortably narrow. So far the variety of products has diminished more slowly than the numbers of companies themselves. As companies merge, they often continue to support the products of their antecedent organizations for quite some time as they work toward more unified product strategies.

This narrowed menu of choices also has a positive perspective. Rather than distributing development resources and talent among many similar products and projects, this consolidated environment focuses larger levels of resources on each one. As the complexity of libraries has multiplied, the systems and platforms needed must likewise be more sophisticated. In addition to software development, many of these new platforms require content components such as knowledge bases, bibliographic services, and large-scale discovery indexes which require enormous resources to create and maintain. Given the cost and complexity of creating these new platforms, it is not surprizing that there are limited numbers of competing products within each product genre. Currently at least two or three major products compete within the technology arena oriented to each library type. Any further narrowing would probably not be well received. The competition is also balanced through open source alternatives. The number of open source projects is likewise narrow, but with global communities of developers coalescing around each one.

This phase of the realm of library technology is like no other that has come before. It is a time where there are fewer brands to choose from within each product genre, but one where the options are distinctive in their visions of functionality. The companies and products in place now are the survivors in an industry where many others have fallen through ruthless rounds of mergers and acquisitions. The products now in play are sophisticated and increasingly specialized for the needs of specific types of libraries. Instead—or in addition—to implementing these new platforms, libraries can also lend their support to the open source projects with large-scale and coordinated development communities.

Libraries today have opportunities to approach technology strategically. Instead of picking through many different brands of the same kind of product, libraries can choose among this smaller set of options with differing visions of resource management and discovery. Libraries can channel their technical expertise less at commodity tasks such as the administration of servers and operating systems and more on higher level activities such as working with the APIs of these new platforms to

create new services. Whether partnering with a company deploying a proprietary platform or participating in an open source project, libraries can work toward advancing the state of the art for these systems and in enriching their own technology environment.

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