

Academic Library Technology: Possible Elements and Ways to Combine Them

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Introduction

“Librarians of Twitter, can you recommend a resource that gives a general overview of a typical ca. 2020 (academic) library tech stack?” was the seeming straight forward question asked by Miriam Posner, Information Studies and Digital Humanities scholar. Having worked in library tech for many years, I could not think of any document that would meet her needs. The academic community needs such a document though, because most of library systems are invisible to users when they are working correctly. It is important for scholars to have some idea of what goes into making an academic library work.

There are complications hiding in plain sight in Dr. Posner’s question. Crucially, where are the boundaries of the library tech stack? Libraries exist within a network of technologies. We expect that libraries will have wired and wireless network infrastructure, email, voice calling, computer work stations, scanners and printers, presentation equipment and other standard academic technology. These items are not typically labeled library technology as they are general-use items. But library-specific technology depends on these technologies. We should not overlook the infrastructure systems that support library technology.

What technologies do library employees configure and control? This question gets to the heart of library technology, where we find integrated library systems, electronic resource management systems, proxy servers, institutional repositories, archival management systems, digital preservation systems, interlibrary loan software, link resolvers, discovery layers, and the other systems that allow the library to purchase, share, and keep records on materials. These are the library-specific systems that allow the library to do its work.

Beyond the library-specific technologies are products that are, by design, a combination of technology and information resources. Article indexes and databases, ejournals, ebooks, streaming video services, datasets, and other technology-requiring information resources fit this category. These are scholarship tools that librarians support but have limited control over. The bulk of the library’s money will be spent on these resources. This class of items is most likely considered part of the library’s collection, but it is completely inaccessible and unusable without supporting infrastructure technology. It is undiscoverable without integration into library-specific technologies. It is highly likely that the library uses resources that are open access. Open access resources must tie into library-specific, library-controlled, systems to be discoverable in the context of the library’s other resources.

Beyond the technology itself is the integration different technology systems. Academic libraries need to integrate their systems with campus systems for usability and data sharing. Student data needs to feed into the library's circulation system and proxy server. Fines and fees need to connect to systems in the student accounts office. Ideally, most of the library's systems are connected to the university's single sign on system. Student ID cards are likely the library card. The integrated library system needs to send email using the university's email system. Library resources can and should be integrated into the university's learning management system. All of these integrations require cooperation between the library and campus IT.

Now that we have a working understanding of what library technology might involve, we encounter the next complication in Dr. Posner's question. What is typical? Academic libraries can range from a one-room, one-person operation to internationally known networks with hundreds of millions of resources. There may be a dedicated library IT staff including developers and systems administrators. Or library IT may be entirely handled by campus IT. One academic librarian I know is both the librarian and the campus IT department for a small private college. Finding typical in this range of possibilities is difficult.

Finally, Dr. Posner asks for a resource that describes library tech. Some library technologists do specialize in studying and describing the deployment of library technology. Integrated library systems and institutional repository system adoption and deployment are described in the literature. However, in my experience, the full array of technologies and integrations is so variable and diffuse that even local documentation is difficult to achieve. So in the absence of a team information science grad students to throw at the problem, I will attempt to sketch out a description of the academic library technology most often encountered in the wild.

I. Essential Academic Library Technology

a. Integrated Library System (ILS)

An integrated library system interconnects workflows and functionality needed to purchase, loan, and describe library materials. Specialized interfaces are available for acquisitions, circulation, and cataloging. Many systems also incorporate electronic resource access management.

Marshall Breeding has documented the integrated library system market for decades through Library Technology Guides (librarytechnology.org). Results of his annual survey show that the vast majority of academic libraries use an ILS from a commercial vendor. The market is currently dominated by Ex Libris. Their flagship product, Alma, is a cloud-based software-as-a-service product. Alma may be implemented at a single university or across a larger consortium of libraries. For some functions, such as cataloging, data is shared all libraries using Alma.

Other ILSs may be installed on local servers and maintained locally. The trend is toward cloud-based systems. Cloud-based systems generally have an annual cost. Pricing is negotiated by each library or consortium.

The ILS must receive user information for circulation users accounts from some campus system. Possible data sources are the campus student information system, identity provider, or Active Directory. Data sharing can be automated or manual. A system for sending fines and fees to student accounts is generally in place. This could be fully automated within the ILS, transferred digitally with staff intervention, or happen on a paper-based system.

If the library uses RFID, the ILS must support the RFID equipment in use. RFID support varies by ILS.

b. Online Public Access Catalog (OPAC) / Discovery Layer

Interestingly, the web site users access the catalog from is separate from the actual ILS software. The OPAC is a web-accessible front end that allows access to the database structure that drives the ILS. The term OPAC comes from an earlier age of locally installed clients to access the ILS. With cloud-based systems, it's all on the web. But the user front end is still separate even on a cloud system. The OPAC may be from the same vendor as the ILS. It might be open source. VuFind is a popular open source OPAC. So far as I can tell, Discovery Layer has mostly replaced the term OPAC in common usage. However, discovery layer generally implies that databases and other resources in addition to library's catalog will be connected to the interface. A library can have multiple discovery layers if they are willing to pay for them. Discovery layers are marketed as being able to search all resources from all vendors. In reality, functionality is limited by vendor interoperability.

c. Proxy Server / Remote access system

In general, vendor-supplied electronic resources are restricted to access within the university's IP range. A proxy server supplies access to users that are outside of the university's network. Proxy servers, such as OCLC's EZ Proxy, can be locally served or hosted as a service. Proxy systems need some way to access a listing of authorized users. Authorized users are determined by each vendor license agreement, but they are students, faculty, and staff. The user data can come from the student information system, LDAP, ADFS, or an identity service such as Shibboleth.

In some cases, virtual private networks can be used in place of a proxy system. However, VPN requires special client software and setup. Library proxy systems are designed to be seamless.

d. Interlibrary loan (ILL)

The library will be a member of at least one interlibrary loan network. This may be a paid service like OCLC WorldShare, or a free service like DOCLINE. The library may be a member of several systems. Some systems are web based, some require special software. There are also supplemental services to consolidate workflows from multiple ILL networks. Some ILL functions may be handled by the integrated library system.

e. Web Presence

An academic library must have some form of web presence. This could be served from library-maintained systems, campus systems, or an outside vendor. The Springshare Content Management System allows libraries a web presence with a fair amount of local control without the need for the library to have equipment or work with campus IT.

II. Work flow and Usability tools

a. Link Resolver

An open URL link resolver is essential for linking full text to indexes and databases. The link resolver may be part of the ILS or purchased separately from another vendor. Many content providers offer linking between their database and ejournal products. However, linking services provided by the content vendor are specific to products from that vendor. Cross-platform compatibility requires a separate link resolver service. The link resolver may be run locally or licensed on a software-as-a-service model. Libraries that rely on one primary content vendor can provide ease of use without a link resolver. If multiple content providers are used, a link resolver is considered necessary.

b. Electronic Resource Access and Management System (ERAMS)

Libraries that use only one or two content vendors may still provide seamless service without an ERAMS. However, an ERAMS is essential for libraries that use multiple vendors. ERAMSs detail the holdings aggregated databases and other packaged electronic content. Without an ERAMS, there is no way for a librarian or a library user to conclusively determine if a library has access to an electronic publication. The ERAMS is a critical part of the interlibrary loan workflow. The ERAMS may be combined with the integrated library system or the link resolver. Link resolvers also require accurate holdings data to function smoothly.

c. Guide and Database Management System

LibGuides is the industry standard. It allows librarians to share and remix content into user help guides, tutorials, and bibliographies. The system also holds a list of the library's databases. Database is a catch-all term for any searchable information resource. The database list is maintained centrally, and content is re-used dynamically throughout the system. Open source system, such as SubjectsPlus, are also in use. The library may also use a home-built system.

d. Cataloging Tools

Catalogers have a specialty tools unique to their area. OCLC Connexion is common. Specialty tools for migrating and manipulating data may be used. Even specialized label software may be in use.

e. Acquisitions Tools

Acquisitions is likely home to many workflows based on spreadsheets or general database software such as Access. However, specialized tools and services do exist.

III. Archives, Repositories, and More

- a. Archival management system
Archives run on very different systems of organization and description than the rest of the library. A separate system is required to organize, describe, and share archival records. The archival management system can be configured to hold both physical and electronic resources. Archival management systems can be hosted locally or on the software-as-a-service model. Locally hosted systems generally require a LAMP stack.
 - b. Institutional Repository systems
Open source and proprietary institutional repository systems are available. There are also organizations that offer hosted open source platforms. Locally hosted systems require local IT staff. Hosted systems allow librarians with little or no hardware knowledge to quickly build large and elaborate repositories. There is an annual cost for hosted systems. Local systems typically have no annual service fees. However, hardware and staff costs must be considered. The institutional repository should have some configuration points inside the integrated library system. There may also be connections to the archival management system.
 - c. Digital Preservation Systems
Libraries supporting large digitization programs may use a digital preservation system to catalog and inventory files, file types, metadata, and preservation plans.
 - d. Storage arrays
Libraries with digitization programs should have some form of storage system. This could be a local or campus storage array, a vendor or consortium supplied storage system, or a commercial cloud-based system such as Glacier.
- IV. Digital Scholarship
- a. Publishing
Publishing functionality may be included in the institutional repository. Digital Commons from bepress includes a journal publishing suite that includes editor tools. Some libraries are home to a full press service that produces physical items.
 - b. Imaging
Many libraries have high resolution scanners and cameras.
 - c. Maker Spaces and VR
Many libraries offer 3D printing and imaging, virtual reality, and other technologies to support digital scholarship.
 - d. Digital Humanities
Some libraries support digital humanities platforms such as Omeka. Libraries may also host small projects for campus scholars. Libraries are generally collaborators in digital humanities programs.

e. Datasets

Many libraries provide funding-agency compliant posting of data sets for grant-supported projects. This is generally done through the institutional repository. Librarians may collaborate on data management plans and perform data conversions.