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Library Technology: The Next Generation

SWEEPING CHANGES
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AND SERVICES TO
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Next-generation library automation products and services have been the focus of attention in the library community for the last few years. It seems that there is tremendous interest in systems that are better aligned with the issues libraries face today. New discovery and library management platforms have emerged from research and development stages into real-world use in libraries. We're seeing intense competition among these new systems and between them and the new versions of established products. I see us as being at a critical time in the realm of library technologies, with many organizations working to break out of established conceptual, functional, and technological bounds.

I interpret the progress seen in these recent years as the establishment of a new generation of technologies for libraries. But it's just a set point in an ongoing series of continuous cycles. This new generation follows several that have come before and others that will unfold in future years. It is important that these technologies continue to advance and be reinvented in ways that break away from the limitations of those previously established. I also see the generations as not totally distinct or discrete from one another. The current chapter in the ongoing history of library technologies consists of many different threads and trajectories. Some are characterized by incremental evolution, and others are based on

a more dramatic revolutionary development of new from-the-ground-up products. The current phase includes a diverse mix of development strategies that defies over-generalization, but we can at least attempt to portray the landscape in broad strokes.

Next-Generation Libraries

Sweeping changes in libraries drive the urgency for a new generation of technology products and services to support them. The composition of library collections have changed to include higher proportions of electronic and digital materials relative to print. While this change has transpired during quite a long period of time, it seems to me that many libraries are suddenly finding themselves at tipping points that demand new operational priorities and strategies. Libraries now simultaneously serve multiple generations of patrons, each bringing their own expectations and experiences regarding library services and a variety of information-seeking strategies. The impact of the current environment of search engines, immediately available streaming content, and social networks cannot be understated relative to the expectations of how libraries present their virtual services. The present generation of libraries also takes the brunt of the blows of decreasing budgets and rising costs. These realities demand

a new generation of technologies able to help libraries take bold steps forward in the way they provide access to and manage their collections, while helping them operate at unprecedented levels of efficiency and productivity relative to the number of personnel available and available funding levels.

Generational Cycles

I've seen several generational cycles of library technologies in my career and have studied the history of those that came earlier. It is useful to think about the current phase of library technologies and the shape of what might come next relative to what has transpired in the past. The earliest phases of computer-based library automation saw the creation of systems that were able to address specific problems or functional areas. These were systems able to apply computer technology to major library functions such as circulation, materials acquisition, or the production of catalog cards and microfiche-based catalogs. The change from manual processing of routine library tasks to using computers to automate them was certainly transformational, but it only represented the beginning of many iterations of technology in libraries that have transpired since.

The following generation brought together separate task-specific computerized projects into the integrated library system (ILS) model, based on multiple specialized modules that shared common data structures. The organization of these systems into modules for cataloging, circulation, serials management acquisitions, and public catalog functions became thoroughly instilled into the conceptual framework for library automation, persisting through multiple generations of products. This early generation of ILSs had a profound impact on libraries, providing a single platform capable of managing almost all aspects of library operations and service provision. The concepts of this model, for better or worse, were deeply rooted in the physical collections that prevailed in that era. It would have been nearly impossible to imagine or

anticipate the needs of future libraries where print might represent a minority of their collections. But these legacy systems have proven difficult to re-shape, even though some library operations have diverged greatly from the basic system premises.

Some of the subsequent generational cycles were based largely on transitions in computing platforms. Mainframe-based systems gave way to those based on mini-computers, preserving the same command-oriented, terminal-oriented interfaces, with the same automation focus on managing print collections, and containing the same functional modules. This generation of systems was ported or built anew on a different set of operating systems, such as UNIX, Pick, and VAX/VMS, preserving the basic business logic of the functional modules.

The next new generation involved the development of products based on client/server architecture with new graphical user interfaces that ran on networks of personal computers, which displaced dumb terminals. In the mid-1990s when client/server products began to emerge, library collections were already beginning to include increasing proportions of electronic materials. But in looking back at the change from today's vantage point, it seems that the transition into client/server computing generally only transplanted the functionality and concepts of the previous phase into new user interfaces and computer architectures. The client/server era saw a proliferation of additional genres of products to address the requirements brought about by the engagement of libraries with print and digital materials. Institutional repositories, link resolvers, digital asset management platforms, electronic resource management systems, discovery interfaces, and other specialized products filled in the gaps between the functionality of the ILS modules and the current realities of library collections and services.

A Transformational Generation

The current round of next-generation products seems more transformational than those in the past since in



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addition to taking on new technology architectures, they also embrace major conceptual changes. This phase of new-generation systems includes at least some examples that defy the deeply ingrained model of ILS modules. In both the realms of discovery and management, an overarching concern to be more comprehensive relative to the totality of library collections prevails. The current wave of web-scale discovery services brings library collections together for library patrons through a comprehensive index that includes print, electronic, and digital materials. The emerging genre of library services platforms aims to help libraries perform all the behind-the-scenes activities involved in supporting collections composed of all these different formats, organizing functionality in ways that differ considerably from that of ILSs.

On the technology front, this new generation of library products and services steps out of the previous era of client/server computing and into that associated with the current era of web-based and cloud computing. These new technological underpinnings include the service-oriented architecture, web-based interfaces for library staff and patrons, deployment through software-as-a-service (SaaS) models, and an increased reliance on shared knowledgebases, just to name a few of the high-level concepts. The distinction of library automation based on a server installed in the library versus that of multitenant SaaS deployed on shared infrastructure brings the potential to shift from a model of isolated, self-sufficient systems to one with inherent resource sharing capabilities. The earlier changes of technology platforms from mainframes, to mini-computers, to client/server networks seemed much more lateral than the possibilities opened up through current, highly scalable cloud-computing platforms.

At the same time that we see some examples in the current generational cycle of wholesale reinvention, we also see other threads of progress made through applying new layers onto those of antecedent products. One of the most exciting areas of de-

velopment in automation systems for public libraries surrounds the support of ebook discovery and lending entirely within the library's own environment instead of the previously established model of transferring library patrons to the platform of their ebook service provider. This dramatic shift has taken place not through the creation of new automation systems but through the enhancement of existing systems. The most successful automation products for public libraries, in terms of ongoing satisfaction and in new sales, are those that have retained the basic model of the ILS but that have also undergone aggressive development in response to the major challenges that have arisen in public libraries. Overall, I observe that in public libraries the transition to new generation systems has been more evolutionary while the change for academic libraries includes some more revolutionary elements.

Anticipating Future Generations

These generational cycles of library technologies will continue to churn into the future. So far, each generation has risen and declined throughout the course of 10 to 15 years. I would suggest that we are still relatively early in the current cycle, with less than a decade until the next. So, we should expect the pace of change to continue to accelerate.

We can also see factors in play that will contribute to the shape of the next generation of library technologies. An increasing array of research and development projects and even pilot implementations explore and exploit the capabilities of open linked data. The mapping of MARC metadata structures into a linked data model currently underway through the Library of Congress' Bibliographic Framework Initiative (bibframe.org) highlights its importance. This current wave of interest in linked data and

the semantic web technologies will undoubtedly play a major role in the future, initially in the realm of discovery. It has yet to be seen if the new systems being rolled out today will successfully adapt to a future library information environment based on linked data or whether linked data initiatives might spark a new generation of discovery or library management systems.

It is interesting to think about the cycles of change and consider how current library technology offerings fit into that context. I am quite encouraged by the surge of innovation reflected in the current phase of library technology development. Yet, we are early enough in this new generation that it remains to be seen whether these innovations that seem so promising in theory will prove themselves in the real world. It is understandable that some libraries may remain skeptical regarding their benefits until they are proven in the field.

Innovation does not just come at the commencement of a new generation of technologies. The new conceptual models and technology foundations might spark the beginning of a new cycle, but ongoing research and development, functional enhancements, and other refinements continue, resulting in more mature and hopefully more effective technology products with time. Each library has its own comfort level relative to the maturity of the technology products in which it invests. Not that many libraries are able to take on the risks associated with being on the cutting edge of development as a new cycle of products is being formed. But whether a library chooses to jump in at the beginning, middle, or end of a technology cycle, the change seems almost inevitable. Ultimately, libraries remaining with systems out of synch with current demands will only impede their overall effectiveness. ■

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