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Electronic Resource Management Systems: The Need and the Realization

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Introduction

Several factors have rendered the job of librarians who deal with electronic resources extremely challenging: the amazing growth of electronic collections, the increasingly central role that these collections play in libraries, the large budgets that are involved in their acquisition, the endless variation in the packages offered by the hundreds of players in the market (such as publishers, interface providers, and subscription agencies), the frequent changes in business models, and, above all, the lack of automated tools to deal with the complexity of e-resource management.

As they attempt to maintain some control over their e-collections, librarians find themselves lost in a mire of spreadsheets and e-mail messages, and responsible for dealing with a variety of independent systems and data containers that are not integrated with each other. Too often, librarians rely on their memory alone to coordinate systems such as the acquisition module of their integrated library system, their alphabetic lists of electronic journals and databases, their metasearch tool, and their local link server. In addition to the initial effort of setting up information in multiple places and the potential lack of consistency between systems, considerable duplication of effort is likely to occur. Much of a librarian's success at carrying out necessary tasks is based on personal experience; however, because the knowledge and experience gained from dealing with e-resources is often vested in too few people—sometimes only one—libraries are left at risk. Furthermore, the provision of meaningful metrics, such as detailed cost analyses and statistics on performance and usage, remains problematic, but without such metrics, managers cannot make fully informed decisions. As the spending on e-collections increases, so does the need for a better solution: "a system that supports management of the information and workflows necessary to efficiently select, evaluate, acquire, maintain, and provide informed access to electronic resources in accordance with their business and license terms" (Anderson *et al.*, 2004).

In the absence of comprehensive commercial solutions, some institutions themselves developed systems that deal with various aspects of e-resource management. Now a number of vendors are working on providing complete solutions that will help librarians not only maintain collections but also develop them further. The offering of some vendors consists of an electronic-resource management (ERM) system that forms an integral part of their integrated library system, whereas for others—such as Ex Libris—the offering consists of a stand-alone module that works with a range of library systems and can also be packaged with other products from the same vendor. The latter solution is becoming more widespread; in a recent article, North Carolina State University librarians Greg Raschke and Suzanne Weiner put forth a good case for such separation while emphasizing the need for tight integration (Raschke and Weiner, 2004).

True integration with systems that already support various aspects of the e-resource life cycle is likely to be the key to success for e-resource management solutions.

Such a solution should not duplicate existing data and procedures but rather complement them while streamlining workflows; it should provide a central "control tower" for librarians from which they can manage the e-resource environment.

Current trends and industry initiatives

Traditional integrated library-management systems were designed for managing print resources and are not well suited to managing electronic resources. For example, library systems typically lack the ability to describe the hierarchical nature of electronic resources: that an e-journal is part of a package, and the package is supplied by an interface provider. Nor do traditional library systems have the means to describe attributes such as license and access information; to handle the various workflows required specifically for e-resource management, such as a trial workflow; and to deal with archival rights and the restriction of access to specific locations and specific communities. Lacking such capabilities, many libraries have been looking for solutions to help them manage this new form of resource.

In early 2001, on behalf of the Digital Library Federation (DLF) [1] Tim Jewell of the University of Washington carried out a survey of systems that were developed in-house at North American universities (Jewell, 2001). The survey showed that libraries were, indeed, trying to display and maintain information about e-resources. One such system is VERA (Virtual Electronic Resource Access) [2], developed at the Massachusetts Institute of Technology (MIT).

A European example of a locally developed system is the University of Bristol's ERM application [3], which allows staff to input metadata and users to search and browse through titles.

Still another solution consists of the A-Z electronic resource lists that most libraries maintain and many of which are homegrown; commercial solutions, however, are increasingly making such lists available.

Although library system vendors have taken some time to catch up, one can now find a list of commercial products—including those already available and those in various stages of development—on the DLF ERMI Web hub site [4] hosted by Cornell University.

The Digital Library Federation ERM Initiative

The Digital Library Federation has been proactive in coordinating the efforts to define requirements and suggest solutions for electronic-resource management. In fact, the study by Tim Jewell that was mentioned earlier was sponsored by the DLF. Through the efforts of Adam Chandler of Cornell University, a Web site was created to host the information emanating from that study. Furthermore, a meeting held at the annual ALA conference in June 2001 led to the establishment of an informal steering group that presented a workshop on ERM standards at a May 2002 meeting sponsored by the DLF and NISO (NISO/DLF Workshop, 2002). The participants, who included not only librarians but also library system vendors and serials publishers, agreed that standards are a key element for ensuring the successful development of ERM systems and that to achieve this end, a more formal and collaborative organization should be formed. As a result, the Digital Library Federation Electronic Resource Management Initiative, or DLF ERMI, was established soon after, as well as

two reactor panels to provide expert advice. One panel was made up of librarians with experience or an interest in managing e-resources, and the other, of library system vendors, serials publishers, and others.

The initiative's aim was to provide the community with a set of specifications that would encourage the development of electronic-resource management systems based on standards and best practices. To this end, the initiative produced a number of deliverables:

- An entity-relationship model, supported by a data-element dictionary and a description of the data structures that map data elements to the entities involved in e-resources. The description also specifies the relationships between these entities.
- A specification of functional requirements
- A workflow diagram
- A report on the possibility of providing an XML schema to encapsulate some of the ERM data elements. XML and associated schema can facilitate data exchange between electronic-resource providers and libraries, as well as between library systems and other applications. The initiative produced a schema for encapsulating license data as a proof of concept and described how that schema would relate to existing rights-expression languages such as the Open Digital Rights Language (ODRL) [5] and the Creative Commons Resource Description Framework (RDF) schema [6]. In particular, the initiative's committee provided use cases to deal with the exchange of licensing information.

All these deliverables are available as appendices to the DLF ERMI's final report (Digital Library Federation, 2004), which was published in August 2004.

What can librarians do with an e-resource management system that they cannot do today?

The first challenge is to clarify what we mean exactly by *e-resource*. An individual electronic journal such as *Nature* or *D-Lib Magazine* is an e-resource, as is an electronic book or an abstracting and indexing database such as MEDLINE®; but an e-resource can also be a package of e-journals or a database of abstracts and indexes that includes the full text of some or all articles referenced by the indexes. Furthermore, we cannot think about an e-resource without considering the interface through which it is offered; these elements are intricately linked, although they can be licensed separately.

Let's look at an example of a complex e-resource, Oxford University Press (OUP), as of November 2004 (the time of this writing):

- OUP publishes about 190 e-journals. A library can buy a package of these e-journals from the publisher itself, through an agent (for example, the NorthEast Research Libraries (NERL) consortium in the United States), or through a number of information vendors.

- OUP provides an interface for accessing many OUP e-journals. HighWire Press® is scheduled to begin hosting the entire OUP journal collection in January 2005 (this company already offers part of the OUP collection).

However, other providers, such as Thomson Gale and ProQuest®, also provide access to OUP journals through their own interface.

- As of the writing of this paper, users can access the full text of only some OUP journals through the OUP interface. In the OUP journal list [7], some journals are linked instead to the HighWire Press interface.

- OUP offers subscriptions to all the journals that it publishes. Although some of the journals are hosted by HighWire Press, they are licensed by OUP. For some of the HighWire-hosted OUP journals, HighWire Press offers free full-text access subject to an embargo period.

In addition to all the limitations just mentioned, an OUP package might be governed by a set of license terms, whereas a specific OUP journal—for example, *JNCI Cancer Spectrum*—might be governed by a different set of terms. This particular journal was included in the 2000-2001 package of Oxford journals; at the beginning of 2002, the journal became subject to a separate license addendum with new business terms that were no longer tied to print.

Other factors that are specific to e-resources and do not apply to the traditional print world include authentication, access, administration, usage, and more. Print and electronic resources differ in the manner in which they are acquired, accessed, and licensed. An ERM system needs to support these differences by providing the infrastructure for both the data and the workflows that are characteristic of e-resources and are typically missing from systems designed to deal with print resources. The system should provide the tools to manage e-resources throughout their life cycle while supplying the data that administrators need to make decisions about acquisitions, renewals, and cancellations of e-resource subscriptions. And the system needs to be extremely flexible and open, capable of supporting rapidly changing business models.

The life cycle of an e-resource

Librarians say that the lives of e-resources are as complicated and challenging as those of human beings: e-resources are born, and at times they also die or are reincarnated under a different name or in a different shape; they form families, and the families may unite with other families, quarrel, or split up; treaties between families are signed and can be later discarded; and so on. Keeping in mind that change is always a possibility, we will now look at the life cycle of an e-resource.

The typical life cycle of an e-resource that is available for a fee would include the following stages:

- **Discovery**: The awareness of a new e-resource originates from a faculty member's request, a recommendation from a subject librarian, an advertisement, a message in a forum, or any other source. The librarian then locates information about the e-resource--information that might include, for example, the bibliographic details of an e-journal, the coverage period available, the packages that include this e-journal, and the interface or interfaces through which such packages are offered. The way in which a

librarian finds the necessary information is related to the role of the ERM system as a collection management tool, as we explain later.

- **Trial**: In many cases, a librarian will want to try out an e-resource before deciding whether to purchase a license for it. A trial enables the librarian to offer the e-resource to some or all users—who may include patrons and librarians alike—and then base a decision on their feedback. During the trial process, the librarian activates the e-resource in the desired areas of the library environment, notifies the relevant audience, and obtains feedback.

  Librarians pay considerable attention to specific issues when testing an e-resource. One example is the technical infrastructure required by the user interface. The librarian needs to document issues related to Web browser and plug-in compatibility, which may have an impact on how browser configurations are rolled out to library and faculty computers or even whether the institution can support the interface at all. Furthermore, the testers need to evaluate the usability of the interface, because the library may well have a choice of interfaces from different providers of a package of resources or subsets thereof. When the trial is complete, the librarian should be able to justify the choice of interface to the institution as a whole as well as to its various departments.
- **Selection:** Once the trial is over, the librarian decides whether to acquire the e-resource. A decision not to purchase the e-resource results in its deactivation in the library environment (if it were activated previously as part of the trial process).
- **Acquisition:** If the librarian decides to go forward and subscribe to the resource, he or she carries out an acquisition process that somewhat resembles the process for print resources; however, an additional level of detail is required, such as information about the license and the availability of the resource to various populations of users. Also, when a library is acquiring e-journals as part of a package from an e-resource aggregator, such as EBSCO, the librarian needs to know which journals are covered by the package and for what period of time; ideally, the librarian would have the option to pay one lump sum for the entire package or to pay separately for each title. Furthermore, the print and electronic formats may be linked in such a way that cancellation of the print format would invalidate the license agreement for the electronic format. Another issue is how to handle the distribution of a payment between the licensor of the package and one or more interface providers. In the UK, for example, a library can obtain Inspec® from the IEE and access it through an interface from a UK data center such as EDINA or MIMAS—a service for which a fee is levied.
- **Access:** Access, of course, is a major issue when you are dealing with e-resources. Once a library has acquired an e-resource, the librarians want to ensure that it is well used. First, they need to make certain that users can access it easily—for example, from an A-Z list; from the OPAC, if relevant; from a metasearch tool; or via a link server. Issues such as access by specific user groups or by remote users (for instance, proxy setup) also need to be solved. After the initial configuration of access, which might have been taken care of, at least partially, at the trial stage, librarians must deal with routine maintenance, problems such as the temporary unavailability of the resource, and changes in the provider's address or the manner of access.
- **Decision to renew or cancel:** An e-resource subscription is typically valid for a defined time period. When the period ends, the librarian must either renew the subscription or cancel it. Unlike the decision at the selection phase,

this decision is based on the information accumulated in the management system, such as the actual usage of the resource while it was available, the reliability of the interface, and the responsiveness of the provider. Whatever the outcome of the decision—renewal or cancellation—the system needs to support it. Furthermore, even after a subscription has been canceled, the library might have perpetual access or archiving rights to the data, another area that librarians must deal with on an ongoing basis.

The description provided here is a simplified version of real life. Many e-resources today are purchased through consortia, which wield considerable purchasing power. In a consortial environment, the procedures involved in acquisition, access, and decision making are much more complex. An ERM system needs to address the heterogeneous needs of these consortia, particularly the differing levels of information sharing and the diverse management requirements—centralized versus localized or a combination of the two.

Standards

ERM systems, by nature, need to integrate into an existing library and the broader institutional environment—that is, the local integrated library system and other applications and services. The use of standards is, therefore, of major importance for enabling such integration to succeed. Let us examine a few illustrations of the importance of standards as related to integration and see how an ERM system would take advantage of such standards.

One of the most important standards for application integration is the Simple Object Access Protocol (SOAP) [8], an XML-based protocol that facilitates the exchange of information between applications and the calling of procedures remotely from one application to another over HTTP. SOAP is a core standard for the Web services architecture [9] for integrating applications built on heterogeneous platforms. ERM vendors should provide appropriate interfaces in the form of Web services to facilitate the integration of their ERM system with other applications.

The exchange of metadata between subscription agents and an ERM system is another area in which standards may help considerably. For example, the ONIX for Serials [10] standard, now under development by EDItEUR [11] and NISO, will facilitate the exchange of serials subscriptions and holdings, and possibly also the process of automatic electronic check-in.

Another aspect that relates to integration and standards is the recording of e-resource usage, particularly when the user moves away from locally administered Web pages to those of information providers. More often than not, libraries rely on statistics provided by the vendor, statistics that come in many formats. Recently, moves have been made to standardize usage statistics from vendors; of particular note in this area is Project COUNTER. The COUNTER specifications define not only terminology—for example, *session*, *search*, and *full-text article*—but also a standard reporting format (COUNTER, 2004). When COUNTER-compliant vendors provide data in XML according to the proposed schema, an ERM system will be able to upload COUNTER statistics into the ERM database and thus enable librarians to analyze usage statistics with other data pertaining to an e-resource.

Hence, the developers of ERM systems must take into account current and emerging standards if they are to integrate their system with a portfolio of library applications. Both public-sector and corporate organizations have long been demanding that library applications be seen as just one component in the delivery of services to users. The key to interoperability is the development of systems that conform to standards and that publish APIs. With the emergence of Web services as a set of standards for application integration, the task of integrating library applications with other institutional systems will become easier.

Developing an ERM system

Developers of the Verde ERM system from Ex Libris have paid close attention to the DLF ERMI and addressed many of the issues mentioned earlier. We will now take a look at the processes through which this system was developed and is integrated into a library environment.

For a number of years, Ex Libris has been involved in providing tools for handling various aspects of e-resource management. These aspects include, in particular, the use of e-resources as linking sources or targets and as resources for metasearching, and the ways in which such resources are represented to end users. Because many Ex Libris customers are members of consortia, Ex Libris products already address issues related to the consortial handling of e-resources.

SFX®, the original link server from Ex Libris, deals with many of the complexities of managing e-resources—particularly e-journals, which pose the greatest management challenge in the electronic world. Although developed to put linking into the hands of the librarian, SFX has in many institutions become the central repository of all e-journal information. SFX tools have been developed to automatically generate e-journal A-Z lists and provide unmediated document delivery, to name just two examples.

MetaLib®, the Ex Libris library portal, provides resource-discovery tools and metasearch (cross-database search) capabilities. The focus of MetaLib is on providing access to databases and packages of e-journals and e-books rather than to individual e-journals that might serve, for example, as targets of a link server. Nevertheless, MetaLib includes tools that relate to individual e-journals, such as alphabetical lists.

SFX and MetaLib are a response to a significant market need; their rapid adoption worldwide suggests that institutions view them as a solution that fulfills the requirements of today's libraries.

The users of ALEPH®, the integrated library system from Ex Libris, manage other aspects of e-resources through the ALEPH OPAC. They often manually catalog e-resources and import their e-journal holdings from SFX, where applicable. The imported data consists of basic information or MARC-enhanced information (via the Ex Libris MARCit! service). Furthermore, some libraries use the ALEPH acquisition module for subscribing to e-resources.

However, this suite of products does not address all aspects of e-resource management. Responding to a presentation by UK members of the international consortium of ALEPH users (ICAU) at the organization’s 2002 meeting, Ex Libris

started working with a focus group selected by Ex Libris users. Through this collaboration, Ex Libris explored the issues, defined the missing functionality, and considered ways of addressing it.

The Verde ERM system adds some important components to the Ex Libris suite: tools for managing business activities associated with the acquisition and licensing of e-resources, and for facilitating cost analysis and collection-development decision making. The Verde database enables libraries to maintain comprehensive information related to e-resources in one accessible location. A stand-alone system that is also readily integrated into a library environment, Verde is likely to become a focal point of the institution's digital library in the near future.

Having gone through similar design stages as the DLF ERMI deliverables, Verde benefited from a modeling of the data entities at an early stage. Ex Libris gained greatly from the excellent work of the DLF ERMI but was also able to provide valuable input to the committee's work.

At the core of the Verde data model is the e-product, which comes in two forms: an e-interface combined with a stand-alone entity and an e-interface combined with an e-package and e-constituents. For example, the MEDLINE abstracting and indexing database from EBSCO may be represented by EBSCO*host*®—an e-interface entity—and the MEDLINE database, which is a stand-alone entity. Let's return for a moment to our OUP example: the e-products in that scenario include HighWire Press as the e-interface, the OUP package as the e-package, and the individual e-journals as e-constituents.

Additional entities that are related to the e-product as a whole or to its components describe the various aspects of, and tasks related to, licensing, acquisitions, administration, cost, usage, and more.

Reflecting the many configurations of e-resources and complex business and licensing models, Verde is designed to be extremely flexible in terms of structures and workflows. The Verde interface provides a sophisticated mechanism for navigating the intricacies of e-resources, enabling librarians to view the various entities and their attributes and to access related items. For example, a librarian can select an e-journal in one e-package and view all entities related to this e-journal and e-package; the librarian can also navigate to other e-packages that offer the same e-journal. At each point, the librarian—if authorized—can add or modify information as necessary. In addition, the librarian can follow a workflow to accomplish a specific task, such as managing a trial. In such cases, the system guides the librarian through the required steps until the workflow is complete.

Designing the interface of Verde with comprehensive navigation capabilities and workflow-oriented functions has been a great challenge. No less important is the design of the knowledge base that serves as the heart of the system. This knowledge base, which is rooted in the SFX and MetaLib knowledge bases and contains additional information, provides the backbone for the discovery functionality required for collection development and supports the appropriate Verde workflow for setting up new e-resources in the library. Although the Verde concept is that of a stand-alone system, libraries that already use SFX and MetaLib will benefit from their localized knowledge bases, which will expedite the Verde implementation process.

From the outset, Ex Libris designed Verde to support a range of consortial models. Its data model permits libraries to share common data while maintaining their local or campus-specific data as necessary. Institutions can implement the model that best suits their needs, whether their administration is local, centralized, or a combination of the two. Such consortial models have been successfully deployed with other Ex Libris products, such as SFX and MetaLib.

Building the ERM system into the library environment

As discussed earlier, various tools already provide some of the functionality required for managing e-resources and end users' access to them. For example, end users can access an e-journal via an A-Z list, library portal, library OPAC, or link server. The Verde ERM system has been constructed to integrate with such tools.

The Verde system is the linchpin of e-resource management activity. Verde interacts with other systems to deal with the various stages of an e-resource's life cycle. For example, setting up an e-resource at the trial stage may require the activation of the e-resource in a link server and also in an A-Z list or library portal. Once acquired, the new e-resource might also be presented in the OPAC for general availability. Cancellation, on the other hand, typically results in the deactivation of the e-resource in all the components of the library system (unless perpetual access or archiving rights to the data are retained).

Verde offers a Web-service (SOAP) layer, enabling the ERM system to interact not only with Ex Libris products but also with third-party products.

ERM systems for collection-development decision making

One of the great advantages of an e-resource management system—and indeed one of the goals of Verde—is to provide tools to assist librarians in the decision making surrounding collection development. Such tools include a global knowledge base, from which libraries can select resources; overlap-analysis reports; cost-usage analysis reports; and more. In a consortial environment, the system can also provide valuable information about the collections of member institutions, which should ideally be able to see what their fellow institutions have acquired or are considering acquiring and to share resources when relevant.

The global knowledge base

Librarians who want to acquire a resource must learn which of many diverse sources will enable them to acquire it—and, clearly, a librarian cannot always be aware of all the available options. An ERM system can facilitate this process by providing a global picture of the e-resource world, a comprehensive knowledge base that describes what is available, including information about the packages, interfaces, and providers.

Statistics

Increasingly, information vendors are making statistical data available to their customers in accordance with the Project COUNTER Code of Practice. Today, an ERM system can store user names, passwords, URLs, and other information about access

to the statistics hosted at the vendor's site. In the future, when such statistics are available in a standard XML schema, librarians will be able to download the statistics to an ERM system to use in cost-usage analysis reports.

With the global e-resource offerings described in the universal e-resource knowledge base, the library's e-resource collection described in the local Verde database, and the library's expenditures expressed in the cost and usage entities, librarians can find new e-resources of interest; take advantage of information already available in the system when adding local information; and, when deciding whether to acquire, renew, or cancel an e-resource, use existing information related to that e-resource and others. Or, as Raschke and Weiner put it, "Imagine a resource management system with a sophisticated reports module where librarians could consult everything from cost per full-text article download to faculty retention requests over the last three years to average annual inflation rate. Our professional judgment about materials would be more informed and efficient while easily accessible usable data would enhance negotiation with users" (Raschke and Weiner, 2004).

Conclusions

There is no doubt that libraries need a system to manage their electronic resources throughout the resources' life cycle. Such a system should not only deal with the daily tasks related to e-resources but also provide comprehensive analyses related to a library's expenditure on electronic materials. Furthermore, an ERM system can open up new horizons related to collection management, in which information about the global marketplace and also about the institution's collection and expenditures can serve as decision-making tools for library staff.

An ERM system is basically a tool for librarians, but its impact also relates to end users. The information gathered in the ERM system can serve as a starting point for users' interaction with e-resources. Such interaction would be built on the ERM system's integration with other library products, such as a link server, metasearch system, or library OPAC. For example, an OPAC could query the ERM system for license permissions to display to the user. However, with a comprehensive knowledge base, such an ERM system may replace some of the roles assumed by other products, such as the generation of alphabetical lists of e-resources.

The DLF ERMI committee has made an invaluable contribution in setting the groundwork for a common understanding of the entities and workflows in the e-resource arena. In the near future, we can expect to see the fruits of the committee's work in the ways in which the various players in the information industry build their ERM systems.

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Notes

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