The Present and Future of Electronic Resource Management Systems: Public and Staff

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As libraries evaluate, purchase and implement Electronic Resource Management (ERM) systems, they encounter challenges in both implementation and functional requirements. In implementation, libraries face the challenge of planning, staffing and data entry for resource descriptions, license description and holdings for ejournal packages. Libraries must develop an effective and efficient implementation plan and then allocate the appropriate resources for system configuration and data entry. As the ERM system is implemented in a production environment, libraries soon see how well the system meets their functional requirements and determine which functional requirements are not met by the current system. This leads to the identification of future functional requirements. These new needs reside on both sides of the end-user spectrum. Professional library staff have a need to analyze their electronic collections for comprehensiveness, title overlap, cost-per-use and other collection analysis functions. They also have the need to automate administrative tasks like IP registration, incident reporting, trial administration, activation, renewal, sample license review and license exchange. Library end-users and public services staff have a need to understand the full range of permissions and restrictions for electronic resource use. They also have the need to be alerted when electronic resources have been upgraded, enhanced or when system outages are planned or are ongoing. Those needs are manifest at all levels of access: the online public access catalog, the link resolver, the federated search engine, A-Z list, etc. Since the electronic resource management system already stores permitted and restricted uses, it is the ideal source for that data at all levels of patron access. As electronic resource management systems evolve, system functionality should evolve to meet the library's needs for ease of implementation—including rapid description of the data model and ease of import of existing resource descriptions. It should also grow to act as a collection development and analysis tool and as the source for critical access and license data for patrons wherever they access the library's electronic resources.

Introduction

The implementation of ERM systems is a recent phenomenon, but there has been significant progress in the planning process and collaborative sharing of data for rapid implementation.

Electronic resource management systems have followed a traditional path in library system development. As the workflow impact and overall importance of

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electronic resources grew in the late 1990s and early 2000s, library staff developed local systems to meet specific functional requirements. As the workflow and overall impact of electronic resources factors increased, library professionals collaborated on formalizing functional requirements and the ideal data elements for ERM systems. This effort took the form of the *Electronic Resource Management: Report of the DLF ERM Initiative* (Jewell et al. 2004). Over time, the locally developed systems could not adequately meet staff needs or could not be maintained and enhanced over the long term. In the early 2000s, library professionals approached commercial system developers to build systems to match the now-formal functional requirements and data elements. It was widely understood that the commercial system developers had the development resources and long-term commitment to providing systems that would meet the needs of electronic resource librarians. These systems were to varying degrees integrated with integrated library systems and other systems already in use by the library (Fons and Grover 2004). As the middle 2000s approached, a robust market of competing systems grew and libraries began to implement the commercial systems at the local and consortial levels. As these systems were developed and the core functional requirements were met, new functional requirements have evolved and pressure is now being applied to system developers to build systems that can grow with the evolving requirements.

The new functional requirements for staff cluster around the need to make routine administrative tasks more efficient through automation and interface development and improved data analysis and reporting.

Usage statistics harvesting is a prime example of the need for automation of routine administrative tasks (Chandler and Jewell 2006). A critical need is integration with other local systems like the integrated library system (ILS), the link resolver engine and knowledgebase and, perhaps most importantly, integration with the administrative functions of the content providers and subscription agents that provide access and licensing services. Another critical need is for standardized license data to facilitate the review of terms for proposed resources and automated population of the ERM system (NISO License Expression Working Group 2007). Librarians are also looking for enhanced reporting functions that maximize the value of harvested usage data and other locally held data such as cost. Access to acquisitions data within the ERM system for enhanced reporting and troubleshooting has arisen as a functional need for ERM systems (DLF Acquisitions Interoperability Subcommittee 2007).

As the primary functional requirements for staff have been met, the need to provide data from the ERM system to library patrons has become an increasingly important functional requirement. Libraries are looking to provide the terms and conditions of use at all points of access to content. These access points include link resolver displays, A-Z lists of electronic journals, the online public access catalog, metasearch environments and the new discovery services platforms—such as Encore from Innovative Interfaces and Primo from Ex Libris—that provide an enhanced resource discovery and delivery experience for patrons.

Background

Before the appearance of commercial ERM systems, electronic resource management was typically handled by a combination of automated and non-automated solutions. Libraries used analog management systems to track contact information and the printed versions of contracts. Some used the integrated library system unmodified for tracking electronic resources (Tull et al. 2005), while others developed local systems for tracking their electronic resources (Jewell 2001). UCLA's ERDb, North Carolina State University's E-Matrix and MIT's Vera are notable examples. The authors of the Electronic Resource Management Initiative's 2007 white paper took advantage of that collective experience to document the critical data elements and functional requirements for the ideal ERM system. The commercial vendors responded strongly to this effort. Beginning in 2004, when Innovative Interfaces introduced its Electronic Resource Management product, there followed a series of releases from other commercial vendors. The ILS vendor Endeavor developed Meridian and Ex Libris developed Verde. The publication access management service Serials Solutions introduced Electronic Resource Management System. Non-commercial organizations such as the Colorado Alliance ("Gold Rush") also appeared in the market during this period (Duranceau 2004).

First-generation commercial ERM systems were developed to create a single system that would serve as the database of record for metadata related to electronic resources. They were built to describe the components of an electronic resource including the electronic product, interface, resource, contacts and license (Jewell et al. 2004). To facilitate an efficient workflow they were designed to record details of the steps in the acquisition and licensing of the resource—including recording the details of the administrative tasks such as IP registration, activation and other stages of the administrative process. Title lists for journal packages and article databases along with access metadata like linking rules, embargo periods, coverage dates and static URLs were also a core

feature of these systems. Knowledgebase data and methods of maintaining data currency provided users with a list of available titles and access points for link resolvers and public displays where they were available. Acquisitions details like pricing models, negotiation notes and quotes were also stored in the ERM system. Workflow paths and responsibilities and tasks were a basic functional requirement along with contact details for platform vendors, publishers, data providers and consortium partners were all important components of the first generation ERM functional requirements.

To varying degrees, all these systems have satisfied the core functional requirements and matched the data elements recommended by the ERMI model. The following section describes the new set of useful functional requirements that have been identified since libraries started to implement these ERM systems.

Implementation

Since commercial ERM systems have been installed in libraries, the opportunities for sharing data and planning processes have increased. Libraries who have adopted the Innovative ERM system take advantage of the user group clearinghouse website for sharing information about the planning and technical details of the implementation process. They have learned which fields are most useful for a rapid implementation and how to customize the staff and public interfaces.

Data sharing has also become an important aspect of the implementation process. The University of Arizona now provides resource descriptions to Innovative Interfaces and these records are shared with all new and existing Innovative ERM systems. This data sharing model allows libraries to quickly identify which resources they subscribe to without data entry for every library.

Staff Needs

The evolving staff needs within ERM systems fall into three categories:

- **Automation:** the need for enhanced efficiency through automation of routine administrative tasks and interface development.
- **Analysis:** the need for sophisticated analysis of existing data to provide a deeper understanding of library holdings and make informed decisions about the return on investment for electronic resources.
- **Consortium Requirements:** the need to track license terms at the appropriate level and to manage title metadata that is shared and unique in a consortial environment.

Automation

As ERM systems have matured, libraries have sought new efficiencies through standardization of data. The License Expression Working Group has been convened to develop an industry standard for the description of the license terms that govern a licensed resource (NISO License Expression Working Group 2007). The need for such a standard lies in the library's time-consuming task of analyzing license documents and coding them according to the features of the local ERM system. This has proven to be a labor-intensive task that requires the skills of a staff member deeply familiar with license terms. The evolved functional requirement is a feature built into the ERM system that will accept a feed of license data and populate the ERM system with the appropriate terms of use and other license elements as profiled by the library. Additionally, ERM systems should offer a view of license terms for resources that are not currently licensed—such as those that are undergoing a trial or other resource selection review process. The ideal application would connect to the system of the content provider or a clearinghouse of license documents and allow the selector to review the proposed license terms before purchase or at any time during the evaluation process. A web-services based request and response model should be in place and integrated with the ERM application. This would allow the user to make real-time, just-in-time requests for licensed or under-trial electronic resources. An industry-standard license description format would provide the backbone for this model.

The automation of routine administrative tasks provides a rich source of new functional requirements for ERM systems. Interfaces between ERM systems and content provider or subscription agent administration systems would facilitate the automation of administration functions such as:

- **IP registration** – As local networks grow or are reconfigured, libraries must broadcast a list of IP address ranges to their content providers. This is particularly true for libraries in a consortial arrangement or agreements with partner institutions and affiliated institutions. This task is required in addition to the registration of IPs when new resources are licensed. Current methods are labor intensive and the actual registration mechanism can vary from provider to provider. As libraries look to the new generation of ERM systems they want to see a single model for IP registration enabled by standard-based protocols within the ERM system.

- **Activation** – As with IP registration, this critical part of the workflow varies from provider to provider. A single activation mechanism enabled

by a standard protocol among all providers could have the effect of avoiding service problems and improve overall efficiency. Automating this activity would have the additional benefit of blending the activation action itself with the recording of the event in the ERM system—thereby contributing to overall efficiency.

- **Renewal** – While renewal might involve a review of license terms or renegotiation of some aspects of the license, where the license is being accepted without revision, it should be possible to indicate an intent to renew or to commit to renewal via communication between the ERM system and the content provider or licensing agency. Where both parties agree to a standard protocol, the amount of staff administrative activity should be attenuated by the automated system.

- **Incident reporting** – Incident reporting is the activity whereby the library notifies the publisher or platform provider that there is a problem with access to an electronic resource or one of its components. It is the administrative function that is perhaps in the greatest need of automation. Current ERM systems allow staff to record the details of a service incident at a detailed level—including title details for journal packages and the reporter and reportee. The fact that this process is not automated contributes to inefficiency. Library staff are forced to report incidents through provider-specific mechanism and then record the details of the incident in the ERM system for long term analysis and to seed follow up tools provided by the ERM system. This should be a single event with a feedback loop based on an agreed-upon protocol.

- **License review** – As described above, there is a need for a request and response protocol for license terms. This will facilitate the review process for not-yet-licensed resources and allow the library to review current or proposed standard license terms for renewing licenses. This mechanism would create the foundation for an automated method for populating the ERM system with license terms.

What is needed here is a standard model for communication between the ERM system and the content provider or subscription agent's administrative system. Each of these administrative functions shares the same identifiers; the only difference between the exchanges is in the administrative data transferred (*see* Table 1).

Administrative Function	Identifiers	Request or Report (Client)	Response (Server)
IP registration	Institution identifier Resource identifier	IP addresses	Confirmation
Activation	Institution identifier Resource identifier	Activation request	Confirmation
Renewal	Institution identifier Resource identifier	Renewal request	Confirmation
Incident report	Institution identifier Resource identifier	Incident description	Confirmation
License review	Institution identifier Resource identifier	License request	License data

Table 1. Core data elements for automation of administrative tasks. While no model currently exists for this data exchange, a web services model with a common request and response syntax could be developed between ERM system developers and content providers or subscription agents.

Analysis

ERM systems have a number of data elements that make them an ideal source for advanced data analysis. They contain or have access to the knowledgebase of titles, links, embargo periods and coverage dates for all licensed and unlicensed ejournal content available to the library. Some ERM systems contain cost data provided by the acquisitions system from an integrated library system or loaded through interfaces. Combined, all these data can serve as the input for advanced analytical tools. Libraries need these tools to inform decisions on subscription renewals, aggregation and publisher-direct cost/benefit comparisons and as evidence for challenging the principles of title bundling--particularly with the bundled ejournal packages. Data-informed analysis tools could provide libraries with concrete evidence of the use pattern within packages and a detailed understanding of the value for money for the little-used titles within a package.

Standard statistical methods can provide valuable tools in the analysis of the patterns of use within a package. The spread of usage of journals within a package can be analyzed by the following statistical measures:

- **Mean**, to measure average usage within a collection.
- **Median**, to identify the middle point in usage within a collection.
- **Skewness**, to identify asymmetry of the distribution of usage values within a collection.

Quantile analysis can be used to group journals into one hundred bins (percentiles) or ten bins (deciles), where journals are arranged from least usage to highest usage and then divided into the bins. This arrangement facilitates histogram views and percentage of usage calculation.

Using these measures, libraries could understand how much on average resources are used (mean), the abstract distribution of usage within a package (median) and test for unequal distribution of usage within a package (skewness and quantile analysis). These latter tools can provide perhaps the most revealing analysis of usage distribution. Quantile analysis can also be used to expose unequal distribution of usage within a package. For example, if a set of journals is divided in equal groups of deciles from least usage to highest usage, it is possible to quickly calculate and analyze the share percentage of each decile. If usage is highly unequal, then the greatest share of total usage will be in the top deciles. In extreme cases, this analysis will show that a few of the most highly used journals comprise the majority of total usage within a package.

Skewness is simply a statistical description of the curve that describes the usage. Again, if a set of journals are arranged in deciles and a graph of the usage is produced, a highly unequal distribution of usage will show a highly negative skew—that is most of the usage will be crowded within the top deciles. This provides an easily comparable measure of the inequality of usage distribution among packages. A gradually rising curve that does not deviate significantly from the median value would demonstrate a more even distribution of usage among journals and an extremely low skewness score would be assigned. See table 5 for mean, spread of usage for journals within the package and skewness analysis for the same packages analyzed above:

Package	Mean	Smallest Usage Count	Largest Usage Count	Skewness Score
American Chemical Society, 2006 Usage	745.6071	20	3337	1.636924
Ovid Journals-Lippincott Williams & Wilkins, 2006 Usage	37.98857	1	352	2.790133
Elsevier-Science Direct, 2006 Usage	221.7717	0	56811	25.14667

Table 5. Statistical Summary for Sample Packages.

These data show that there is tremendous variation in usage of journals within a package and the distribution of usage within the deciles can be highly unequal. As an analytical tool, these measures could provide electronic resource

management staff a concrete measure of the true usage of bundled journal packages.

Collection Analysis Tools

The utility of ERM systems is expanded dramatically when collection analysis tools are present. The most useful tools and candidates for new functional requirements are:

Cost-per-use Analysis

When cost figures are available to the ERM system, the ERM system can use the payment data to support electronic resource collection analysis functions--especially cost-per-use figures. For example, where title-level usage data is stored in the ERM system, payments for those titles stored on the system can be used to calculate cost-per-use figures for each. Those same usage and payment figures can then be combined to calculate average resource- or package-level costs-per-use. This would allow libraries to make meaningful comparisons across content platforms offering similar content. The goal of these calculations is typically not to determine extremely high or low cost amounts, but to provide concrete cost figures at the use level for reporting to faculty, staff, funders, selectors or other analysts of the relative cost of the library's licensed resources (Fons and Jewell 2007).

Overlap Analysis With Cost-per-use Analysis

Where packages contain identical titles, it is useful to understand the degree to which titles overlap and the holding ranges overlap. When identifying candidates for selection review, it is useful to understand the degree to which titles are available in other packages. Overlap analysis tools should generate percentages for unambiguous analysis. Where possible, resource-level cost-per-use figures should be included to provide a value-for-money dimension. Relative cost-per-use can be a valuable tool in understanding which of multiple resources provides the maximum value for money spent.

Usage Statistics Harvesting

The development of the Standardized Usage Statistics Harvesting Initiative (SUSHI) or Z39.93 standard at last provides libraries with an efficient method for gathering usage statistics across all of their COUNTER-compliant content providers, and thereby to support and streamline these kinds of analyses. SUSHI harvesting capability should be a baseline functional requirement for all ERM systems. In addition to cost and usage data, future ERM systems should have

access to bibliographic data elements like subject and publisher to provide the full range of analysis tools (Fons and Jewell 2007).

Acquisitions Data

As previously discussed in the section on cost-per-use analysis, acquisitions data can be useful in the ERM context, where they can support cost analysis and a set of use cases related to supporting the electronic resource lifecycle. These include payment verification for resources that have been reported as unavailable by users and the relative cost at the journal level for aggregated journals and publisher-direct subscriptions.

The most significant challenge to making acquisitions data available to the ERM system is the location of the acquisitions system of record for the institution. The majority of ERM systems are offered as parallel applications to the ILS. Where the acquisitions and ERM systems are built on the same platform, it is possible to have direct access to the cost data described above. Where these systems exist in parallel there are no existing standards for the automated exchange of cost data. The Acquisitions Interoperability Subcommittee of the DLF's ERMI Phase II project has identified the core data elements for exchange between systems (DLF Acquisitions Interoperability Subcommittee 2007). The challenge for ERM system developers is to build interfaces to acquisitions systems to import those data. The ideal application would allow requests carrying the appropriate institutional credentials and specific resource identifiers. The return data would follow an industry standard for processing into the ERM system. Until such a model can be developed, ERM systems should accept data in proprietary formats from a variety of sources.

Consortium Requirements

Managing electronic resources that are available through the library's consortial memberships has become an important requirement for ERM systems. Both at the library and the consortial level, it is important to track these components:

- View of consortial (shared) resources. Here it is critical to track the license terms as they apply to each member of the consortium. Libraries need to understand the terms and conditions that apply to the use of the shared resources and to what extent they can share the resources with their extended user community.
- View of library-specific resources. In a system that tracks consortial resources it must be possible to filter searches and views to the resources that are made available exclusively through the library's funds.

- Proposed and tried resources. Libraries in consortia want a mechanism to publish resources that are under consideration for purchase. A feedback mechanism for each library's purchase preference is a useful component of this feature.

Libraries have pursued consortial arrangements because of the perception that the buying power of a group of libraries offers a wider range of resources than could be acquired by each library acting independently. These arrangements have allowed libraries to expand their resources through the "big deal," from resources that they license directly to resources that they license collectively and to resources that are available outside of their specific subscriptions, but are available through the consortial configuration. Resources that are not owned directly, but are available for use through consortial negotiations are not tracked well in current ERM systems. The requirements above combine to provide a rich area for improvement with next-generation ERM systems.

Patron and Public Services Needs

Current ERM systems have been designed to support the acquisitions workflow, collection analysis and ongoing management of electronic resources. However, the need for a tool for public services staff in supporting electronic resources for library patrons and for the library patrons themselves remains significant. Library public services staff frequently support inquiries about the current status of, and access parameters of, electronic resources. The ERM system is designed to store information about resource status, incident status and the specific terms and conditions of use. This information should be exposed at all points of description and access. More importantly, it is not uncommon for licenses to require the library's best efforts to express the terms and conditions to the end user. Therefore, all public points of access should display:

- **Terms and conditions of use** – Perhaps the most critical data for public services staff. The ability for public services staff to consult an easily-accessible interface that describes the terms and conditions such as authorized categories of users and terms of core activities like interlibrary loan allows faster resolution of access problems and rapid resolution of patron inquiries.

- **Resource availability and advisory** (With forecast for problem resolution when system outage is on-going) – When resources are not available because of scheduled outage, unscheduled outages or administrative error, it is critical for public services staff to be able to

communicate the current status of the issue to library patrons and to have a resource to consult when library patrons inquire about the status of a resource. The public display component of the ERM system is the ideal location for this information. Coupling these displays with the incident reporting functionality described above would maximize efficiency within the system.

The advisory component of the public display would allow the library to go beyond the simple service outage notification feature. The advisory component would also allow the library to promote some aspect of the resource that might be relevant to the moment or to broadcast new content sponsored by the library or library consortium. For example, the library could promote the recent addition of new titles or other enhanced content and to provide credit to the funding agency.

- **Resource scope/description** – As with appropriate resource selection where there are multiple resource options, a scope note displaying at the point of discovery or access, the ERM system becomes both the system of record for all metadata about a resource and a reference tool for library patrons. Resource scope notes and general description has the potential to help a user determine the type of resource being accessed (journal collection, article database, index, etc.). It can also help the user determine the depth of treatment of topics, e.g. general knowledge/multidisciplinary or specialized resource.

- **Technical requirements for access** – As web browsers mature and incorporate helper applications, this component is less critical than it has been in the past. However, the broadcast of technical requirements for access can be useful for specialized databases where specific helper applications are required for file types included in the resource.

The advantage of including information from the ERM system in public access applications extends beyond the description of access terms and resource descriptions. It also provides the library with the opportunity to centralize all information about the electronic resource including resource features, enhancements, library value-adds and library sponsorship of research-related content.

Discovery Services Platform, Link Resolver and Metasearch Views

The value of ERM data in public views is not restricted to the online public access catalog and A-Z lists of resources and journals. It extends to external points of access such as the discovery services platform (Encore and Primo are examples), link resolver and metasearch environment. Library patrons accessing licensed content should have a clear understanding of access rights and restrictions as well as relevant administrative data describing the nature and availability of the desired content. Particular attention should be paid to providing information about the technical requirements for full text access to content. This includes browser versions required and suggestions on secondary applications required for accessing content. All these data should be available in the ERM system. Where the ERM system and the link resolver share the same platform, these linkages should be built in; otherwise, interoperability methods should be developed between systems to allow the real-time request for the appropriate data elements.

Exposing ERM data to public interfaces presents some of the same challenges that we saw in making cost data available to the ERM system. The ERM system often does not share the same platform as the public interfaces and no standards exist for the query and supply of the data elements identified above. The development of an industry-standard model for the request of these data is a positive direction for the development of the next generation of ERM systems.

Conclusions

The rapid development and implementation of ERM systems in the library marketplace shows that these systems are important components of the contemporary library management toolset. ERM systems were important enough to libraries that they evolved from locally developed systems to commercial products sold by commercial software vendors. However, ERM systems must evolve to provide features beyond those provided by first-generation commercial ERM systems. The SUSHI standard demonstrates that it is not only possible, but highly desirable, to develop new standards to bring greater efficiency to electronic resource management. As SUSHI used web services technology, that same technology could be used to bring new efficiencies to routine administrative tasks such as IP registration, activation, renewal, incident reporting and license review. Data standards for license data will further facilitate those interfaces. Standard statistics techniques should be applied to the analysis of ejournal packages to give electronic resource professionals the tools they need to make informed decisions about electronic resource purchases and the quantitative analysis data required to successfully

negotiate with electronic resource providers. And finally, new technologies and intra-industry cooperation should be sought for the sharing of ERM data with the critical public interfaces. Overall, there is much room for growth in electronic resource management systems and their profile as a critical tool for professional management of the library's most critical resources will continue to grow.

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