Discovery Product Functionality

Abstract

Chapter 1 of Library Technology Reports *(vol. 50, no. 1) "Library Resource Discovery Products: Context, Library Perspectives, and Vendor Positions" provides an introduction to the realm of library discovery products, including an outline of their evolution in scope and functionality and some of the major technologies and concepts involved. It highlights how each type of library has its own requirements and how these have been addressed among the products and services available. Emphasis is given to the current dominance of index-based, web-scale discovery systems designed for academic or research libraries and the emergence of e-book lending features in those oriented to public libraries. Each of the major products in these respective categories is discussed. Results from a survey of libraries using these products provide additional insight into the capabilities of each of these products.*

A great deal of progress has been made in the interfaces that libraries implement to provide access to their collections since I authored the July/August 2007 issue of *Library Technology Reports,* "Next-Generation Library Catalogs." That genre of software has advanced in many different ways, especially through new technologies and architectures that dramatically expand the scope of resources they address. For academic libraries with large investments in subscriptions to electronic resources, the advent of web-scale discovery services now provides powerful search and access capabilities and a near-comprehensive representation of the print and electronic collection components. For public libraries, some of the most interesting aspects of the advancement of discovery products include the integration of e-book lending. While we naturally expect these products to continue to see ongoing development, it is reasonable to consider this genre as a whole not as in an early stage of development, but rather as relatively mature. Libraries that have not yet invested in one of these products will find a number of mature and stable alternatives.

This issue of *Library Technology Reports* aims to provide libraries with the information needed to shape their strategies regarding the tools they might offer to provide access to their collections. We will provide information about the current state of the art of library discovery, describing some of the trends that have played out in recent years and some of the issues that libraries should consider as they evaluate these products. This report brings together data gathered from a survey that solicited information from libraries that use these products, from the vendors that develop them, and from news reports and the professional literature.

Terminology

In this report, we will use the term *discovery product* or *discovery service* to include the tools or interfaces that a library implements to provide its patrons the ability to search its collections and gain access to materials. These tools include both software that might be installed on a local server and tools offered as a hosted service. Discovery service will be used for those deployed as a hosted service. In other contexts, these products have been called next-generation library catalogs or discovery interfaces. Some of the products, especially those with a long product history, may have previously been considered under these product categories. Online catalog will be used to refer to the module of an integrated library system intended for use by patrons. We will use the term *patron* to refer to the users or customers of the library.

Library Survey

A survey was developed to gather data from libraries regarding their impressions of the discovery product they use. This survey included numeric rankings for overall product satisfaction, its perceived effectiveness for several categories of library users (undergraduates, graduate students, faculty, and general public), its comprehensiveness relative to the library's overall collections, the effectiveness of its relevancy rankings of results, its objectivity in producing search results, its integration capabilities, and its ease of administration. Libraries could indicate whether they were considering migrating to another discovery product and what alternatives were under consideration. Narrative fields were provided for libraries to list any content resources not well covered by the discovery service, explain perceived bias, comment on any previous migrations of discovery products, and make general comments.

The survey instrument allowed only one response per library, and each survey response is linked to that library's entry in the lib-web-cats directory on Library Technology Guides. The association between survey responses and directory entries provided the ability to enhance survey responses with additional demographic data about the library, such as the ILS in use, its relative size and type, or other data elements.

Library Technology Guides
www.librarytechnology.org

Responses were received from 396 libraries, distributed according to the type categories shown in table 1.1.

A total of 29 countries were represented in the survey responses, with the vast majority of libraries—252—in the United States; in addition, there were 27 in the United Kingdom, 27 in Canada, 16 in Australia, and fewer than ten from each of the remaining countries.

Results from the survey will be interspersed throughout this report according to the topic under discussion. Table 1.2 summarizes the responses and statistical calculation for the most general question: "How do you rate the library's satisfaction with the overall performance of the Discovery Product?"

The results were gathered and summarized using tools similar to those used for other surveys conducted through the Library Technology Guides website. The June 2011 issue of *Library Technology Reports* was based on data collected for surveys conducted on library perceptions of library automation systems from 2007 through 2010.[1]

The following description of the statistical methodology is based on that provided for other surveys

Academic	247
Consortium	15
Government agency	2
Law	7
Medical	5
Museum	1
National	1
Other	1
Public	96
Special	14
State	4
Theology	3

Table 1.1
Distribution of types of libraries participating in the survey

performed through the Library Technology Guides infrastructure:

In order to avoid making generalizations based on inadequate sample sizes, the processing scripts included a threshold variable that would present results only when the number of responses exceeded the specified value. The threshold was set to a value of 20.

For each of the survey questions that involve a numeric rating, a set of subroutines was created to calculate and display simple statistics.

- **Responses** indicates the number of survey responses that made a selection for this question.
- A **Response Distribution** array lists the number of responses for each possible value from 0 to 9.
- The **Mode** indicates the numeric response that received the most selections.
- The **Mean** is the average response, calculated by adding together all the responses and dividing by the Responses value, rounding to two significant decimal places.
- The **Median** is the middle response, calculated by placing each of the responses in a sorted array and selecting the middle value.
- The **Standard Deviation** (Std Dev) was calculated by subtracting each response value from the mean, squaring the difference, summing the squares, and dividing by the number of responses to determine the variance. The standard deviation is the square root of the variance.

The tables displaying results from each topical ranking are produced by a script that processes each of the numerical ratings, displaying each of the statistical components listed above for each product that received responses above the threshold value. This report provides a convenient way to compare the performance of each product for the selected question.

Overall Satisfaction with Discovery Product		Response Distribution										Statistics			
Product	Responses	0	1	2	3	4	5	6	7	8	9	Mode	Mean	Median	Std Dev
EBSCO Discovery Service	63			1	1	1	3	11	24	16	6	7	6.98	7	0.88
VuFind	18			1		1		1	8	6	1	7	6.94	7	1.65
BiblioCore	15				1	2	4	3	4	1		6	6.67	7	1.81
Summon	70	1		1	1	3	4	11	32	15	2	7	6.64	7	0.84
WorldCat Local	23			2	1			7	6	4	3	6	6.52	7	1.46
AquaBrowser Library	10			1	1				5	2	1	7	6.50	7	2.21
Enterprise	10				2			1	5	1	1	7	6.40	7	2.21
Primo	65			1	2	4	7	19	23	8	1	7	6.26	6	0.50
Arena	17			2	1	3	3	8				7	5.82	6	1.46
Encore	40	2		1	2	2	4	15	8	5	1	6	5.78	6	0.95
All responses	**354**	**4**		**9**	**13**	**17**	**23**	**77**	**129**	**64**	**18**	**7**	**6.44**	**7**	**0.32**

Table 1.2
Summary of responses to the question "How do you rate the library's satisfaction with the overall performance of the Discovery Product?"

The report sorts the statistics for each product in descending order of the mean. The report categories correspond to the survey questions with numerical scale responses.[2]

Vendor Questionnaire

Each product section will also include some tables that itemize the features offered by each product. The author created a questionnaire of functionality and technical characteristics that was submitted to each vendor to complete. To the extent possible, the functionality asserted by the vendor was verified against working implementations in one or more libraries. The questionnaire included sections on general characteristics, search features, display features, social features, central index, relevancy, account management, technical deployment and integration, application programming interfaces, and a narrative where the vendor could make additional statements that might help libraries understand the distinctive characteristics of the product.

Vendors providing responses to the survey included:

- Ex Libris: Primo/Primo Central
- ProQuest: Summon and AquaBrowser Library
- OCLC: WorldCat Local
- EBSCO Information Services: EBSCO Discovery Service
- BiblioCommons: BiblioCore
- Infor Library and Information Solutions: Iguana
- Axiell: Arena
- VTLS: Chamo Discovery
- Villanova University: VuFind

The vendor responses will be interspersed throughout the report, including in topical areas with information about each of the products as well as in the profile section developed for each product.

Online Catalog ILS Modules

Discovery services represent the latest in a series of technology tools developed for libraries to provide access to their collection materials. The online catalog emerged in the early days of library automation as a module of the integrated library system. This module provided an interface that could be used by library patrons to find materials owned by the library and managed in the ILS. Online catalogs were entirely integrated with the data structures of the ILS and provided the ability to search or browse the collection, to view an item's current location and availability status, and to perform requests such as requesting an item on loan to another borrower.

The early online catalogs were deployed through computer terminals connected to mainframe-based integrated library systems. They were operated through text-based interfaces, using menus or command codes for their operation. In the early phase of library automation, these online catalogs were deployed only within the physical library. Wider access was provided through dial-in modems, later through campus networks, and eventually through the Internet. As the mainframe-based ILS gave way to those based on client/server architecture, graphical clients designed for Microsoft Windows or the Macintosh OS operating on personal computers replaced the text-oriented terminal clients.

Web-Based Online Catalogs

The advent of the web led to the development, beginning around 1995, of browser-based online catalogs, which quickly became the preferred approach even as the modules of the ILS used by staff continued to be based on graphical clients. For example:

- Sirsi Corporation announced its WebCat online catalog product in February 1995.[3]
- Innovative released its web-based catalog in September 1995.[4]
- Geac released GeoWEB by January 1996.[5]

Web-based online catalogs proved to be very flexible, enabling convenient access to library patrons not only in the library itself, but also in their homes and offices and from any computer connected to the Internet. But these online catalogs eventually became less useful as libraries became increasingly invested in materials that were not directly represented in the ILS and as search and navigation capabilities became popular on other websites that made the interfaces within the online catalog seem in comparison much less modern and more difficult to use.

Emergence of Discovery Interfaces

These considerations led to the emergence of a new generation of interfaces in the mid-2000s, generally known at that time as next-generation library catalogs or as discovery interfaces. These products included search and retrieval technology and modern interface conventions and were generally designed to work independently from any given integrated library system. The search capabilities of these products were based on the creation of a new index, populated by exporting records from the ILS and other repositories maintained by the library. This approach allowed them to use more modern and powerful search and retrieval technologies, such as Lucene or Solr, open-source products widely used in all information technology sectors with very advanced capabilities. These technologies offered capabilities generally not available within the ILS itself. The structure of operating a separate discovery interface also meant that content resources could be added fairly easily without the complex overhead of loading records into the ILS.

ILS Integration

Implementing a discovery interface separately from the library's core automation system came with the requirement for integration. As noted above, bibliographic and holdings records from the ILS must be exported and loaded into the discovery service's indexes and synchronized perpetually. A typical implementation would load all the records at the time of initial installation of the discovery interface, with new, changed, or deleted records processed at regular intervals, such as daily or hourly, depending on the level of currency desired and the processing overhead involved. This approach to creating and maintaining the indexes kept the indexes of the discovery interface closely up-to-date so that patrons would be able to search the collection. Additional mechanisms were also needed to provide the same functionality as the native online catalog. It was important, for example, to display an indication of whether any item selected is currently available on the shelf or if it is on loan to another patron. Such real-time information cannot easily be represented in the indexes of the discovery interface, but must be determined through a query to the circulation module of the ILS. For items not available, the discovery interface needed to offer the ability for the patron to sign in and place a hold request. In order to perform these real-time status displays and service requests, the discovery interface and the ILS would need to communicate with each other.

ILS-DI Initiative

The introduction of these new discovery interfaces allowed libraries to consider using a different system for search and access to their collections than the online catalog built into their ILS. The system-to-system communications needed to support real-time availability and other self-service patron features represented a complex set of interactions that were accomplished through a combination of standard protocols and proprietary mechanisms. The growing array of emerging discovery interfaces, which each needed to be able to communicate with different ILS products, sparked an interest in exploring the need for a more standard set of intercommunication mechanisms. The Digital Library Federation created the ILS Discovery Interface Task Group in summer 2007 to investigate possibilities in this domain and to make recommendations. The group was chaired by John Mark Ockerbloom (University of Pennsylvania).

The Digital Library Federation released the ILS-DI interface specification, also known as the Berkeley Accord, in June 2008.[6] The ILS-DI proposed four levels of integration:

1. **Basic discovery interface**, which provides a minimal level of interactions that focus mostly on populating the index of the discovery interface, relying on handoffs to the native web-based online catalog of the ILS for real-time availability status and most patron self-service functions.

2. Elementary OPAC supplement, which includes some communications between the discovery interface and the ILS, but continues to rely heavily on the ILS online catalog.

3. Elementary OPAC alternative, which allows the discovery interface to provide most real-time and self-service features, but may rely on the native catalog for advanced features.

4. **Robust or domain-specific discovery platforms**, which fully replace the online catalog of the ILS, providing all real-time status and self-service features, including advanced features such as fines and payments and academic course reserves.[7]

The Digital Library Federation no longer exists as a separate organization. It was merged into the Council on Library and Information Resources in April 2009. Many of the DLF programs continue to operate within CLIR, but the ILS-DI initiative has not been actively maintained. Today, the ILS-DI remains useful as a reference model, but has become increasingly dated relative to the needs of discovery product integration processes today.

At five years since the ILS-DI recommendations were issued, expectations for discovery products have advanced considerably. Today, libraries expect a discovery product to incorporate all the functionality of the online catalog for the materials managed within the ILS, generally consistent with level 4 of the ILS-DI. Handoffs to the online catalog can be confusing to patrons and much less acceptable to libraries as they design their websites and virtual library environments. In some cases, especially with the new generation of library services platforms, a traditional online catalog is not available, with the library relying entirely on either the vendor's or a third-party discovery product.

Table 1.3 describes integrated library systems supported by each discovery product.

Interface Features

Traditional online catalogs, though efficient, fell out of favor at least partially due to their more complex and esoteric user interface, which became increasingly problematic when used by patrons who were used to the search and navigation conventions of the web. Although web-based online catalogs offer very sophisticated search capabilities designed specifically for searching and browsing library collections, patrons had become acclimated to a simplified search process on the web able to deliver relevant and meaningful results. Much of the initial work as seen in the first wave of discovery interfaces was directed toward creating search and navigation capabilities more consistent with other web-based services, optimized for the retrieval and access of library materials.

Some of the interface features of the first wave of discovery products included the following:

- **Single search box**. Rather than presenting a complicated set of advanced search options on the initial search page, discovery interfaces generally begin with a simple search box. This approach produces a broad set of results that can be narrowed as needed to guide the user to a useful result set. This contrasts with the operation of the traditional online catalog, which prompts the user to specify qualifications at the beginning of the search process.

- **Relevancy-ranked results**. In the general web environment, search results are almost always ordered according to relevancy. Google, Bing, and the other search engines devise very sophisticated algorithms to identify the items that best match the search query and order the results accordingly. This technique contrasts with that of the traditional online catalog, which listed results according to dates, authors, subject headings, or other structures. Ordering search results for library collections has proven to be one of the most difficult challenges for discovery interfaces. Identifying in an objective way the best results that match a patron's query requires more than applying keyword-based algorithms. In a library discovery environment, many other factors may also need to be considered to rank results in a way that will provide the best items from the library's collection in response to a query. Result candidates may be identified by keywords, but ranking may also need to consider indicators that reflect scholarly value, disciplinary focus, popular interest, or other factors. As discovery products have matured, the methods for calculating relevancy have become more sophisticated.

- **Faceted navigation**. Consistent with the general search paradigm of working from general to specific, discovery interfaces provide lists of terms that can be clicked to narrow search results. These facets, derived from the result set, provide the means to select materials according to specific authors, subject terms, material types, date ranges, languages, or other categories. Most of the discovery interfaces present facets in a narrow column on the left side of the main search results, with an indicator of the number of results expected if a facet is selected. Patrons can select multiple facets as they navigate through the results to home in on the specific materials of interest. Other interface conventions include presenting a list of the facets selected during the search session, which can be deselected to re-expand the result set.

- **Recommendations**. A variety of techniques can be offered in a discovery product to guide the user

Product	Library management systems supported
Summon	The Summon service has been successfully integrated with more than a dozen ILSs, including popular systems such as EOS, Evergreen, Ex Libris Aleph, Ex Libris Voyager, Innovative Interfaces Millennium, SirsiDynix Horizon, SirsiDynix Symphony, OCLC PICA, and Talis.
EBSCO Discovery Service	EBSCO Discovery Service is capable of integrating with most ILS vendors' services. Including customers' proprietary solutions, EDS has successfully integrated (or is in the process of doing so) with the following: ABEKT, Aleph, Alephino, Alexandria, ALICE, ALIST, Almaviva, AMICUS 3.5.3, Apollo (Biblionix), Bibliotheca 2000, Berytos, bliss, BOND, BOOK-IT, Capita, CARL, CDS/ISIS, Clavius, COBISS, Cosmotron, CyberTools, Destiny (Follett), E-Cats Library (CMS Corporation), Encore, Enterprise (SirsiDynix), EOS, Evergreen, Ex Libris, FindPlus (LA Systems Technology), FIRST LMS, Flora, GEAC ADVANCE, Heritage UK, Horizon, HyLib, Idea, ILMU, Inmagic, IRBIS, Janium, KIS DAWINCI, Koha, KP-Win SQL, Kybele, LBS (OCLC), LIBERO, Liberty (Softlink), Libra, LibraryWorld, LibriSuite (SABINI), Libsys, Mandarin M3, Mandarin Oasis, Milas, Millennium, Mirtech, Mitopac, Mondo, OCLC PICA, OLIB (OCLC), Oliver (Softlink), Open Journal Systems, Pérgamo Gestión, Pergamum, PMB, Polaris, Portfolio 7 (ISACSOFT), PrettyLib, Prism, Prolib, Sagebrush InfoCentre Library Manager 2.3, Sebina, Sierra, SIPUS, SirsiDynix, SOLAS III (DLI2), SophiA Biblioteca, SOUL, Spydus (Civica), Sydney, Symphony, T2Pro, Talis, TLC, TOTALS, Troodon, Tulip (Futurenuri), UNIBIS, Unicorn, Virtua, Voyager, V-smart, Vubis, WebCat (Sirsi), Winnebago Spectrum, XMLAS, YORDAM, Zebra.
Primo + Primo Central	Aleph, Voyager, Alma, Millennium, Talis, Symphony, Horizon, Unicorn, OCLC, SISIS, Virtua, BIBSYS, NALIS, Spydus (Civica), Evergreen, Inmagic, Sierra, Limedio, KP-Win SQL, LIBERO, Sebina, Koha, and other homegrown ILSs.
WorldCat Local	Innovative Interfaces: Millennium, INNOPAC, INN-Reach; SirsiDynix: Horizon, Symphony, Unicorn; Ex Libris: Voyager, Aleph; Axiell: OpenGalaxy Plus; Talis: Alto; Evergreen; OLIB; AMLIB; WMS; Prism; Viewpoint; GLADIS; Polaris; Koha; CARL-X.
AquaBrowser	SirsiDynix Horizon, Unicorn, Symphony; Millennium; CARL; Voyager; Aleph; TLC; Virtua (VTLS); Polaris; Follett; Koha; Info Vubis Smart; Talis; SISIS; AMICUS; Concerto; BIBDIA; Bicat; AMLIB. Also, any ILS with MARC21 (UTF8) export facilities plus XML-based web service for real-time availability OR HTML-OPAC page for screen scraping, plus ILS with facility to place a title-level hold via a web-based system with direct known URL format that uses the ILS's internal record identifier to resolve.
Chamo Discovery	Chamo Discovery is an open-ended system and therefore can integrate with any system. Actual integration is demand-driven.
Enterprise/ Portfolio	Symphony and Horizon are completely integrated via web services for real-time holdings and patron self-service functions. However, Enterprise is capable of harvesting bibliographic data from any ILS capable of exporting it. Standard configuration options allow for the redirection to the ILS for item status and patron self-service functions.
Encore (release ES)	Millennium, Sierra, SirsiDynix Symphony, SirsiDynix Horizon, Voyager, Aleph.
BiblioCore	Symphony, Horizon, Polaris, Millennium, Sierra, Evergreen; VTLS and CARL-X are coming soon.
Iguana	V-smart, Vubis Smart, SirsiDynix Horizon.
Arena	Any through web services. Present implementations: BOOK-IT, Libra.se, DDElibra, Pallas Pro, Origo, LibraFI, Aurora, OpenGalaxy, Mikromarc.
VuFind	Aleph, AMICUS, Clavius, Evergreen, Horizon, Innovative, Koha, NewGenLib, Polaris, Symphony, Unicorn, Virtua, Voyager, XC NCIP Toolkit.

Table 1.3
Integrated library systems supported by each discovery product

toward finding library materials. As the patron begins to type in the search box, the interface can anticipate valid search terms that can be dynamically presented, usually in a drop-down, that can be clicked to select the term. This type-ahead, or auto-complete, can be helpful in identifying query terms that the user might not have otherwise considered, as well as reducing typing effort. Another convention taken directly from the web search arena helps with queries that might include typos or terms that yield no results. In these cases, the interface can respond with "Do you mean . . . ?" offering validated search terms. Discovery interfaces can also make additional recommendations of related material that might be of interest to the searcher, based on related subject headings or calculated from other indicators in the query or results.

• **Enriched records.** In addition to the MARC records extracted from the ILS, many discovery products build enhanced content for collection items, including graphics that represent book jacket images or format indicators, tables of contents, summaries, reviews, and other information, often provided through a commercial service such as ProQuest's Syndetic Solutions, LibraryThing, or ChiliFresh.

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Effectiveness of Interface		Response Distribution										Statistics			
Product	Responses	0	1	2	3	4	5	6	7	8	9	Mode	Mean	Median	Std Dev
EBSCO Discovery Service	63		1			2	1	12	18	21	8	8	7.17	7	1.13
BiblioCore	15						3	1	4	6	1	8	7.07	7	1.81
Summon	67	1		1	1		3	9	22	25	5	8	7.06	7	1.10
VuFind	18			1			5	4	7	1		8	6.94	7	2.12
WorldCat Local	23					1	1	8	6	3	4	6	6.91	7	1.46
AquaBrowser Library	10					1	1	1	4	3		7	6.70	7	2.53
Enterprise	10			1	1			1	2	4	1	8	6.60	8	2.21
Primo	66			1	1	2	9	17	15	20	1	8	6.58	7	0.98
Encore	40	2			3	1	1	9	13	10	1	7	6.30	7	1.11
Arena	18				3	2	4	1	8			7	5.50	6	1.41
All responses	**348**	**3**	**1**	**4**	**10**	**10**	**23**	**67**	**106**	**101**	**23**	**7**	**6.76**	**7**	**0.38**

Table 1.4
Summary of responses to the question "How do you rate the effectiveness of the **user interface** of the discovery product?"

Product	Mobile access
Summon	yes. The Summon service autodetects a user's device and provides a separate mobile interface that is responsive in design.
EBSCO Discovery Service	yes, via responsive design. EDS is highly mobile device–compatible. No additonal apps, links, or interfaces are required to search EDS from a mobile device.
Primo + Primo Central	Primo supports mobile devices through responsive design. Mobile app is on the development roadmap.
WorldCat Local	yes
AquaBrowser	supported through a separate interface
Chamo Discovery	Chamo has a mobile skin. VTLS also has MozGo available for an additional purchase. At present, it accesses indexed searches and not federated searches, which will come soon.
Enterprise/ Portfolio	yes. BookMyne and the customized, site-specific version BookMyne+ offer full catalog functionality for smartphones and tablets. The current 3x version is available for iOS and Android with HD resolution. Available in 2013, version 4x uses responsive design HTML5 tools for iOS, Android, or any browser. Key functionality includes find a library, directions, contact, add to favorites; discovery (including Portfolio data; v4x includes discovery of eRC data); enriched content; holds, my lists, related materials; my account; suggested reading.
Encore (release ES)	yes
BiblioCore	BiblioCore currently provides native apps for iPhone and Android and a mobile web–optimized version but is moving its services to responsive design.
Iguana	Iguana includes a mobile web interface and an app. Iguana's CSS implements a responsive design as well.
Arena	yes, all alternatives
VuFind	VuFind currently supports a separate mobile interface, and a responsive design theme is under development for the next release.

Table 1.5
Support for mobile devices offered by each of the discovery products

at alatechsource.metapress.com to view the full tables that list search features and display features offered by each discovery product. Table 1.4 summarizes responses and statistical calculations from the library survey for the question "How do you rate the effectiveness of the user interface of the discovery product?"

Support for Mobile Devices

The adoption of smartphones, tablets, and other mobile devices by the general public continues to increase. The degree to which a discovery product provides support for mobile devices can be an important consideration,

especially if the library observes increasing use of its resources by mobile devices as it monitors its website activity through analytics or statistical reporting tools. Many applications are built with "responsive web design" principles, where the type of device is detected and the presentation adapts according to the device's screen size and technical capabilities. Table 1.5 describes how each of the discovery products accommodates mobile devices.

Expanding the Scope of Discovery

One of the foundational issues behind the rise of discovery products lies in the expansion of their scope to include materials in the library's collection that are not managed within the ILS. The ILS has traditionally managed library materials at a fairly high level and in a way optimized for print materials. These systems were designed to manage inventories of books, including multiple copies and copies distributed among multiple branches, and to manage periodicals. But they do not manage some of the most important aspects of library collections today, such as the articles contained within journals and other bodies of content that might be managed with separate platforms, such as institutional repositories, digital collection management platforms, e-book collections, archival information systems, and others, each with its own interface for patron access. Library patrons may not be aware of all the different tools that they need to explore to find all the materials offered by the library in their area of interest. Discovery products can funnel many of these different components of a library's collection into a single search environment.

Metasearch

One of the tools that emerged beginning around 2000 used metasearch technology to provide a simpler way for patrons to search for library materials. Metasearch operates by transmitting the patron's query to multiple content targets, including those within the library's own environment and external information providers. Targets could include the ILS and repositories, but would especially include the databases of electronic resources to which a library subscribes.

Using metasearch with e-resource databases allows libraries to provide access to the content in articles within search results. Prior to metasearch, libraries would offer lists of e-journals and databases, each of which would need to be searched separately for patrons to find articles related to their area of research. Especially as these lists proliferated, with an academic library subscribing to many hundreds, if not thousands, of electronic resources, any tools that would help simplify the research process could make these resources more accessible for library patrons. The increasing proportions of collection budgets allocated to electronic resources in comparison to print materials also strengthened the need to provide better access tools to ensure that the most value was gained from these investments.

Metasearch products followed an architecture based on transmitting a user query to multiple information targets, presenting result lists to the patron, and then linking out to a document on the publisher's service when that document was selected. The basic workflow of these products might follow these general steps:

- Prompt the user for the query through the web-based interface of the metasearch product.
- Select the search targets. As part of the configuration process, the library would select specific information resources within its body of subscriptions that correspond to subject areas. A group of general-purpose resources might be established as a default set if no subject scope is specified. This configuration will allow patrons to simply indicate that they intend to search a discipline, such as "chemistry," and the metasearch will be conducted against the databases the library has selected for this discipline, saving patrons from having to be aware of the brand names and specializations of the library databases.
- Format the search query into the forms required by the search targets. Each information target will have specific ways in which it expects to receive a query. The metasearch tool must reformat the query accordingly as it is transmitted to each target.
- Transmit the query to each search target using supported protocols, such as Z39.50 or SRU/SRW, or through an API or specialized XML gateway.
- Capture the results returned by each target. Each resource target will issue a set of results in response to the query received. To minimize the response time and computing resources expended, targets usually transmit only an initial set of records relative to the comprehensive search results. For a broad query, a comprehensive result might entail tens of thousands of records or more. Receiving comprehensive result sets exceeds the capability of this search architecture.
- Organize results returned by each of the content targets. Depending on the design and configuration of the metasearch application, the results from each of the multiple targets will be collated into a blended list or grouped separately. The metasearch application will sort the results according to preconfigured or user-selected options, such as by reverse chronological order, relevancy, or alphabetical order. Since only partial results are available to the metasearch environment, challenges

include notifying users that more results may be available and sorting the results effectively.

- Present the result lists. Once the result lists have been presented through the metasearch interface, patrons can select items of interest to view additional bibliographic details and to select documents for view or download. The linking to documents will often be accomplished through the institution's OpenURL link resolver.

Metasearch products, such as MetaLib from Ex Libris, Central Search (later 360 Search) from Serials Solutions, MuseSearch from MuseGlobal, WebFeat, Explorit from Deep Web Technologies, and other products, are offered as stand-alone products, often packaged with an OpenURL link resolver.

Beginning with the early phase of discovery interfaces, these metasearch technologies were also integrated to expand the scope of search. Many of the discovery interfaces included a metasearch component that could be used to supplement results derived from the local index with results from remote resources, providing at least some exposure of article-level content. Some of the discovery interfaces that included this capability were Primo, AquaBrowser, and Encore Synergy. Although many discovery products continue to include a metasearch option, this approach has largely fallen out of favor as the genre gravitated toward web-scale or index-based architectures.

These discovery services are not necessarily intended to replace the native interfaces that content providers offer, but rather can serve as an alternative the library can use to provide a simplified search environment. Patrons with advanced, discipline-specific information requirements, for example, would likely continue to use the native interfaces of the content resources in their area of interest.

Web-Scale Discovery

The search model of metasearch was a pragmatic means for providing a simplified tool capable of spanning multiple content resources, but it was inherently limited due to its dependence on real-time responses from multiple targets. Beginning around 2009, a new search model came on the scene that was based on indexes created from the content represented in all of the many resources relevant to library collections. These search services make arrangements with the e-content publishers and producers of library-oriented databases to gain access to their resources—solely for the purpose of indexing—with the expectation that as patrons select an item of interest, they would be linked to the copy on the publisher's server from which the library licensed the content. As with metasearch, this model provides an alternative to the native interface of each content resource for search but maintains the role of database providers and publishers in delivering content.

The term *web-scale* applies to the discovery services that, usually through massive indexes, aim to represent the full body of library content. In the same way that general search engines such as Google provide access to all the information on the Internet, these discovery services aim to address the full breadth of content resources relevant to libraries. Web-scale connotes a search scope of the broadest applicable body of content supported by massive technology infrastructure. Current products claim indexes of around a billion items. Though still small relative to search engines such as Google, they break well past the limits of catalogs and discovery interfaces based on local indexes.

The web-scale discovery services tend to be adopted mostly by academic and research libraries. The article-level discovery capabilities of these products are better suited to these types of libraries than to public libraries, which have other collection priorities. This differentiation is not absolute, given that many public libraries offer at least a limited number of article-level research databases.

OCLC's WorldCat Local can be seen as an early example of web-scale discovery. With pilot implementations beginning around 2007, WorldCat Local provided a global resource for the discovery of books, and many databases had been loaded to provide at least some article-level material. A library's holdings as represented in its ILS were synchronized with its holdings in WorldCat, and real-time availability and self-service features were supported.

The launch of Summon from Serials Solutions in 2009 solidified the genre of web-scale discovery, with the ambitious goal of providing access to all the library's subscribed resources in addition to locally managed resources. Other vendors subsequently launched competing discovery services, including EBSCO Discovery Service, announced in April 2009, and Primo Central, announced by Ex Libris in July 2009. These four discovery services—Summon, Primo Central, EBSCO Discovery Service, and WorldCat Local—represent the main offerings in the genre of web-scale discovery that continue to compete to offer the most comprehensive indexes and most powerful search features.

The construction of the index associated with a web-scale discovery service involves harvesting content from a wide variety of sources. An organization that produces a web-scale discovery service must cultivate partnerships with as many of the publishers and other content providers as possible. These agreements would include the delivery of citation metadata or full text by the various content providers. A content provider might partner with a discovery service creator in this way simply to make its materials more easily used by the patrons of libraries that implement one of these products. In other cases, some kind of reciprocal

arrangement or other incentives may be involved.

Discovery service providers must create a technical infrastructure capable of supporting these massive indexes and develop interfaces that patrons use to search and gain access to the content items. These large-scale platforms require significant investments in technology infrastructure, software development, and human and automated processes for populating and maintaining the indexes. The cost and resource allocation needed to create one of these web-scale discovery services exceed what would be feasible for a single library or most library consortia. So far, the field of products in this genre remains limited to the four commercial services. Although many other discovery interfaces are available, the others have not developed comprehensive article-level indexes. Many of the discovery interfaces that have not developed comprehensive central indexes have been integrated with one of the web-scale indexes, as discussed below.

Cumulative Functionality

These web-scale discovery services also include many of the components of the earlier generation of discovery interfaces. All the interactions, as described above, with the local ILS continue to apply. In addition to the content harvested from remote publishers and aggregators, the discovery service must also harvest and synchronize data from the local ILS and other repositories and perform all of the functions needed to provide support for the library's physical collections, such as real-time availability and the ability to place hold requests, view and modify profile details, view items currently charged, and perform other self-service actions.

Resource Coverage of Web-Scale Discovery Service Indexes

The ideal implementation of a web-scale discovery service would include an index populated by all the possible information providers involved with libraries. In order to operate effectively, a discovery product needs to provide access to as large a representation of the library's resources as possible. Even though these products have been developing for four years, some gaps and coverage issues remain.

In order to accommodate the concerns of content providers with proprietary content, discovery services must implement the ability to differentiate search results and content that can be exposed to the general public and what must be restricted to authenticated users. Access to content resources must naturally be aligned with what is available through the library's subscriptions and other content selections—a discovery service will not enable access to content resources

to which a library is not otherwise authorized, through either its paid subscriptions or what is available in the public domain or through open-access licenses. The concept of mutual subscribers often comes into play in which a library subscribes to both the discovery service and the content resource.

Primary publishers of content resources oriented to libraries generally are well motivated to cooperate with discovery service providers in order to improve access and increase use of their products, which strengthens interest in renewals. In many cases, the full-text e-journal articles and other content elements are indexed along with basic citation metadata.

The coverage of indexing and abstracting services or other subject indexes plays a much more complex and controversial role in the discovery services arena. These products include proprietary information in the form of structured discipline-specific vocabularies, abstracts, and other elements that provide great value to the discovery process. In the form of stand-alone databases, these products are well used to provide precise searching capabilities to aid researchers in finding scholarly articles. The providers of these products are often concerned that their proprietary content may become available to nonsubscribers and that the general idea of index-based discovery may weaken interest in their products.

The current business environment surrounding web-scale discovery includes some complications that have an impact on the capabilities, especially regarding the inclusion of subject databases across the slate of discovery services. Of the four producers of web-scale discovery services, two are also major providers of subject indexes: EBSCO and ProQuest. Due to a variety of business concerns, these two organizations do not currently fully cooperate in their role as content providers with the competing discovery service providers. EBSCO, for example, does not provide metadata associated with its popular EBSCOhost databases to other discovery service creators for inclusion in their indexes, though it does offer access to the EBSCO Discovery Service API for libraries with mutual subscriptions. These examples of noncooperation have been a point of frustration for libraries. The Orbis Cascade Alliance, for example, has engaged in a public discussion of its concerns with EBSCO not providing EBSCOhost metadata to Ex Libris for inclusion in Primo Central.[8]

EBSCO Information Services provided the following statement on its position regarding its provision of subject databases to competing discovery services:

> Although this point is often confused, the overwhelming majority of leading indexes do not participate in discovery services. While individual publications indexed in these indexes may be covered in some inferior way in a discovery service, the depth and quality of the indexing sets these databases apart, and makes them critical components of

a library's resources. There is no substitute for the index itself. Because EDS leverages the EBSCOhost platform, for customers subscribing to these important indexes on EBSCOhost, EDS is able to bring these results into the discovery experience. This is perhaps the biggest differentiator for EDS vs. competing services, and has proven to increase usage of these essential indexes for EDS customers. To be clear, this is not accomplished through federation, it is through unique EDS technology that allows records from indexes to which a library subscribes to become infused as part of the discovery experience. While other services may attempt to convolute this issue by inferring that they cover a certain percentage of the journals in a given index, this approach pales in comparison to the ability to bring actual records (full indexing) from key databases to which you subscribe into the user experience. The difference in the quality of a given record from a typical discovery service vs. the same record from a respected subject index is dramatic—and has a profound effect on the quality of searching, relevance ranking, and subsequent value to the end user.

One of the major considerations in the selection of a discovery service involves how well the products under consideration cover the library's collection. Whether any discovery service does or does not provide adequate coverage of any given set of the library's major content resources is information that libraries need to have available as they evaluate these products.

Each of the major web-scale discovery services includes a massive amount of library-oriented content in its indexes. It is very difficult to quantify the relative coverage of these indexes. The following descriptions were provided by the respective developers of web-scale discovery services.

From Serials Solutions:

The Summon unified index contains more than 1.4 billion items in which the vast majority of article and book content is full-text searchable. The Summon service's unique match-and-merge technology combines, normalizes, and corrects—from multiple sources—full text and metadata, such as abstracts, subject terms, thesauri and controlled vocabularies, citation counts, and enrichment data. This means each entry in the Summon index represents a unique item, with nearly 500 million duplicates removed to date.

From EBSCO Information Services:

EBSCO Discovery Service includes content from approximately 23,000 providers (and growing), which accounts for more than 400,000 publications from the world's top publishers and information providers. Because EDS is a custom solution, the complete index to materials for any given customer may be expanded beyond the coverage referenced. In terms of depth of coverage for publications included in EDS, content extends back to the 15th century, and in some cases, even earlier. The

inclusion of custom catalogs, repositories and other resources may further extend the dates of archival coverage for a given institution.

EDS currently provides more full-text searching than any other discovery service, as well as rich metadata for more than half a billion records from high-quality sources including:

- Magazines, Journals, and Trade Publications
- Books
- Conference Proceedings
- CDs and DVDs
- Newspapers and Newswires
- Other content-rich source types, including: Biographies, Book Summaries, Case Studies, Company Profiles, Conference Papers, Congressional Documents, Country Fact Sheets, Country Reports, Dissertations, Educational Reports, Essays, Financial Reports, Government Documents, Grey Literature, Health Reports, Industry Reports, Law Documents, Market Research Reports, Newspaper Columns, Pamphlets, Primary Source Documents, Reviews, State/Provincial Fact Sheets, Study Guides, SWOT Analyses, TV and Radio News Transcripts and Working Papers.

From Ex Libris:

The Primo Central index is a mega-aggregation of hundreds of millions of scholarly e-resources of global and regional importance. These include journal articles, e-books, reviews, legal documents and more that are harvested from primary and secondary publishers and aggregators, and from open-access repositories. Ex Libris works with the world's leading providers of global and regional information to benefit its customer community. The Primo Central index fully exploits the richness of the underlying data to facilitate fast and easy search.

From OCLC:

OCLC's neutral position in the market allows the central index to provide the broadest possible coverage of library e-journals from a variety of providers. The central index of 1 billion articles includes content from EBSCO, Gale and ProQuest. Central index provides access to 1,879 databases and collections from familiar content providers.

The discovery service producers will provide lists of resources that a library can use to evaluate its coverage relative to the library's subscriptions.

- ProQuest provides extensive information on its website describing the coverage of Summon in the lists "Key Databases & Packages," "Participating Publishers," and "Serial Titles."
- OCLC provides the spreadsheet "WorldCat Local Databases and Collections," currently listing 1,909 content products.
- EBSCO Information Systems provided lists of its 309 major publisher partners and 19,380

Comprehensiveness of Discovery		Response Distribution										Statistics			
Product	Responses	0	1	2	3	4	5	6	7	8	9	Mode	Mean	Median	Std Dev
VuFind	18						1	4	5	3	5	7	7.39	7	2.12
Summon	67	1		1	1	1	4	11	21	21	6	7	6.93	7	0.86
WorldCat Local	23			1	1	1	1	4	5	4	6	9	6.91	7	1.88
EBSCO Discovery Service	64			1	1	2	4	17	19	14	6	7	6.78	7	0.75
Primo	66	1			2	1	7	11	27	9	8	7	6.73	7	0.86
Arena	18					1	1	5	8	3		7	6.61	7	1.89
Encore	40	1	2		3	3	4	1	9	8	9	7	6.42	7	1.11
BiblioCore	14					3	1	1	6	3		7	6.36	7	1.87
AquaBrowser Library	10	1		1	1			2	2	1	2	6	5.70	7	0.63
All responses	346	4	2	6	9	14	24	60	107	74	46	7	6.74	7	0.38

Table 1.6
Summary of responses from all libraries to the question "How comprehensive is the discovery product relative to the collections of the library?"

individual resources indexed in EBSCO Discovery Service; this information is available to existing customers through the company's wiki for registered users. EBSCO will make these lists available to potential subscribers and will perform a customized resource analysis based on current subscriptions.

- Ex Libris does not provide lists of content resources openly on its website, but will make the lists available to institutions looking into acquiring Primo Central.

Summon coverage information
www.serialssolutions.com/en/services/summon/content -and-coverage

WorldCat Local Databases and Collections
www.oclc.org/worldcat-local/content/dblist.en.html

EDS Resource Analysis
www.ebscohost.com/discovery/content/custom-content -review

Table 1.6 provides a statistical summary of responses to the survey question "How comprehensive is the discovery product relative to the collections of the library?" Table 1.7 includes only the responses to this question from academic libraries.

A related concern involves how a discovery service ranks resources relative to such factors as content providers. A fully objective relevance ranking would order results in a neutral way, without a bias toward any given content provider. A potential concern is raised when the discovery service creator is also a major content provider, with the possibility that its content resources might receive preference in the way they are presented in search results. Whether by absence from the index or in preferential treatment in the discovery service, an important issue in the current discovery service environment relates to objective performance.

Each of the discovery service producers provide extensive lists of what is included. It is also helpful to understand any content resources that libraries report that they do not believe to be represented within the discovery products that they are using. The survey included the question "Describe any major resources that are not addressed by the discovery product." The following sections include responses given to that question. These responses are not verified—they may include resources that are not available due to other factors such as local configuration selections— and should not necessarily be taken as definitive. The narrative comments are provided verbatim, with only minor editing to correct typographic mistakes and redacted only to preserve the anonymity of the individual or organization responding.

EBSCO Discovery Service

- "Pharmacy, there is some business but definitely not all, legal."
- "Gale databases."
- "Very hard to tell. Even though a database is not listed as specifically covered, there is often indexing for much of its content and the links go to the content in that database (e.g., Sage, Springer, etc.) Most of our databases come from EBSCO though so those are definitely included."
- "ProQuest Historical Newspapers, limited nursing and pharmacy resources."
- "We do not include some of our specialized

Comprehensiveness of Discovery		Response Distribution										Statistics			
Product	*Responses*	*0*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*Mode*	*Mean*	*Median*	*Std Dev*
Summon	62	1		1		1	4	11	20	18	6	7	6.94	7	0.89
WorldCat Local	21			1	1	1	1	3	5	3	6	9	6.90	7	1.96
EBSCO Discovery Service	55			1	1	1	3	15	18	11	5	7	6.78	7	0.81
Primo	57	1			1	1	7	8	25	8	6	7	6.72	7	0.93
Encore	17	1			2	1	3		5	2	3	7	6.06	7	1.70
All responses	**230**	**4**		**4**	**5**	**7**	**18**	**41**	**77**	**46**	**28**	**7**	**6.72**	**7**	**0.46**

Table 1.7
Summary of responses from academic libraries to the question "How comprehensive is the discovery product relative to the collections of the library?"

databases due to cost of adding non-EBSCO databases."
- "All are connected."
- "We have some DSpace collections that we're trying to get included, but EBSCO is having some kind of technical issue on their end that is preventing it. Also, our Springerlink ebooks are not included, but we have a workaround in place."
- "ProQuest."
- "ProQuest products. LexisNexis Academic (promised but not delivered yet)."
- "Products that are owned by ProQuest are not indexed. Databases on the platform Engineering Village are not indexed."
- "Native indexing for 20–30% of our collections and licensed resources are not available."
- "Several key databases from competing vendors do not have a presence in the EDS."
- "ProQuest products, including ABI/Inform, Dissertations Full Text, the CSA A/Is, LexisNexis Academic, EEBO. SciFinder Scholar."
- "Quite a few of our science databases are not represented."
- "ProQuest and many Gale Cengage resources. Lawtel. KeyNote."
- "Business market research reports, material from rival supplier. Law resources."
- "Most of our resources are now accessible through the Discovery Service. We use 'discover-ability' as part of our evaluation of new resources now."
- "HathiTrust records in EDS not complete."
- "ProQuest databases, S&P NetAdvantage, Factiva."
- "We are not a large academic library, so EDS pretty much covers all of our primary electronic resources and most of our secondary ones."
- "WorldCat."
- "ProQuest databases (e.g., ABI/INFORM, ebrary, Sociological Abstracts), Films On Demand, LexisNexis Academic."
- "Difficult to add in some supplementary databases that we have licenses for, but otherwise fine."
- "We're waiting for WorldCat, LexisNexis

Academic, RefWorks, and a few other databases to be fully integrated. We don't like the 'connectors,' and we have widgets for many of the databases not in there, but it would be better if they could be fully integrated into EDS."
- "ProQuest/CSA products (e.g., historical newspapers, sociological abstracts)."
- "Local, ie New Zealand, ones."
- "Library digital collections and library institutional repository (lack of coverage for these is a result of library decisions/staffing rather than the inability of the vendor to process etc)—The big ProQuest collections for which no licensing agreement has been reached—Various highly specialized databases or data files."
- "ProQuest products (ebrary, for example) by and large are the biggest collection of resources not addressed by EDS. There are workarounds for a large percentage of those items (MARC records, publisher metadata, etc.), but it still leaves a gap and not the best user experience."
- "We have a number of resources that are produced for industry rather than academia and these tend to be the ones that are not included. We also find the fact that only a certain % of one of the database we subscribe to is covered."
- "Law subject coverage is poor."
- "Most of our [discovery requirements] are addressed by adding the resource MARC records to the ILS. Journal titles are a problem—we use a non-EBSCO Link resolver and do not have MARC records in the ILS."
- "Westlaw, Scopus not fully, Lexis not fully, iLaw, Family law."

Encore

- "ProQuest products are not addressed. EBSCO products are addressed but require an extra step to retrieve full text."
- "Not integrated with individual library resources."
- "We only have one platform included in our

discovery tool. We also would like it to search our website for hits as well."

- "We would like to have even more databases available as part of the Synergy product, but we are waiting for Encore ES and its OverDrive integration. Our members are very excited about this development."
- "Only allowed (based on cost) 30 sources. We have many other resources that remain outside the scope of our discovery product."
- "While many of our resources may be found in the articles section of Encore Synergy, most stay in the catalog interface and access one of the articles displayed from the primary database [EBSCO MasterFile Premier]."
- "Adlib archives catalog is the major local resource not integrated. Integrations of subscribed e-resource content are not complete."
- "Special collections, over 400 of our databases, primary resources, some government documents."
- "Institutional repository & doctoral theses archive. We plan harvesting for the end of the year."
- "Archives (special collections)."

Enterprise

- "Uncatalogued local history collection (archived, non circulating)."
- "Not all of our ebooks and eaudiobooks are cataloged and accessible in a search. However, we do link to the full ebook and eaudiobook collections via those vendor web sites. We only include the most used databases in the federated search."

Primo

- "EBSCO databases."
- "Comprehension is expressed by the vendor as 58% of databases and 98% of journals. We only count campus-wide content activations, not single libraries' acquisitions. Major resources missing are Ebsco databases, Psychinfo and Psycharticles, Italian law databases (Il sole 24ore, Leggi d'Italia)."
- "ProQuest and EBSCO don't give our discovery product access to metadata from products even though we subscribe to those ProQuest and EBSCO products as 'database silos.' This treatment of metadata as a 'feature' to sell discovery products from these two vendors creates coverage issues for us."
- "ATLA, Chemical Abstracts."
- "EBSCO products, ProQuest products."
- "Right now, none of our Gale products are working properly with it, nor is Credo Reference/Literati. Oddly, it seems to be most functional with open web resources (results from Wikipedia are much better integrated than those from EBSCO).

Encyclopedia Britannica is also better integrated than Credo, Gale, or EBSCO products. Most of the libraries in our consortium are public or school libraries and the interface is a bit overwhelming for their purposes."
- "Ongoing issues with deep linking to Westlaw journal article level."
- "EBSCO resources are so poorly integrated that they might as well not be addressed by the discovery product. We also have significant resources, particularly in Business and Engineering, that are not included at all."
- "EBSCOHost databases not addressed well by the product."
- "Special Collections non-cataloged materials."
- "Ebsco, Proquest."
- "Full level ebook indexing."
- "Incomplete coverage of key EBSCO and ProQuest products."
- "American Chemical Society, IEEE, JSTOR."
- "Content of EBSCO is only in parts in Primo."
- "All EBSCOhost databases, though ExLibris claims over 90% of EBSCO items are indexed elsewhere in the Primo Central index."
- "Addressing coverage is hard to do, since the coverage lists we got don't correlate easily with our databases. Also, we haven't had Primo long enough to have much experience searching it. My impression is that Primo isn't great for anything medical related, which impacts our nursing, dental hygiene, optometry, and pharmacy programs."
- "EBSCO, Proquest, Australian content, some legal resources."
- "'Professional literature' is lacking, e.g., market reports, industry and country profiles, technical reports and specifications, e.g., EIU, MarketLine, SAE. Online reference works with article-level records e.g., Encyclopedia of Life Sciences (Wiley), New Palgrave Dictionary of Economics."
- "EBSCO."
- "EBSCO databases (shame on EBSCO for refusing to provide meta data to competing discovery tools). Swedish law."
- "Archival material database."
- "Databases by EBSCO are not covered."
- "EBSCO SportDiscus. Also while Factiva is searching linking to it is horrible."
- "The Ebsco databases are only available through a plug in and the results are not integrated well in the overall search results. We are working on gradually including more digital library collections in Primo."
- "ProQuest dissertations and other databases, newspapers. Metadata often differs and is not as complete from what one can get via MARC records and Ebsco databases."
- "ProQuest and EBSCO databases (although the

coverage at the journal level is better).”
- “Mainly regional resources in French.”
- “Databases such as ProQuest and Ovid missing.”
- “Some content licensed by the Library for which Ex Libris has not been able to establish a license agreement with the vendor. EBSCO and ProQuest are examples.”
- “Libguides.”
- “EDS's approach to making their content available only if you're willing to handicap overall functionality in the Primo discovery interface is unacceptable, so their resources and content enhancements are available only in a very restricted manner or not available at all. Some ProQuest content can also suffer from restricted access. Content vendors who take the approach of not making all their content available to the discovery service of the library's choice, are short-sighted and do not understand the academic end-user environment needs that libraries are trying to meet.”
- “E-books collections published by Oxford, Blackwell, WISO, UTB, Springer. Specific databases like ATLA, Bergman/Schaefer . . .”

Summon

- “Journals indexed in EBSCOhost databases are not 100% covered e.g., local nursing journals in CINHAL and A&I such as EconLit, PsycINFO.”
- “Deep Linking with EBSCO products is not as good as other vendors.”
- “There are 18 databases that are not searched by the product: Art Full Text, Applied Science & Technology Full Text, Art Index Retrospective, Biological & Agricultural Index Plus, Business Abstracts with Full Text, Chronicling America, Education Full Text, General Science Full Text, Humanities Full Text, Index to Legal Periodicals Full Text, LexisNexis Academic Library, Literature & Information Science Full Text, Mineralogical Abstracts, Omnifile Full Text Mega Edition, Pop Culture Collection, Readers' Guide Full Text, Religion & Philosophy Collection, Social Sciences Full Text.”
- “Newsbank America's newspapers only has journal level linking, so no good for our library (we only include resources that link to full text at article level).”
- “EBSCO databases (since EBSCO won't share metadata).”
- “We have had a few implementation glitches that have interfered with full discovery of OAI-PMH compliant metadata from our institutional repository and ContentDM instance.”
- “Ebscohost I guess.”
- “Scopus, Espacenet.”
- “Keynote (due soon), GMID, Bankscope.”
- “EBSCO continues to make discovery from any

other product difficult if not impossible.”
- “Biography & Genealogy Master Index, Oxford Bibliographies Online.”
- “Open educational resources.”
- “Inspec and Compendex are not included. Also, while Web of Science is included, our patrons don't seem to realize that it is there—and includes citation data. Our collection of limited technical reports also cannot be indexed by Summon.”
- “Broad coverage is pretty good but not 100% in all databases. This means that you still need to go into individual databases to search again to make sure you found everything. For example Summon indexes about 90.7% of Hein Online.”
- “Some specialized bibliographic sources related to deaf studies, which are important to a significant portion of our campus population, are not covered by our discovery service. But, title by title analysis shows over 95% coverage for traditional library resources. There are limitations in the coverage of nontraditional sources, such as multimedia.”
- “No major resources but many niche resources.”
- “About 20% of our EBSCOhost content is not covered. Several of our historical collections are not covered at the Full-text level.”
- “Scifinder Scholar is not included.”
- “Specialist law aggregated databases and publications.”
- “Scopus. Medline/PubMed. CINAHL. RILM. Factiva. Australian Law resources including: LexisNexis, IntelliConnect, Westlaw.”
- “Econlit, PsycINFO, RILM Abstracts of Music Literature, MEDLINE, LISTA, CINAHL Plus, Art Full Text, SciFinder, PAIS.”
- “NetLibrary and some Japanese products (MAGAZINEPLUS, BOOKPLUS, Maruzen e-Book Library etc.) are not addressed. And some major Japanese products are not updated such as JapanKnowledge, CiNii Articles and Ichushi web.”
- “Some reference e-resources and e-books are not included.”
- “Reference works aren't consistently covered at the article level.”
- “Primarily law and some financial databases.”
- “Mintel.”
- “Business resources and Legal resources.”
- “SciFinder Scholar, and some other major resources that will not cooperate with any vendor.”
- “Ebsco Databases.”
- “Being a business school, several of our databases where the content is data versus articles are not well represented.”
- “We're lucky in that there aren't that many resources that aren't included from our collection. The legal publishers are slowly coming on board, i.e., LexisNexis and Westlaw although the currency of the data they are providing to Serials Solutions is

still not great. We have a lot of image/multimedia databases—these are not very well covered, if at all. Likewise with anything that is statistical, but I understand how that might be difficult to include as part of a standard search in Summon."

- "Free government document databases such as http://www.gao.gov/ would be nice to have included."
- "EBSCO packages (although could be accessed through publisher level agreements)."
- "Many journal articles and ebooks in EBSCO collections. Many law resources (e.g., case law). Local resources and titles, such as Index New Zealand, NZCER journals, Waikato Journal of Education."

WorldCat Local

- "Currently, our digital archives are not included."
- "None. All are included."
- "Business databases that have non-traditional data that is not easily described with typical bibliographical metadata."
- "We have a lot of engineering and other technical databases that are not as well addressed. Anything that is an 'index' or 'abstract' without full-text would require a login first, or is not centrally indexed, which limits access for some situations. But we can do 20 mainstream database products for all to see, with full-text requiring login. 46 more can be added to the search."
- "Uses a central index for e-resources, but we have several databases and collections that are not in the central index."
- "We can't include video collections in WorldCat Local."
- "The discovery tool is not able to provide specific metadata for partial content licenses (i.e., a 'light' version or limited access license cannot be selected separately). Instead only the entire database can be selected. This leads to false positives in searches."
- "Hein Online."
- "Breadth of material covered is over 85% of our holdings. Depth of indexing is where the weakness is. Mostly table of contents only, no abstracts, or vendor subject indexing."
- "Few external databases are available through the discovery service; those who are quite often can only be searched using Z39.50 (slow and with unpredictable results)."
- "(1) Areas that are still hard to discover include: Institutional resources like repository, or special collections, reference materials, foreign language, and Multimedia, music or other non-book materials. The other issue with some discovery tools is to maintain a good balance between types of materials, either articles or books. It's not always apparent what the format of the material is. (2) We are practically limited to using databases that have their holdings in WorldCat, therefore many of our subscription databases are absent from the discovery layer. The default search includes only multidisciplinary databases, but not those multidisciplinary tools that are most useful in the sciences (e.g., Web of Knowledge, Scopus). Entire subject areas are excluded from the discovery layer altogether, including most of the life sciences. (3) Although increasing all the time, not all electronic titles or collections are found in the OCLC Knowledge Base to be discovered through WorldCat Local. Also undiscoverable are the holdings of libraries that do not obtain bibliographic records from OCLC and don't declare their holdings in the global WorldCat database."

AquaBrowser Library

- "Article Databases."
- "Archives."
- "Older documents, article level access to journals; Unable to index serials holdings at this time."
- "As far as vertical integration is concerned for public libraries in [. . .] AquaBrowser does a good job (Liquid version). We also have some local databases and spidered resources (horizontal integration). We thought this was a real strength and a path for further development. We're not sure whether this is a strategy AquaBrowser will be pursuing. A welcome development would be the ability to curate non-physical resources. e.g., It would have been nice to be able to plug in an RSS feed of a local blog or of a Delicious account. It would also have been nice to link individual items to curated resources e.g., a YouTube movie. The add-on MyDiscoveries 2.0 service misses further development, as well as the lack of ability to personalize the discovery experience. It would also have been nice to be able to create channels to push new items or alerts."

Axiell Arena

- "At the moment electronic materials, such as e-books, are not integrated very tightly into Arena. For example we have e-book links to e-book vendor's web service and customer has to sign in to loan e-books."
- "Electronic data bases—e- newspapers/e-periodicals (databases)."
- "BiblioCore."
- "Unless various media types are designated in local tags like 9xx's, BiblioCommons does an adequate to poor job of discerning various media types for the end user. I continue to be perplexed

Effectiveness of Relevancy Rankings		Response Distribution										Statistics			
Product	Responses	0	1	2	3	4	5	6	7	8	9	Mode	Mean	Median	Std Dev
AquaBrowser Library	10			1				1	4	2	2	7	7.00	7	2.53
BiblioCore	15					1	2	2	4	3	3	7	7.00	7	1.81
VuFind	18		1		1		3	1	4	5	3	8	6.67	7	1.89
EBSCO Discovery Service	62		1		2	6	1	12	19	17	4	7	6.66	7	0.51
Summon	70	1			1	4	9	15	22	14	4	7	6.51	7	0.36
Enterprise	10				2		1		4	1	2	7	6.50	7	2.21
WorldCat Local	23		1		1	1	3	5	7	3	2	7	6.26	7	1.46
Encore	40	2		1	2	3	8	7	7	8	2	5	5.83	6	0.47
Primo	66		3	4	4	4	12	14	13	11	1	6	5.62	6	0.12
Arena	20	1	1		1	2	3	4	8			7	5.35	6	1.57
All responses	**352**	**4**	**8**	**6**	**15**	**22**	**44**	**65**	**98**	**64**	**26**	**7**	**6.24**	**7**	**0.16**

Table 1.8
Summary of responses from all libraries to the question "How do you rate the effectiveness in ordering search results by relevancy?"

why a library company chooses to mostly ignore information in MARC records that would actually make their jobs easier and provide more accurate information for the end user."
- "E-books, etc. must be added manually to catalog."
- "Lexis, Westlaw, HeinOnline, Loislaw."
- "The integration with electronic databases and eBooks is not yet effective although BiblioCommons is working on this."
- "At the moment does not integrate the Downloadable collection. Would love it to be as comprehensive as our ILS in terms of finding things so that I could say to staff to just use BiblioCommons to search. Right now for some searches it is easier to use Horizon."
- "Serials are not handled well in the product, and we've had other problems with materials that were suppressed and then are unsuppressed, but don't show up for 3 or more days."
- "Does not yet support seamless integration to e-content as it pertains to holds queues and renewals (e.g., Overdrive and Recorded Books)."
- "Ebooks, both text and audio, nor are any of the individual database subscriptions addressed by this product. . . . Not as important in a public library as in an academic library."
- "Database search in general."

Relevancy

Since discovery services deal with such large quantities of content, the ordering of search results has an important impact on their effectiveness. All of the discovery products include the ability to present search results according to a relevancy ranking. Keyword-oriented search engines can identify result candidates that match the query and can provide an initial relevancy ranking according to the placement of keywords. But a keyword-only approach has limitations relative to library resource discovery, especially since some materials may be represented in full text and others by citation-level metadata. Critical or analytical works may have higher distribution of keywords than the primary work they address. It is important for discovery products to take additional factors into consideration in their relevancy algorithms. These factors might include usage data as an indicator of popularity or impact factor, citation frequency, and other measures of scholarly value or interest.

Each vendor provided information that describes its approach to calculating relevancy (go to the landing page for Vol. 50, No. 1 at alatechsource.metapress.com to view the full table). Table 1.8 summarizes the statistics on how libraries rated the effectiveness of their discovery product. Table 1.9 shows answers from just academic libraries; table 1.10 shows answers from public libraries.

Objectivity and Non-bias

As a discovery service produces search results, it uses relevancy algorithms to determine what results to display and in what order. As seen above, there continue to be issues in what resources are covered in the indexes. A further consideration, which can be related to index coverage as well as relevancy rankings, relates to whether the discovery product performs objectively relative to each category of content, such as provider, material type, or other factors. To explore this issue, the discovery survey asked libraries

Effectiveness of Relevancy Rankings		Response Distribution										Statistics			
Product	Responses	0	1	2	3	4	5	6	7	8	9	Mode	Mean	Median	Std Dev
EBSCO Discovery Service	53		1		2	4	1	12	16	13	4	7	6.64	7	0.55
Summon	63	1				4	9	13	20	12	4	7	6.52	7	0.88
WorldCat Local	21		1		1	1	3	3	7	3	2	7	6.29	7	1.53
Encore	17	1		1	1		3	3	3	4	1	8	5.88	6	0.73
Primo	57		3	3	2	4	11	12	11	10	1	6	5.68	6	0.13
All responses	**229**	**2**	**6**	**4**	**7**	**14**	**28**	**46**	**64**	**44**	**14**	**7**	**6.26**	**7**	**0.46**

Table 1.9
Summary of responses from academic libraries to the question "How do you rate the effectiveness in ordering search results by relevancy?"

Effectiveness of Relevancy Rankings		Response Distribution										Statistics			
Product	Responses	0	1	2	3	4	5	6	7	8	9	Mode	Mean	Median	Std Dev
BiblioCore	14					1	2	2	3	3	3	7	7.00	7	1.87
Encore	15	1			1	2	3	3	3	2		5	5.40	6	1.55
Arena	13	1	1		1	2	3	3	2			5	4.54	5	1.66
All responses	**75**	**2**	**2**		**5**	**6**	**11**	**10**	**20**	**11**	**8**	**7**	**6.08**	**7**	**0.46**

Table 1.10
Summary of responses from public libraries to the question "How do you rate the effectiveness in ordering search results by relevancy?"

to rate the objectivity of the product they use and to provide narrative comments regarding their experiences (tables 1.11 and 1.12).

The following sections include comments offered by libraries about the objectivity or bias of the discovery services.

AquaBrowser

• "The relevancy index is really nice, also the ability to boost or decrease relevancy for certain resources (e.g closed stack collections). Whether this leads to a bias is, I suppose, a matter of implementation."

BiblioCore

• "I believe BC does a pretty good job of ordering search results by relevancy. However, in doing so, I am concerned that many appropriate materials never see the light of day in such searches. I wish the product offered a way to turn relevancy on and/or off as desired (defaulting to relevancy, of course)."
• "It seems to be driven by keyword searching."
• "Search results are ordered based on the best match. The items at the top of the search results will be those that contain your exact search text, in the exact order you typed them (if you used more than one word). After exact matches, words

in the title are given a priority, followed by author name, headings, and tags. Popular titles appear ahead of less popular ones."

EBSCO Discovery Service

• "Prioritizes EBSCO resources over Library Catalog and other databases."
• "Relevancy was a bit questionable . . . as was the interface. I did not see too much bias in terms of resources but I have to say I did not use it long enough to really know for sure."
• "It seems slightly tilted toward EBSCO resources."
• "It seems to place EBSCO resources higher on the relevancy list; however we believe this could be due to their vocabulary."
• "We have biased the discovery relevancy toward our book collections slightly so there is bias."
• "There seems to be a slight preference for EBSCO resources, but then again, we have a lot of EBSCO products."
• "Not sure yet but it usually seems to include non-EBSCO results on the first few pages. Gives good priority to results from our ILS. I am very pleasantly surprised by the amount of open access content which is indexed and accessible to us now. Our GovDocs librarian is thrilled with some of the indexing that is included to hard to access gov docs, like the Serial Set and Patents."
• "Because our users search in specific fields, most

Objectiveness of Discovery		Response Distribution										Statistics			
Product	Responses	0	1	2	3	4	5	6	7	8	9	Mode	Mean	Median	Std Dev
AquaBrowser Library	10				1				1	3	5	9	7.90	9	2.85
WorldCat Local	23			2			1	2	3	6	9	9	7.43	8	1.46
VuFind	18				1	1	1	2	4	2	7	9	7.28	8	2.12
Primo	61			2	2	3	5	6	13	17	13	8	7.00	7	0.26
Encore	38	2	1	1	4	2	4	4	7		13	9	6.74	8	1.14
Summon	68	2		3	1	2	8	6	14	21	11	8	6.74	7	0.97
BiblioCore	13			1		1	2		4	2	3	7	6.69	7	1.94
Arena	18			1	1	2	1		9	3	1	7	6.61	7	2.12
EBSCO Discovery Service	62	1		6	3	6	10	7	12	13	4	8	5.82	6	0.38
All responses	**336**	**6**		**17**	**11**	**18**	**33**	**31**	**71**	**77**	**72**	**8**	**6.70**	**7**	**0.38**

Table 1.11
Summary of responses from all libraries to the question "Does the discovery product provide objective access to library resources, or do you observe any bias?"

Objectiveness of Discovery		Response Distribution										Statistics			
Product	Responses	0	1	2	3	4	5	6	7	8	9	Mode	Mean	Median	Std Dev
WorldCat Local	21			2			1	1	3	6	8	9	7.43	8	1.53
Primo	52			2	2	3	4	4	10	15	12	8	7.00	8	0.28
Summon	62	2		3	1	2	7	6	11	19	11	8	6.71	7	1.02
Encore	17	1		1	1	2		2	1	3	6	9	6.47	8	1.70
EBSCO Discovery Service	53	1		5	3	5	9	6	10	10	4	7	5.77	6	0.41
All responses	**222**	**4**		**14**	**8**	**12**	**22**	**21**	**39**	**57**	**45**	**8**	**6.62**	**7**	**0.47**

Table 1.12
Summary of responses from academic libraries to the question "Does the discovery product provide objective access to library resources, or do you observe any bias?"

of the results come from the same databases—Ebsco provides the Discovery Service, but results from their databases come somewhere in the middle of the results list."

- "Metadata presence, which links into relevancy ranking, is more comprehensive in some EBSCO- and specific partner-supplied resources. Other vendors deliver less metadata to EBSCO, and therefore receive lower relevance ranking. Links are also more reliable for these resources, which we've seen reflected in lower usage stats for those outbound links."
- "EBSCO will rank their products higher by default; this can be changed afterwards."
- "Again, it's all about the indexing partnerships. Vendors that have a partnership with EBSCO get first-class treatment, vendors that don't are relegated to a federated fallback option or having MARC records loaded from our catalog. It sounds bleak, but in practice almost every vendor that we use has made a deal with EBSCO."
- "No Proquest, and it ranks articles much higher than MARC data from the catalog books, journal titles, etc."
- ". . . the library has significant control in determining the content included as well as the ranking of results so any bias may be institutional."
- "EBSCO's owned results are quite high in the list."
- "Results tend to be very EBSCO-centric."
- "Clearly makes it easier to discover EBSCO products & related partners over other vendors' products."
- "From the various demos I've seen, I am convinced that each vendor makes a credible effort to maximize the usefulness of included collections, especially through the facets and relevancy options. In the case of EDS, that means they weight subject metadata and other elements. I consider this weighting appropriate. The strong metadata and academic focus is one of the reasons we selected EDS."
- "Ebsco product, Ebsco bias."
- "There are some biases inherent in the setup. For instance if a journal article is available in both

JSTOR and an EBSCO database the EDS defaults to the EBSCO version—slightly skewing the statistics away from JSTOR. Other biases seem to be the result of the failure of some vendors to share sufficient metadata to make their resources findable."

- "EBSCO products are usually in the top results. However, it is difficult to determine if this is truly bias as many of the Library databases are indeed provided by EBSCO."
- "I'm not sure if this is related to objectiveness, but if it is, I would say objectivity is good where vendors have cooperated with EBSCO to get their content indexed; otherwise competitive vendor content is excluded, of course, in the search results."
- "Strong focus on EBSCO resources because of their 'more comprehensive records.'"
- "One of the reasons we selected EBSCO Discovery Service was because we already subscribed to plenty of EBSCO databases. It makes sense to me that search results include a lot of EBSCO results because we have a lot of good EBSCO products. I don't think EBSCO should penalize its own results in an effort to show objectivity. First and foremost, I want my students to find results relevant to their search queries—the contributing source is secondary, to my mind."
- "Definite bias towards their own products."
- "I have not tested with this specifically in mind, but in normal use the only particular bias I note seems to have more to do with the most recently loaded database. This is minor and fleeting."
- "We haven't observed discernible bias."
- "Results are mostly objective. EBSCO items are favored in some cases only because of the available metadata. I think that's a plus. If other vendors/publishers want their results to appear higher, than they should improve the available metadata. Relevancy is difficult for me to assess by myself. I'm actually working on a study to assess others' perceptions of relevancy."
- "Links well to EBSCO resources, we had to get them to alter filters so other resources, e.g., ebooks where we had content also appeared."
- "There is some bias observed, but not sure if that is due to suppliers of competing products withholding data or an attempt to promote sources."
- "Bias is a result of commercial competition between different discovery service suppliers."
- "Encore."
- "Never noticed any bias."
- "I have never noticed any bias but I have not looked. After this question, I think I will be more aware and be looking for it."
- "Bias is toward electronic or media results."
- "Never noticed any bias in search results."
- "We are not retrieving articles so I don't think bias could be a factor."

- "Federated results still reflect speed of response from external sources."
- "Primo/Primo Central."
- "No bias observed regarding article vendor, but have not explored the issue in depth."
- "I think that the results themselves aren't biased by resource provider, but the relevance ranking is extremely poor. The interface is also not particularly user-friendly and user workflows are cumbersome."
- "We've developed local boosting of records to give our local resources prominence."
- "No perceived bias in search results."
- "I'm not always thrilled by the ranking of results, but I have not observed the ranking to be biased."
- "Only one group of resources is biased (our local index—library book collections and university repository) and it is required."
- "We have been able to request that certain classes of materials get a higher priority in the sorting algorithm."
- "No bias noted."
- "Bias towards literature indexed in full text, e.g., Springer and Elsevier, and Project Gutenberg (which might seem odd to users). But can only be solved by full text indexing of all resources I guess."
- "Search results feel weighted towards the sciences."
- ". . . varying quality of meta data affects the ranking, which in turns results in bias towards material from certain sources. Blending of local repositories and the central index is not optimal and some tweaking of boost parameters in the back office have to be done in order to achieve results that are acceptable."
- "Sometimes users are not happy with result rankings but there has been no bias mentioned."
- "While Primo, like any search tool, can have problems correctly evaluating relevancy, there is no hint of bias in its functioning. We consider this important in presenting objective information to our patrons. It would be highly desirable if all of our resource providers would cooperate to contribute their records to Primo Central (which we use) and all other such mega-aggregate services."
- "The content neutrality of Ex Libris is one of the big selling points of Primo over the competition."
- "Some collections are rated higher than others, so you see them first in the relevancy ranking."
- "Not linked to content, so I don't see a bias."
- "We use an API to obtain data from Ebsco products so they tend to be the top of the results list."
- "If vendors don't make their content fully available to the discovery system of the library's choice, it's important to understand this too is bias. I also believe if librarians don't have full

control of the relevance ranking algorithm being utilized to present results, the library has surrendered to their vendor an important differentiator for their library to utilize in serving end-users. This to me, is dangerous and should not be found acceptable. It is key to librarians' future to be able to determine how their assets are presented to end-users. As in many facets of life, bias exists in many forms."

- "We don't know how does the relevancy ranking work (lack of transparency). The digital resources are given preference at the expense of the traditional documents. We'd like to be able to modify this, but it is not possible."

Summon

- "Doesn't seem to be biased towards Proquest results, though by nature there are a lot of Proquest newspaper articles and trade journals. Not quite related but in fact links to Proquest material break as often as to others, so it seems there is no special treatment here."
- "We chose Summon because we felt it had less bias than the other products we considered."
- "The library created a bias towards resources that link through to full text well and towards journal packages over aggregates."
- "The only bias is for content type—e.g., books get slightly boosted in the results."
- "Relevancy is definitely improving."
- "Some vendors either supply robust metadata to the service . . . or not. I don't think there is bias necessarily but I am not sure that publishers/vendors are interacting enough with discovery providers to fully index their metadata."
- "Not aware of any bias."
- "The defaults all tend to favour Proquest products, but these are usually easily overridden—the fall down is that direct linking always takes precedence over link resolution—not completely happy about that."
- "None really observed."
- "Our discovery service usually ranks locally held resources higher, though we can only guess when we have multiple sources for some records. There may be some bias towards other products under the vendor's umbrella, but this is not entirely unfair—like sources tend to integrate better. It's never posed problems for our end users."
- "We had to de-prioritise Ebsco resources due to problems of linking, thereby giving a bias towards other publishers, especially ProQuest."
- "Results are only biased by the lack of certain content in the discovery layer."
- "I think any problems with not finding expected items near the top are mostly due to metadata,

weighting issues (or lack of thereof) and not to bias. Some content providers aren't cooperating fully and some specialized indexing is not being made available to discovery products."

- "There is a definite bias towards ProQuest products. EBSCO results are always much further down the results lists. We have turned off the Database Recommender because the recommendations were not related to the search term and were always for content from ProQuest databases."
- "The bias, if such, is only because certain aggregators may not be able to supply metadata coherently enough to index properly. New standards are being created and it is clear that several vendors don't follow them, but I would not say it is a political or intentional 'viewpoint' bias. At some point, though, other book jobbers and aggregators need to understand that the data has to be somewhat uniform in order to be properly accessed. They aren't being shunned for bias, but are unable to provide data in a standardized format that can be readily used by other discovery vendors. I believe that Serials Solutions is fairly vendor neutral, despite advocating and providing access to several unique ProQuest sidetools throughout the product (jackets, Ulrich data, etc.)."
- "Summon presents RefWorks in the Saved Items export options, and there is no ability to turn this off in the Admin console. Both products are owned by ProQuest. Though I can't see a way to turn off EndNote either. Resources that support direct linking (i.e., those with agreements with Summon) take preference over those that use OpenURL linking. So we can't choose to promote EBSCOhost over ProQuest when an article is held on both platforms."
- "Newspaper articles tend to flood results in Summon, perhaps because PQ has tons of newspapers? We've filtered these out of the default result as a workaround. Other than that, the system does not seem to favor any content types or publishers."
- "Only comments about a quantity bias. Number of newspaper articles retrieved overwhelmed others until we adjusted results."
- "Though we observe no direct bias, this is difficult to say as we are not privy to the inner workings of the relevancy algorithm."
- "The amount of ProQuest resources, particularly newspapers, that float to the top of the search results indicates resource bias."
- "We suspect that the ProQuest items are handled differently."
- "Possible US bias—not biased to any provider/publisher."
- "The main issue we have with Summon is that it does not index full text material very well when it is contained within EBSCO databases."

WorldCat Local

- "Within global search and retrieval of resources, our local resources are bubbled to the top; digital products that we own and have access to—when these resources are included in the 'knowledge base'—are revealed."
- "This is hard to say, but ours is vendor-neutral so there is no reason to add a bias, and I don't notice any."
- "There is no observed bias."
- "Vendors like Ebsco and Proquest bias their index content by supplying only very brief summary of their full indexing. Unlike vendor products the ranking and results seem to be relatively unbiased. The relevancy ranking with this product is poor. Better to just list by newest date and library availability."
- "(1) WorldCat Local's discovery bias is obviously toward those libraries whose holdings are found in the WorldCat database. But the tool does allow for a great deal of customization by libraries or their users in terms of which databases or catalogs to search and the order in which search results are sorted or filtered. (2) Discovery service tends to emphasize its scale of bibliographic collection rather than its guide to access, selections, or playlist, etc. (3) One of WorldCat's most powerful features is the ability to search beyond local holdings, but materials that are not locally held are hidden from discovery layer results, buried after local and consortial holdings despite their relevance. While it's valuable to be able to search for locally held items, sorting this way means WorldCat doesn't add value beyond a catalog search. (4) Most discovery services either have a book background, such as WorldCat Local or an article background such as Ebsco Discovery. These services tend to have a bias toward their primary function and highlight those types of materials first or return more of that type of result."

The Open Discovery Initiative

The Open Discovery Initiative, a work group of the National Information Standards Organization, was created to address some of the concerns in the index-based discovery arena. The work group was formed to develop best practices to help improve transparency in the ecosystem of index-based discovery, which includes content providers, discovery service creators, and libraries.

The Open Discovery Initiative began as a set of discussions that led to an invitational meeting at the June 2011 ALA Annual Conference held in New Orleans, Louisiana. This meeting, which included librarians, representatives from the organizations that offer discovery services, publisher representatives, and other interested parties, was meant as a forum to explore issues of mutual interest and to gauge interest in forming some sort of follow-on activity to address issues and concerns. Conveners of the group included myself, as an independent consultant; Oren Beit-Arie, chief strategy officer for Ex Libris; and Jenny Walker, an independent consultant working at that time on behalf of Ex Libris. With the consensus of the group in favor of moving forward, a proposal was developed and submitted to NISO to form the Open Discovery Initiative as a NISO work group, reporting through the Discovery to Delivery Topic Committee. The proposal was accepted in October 2011, when the committee voted to form the ODI work group with Marshall Breeding and Jenny Walker serving as cochairs. Initial tasks included developing the charge and work plan for the group and appointing its membership. Participants from the group included representatives from each of the four organizations that create index-based discovery services, representatives from primary publishers and A&I database providers, and librarians.

The key goals of the Open Discovery Initiative have been summarized as follows:

- Identify . . . needs and requirements of the three stakeholder groups in this area of work.
- Create recommendations and tools to streamline the process by which information providers, discovery service providers, and librarians work together to better serve libraries and their users.
- Provide effective means for librarians to assess the level of participation by information providers in discovery services, to evaluate the breadth and depth of content indexed and the degree to which this content is made available to the user.[9]

ODI formed work groups to work on information gathering and preliminary recommendations in four areas: Fair Linking and Library Rights, Technical Formats, Usage Statistics, and Library Rights and Level of Indexing. One of the main activities during the information-gathering phase of the ODI involved creating a survey. The report of the Open Discovery Initiative, including its proposals of recommended practice, was completed in September 2013 and is pending work group approval and will be made available for public comment.[10]

Social Features

In addition to their role in the search, retrieval, and access of library materials, discovery products can also promote engagement between a library and its patrons. While web-scale discovery has become a major trend for academic libraries, in the

public library realm, social features have increasingly become a distinguishing factor. In this vein, many discovery products include a variety of features to enable patron interactions. Some of these capabilities include allowing a patron to:

- rate or review items in the library collection
- comment on materials
- share items of interest on social sites such as Facebook, Twitter, or Pinterest
- develop a personal bookshelf of materials
- create lists of books in certain categories he or she would recommend to other readers
- share reading lists publicly
- communicate with other library patrons

While discovery systems do not necessarily function as complete social networking venues, their design is increasingly influenced by the pervasively social nature of the web.

A variety of different strategies can be seen among the library discovery products. BiblioCore incorporates social features as one of its fundamental design principles. It includes many built-in social features and allows patrons among all the libraries using BiblioCore to interact with each other. WorldCat Local also includes built-in capabilities for patrons to contribute reviews or ratings of collection items. Other discovery products or online catalog products bring in social features through integration with third-party services such as ChiliFresh or LibraryThing for Libraries. ChiliFresh Connections, for example, aggregates reviews and other patron interactions across all the libraries that use its products and can be integrated into any of the major discovery interfaces or online catalogs.

ChiliFresh
www.chilifresh.com

LibraryThing for Libraries
www.librarything.com/forlibraries

Website Portals

Libraries offer many different items on their websites in addition to those related to discovery. They need to provide descriptive information about the library and its many different services; list when facilities are open; include a directory of the administrators, librarians, board members, and other personnel; provide chat-based reference; provide guides to resources for subjects and topics; provide calendars and descriptions of events or programs; promote library materials by various means, such as through bestseller lists;

and perform a myriad of other functions. Designing, implementing, and maintaining the content of a library website can be a complex task, and especially for larger libraries, it is accomplished through a web content management platform. Open-source CMS products such as Drupal and Joomla! have gained popularity for managing library websites, as have a variety of commercially licensed products such as Microsoft SharePoint, Adobe Contribute, and others. For a library using a content management system, information access tools such as its discovery product or online catalog are among the many components that need to be integrated.

A genre of discovery products has emerged that also offers the ability to manage a library's entire website through an integrated set of library-oriented content management features. Whereas other discovery products can replace or supplement the library's online catalog, these products provide the library's entire website. This inherent integration between its discovery functions and general website content and specialized services provides a unified experience for library patrons, without the otherwise distinct hand-off. These products can be considered as a managed library web portal with integrated discovery. Products in this genre would include Arena from Axiell, Iguana from Infor Library and Information Solutions, SirsiDynix Enterprise, and BiblioCore from BiblioCommons (see table 1.13).

Some libraries may have very complex needs for their websites, with requirements beyond what can be met through one of these managed portal and discovery products.

Integration through Application Programming Interfaces

In addition to complete prepackaged products, there are many scenarios in which libraries benefit from the ability to deliver the functionality of their discovery service through other interfaces or platforms. Libraries may want to provide search tools for course pages in learning management systems, disciplinary portals, and other contexts in which their patrons may want to conveniently access library information.

Application programming interfaces, or APIs, provide a technical mechanism that allows programmers access to the functionality of a given software application (go to the landing page for Vol. 50, No. 1 at alatechsource.metapress.com to view the full table). These APIs enable system-to-system connectivity, receiving requests from external systems and providing responses that deliver data or elements of functionality. The availability of APIs has been an increasing area of interest among library technology products in general, including those related to discovery, providing

Product	CMS for full library web presence
Summon	not supported; the Summon service is not a CMS for library websites.
EBSCO Discovery Service	EDS is highly configurable and can be set up to be viewed as a library homepage, including a search box for EDS, along with links and images the library chooses to display on its page. Additionally, the interface and other aspects of EDS can be customized in ways that adapt and employ EDS to best suit a library's and its patrons' needs in terms of both content and the user experience. Options for customization include but are not limited to naming of the product; various branding sections on both search screens, results, and other pages; tool bar links (both labels and link destinations) ; color combinations of the interface; labeling and ordering of various components, such as facets on the result pages; global defaults for search modes utilized, basic vs. advanced search pages, limiters applied, and more; options for various profiles (more than a single iteration of EDS) to address more granular needs such as dedicated discovery experience for a given subject area (e.g. business); a multitude of options for "widgets" on result pages and detailed record pages. EDS features and functions can also be integrated into a library's website. The EDS API allows for integration with a library's ILS system, offering a seamless interface for library patrons. Future releases of EDS will allow for patron functionality within the EDS result list for those libraries that want to use EDS as the front end to the catalog. EDS also allows libraries to insert search boxes into any location on their website. This functionality allows easy access to EDS and does not require software engineers to use the API.
Primo + Primo Central	The Primo user interface is flexible and customizable and can include tiles that are generated by other systems. Therefore, services provided by the library can be presented as part of the Primo pages.
WorldCat Local	not supported
AquaBrowser	not supported
Chamo Discovery	yes, in conjunction with Drupal. This is an optional add-on for a fee.
Enterprise/ Portfolio	yes. Enterprise includes a built-in CMS that allows libraries a full web presence without the need for third-party products or services. Using a feature-rich admin interface, libraries and consortia can create modern and robust websites that can target specific audiences with the right information and style. Content can be added using a simple WYSIWIG editor or a raw HTML editor. Enterprise easily integrates locally developed CSS, and site-specific branding for every profile. Each profile can be tied to an IP address or range, or patrons might be prompted to log in before they can search from a particular profile. Each custom page or virtual room is full-text indexed and searchable, and can be easily copied, hidden (but still searchable if desired), and enabled for specific profiles.
Encore (release ES)	not supported
BiblioCore	yes. BiblioCommons provides a separate BiblioCMS module that integrates with the BiblioCore catalog. It is live with two libraries now, and Chicago Public went live with this new CMS service in fall 2013.
Iguana	yes. Iguana fully integrates a library's website and catalog.
Arena	available
VuFind	In theory, VuFind's use of Zend Framework 2 makes it fairly straightforward to add new pages to the system, but it does not have full CMS capabilities.

Table 1.13
Vendor-provided information on CMS capabilities offered for a library's web presence

the means for libraries to tap into the functionality of their systems in ways other than through the prepackaged interfaces.

One important use case for APIs involves providing access to web-scale discovery indexes through discovery interfaces that do not otherwise have that capability. Some libraries may have implemented discovery environments based on open-source software such as VuFind or Blacklight and may want to extend the scope to include their electronic resources. This approach allows a library to have a highly customized discovery interface for its patrons plus its choice of discovery index for article-level resources. Examples of blending open-source discovery interfaces with commercial discovery indexes include Villanova University's Falvey Memorial Library, using VuFind along with Summon; the University of Leipzig, which uses VuFind with Primo Central; Indiana University, which integrates EBSCO Discovery Service with Blacklight; and the Gemeinsamen Bibliotheksverbundes union catalog, based on VuFind with the EDS index.

Vendors offering discovery interfaces or integrated library systems that have not invested in the creation of a web-scale index may opt to license one to expand the capabilities of their products. Library automation vendors involved with diverse types of libraries may not be able to make the massive investments required to develop their own web-scale index, but may want to license one for their customers interested in this capability.

It should be noted that the integration partnerships generally involve an additional licensing cost to gain access to the web-scale discovery index. While a library may be able to implement an open-source discovery interface without costs other than the resources expended to implement and customize the software, it will need to pay the licensing fees associated with the discovery service. It may or may not be less expensive to gain API-level access to the discovery index relative to the cost of the complete package including the pre-packaged interface. Libraries using a commercial discovery interface would incur fees for both the interface and index components.

An important strategy for EBSCO Information Services relates to forming technology partnerships that take advantage of the APIs in EBSCO Discovery Service for integration with other discovery interfaces and library automation products. EBSCO Information Services is one of the few developers of discovery products that do not also offer an integrated library system or new-generation library services platform. These integration partnerships open opportunities for EBSCO Information Services to license its discovery technology and provide these other products access to a web-scale discovery index without having to make the investments necessary to build their own. In June 2012 EBSCO released the API for EBSCO Discovery Service that allows full access to the index and search capabilities of EDS via non-EBSCO interfaces. Some of the publicly announced partnerships that EBSCO Information Services has formed to integrate EBSCO Discovery Service into other products include the following:

- SirsiDynix: SirsiDynix integrated the EDS index into its eResource Central platform through an agreement announced in June 2012.
- Innovative Interfaces: EBSCO Information Services formed a partnership with Innovative in June 2012 to integrate the EDS index with Encore; the EDS index is a component of the Encore ES version.
- VuFind: In October 2013 EBSCO announced a technology partnership with Gemeinsamen Bibliotheksverbundes to integrate the EDS index with the VuFind discovery interface used with the resource-sharing service for 250 academic libraries.
- OCLC: EBSCO has technology partnerships with OCLC to enable the use of EBSCO Discovery Service as an end-user interface for WorldShare Management Services and to integrate the EDS index with WorldCat Local.
- Kuali OLE: EBSCO Information Services became a Kuali Commercial Affiliate in June 2013, which means the company will offer services to assist libraries implementing the Kuali OLE open-source

platform to integrate EDS in its discovery environment.
- Talis partners with EBSCO to offer optional integration of EDS into the Talis Aspire Reading List and Talis Aspire Digitized Content modules.
- EOS International: EOS International announced its partnership to integrate EDS into its EOS.Web suite of library automation products in June 2013.
- Credo: Credo announced its partnership to integrate the EDS index into the Topic Pages it produces through its Literati reference solutions.
- Soutron Global: Soutron Global announced in March 2013 that it will integrate the EDS index into its library and knowledge management systems.
- Capita: UK-based Capita announced its partnership to integrate EDS into its Prism discovery interface in September 2012.
- Blacklight: Indiana University has integrated the EDS index into its discovery environment based on the open-source Blacklight software.
- IBS (Information Portal Suite) originally developed by IHS Technologies GmbH: The Universitätsbibliothek Freiburg in Germany integrated EDS with its IBS-based discovery interface in 2012.
- Others: EBSCO Information Services reports that it has technology partnerships with over thirty ILS vendors worldwide.

E-book Integration

With the dramatic rise of interest in e-book lending programs in libraries, many developers of online catalog and discovery interfaces have been working toward integrating these capabilities into their products. Instead of simply providing links to an external e-book lending service, such as OverDrive, libraries are increasingly interested in the ability to offer e-book discovery and lending within their own environment. When e-book lending takes place externally on the platform of an e-book lending service, the patron moves outside of the library's sphere of control. E-book lending platforms have improved dramatically from earlier times, when they involved a cumbersome multistep process. They have also begun to offer APIs that enable libraries to integrate e-book lending functions within their own environment. This integrated approach allows patrons to discover and gain access to both print and e-books through the same interface. Once signed into their library account, patrons would be able to see a list of items currently checked out, place holds, and perform other tasks for items of both types. For e-books, once they are found through the catalog or discovery interface, available titles could be downloaded onto the patron's e-reading device with only a click or two. Libraries not only benefit from the

Product	E-book integration
Summon	The Summon service links users directly to the full text of e-books. Viewing and downloading are performed in the interface of the native platform.
EBSCO Discovery Service	EBSCO's partnerships with ILS vendors around the world allow for the seamless accessibility to e-books from various publishers directly through the ILS system. EDS customers who purchase EBSCO e-books are able to take advantage of instant access to those e-books without loading the MARC records into the catalog and updating the catalog in EDS, whether EDS is implemented through an ILS partnership or not. EBSCO eBooks currently includes approximately 438,500 e-book titles from more than 850 publishers and more than 20,900 audiobook titles. Thousands of new titles become available on a monthly basis. Libraries can browse individual titles to build a collection, choose librarian-crafted collections across a wide range of topics, or let EBSCO's collection development team create a custom collection, such as a chemical engineering collection. Subjects covered include general arts and humanities, literature and literary criticism, history, social science and cultural studies, political science, sociology, psychology, education, mathematics, economics and finance, accounting, business strategy and management, marketing, computer science, earth science, physics, biology, engineering, research skills, and more. EBSCO eBooks is offered with EBSCOhost Collection Manager, a powerful, easy-to-use tool that allows libraries to build and manage EBSCO eBook collections directly on the EBSCOhost platform.
Primo + Primo Central	E-book supported through linking to full text of resource, consistent with other electronic resources.
WorldCat Local	Current e-book capabilities support accessing the full text of an e-book only if an 856 link or knowledge base coverage provides this capability. WorldCat Local will introduce full transactional integration with e-book APIs (for availability, checkout, holds, patron account, etc.) in summer 2014.
AquaBrowser	not supported
Chamo Discovery	3M's API is done and available in MozGo, which is VTLS's mobile product. OverDrive's API doesn't allow this to be done.
Enterprise/ Portfolio	yes, via the new eResource Central add-on. eRC is a cloud-based application that is API/web services–connected to a growing list of e-content vendors such as OverDrive, Baker & Taylor, 3M, and Recorded Audiobooks. Libraries can use the eRC Admin to seamlessly harvest metadata for their licensed collections. They can organize the harvested data into collections, which can then be synced (with a single click) in a matter of minutes to any Enterprise profile. Once the collections are synced, library users can find the e-resources in an integrated results list that includes the other data targets discoverable with Enterprise. Users can preview or download materials {using stored credentials). Coming soon, users will be able to manage their e-resources alongside their physical resources within My Account.
Encore (release ES)	3M full integration and OverDrive availability
BiblioCore	BiblioCore was the first catalog to go live with this functionality in January 2012 (with Seattle Public, NYPL, and Boston Public). It was also the first catalog to integrate two different e-book vendors into the catalog with OverDrive titles and 3M Cloud titles with NYPL in September 2012. In May 2013, it went live with BiblioDigital in beta—a fully integrated e-book platform that also provides a library-branded, fully integrated e-book reader.
Iguana	E-books are shown in the results set, while tighter integration will be achieved through APIs.
Arena	full integration in search and lending in the Arena interface regardless of supplier via the Axiell eHUB service. This keeps the user on Arena and adds info to LMS, giving visibility and statistics together with the physical loans.
VuFind	This is not currently a feature of mainline VuFind, but it has been implemented in the VuFindPlus fork of VuFind 1.x; it is hoped that these features will eventually be integrated into the master code.

Table 1.14
Vendor-reported information on e-book integration

ability to offer an easier and more streamlined service to their patrons, but also gain improved abilities to capture statistics across their entire collection.

The e-book lending arena has seen a flurry of integration projects in the last year, when APIs became available from the major service providers. OverDrive, the earliest and dominant provider, is developing an increasingly broad set of APIs that include features for discovery, availability, and lending. More recently launched services, such as the 3M Cloud Library and Axis 360 from Baker & Taylor, also offer APIs. The availability of APIs has become an increasingly important competitive factor both for e-book–lending service providers and for developers of library catalog and discovery products.

To date, much of the integration of e-book lending (see table 1.14) has taken place among the vendors focused on public libraries and by public libraries themselves. The Douglas County Libraries in Colorado, Califa Library Group and the Contra Costa County Libraries in California, and the Marmot consortium in Colorado have extended VuFind to provide

March 2013	Serials Solutions announces Summon 2.0.
June 2012	Ex Libris releases Primo 4.0.
Jan. 2013	VTLS announces Chamo Discovery.
July 2009	VTLS announces Chamo.
Dec. 2009	BiblioCommons launches production service.
Jan. 2010	EBSCO Discovery Service released.
Aug. 2010	Iguana from Infor Library Solutions implemented in production.
July 2007	Axiell announces Arena.
July 2010	University of Virginia launches discovery interface based on Blacklight, now known as Hydra.
2009	Development of online catalog based on Blacklight begins at the University of Virginia. University of Rochester receives grant from the Andrew W. Mellon foundation for the eXtensible Catalog.
April 2010	Innovative announces Encore Synergy.
July 2009	Ex Libris announces Primo Central.
July 2009	Summon becomes a production service.
April 2009	EBSCO announces EBSCO Discovery Service.
Jan. 2009	Serials Solutions announces Summon.
March 2008	Serials Solutions given responsibility for AquaBrowser Library within ProQuest.
Jan. 2008	WorldCat Local moves into production.
2007	BiblioCommons founded to develop discovery interface for public libraries, with initial background study beginning in 2004 and software development commencing in 2006.
Oct. 2007	Encore moves into production.
April 2007	OCLC begins pilot of WorldCat Local.
May 2007	Primo moves into general release.
June 2007	ProQuest acquires Medialab Solutions BV through its R.R. Bowker subsidiary.
July 2007	Villanova University releases initial version of VuFind.
May 2006	Innovative Interfaces announces Encore.
March 2006	Ex Libris announced Primo.
Oct. 2005	SirsiDynix announces Enterprise portal product.
Sept. 2004	The Library Corporation becomes exclusive distributor for AquaBrowser Library in the United States.
2002	Medialab Solutions BV releases early version of AquaBrowser Library.
2000	WebFeat launches federated search service.
July 2000	Ex Libris announces MetaLib federated search tool.
Jan. 1996	Geac releases GeoWeb.
Sept. 1995	Innovative Interfaces releases web-based online catalog.
Feb. 1995	Sirsi Corporation releases Webcat.

Table 1.15
Chronology of web-based library resource discovery technologies

integrated e-book discovery and lending. In the commercial arena, vendors that have developed e-book lending integration include the following:

- Polaris Library Systems has integrated the e-book lending services of the 3M Cloud Library and Axis 360 from Baker & Taylor.
- BiblioCommons offers integration with OverDrive.
- SirsiDynix, through its eResource Central platform, offers integrated e-book acquisition and lending through multiple providers: OverDrive, Baker & Taylor Axis 360, Recorded Books, 3M Cloud Library, and EBSCO eBooks.
- Innovative Interfaces enables e-book integration into Encore with OverDrive.
- The Library Corporation offers integrated e-book lending with Baker & Taylor Axis 360 through LS2 PAC.
- VTLS offers integrated e-book lending with OverDrive though its Chamo Discovery and MozGo

mobile app.

- Softlink announced its plans to integrate e-book lending with OverDrive into its Oliver and Liberty library management systems.
- Book Systems has integrated OverDrive e-book lending through its Atriuum ILS.
- OdiloTID, a company based in Spain, offers fully integrated e-book lending capabilities based on the Douglas County model.[11]

The Ongoing Role of the Online Catalog

While this issue of *Library Technology Reports* focuses on discovery products, it is also important to underscore the ongoing role of library catalogs. From the user interface perspective, library catalogs and discovery products are increasingly less differentiated. Many library catalogs now include many of the interface features we have described for discovery products, such as relevancy-ranked search results, faceted navigation, and enhanced content, and many have invested in new designs with a strong emphasis on user experience. The main point of differentiation lies in the direct association of a library catalog with a particular ILS, usually through direct proprietary mechanisms versus discovery interfaces that work with any ILS, library services platform, or content repository using more abstract connectivity layers. (See table 1.15.)

The advancement of the online catalog as provided with integrated library systems has mitigated the need for libraries to invest in separate discovery products. Public libraries, for example, continue to manage most of their collections within their ILS and have less demand for a separate discovery product that unifies its resource components. E-book collections represent an important set of resources that tend to be managed outside of the ILS, but as we noted above, many of the ILS online catalogs as well as discovery products have been enhanced to integrate the discovery and lending of these materials.

Among public libraries, there is more of a trend to move away from third-party discovery products to online catalogs provided by the ILS vendor. Almost all of the public libraries that had initially implemented AquaBrowser using an ILS from the Library Corporation have migrated to LS2 PAC. Libraries moving to Polaris likewise tend to use its PowerPAC online catalog, often displacing a previously implemented discovery interface along with the legacy ILS. One of the main exceptions to this trend involves BiblioCommons, which is able to entice public libraries away from the online catalog of their ILS.

Another emerging trend relates to the new-generation library services platforms. Some of these products do not come with a traditional online catalog and are inherently designed to interoperate with a discovery service instead. Alma from Ex Libris, for example, was designed to user Primo as its patron interface. The open-source Kuali OLE platform being created for academic and research libraries likewise will not include a patron interface, but expects libraries to integrate it with the discovery service of their choice.

Notes

1. Marshall Breeding and Andromeda Yelton, "Librarians' Assessments of Automation Systems: Survey Results, 2007–2010," *Library Technology Reports* 47, no. 4 (June 2011).
2. Adapted from Marshall Breeding, "Perceptions 2007: An International Survey of Library Automation," Library Technology Guides, January 9, 2008, www.librarytechnology.org/perceptions2007.pl.
3. SIRSI Corporation, "New SIRSI World Wide Web Home Page Provides Hands-on Demo of the Virtual Library: Internet Browsers Can Search the Web's First Library Catalog Learn What's Hot in Information Automation," news release, February 8, 1995, www.librarytechnology.org/ltg-displaytext.pl?RC = 6307.
4. "World Wide Web Access Now Available for Innopac Systems," Library Systems Newsletter 15, no. 9 (September 1995): 86, cited on Library Technology Guides, www.librarytechnology.org/ltg-displaytext.pl?RC = 5449.
5. Infor Library and Information Solutions, "Annual Report 1996: Divisional Report—Library Systems," news release, January 1, 1996, www.librarytechnology.org/ltg-displaytext.pl?RC = 8245.
6. Digital Library Federation, "Digital Library Federation Releases ILS-DI Interface Specification," news release, June 8, 2008, www.librarytechnology.org/ltg-displaytext.pl?RC = 13304.
7. Marshall Breeding, "Progress on the DLF ILS Discovery Interface API: The Berkeley Accord," Information Standards Quarterly 20, no. 3 (Summer 2008): 18–19; Digital Library Federation, DLF ILS-Discovery Interface Task Group (ILS-DI) Technical Recommendation: An API for Effective Interoperation between Integrated Library Systems and External Discovery Applications, revision 1.1 (Washington, DC: Digital Library Federation, December 8, 2008), http://old.diglib.org/architectures/ilsdi/DLF_ILS_Discovery_1.1.pdf.
8. "EBSCO and Ex Libris," Orbis Cascade Alliance, last updated September 4, 2013, www.orbiscascade.org/index/ebsco-and-ex-libris.
9. Marshall Breeding, "Introducing the Open Discovery Initiative" (presentation, NISO Update Session: What the Future Entails for Library Systems, NASIG Annual Conference, Nashville, TN, June 24, 2012).
10. "Open Discovery Initiative," National Information Standards Organization, accessed October 14, 2013, www.niso.org/workrooms/odi.
11. Marshall Breeding, "Technology to Empower Library Control of E-book Lending," Smart Libraries Newsletter 33, no. 8 (August 2013): 3–6.