# Proposal:  Integrating Licensed Library Resources with Sakai

Submitted to the Andrew W. Mellon Foundation
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November 10, 2005

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# Integrating Licensed Library Resources with Sakai

# I.      The Proposal

Indiana University, together with the University of Michigan as a subcontractor, requests $438,267 from the Andrew W. Mellon Foundation to support a project to integrate access to library licensed digital content within Sakai. The project will run over an eighteen-month period from January 1, 2006 through June 30, 2007 and will provide funding for 3 additional FTE for project management, programming, interface design, and evaluation, as well as support for necessary travel, meetings, and computer hardware.

# II.     The Environment

## A.    Course Management Systems and Sakai

Course management systems are increasingly becoming central to teaching and learning activity on university campuses. The Sakai Project has emerged as the premier community source-based course management system (CMS) development project in higher education, designing and delivering the Sakai application framework and tools to meet the needs of the growing Sakai community. The Sakai Educational Partners Program (SEPP) currently has over seventy member institutions ranging from major research universities to liberal arts colleges and community colleges. The Sakai framework and tools are currently in production as CTools at the University of Michigan, Oncourse CL at Indiana University, and ETUDES-NG at Foothills College, and over twenty additional institutions are in various stages of investigating and implementing Sakai.[1] At the University of Michigan, CTools has over 25,000 users[2] and the campus will be fully migrated from its legacy course management system in Fall 2005. In addition to the educational partners, Sakai has commercial affiliates including Unicon and IBM. Future goals of the Sakai Project include development of its interoperable framework, tools, and extensions. SEPP will continue to grow and the development model used for Sakai is expected to become more broadly applicable.[3]

Described as the "digital home of students' coursework,"[4] the CMS is becoming the primary mechanism for faculty to provide students with scholarly information and resources, and in turn, for students to access such materials. While use of the campus CMS is on the rise, it is still not possible for library licensed digital content to be accessed through Sakai. In many cases, current campus technological infrastructure requires instructors and students to visit the library web site and CMS separately, with few ways to effectively link resources between the two environments. Overwhelmed by this complex environment, students turn to search engines like Google to find information for scholarly research. A recent study at Colorado State University showed that 58 percent of freshman used Google or a comparable search

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[1] https://www.indiana.edu/%7Esakaikb/display.cgi?docid=aprd
[2] Hilton, James and Bradley C. Wheeler (2005). "The Sakai Project: Outcomes, Reflections, and What's Next." Presentation from *EDUCAUSE Live!* Seminar series.
http://www.educause.edu/LibraryDetailPage/666?ID=LIVE054
[3] http://sakaiproject.org/index.php?option=com_content&task=view&id=103&Itemid=208
[4] Lippincott, Joan K. (2005) "Net Generation Students & Libraries." In Diana Oblinger and James L. Oblinger (Eds.), *Educating the Net Generation* (p. 13.2). Boulder, Colo.: EDUCAUSE.
http://www.educause.edu/educatingthenetgen/

engine for research, while only 23 percent started with a library-provided database or index.[5] As a result, students are not taking advantage, nor learning about, the scholarly research materials in their disciplines.

## B.    Multiple Sources of Content

While students attempt to use Google to locate scholarly resources, faculty members continue to develop assignments that require students to compare and contrast primary and secondary resources, read editorials from multiple news sources, develop an understanding of popular and scholarly literature, and create research projects utilizing multiple sources and formats.  Faculty also create reading lists as a basis for class discussion and point students to information on current events. At the same time the CMS continues to evolve and play a more central role in the academic life of the campus, faculty members are confronted by an ever more diverse and sometimes confusing array of sources from which to choose when putting together such assignments and reading lists. These sources include:

1. **Open Web sites:** Faculty are making increased use of information available on the open web from research, commercial, and other sources, discovered via use of search engines such as Google or various other means.

2. **Personal documents:** Many faculty have growing personal electronic collections of articles, papers, etc. written by themselves or by colleagues—either created originally in electronic form or scanned in—that they wish to upload to a CMS for use by their students.

3. **Local repositories:** A growing number of universities are implementing institutional repositories to preserve and to provide electronic access to the research output of their faculty, as well as repository systems providing access to locally digitized or digitally acquired library resources, including electronic books, manuscripts, and other media.

4. **Licensed full-text databases:** One of the most heavily used categories of electronic information resources is that of subscription databases licensed from vendors by libraries. These resources primarily support access to full-text articles from journals and other periodicals and range from individual e-journal web sites to services run by journal publishers to large aggregation services such as ProQuest and Ebsco. In addition, efforts such as JSTOR, developed with support from the Andrew W. Mellon Foundation, are working to digitize back issues of scholarly journals from print for subscription electronic access. Licensed databases also increasingly provide access to other full-text materials, including electronic books and a variety of primary source cultural heritage materials. Libraries provide access to licensed content from a multitude of publishers. Accessing this content is not as simple as linking to a particular article or image, as URLs are unstable, licensing agreements require authentication and copyright management, and publisher formats and delivery methods can and do vary.

5. **Electronic reserves services:** Many academic libraries operate electronic reserves services to support instructional use of articles, book chapters, and other texts that are already readily available in electronic form on the Internet through free or subscription-based services. These services scan in materials and typically make them available

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[5] Lippincott, p. 13.4.

through a password-protected web interface accessible to the instructor and students in the class.

## C.    The Current State of CMS–Library Integration

An initial exploration of how other Course Management Systems (CMS) commonly used in higher education attempt to integrate with library systems was conducted, to both familiarize ourselves with existing knowledge in the problem domain and to help seed internal discussions about desirable features and available protocols. In this study, we looked at the possibility of integrating data from OPACs and a specific federated search tool (MetaLib from the Ex Libris corporation) into various CMS products.

In addition to Sakai, three CMS systems were examined. Moodle is the most popular open-source CMS after Sakai, our target system, according to a May 2005 survey by the Alliance for Higher Education Competitiveness (Abel, 2005). Drawing from the commercial realm, Abromtis (2002) notes that Blackboard and WebCT "…have established themselves comfortably as the top CMS [Course Management System] choices," a situation which has solidified in the intervening period.

All four systems were examined and broken down by their ability to communicate with library catalogs and the MetaLib search engine along a continuum from very general (non-library-specific) communication through complex, highly-contextualized two-way integration between the CMS and library systems.

For our purposes, this continuum can be broken down into five categories:

1. **Contextualize external pages**. This is essentially just showing a web page within the CMS's web interface, whether in a frame or integrated into the rest of the page by a rendering engine. A link is followed, and the results are embedded in the frame of the CMS instead of showing up in its own window, allowing the CMS to provide a course-based context for the information.
2. **Parse and display well-formed content**. Unlike an embedded web page which simply presents the received data "as is", a content parser is able to receive data in a well-defined format (e.g., some flavor of XML such as RSS or Atom) and then transform that data for useful display within the CMS.
3. **Integrate external content.** Essentially a more fine-grained implementation of the previous items, this implies the ability to "mix and match" locally-created content (e.g., a syllabus) with externally-generated content (e.g., a list of reserve materials).
4. **Assist with deep linking.** The URL used to access content inside a database as featured as an OPAC or to control a federated search engine is generally incredibly long and complex, making the inclusion of such content so onerous that the possibility may be ignored. A CMS tool that helps users create such a URL to directly access a specific set of search criteria or a specific record in the target search or OPAC tool provides greater opportunity and utility.
5. **Provide pre-defined two-way library integration**. This is a catch-all, describing fully integrated tools that allow users both affect library systems (e.g., define a search set, put something on electronic reserves) and consume library data from within the system.

The first three items are essentially independent of a specific library use and speak only to the tools available to assist in pushing data from *any* system, including the library, into the CMS. The latter two items, because of their reliance on library systems, would necessarily be coupled to either a specific library installation or a well-defined intermediate system capable of communicating with library systems from multiple vendors.

A preliminary search for tools that support library integration with each of the four target systems shows few differences between them, and little overall support for the integration of library services.

| | Sakai | BlackBoard | WebCT | Moodle |
|---|---|---|---|---|
| **External Pages** | Yes | Yes | Yes | Yes |
| **Content parsers** | RSS | RSS, Atom | Several IMS standards and 3$^{rd}$ party | 3$^{rd}$ party RSS |
| **Content integration** | Limited/ Custom (IMS) | Limited (SCORM, MERLOT) | Limited (MERLOT, IMS) | IMS standards, MERLOT |
| **Assisted deep linking** | Twin Peaks (beta) | Very limited, 3$^{rd}$ party[6] | No[7] | No |
| **Two-way integration** | No | No | No | No |

While all of the systems have support for the most general, limited content integration from outside sources, none are designed to provide easy integration with externally-housed data in structured formats other than RSS/Atom. Support for content integration tends to be focused on *importing* data (i.e., for local storage within the CMS) with standard formats or using standard protocols into the internal data store of the CMS. For integration with library services, the ability to pull data "on demand" from dedicated library engines is crucial.

The few attempts so far to provide communication (one-way or two-way) with library systems through deep linking or more extensive integration have been driven by users through the production of plugins. With the exception of Twin Peaks, these are little more than guides to help with (but not hide or abstract away) the complexities of dealing with library systems.

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[6] Sirsi Corporation, a major library systems vendor, has announced plans to "work more closely" with Blackboard and WebCT on integration issues.
[7] Ex Libris, another library vendor, recently announced a partnership with WebCT, so this may change soon.

# III.    Focus of this Project

In this project, we propose to develop new tools and enhance existing tools within Sakai to provide easy access to licensed electronic full-text resources. This work will build upon two existing projects—Twin Peaks Navigator at Indiana University and the RSS library resource application at Michigan—and will create functionality that will be useful for and usable by both faculty and students and readily deployable by other institutions implementing Sakai.

Using the taxonomy developed above, we place the RSS Library tool at the Content Parser level — relatively low-level, easy to extend, and dependent only on a standard transformation of library material into a well-defined format. Twin Peaks, as noted in the table, assists with deep linking by providing an abstract interface within which one can create the complex URLs necessary to control the OPAC and federated search engines.

To effectively deliver content to Sakai and avoid duplication of efforts, libraries and CMS developers must work collaboratively to develop seamless integration, leveraging the strengths of existing infrastructure and resources while at the same time developing new tools and modes of delivery. In *Surveying the Digital Landscape: Evolving Technologies 2004*, the Educause Evolving Technologies Committee writes that "the convergence of systems and services offers exciting opportunities for improved faculty/instructor and student use of valuable, increasing expensive, digital resources. Convergence creates dialogue among stakeholders, expands institutional understanding of the roles played by each, and opens new doors to collaboration."[8]

We have chosen to focus on licensed full-text, as it has received relatively little attention within Sakai. Personal documents and content from open web sites are already handled reasonably well by Sakai, and content from local repositories is an area being actively addressed by other activities within the SEPP framework, including the technology analysis of repositories and services being conducted at Johns Hopkins University. Licensed resources represent significant and heavily used content on which colleges and universities, through their library collection budgets, are spending millions of dollars per year, but to date have not received much attention within the Sakai project and the Sakai Educational Partners Program (SEPP) community, and electronic reserves will continue, at least in the near-term, as a common vehicle for delivery of published content that is not already available in electronic form from vendors.

While some smaller pilots and demonstration projects related to integrating library resources with Sakai by the Indiana University and the University of Michigan Libraries may be possible without the funding requested in this grant, a project of this scale would be impossible without additional staff.  In particular, development work related to extending metasearch functionality into the Sakai environment through Twin Peaks in and building prototype librarian functionality within Sakai described in this proposal will require resources beyond which IU and UM Libraries currently have available.  Additional programmers and project staff will allow for dedicated personnel to focus on this work with a Sakai Project developer assigned to the project to ensure that the tools developed are

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[8] EDUCAUSE Evolving Technologies Committee (2004). "Surveying the Digital Landscape: Evolving Technologies 2004." *EDUCAUSE Review*, November/December 2004, p. 86. http://www.educause.edu/ir/library/pdf/erm0464.pdf

enterprise ready, i.e. that they can scale to meet the needs of multiple institutions and can be supported as mission critical components of an institution's technology infrastructure, and to conduct requirements and evaluation work to ensure that what we are doing is truly useful for students and faculty.

# IV.    Project Goals

## A.    Overall project goals

1. Enhance the teaching and learning experience by building tools to provide seamless integration of content from licensed library databases within Sakai.

2. Leverage existing and emerging library technology infrastructure and existing preliminary work on Sakai integration as much as possible in developing these tools.

3. Prototype functionality for librarians to present content in Sakai and students to discover licensed content within Sakai.

4. Engage librarians, students, and faculty in the design and testing of tools for integration of library content and services.

5. Collaborate with the Sakai community to optimize development for usefulness in multiple settings and to promote seamless integration within the Sakai software platform.

We will achieve these goals via the activities summarized below and outlined in further detail in the project Work Plan.

## B.    Project Summary

In this project, we will:

1. Adapt and expand Indiana University's existing Twin Peaks Navigator search and linking tool to integrate with library metasearch tools and with the Sakai Resources tool.

2. Extend the preliminary Sakai-Library integration work of the University of Michigan (RSS library resource application) by implementing additional sources for RSS feeds and enhancing information presented in feeds, and packaging the application for release to the SEPP community.

3. Investigate the role of and utilize OpenURL technology and link resolvers in Twin Peaks for building persistent links from Sakai to articles and other resources.

4. Support core Sakai developers at the University of Michigan in enhancing the Sakai Resources Tool to enable better integration with Twin Peaks and other future content access tools via a plug-in architecture.

5. Engage faculty and students in functionality and interface design, and perform pilot testing and evaluation of the developed tools with students and faculty at multiple institutions.

6. Prototype functionality that will allow librarians to produce (and instructors to incorporate) subject guides resource consisting of relevant links, constrained metasearches, and expository material in Sakai. Pilot test prototype at the University of Michigan and Indiana University.

7. Make the Twin Peaks and RSS library resource tools available as an open source package for use by other Sakai implementers, either packaged as part of Sakai or through a separate distribution.

# V.     Existing Sakai-Libraries Building Blocks

## A.    Twin Peaks Navigator

Staff in Indiana University's Library Information Technology department have been working on a pilot experiment[9] to develop a user interface for accessing digital library resources from within the Sakai course management environment. Originally conceived of by Brad Wheeler at Indiana University and funded through a grant from Sun Microsystems, the interface is titled "Twin Peaks" to illustrate the currently separate mountains of library and course management resources that need to be bridged. It is a fully JSR168 compliant tool being developed as an experimental option within the WYSIWYG authoring tool of Sakai that allows an instructor authoring an assignment, an announcement, or other text in a Sakai course site to easily bring up a search window from which he or she can query various individual licensed and free full-text databases. From the results display, the instructor can view the full-text of an article to confirm that it is the desired one and then generate a persistent link to the article that is automatically pasted into the text the instructor is creating along with the title of the article.

Currently available information resources are limited so the effort as is centered on foundational aspects of user interface and integration into Sakai. The goal is to provide a system to make it easier for instructors with limited time and very limited technical expertise to simply locate and reuse online digital content, in the widest sense of such content (licensed, local, etc). The functionality is targeted for eventual acceptance as a default tool within the core Sakai code.

Challenges to overcome in the development of Twin Peaks have included:

- Sakai itself is rapidly evolving and still undergoing steady changes in integration of the four lead institutions' efforts. We are in essence adding customized functionality to a moving target that is barely in production and mostly a pilot effort itself.

- Few licensed database/journal vendors currently offer natively persistent links. Those that do offer them in vendor-specific formats not consistent in interface or format.

- Many library vendors dislike the reduction in their "branding" that occurs when libraries or search engines execute direct searches against their systems (and occasionally such direct searches, depending on frequency or scope, can violate licensing agreements).

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[9] https://twinpeaks.dev.java.net/

- Citation lists obtained via meta-searching may not result in links that offer intuitive "one click" access to the full-text resources. This could be because the tool requires a second search to be executed to ensure currency of the full text availability or due to the resource only offering abstract level coverage.

- The same journal title may be available from multiple aggregators.  Libraries frequently switch vendors in order to lower costs and gain functionality.  This practice makes it difficult to maintain persistent URLs.

- To date, as a proof-of-concept implementation, Twin Peaks has focused on a relatively small number of resources, using custom-built "screen scraping" connectors. In addition, Twin Peaks can currently query only one database at a time and requires that the user enter the query using the syntax and semantics of the specific database selected. To address these limitations will require integration of Twin Peaks with the growing array of metasearch tools.

We plan to address many of these challenges in the course of the work described in later sections of this proposal, while others (such as the loss of branding) are inherent in providing a standard interface for searching multiple resources, and are being discussed and addressed within the wider metasearch community.

## B.    RSS Library resources application

The University of Michigan Library has created, supports, and maintains the RSS-Library resources application, a program that produces RSS feeds of library reserves information suitable for use in CTools, the University of Michigan instance of Sakai. Written in the free and widely available PHP programming language, it serves as a dispatcher between CTools, registrar data, and Aleph, the online catalog. The RSS library resources application affords access to enterprise registrar data via simple API calls that reference a detailed course string. For display within Sakai, CTools developers repurposed the Sakai "News" tool as an instructor-controlled "Library Reserves" tool. This "Library Reserves" tool within Sakai automatically generates a resource feed query when activated, based on course information already present in CTools.

Communication between the RSS Library resources application application and the library catalog, Ex Libris's Aleph, is provided by the Ex Libris Aleph X Server. Maintained within the library, the X server acts as the middleware sitting between user programs and Aleph. It exposes an extensive programmers API and outputs OAI XML. Most search and aggregation functionality of the product is thus available to programmers through the exchange of relatively simple XML documents. Using this interface, programmers can (and have) create query interfaces independent of the vendor-supplied interface and embed calls to sophisticated searches and result sets from any web page, including those generated by a CMS.

There remain several open issues with the RSS library resources application. The version of RSS supported by Sakai (0.92) allows only relatively simplistic data and metadata display. Other challenges center on dealing with distant content (sometimes print) and organizational irregularities in central registrar data. While problems with central registrar data are unlikely to be resolved soon, enhancements to the RSS display, including making links to full-text

more prominent, are underway. An extension of the RSS library resources application to work with additional catalog and reserves systems would be relatively easily implemented and should prove beneficial to many libraries. Possible enhancements include changing the data flow to include an intermediate data form (perhaps based on the IMS Resource List Interoperability format[10]), which can then be transformed into multiple formats for consumption (RSS 0.92/1.0/2.0, Atom, HTML, etc), and providing both URL-based (REST) and web services (SOAP) interfaces to allow the maximum flexibility in accessing the data across technologies.

# VI.     Existing and Emerging Library Technologies

## A.    Metasearch

While Twin Peaks and the RSS library resources application are steps in integration of library resources with Sakai, there is still much work to be done. Students and faculty are still required to navigate the complex electronic resource environment entirely independent of the CMS. A key component of this project will be integrating the library's metasearch products with Sakai. Metasearch (or federated search) tools provide a single point of access across disparate databases by multiple vendors (OCLC, ProQuest, Cambridge Scientific Abstracts, etc.). Search results are displayed in a single search interface with links to citation and full-text information, as well as links to the native vendor search interfaces. Metasearch products also provide mechanisms for creating custom sets of electronic library resources and often utilize the OpenURL protocol (see page 11 for more information) to deep link to content. Metasearch tools can play an important role in the resource discovery process, providing a single Google-like search box as a point of entry into the vast offerings of the library.

In theory, metasearch tools allow a user to search all of the resources relevant to his or her particular topic or discipline, view the results in an integrated fashion, and link to full text as desired, without having to care about which vendor's database to go to and interface to use. In practice, there are some performance and user experience problems inherent in metasearching, caused by varying availability and performance of databases, varying search syntax and semantics, and varying citation formats and methods for offering links to full-text resources across different databases and vendor systems. In addition, these federated search tools connect to information sources via a variety of different means, including the Z39.50 query protocol, SRW/SRU, vendor-defined XML interfaces, and HTTP/HTML screen scraping. NISO's Metasearch Initiative[11] is attempting to define standards and best practices for metasearch, involving representatives of metasearch tool developers, content providers, and libraries.

## B.    Accessing library metasearch systems from Sakai: Extending Twin Peaks

For Twin Peaks to be useful to faculty, it must offer searching of a variety of different databases as well as simultaneous searching of multiple databases. Rather than attempt to duplicate the functionality of existing metasearch products, it makes sense for us to adapt Twin Peaks Navigator to take advantage of the services provided by these products.

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[10] http://www.imsglobal.org/rli/
[11] http://www.niso.org/committees/MetaSearch-info.html

Metasearch engines are still a relatively new technology, and there will certainly be challenges to this integration. These challenges include abstracting functionality across competing metasearch engines such that we can build one tool that interfaces with multiple vendors' products; figuring out the best means of communication between our tool and the metasearch engines; and generating persistent URLs for results.

Our focus will be on working with the two metasearch products in place at Michigan and Indiana – Ex Libris MetaLib and Sirsi SingleSearch – as well as their accompanying Online Public Access Catalogs (OPACs). MetaLib and SingleSearch are two of the most commonly used metasearch systems among academic libraries, but we will also examine other metasearch products such as WebFeat and Endeavor ENCompass to ensure that our design does not lock out integration with such products in the future. We hope that our work will be helped by the fact that members of the metasearch community appear to be starting to explore common means of exposing their services to other tools via the use of SRW/SRU or other Web Services.

## C.    Ex Libris MetaLib

Much like its OPAC counterpart Aleph, the MetaLib federated-search product from Ex Libris has an optional add-on product that allows programmatic access to searching functions. Called the Metalib X Server, this programming interface gives external programs access to MetaLib functionality, returning the data in a well-defined XML format that can then be displayed or transformed as is necessary. Current uses of the X Server range from tweaking search parameters to creating a full-fledged interface completely independent of that shipped with MetaLib.[12]

Interfacing with the MetaLib X Server happens at a relatively low level. A query must be prepared as an XML file, following a particular vocabulary and specifications. This is sent to the X Server, which internalizes the query and sends back a unique identifier denoting this particular search set. Another query is constructed as XML, which this time embeds the unique identifier, asking the X Server for a subset of the results. Finally, these results are returned by the X Server as another well-structured XML document. The calling program then takes these results, parses them, and transforms them for display.

The existence of the X Server significantly eases the creation of an interface for searches and links from an external program (i.e., the CMS). Instead of attempting to call the search tool strictly through relatively clumsy URLs and then try to "screen scrape" the resulting HTML, the X Server and its protocols provide a clean platform upon which programmers can build new interfaces. By having the interaction between the user and MetaLib mediated by a custom program, both the search parameters and the display of results can be customized to work well within a framework external to MetaLib.

The functionality embodied in the X Server provides two important opportunities. First, it allows the embedding of the metasearch functionality directly in the CMS, allowing for a much tighter integration of library services in the course context. Second, and most importantly, it may allow for pedagogical manipulation of the search functionality itself. By allowing instructors and/or instructional designers to set parameters based on the user

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[12] See http://library2.csusm.edu/xerxes/ for an example

population specific to a particular course, searches can default to use resources appropriate for the students' level of expertise, focus on particular databases, and provide a much tighter integration with the course content.

### D.   Sirsi SingleSearch

Indiana University has recently implemented Sirsi's SingleSearch metasearch product, based on technology developed by MuseGlobal, Inc. There are several options available to us for the integration of SingleSearch's functionality into other tools such as Twin Peaks. One option is to send queries via HTTP to the standard SingleSearch web interface and then parse, or transform via XSL, the results page that comes back. Another option is the Muse Web2 Bridge, which provides an XML/HTTP-based interface to the Muse metasearch engine. Finally, MuseGlobal is working on developing an SRW/SRU target for SingleSearch to allow it to be used by SRW/SRU clients. We will work closely with Sirsi and MuseGlobal to explore the various options available and select the most appropriate, scaleable, and sustainable option for us.

The Sirsi Unicorn system exposes most OPAC functionality through a series of APIs accessible from any major scripting language. The results can then be translated to whatever format is needed by the CMS.

### E.   Google Scholar

Google Scholar is emerging as a potentially important resource in the research toolkit available to students. Google Scholar crawls scholarly content on the web by targeting open access materials and publisher material with which Google has contracts.[13] Search results include citations and full-text articles. Still in its infancy, it remains to be seen how much content Google Scholar will actually crawl and how effective Google searching algorithms will be in the complex scholarly resources landscape. Google Scholar also employs OpenURL technology, providing direct links to the content of selected libraries. To participate, libraries provide holdings information to Google Scholar through registration via the library's link resolver. To begin with, Google Scholar will likely serve as a target in the library metasearch tool integrated with Sakai, but as it develops, other uses will be discussed and explored.

### F.   OpenURL

The OpenURL standard[14] provides a syntax for packaging metadata and identifier information about an information object (such as a journal article) into an "actionable" URL. This URL is passed by a database (for example, from a citation in an index) to an institution's link resolver service, which then presents the user with appropriate services that have been identified by the library. These services may include access to full-text content for the resource from a database licensed by the library, access to information on print holdings, links to document delivery services, among others. OpenURL technology will be useful for creating persistent links to library resources within Sakai.

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[13] Tennant, Roy (2005). "Is Metasearching Dead?" *Library Journal*, July 2005, p. 28.
[14] http://www.niso.org/standards/standard_detail.cfm?std_id=783

### G.    Extend functionality to include subject research guides

We plan to develop a prototype tool that will allow librarians to present (and instructors to incorporate) research guides[15] consisting of licensed databases (ProQuest, Ebsco, RLG, etc.), relevant links, constrained metasearches, and expository material in Sakai. Requiring cooperation between both Sakai tools and library resources, these guides will necessarily be built using many of the same technologies made available through this project: deep links into catalogs and link resolvers, constrained searches, the display of externally-housed data within the Sakai structure, an authoring tool based on Twin Peaks technology, and the library's content management system.  Already available via library websites, these research guides provide students with important information on current  library subscriptions to electronic databases and journals, as well as information on subject librarians available for consultations and guidelines for evaluating course websites.

Prototyping this functionality will serve as a proof-of-concept of the CMS as a vehicle for presenting relevant course and research licensed content to instructors, students, and researchers.  It will also bring the librarians' subject and research expertise, already heavily utilized via the classroom and traditional and virtual reference services, to the course management system environment. Development challenges include the role (if any) of the library web content management system currently used for generation of subject guides; how instructors place requests for customization of subject guides via Sakai; and  how librarians are granted access to appropriate course sites within Sakai.

# VII.    The Sakai Resources Tool

The Resources Tool is a core feature of Sakai that allows an instructor to assemble a collection of documents or other files supporting a course and organize them into folders and subfolders for access by students. When an instructor creates a new resource item in Sakai, he or she can choose to upload an existing file from his or her local system, author a text document or HTML page directly through the Sakai interface, or link to existing content via a URL. The instructor can then enter Dublin Core metadata for the item (as of Sakai 2.0), along with information on copyright and access permissions. Once a resource item has been created, it can easily be selected and attached to postings within other Sakai tools, including Announcements, Assignments, Discussion forums, and assessment (quiz/testing) tools.

From discussions with lead Sakai developers and members of the Sakai Board, we understand that the Sakai Project is planning to significantly enhance the Resources Tool in an upcoming version. While these enhancements will be based on the existing Resource Tool code and will preserve its existing API, known as ContentHosting, they will add new features borrowed from the work of the Open Source Portfolio Initiative (OSPI), as well as an implementation of the JSR170 Java Content Repository API. Most pertinent to this proposal, developers plan to create a framework for "resource picker" plugins within Sakai. This framework would allow the development of plugins that extend the methods of access to

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[15] See http://www.libraries.iub.edu/index.php?pageId=2055 and
http://www.lib.umich.edu/aael/division.php?divisionID=9&filterID=16&d=v for examples of research guides at IU and UM.

content beyond the existing choices of file upload, URL, and direct authoring. In addition, the various WYSIWYG editors within the Sakai authoring environment would be extended to enable linking to resources, so that links to external resources could be embedded directly within authored content, not just appended as attachments as at present.

Because a faculty member assembling online materials for a class will typically be drawing on many different information sources, of which licensed library databases are only one (albeit large) category, it makes sense to integrate the search and linking functionality of Twin Peaks Navigator into the Sakai Resources Tool as a "resource picker" plugin. This will allow linked articles from licensed databases to be treated like any other resource in Sakai and organized and placed into folders alongside other documents uploaded or linked to by the faculty member.

As with the RSS library resources application discussed earlier, we will evaluate the IMS Resource List Interoperability (RLI) specification as a potential export/exchange format for resource and reading lists for implementation within the Sakai Resources Tool.

Enhancements to the Resources Tool will require work of Sakai developers. With funding requested in this proposal for a 50% FTE core Sakai developer at UM, Sakai is committed to making these necessary enhancements in order to facilitate our integration with the Resources Tool and with Sakai. Throughout the process of this project, we will consult and collaborate with the Sakai development team and the Sakai Foundation Board on our design and implementation to ensure a successful outcome.

It is important to note the distinction between the Sakai Framework and Tools. The Sakai Framework is the "hosting environment" for Sakai, providing user interface presentation support; a kernel with core management functions such as component registration, user session management, login, and authentication; and a set of common services used throughout Sakai such as authorization and course management.[16] Within this Sakai Framework, different Tools, or portable web applications, may be inserted to provide functionality for users. A Tool consists of both user interface code and underlying "application services" supporting the tool's functionality. Via application services, a tool may also provide services to other tools. As an example, the Resources Tool that we propose to enhance as part of this project provides both a user interface for adding and managing content and services to other tools such as Discussion, Announcements, and Assignments to support linking to content.

## VIII.   Summary of Project Outcomes

In summary, the tangible outcomes of this project will be:

- Modifications to the Resources tool in the core Sakai product to add a plugin architecture supporting access to various types of external information resources

- Development of a library resource search tool integrated into Sakai, based on Twin Peaks Navigator, capable of searching multiple databases through the use of metasearch and OpenURL technologies

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[16] Norton, Mark J. (2005). "Overview of Sakai Technology."
http://bugs.sakaiproject.org/confluence/download/attachments/3970/sepp-technical-0605-baltimore.ppt

- Creation of a RSS library resources application that supports feeding course reserves, catalog records, and other RSS-appropriate library data sources into Sakai

- Development of a prototype of a "subject research guide" tool for Sakai that allow librarians to present (and instructors to incorporate) research guides for students, consisting of licensed databases, relevant links, constrained metasearches, and expository material in Sakai.

All software developed as part of this project will be released as open source, licensed under the Educational Community License.[17] A non-exclusive license will be granted to the Sakai Foundation so that the Foundation may serve as a home for extensions and maintenance of the code by the scholarly community.

# IX.     Project Organization and Context

Development work will take place at IU and Michigan, two leading institutions in Sakai development and implementation. Project staff will join project managers and programmers at each institution already engaged with library Sakai integration efforts.

Because the lead institutions are core Sakai development sites, expertise and experience with the Sakai framework and tools is local to pilot project developers. This local knowledge and experience will be extremely valuable as development of the pilot projects progresses. Through leveraging this existing infrastructure and expertise, we will be more efficient and effective in project work.

Indiana University staff will manage the overall project and the subcontract with the University of Michigan, and will lead efforts on architecting the integration of Twin Peaks with metasearch and OpenURL linking tools, implementing the connection between Twin Peaks and Sirsi SingleSearch, and architecting and implementing the integration between Twin Peaks and the enhanced Sakai Resources Tool.

**Jon Dunn**, Digital Library Program Associate Director for Technology and Libraries Senior Technology Advisor, will work with Susan Hollar to manage the overall collaborative project and to coordinate and provide technical direction for the project work at IU. **Ralph Quarles**, Assistant Director and Operations Manager, Library Information Technology, will manage the software development work on extending Twin Peaks Navigator. The development will be carried out by **Steven Smail**, the existing Programmer/Analyst who has been working on Twin Peaks, along with a Programmer/Analyst to be hired on this grant. **Mark Notess**, Usability Specialist and Development Manager in the Digital Library Program will coordinate evaluation and testing activities, including supporting pilot tests of the tools developed on this project with faculty and students at IU and Michigan, and gathering feedback from beta test sites and other SEPP members on tool requirements and feedback from beta testing, with support from a half-time Project Assistant. **Carolyn Walters**, Executive Associate Dean, and **Diane Dallis**, Acting Head of the Information Commons, will also assist in recruiting and working with faculty and students on requirements development and testing. This project has the support of Ruth Lilly Interim Dean of University Libraries **Pat Steele** as well as **Brad Wheeler**, Associate Vice President for Community Source

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[17] http://www.opensource.org/licenses/ecl1.php

Initiatives and Dean of Information Technology, who will serve as a liaison between this project and the Sakai Project Board and future Sakai Project governance.

The University of Michigan will focus on extending the RSS library resource application, connecting Twin Peaks Navigator to ExLibris Metalib, prototyping librarian and student tools, and enhancing the Sakai Resources Tool to support "resource picker" plug-ins in order to connect with Twin Peaks.

At the University of Michigan, programmer(s) will join the staff from the Library Information Technology department who have significant experience with Ex Libris MetaLib, Open URL, and RSS. Library staff have a collaborative working relationship with the central Sakai development team and the local Sakai implementation team on the UM campus, as evidenced by the successful implementation of the RSS library resources application in CTools described on page 8. The programmers and project staff hired to do this work will use a similar collaborative model, but have the advantage of already established organizational relationships.

**Susan Hollar**, Curriculum Integration Coordinator, will work with Jon Dunn to manage the overall collaborative project and will coordinate and supervise the technical staff at the UM Library. **Bill Dueber**, the Library Web Services Programmer currently responsible for the RSS library resources application and technical liaison with the local Sakai implementation team, will work with the Programmer/Analyst hired on this grant to further develop the RSS application, develop ExLibris MetaLib integration with Twin Peaks, and to prototype librarian functionality. The Project Assistant will offer support in implementing testing on the UM campus, assistance writing documentation, and general administrative support coordinating meetings and communication. The project has the support of **Brenda Johnson**, Associate University Librarian for Public Services, **John Wilkin**, Associate University Librarian for Library Information Technology and Technical and Access Services, and **James Hilton**, Associate Provost for Academic, Information and Instructional Technology Affairs and Interim University Librarian. **Joseph Hardin**, current chair of the Sakai Project Board, is also supportive of the project and will serve as a resource and liaison to the Sakai project.

Jon Dunn and Susan Hollar will jointly supervise the work of **Jim Eng**, 50% FTE Senior Programmer and Sakai consultant for the project at the University of Michigan.   Jim will provide project staff with design direction for optimal integration with the Sakai framework and tools.  Jim will also make the necessary programming adjustments within Sakai to facilitate integration of Twin Peaks and licensed content.

## A.    Collaboration between IU and UM

Communication is central to the success of this project, and we will employ multiple strategies for effective information sharing and collaboration. To launch the project, we will hold a project kick-off meeting at IU. Regular conference calls to discuss technical strategies and issues will facilitate the project moving forward in a coherent manner, as will the project Wiki. While IU and UM are similar institutions, we do use different library management systems and metasearch tools (from Sirsi and Ex Libris). This diversity will be valuable in developing tools with broad applicability.

## B.    Participation in the SEPP Community

Participation in the SEPP Community is crucial. People at both the IU and UM Libraries are already active in the Library Discussion Group, and have attended SEPP conferences. Through relationships in the SEPP community, we will invite institutions to serve as pilot testers of the library tool to help guide development and provide feedback. Attendance at SEPP meetings will be an important means of engaging other libraries interested in Sakai, primarily through technical demonstrations and Birds of a Feather sessions. By taking an active role in the SEPP community, we will serve as leaders in integration of library resources with Sakai.

Communication with related projects being conducted both within SEPP and in the wider library and educational technology communities is essential, in order to avoid duplication of effort and to explore ways in which code and lessons learned may be shared between complementary tools. A particular example of such a tool is the VUE[18] (Visual Understanding Environment) concept map application being developed at Tufts University. VUE has focused on the use of concept maps as an organizational model for learning content and on the use of the OKI[19] (Open Knowledge Initiative) Digital Repository interface for searching and linking to content in the Fedora digital repository system. The tools we propose to develop in this project focus on a more traditional hierarchical approach to content organization, tightly integrated within the Sakai user interface environment, and on the integration of multiple licensed digital content resources. We believe that both approaches to content organization are appropriate to particular disciplines and teaching styles, and that our work on interfacing with a wide variety of licensed resources could be utilized by VUE. Conversely, the work that VUE has done with OKI, as well as work being conducted by Jeff Merriman and Jeff Kahn at MIT on exploring integration of OKI with Twin Peaks should inform the architecture and technical design of our own project.

## C.    Collaboration with Sakai Developers and the Sakai Foundation Board

As discussed above, collaboration with Sakai developers will be necessary to enhance the Resources tool. Project staff will consult with developers via the project consultant, Jim Eng, on a regular basis and will work cooperatively with the Sakai organization to meet project goals. As Sakai moves out of development and to a self-funded model, we will work closely with the Sakai Foundation Board or other governing body as appropriate. In writing this proposal, we considered seeking matching funds from the Sakai Educational Partners funds via the Sakai Board, but soon realized these funds were already allocated to other tasks.

Through close collaboration with Sakai developers and organization, we will be able to coordinate our work with other related Sakai development activities. One example is the University of Michigan's recently-proposed work to explore the development of services for Semantic Web technologies such as RDF (Resource Description Framework) and Web Ontology Language (OWL) within Sakai. This work is currently in the planning stages, but if its conclusion is that RDF and OWL will become major infrastructural components of Sakai for data representation, we will ensure that metadata for items discovered through Twin Peaks or imported via the RSS Library Tool can be transformed into RDF and/or OWL for

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[18] http://vue.tccs.tufts.edu/
[19] http://www.okiproject.org/

interoperability with other Sakai services and tools. Jim Eng will serve as the liaison between our project and this and other continuing core Sakai development work.

# X.     Testing and Evaluation

For this project to be successful, both formative and summative evaluations are needed. To facilitate evaluation, this project will identify several courses at Indiana and Michigan that are good candidates for using the library integration tools within Sakai. The selected demonstration courses will be used for both formative and summative evaluation activities.

Selection criteria for demonstration courses:

- Course must currently make substantial use of online library resources accessible from the tools we plan to build.

- Instructor must be an experienced CMS user willing to work with immature technology.

- Course should have a large enrollment (30+) and should be offered both Spring (IU)/winter (UM) as well as Fall (both) semesters.

## A.   Formative Evaluation

We will work with the faculty teaching these the demonstration courses throughout the course of the project to validate requirements and design. Validation activities will include the following activities:

- Observations of current course activities and artifacts

- Questionnaires and/or interviews with instructors and other personnel involved in course delivery and support such as subject area librarians and graduate assistants, as well as a sampling of students (hereafter collectively referred to as stakeholders)

- Prototype reviews with stakeholders

Though the tools that we propose to build for linking Sakai to library content will be general enough to have many potential uses, these activities will allow us to develop a better understanding of what use cases we should particularly focus on in our design and development. Formative evaluation activities will primarily occur during the Spring 2006 semester and in the summer, with the goal of having the Fall pilots run as smoothly as possible.

## B.   Summative Evaluation

Summative evaluation will focus on assessing the value stakeholders place on the library/Sakai integration as well as identifying strengths and weaknesses of the implementation. Of particular interest is a comparison of the Sakai-integrated tools to prior methods stakeholders have used to accomplish similar aims. The goal is to characterize the benefits and costs to stakeholders of using Sakai-integrated tools. Evaluation of the tools will be conducted via questionnaires and interviews with stakeholders from the Fall 2006 and Spring 2007 demonstration courses. In addition, system activity logs will be used to measure

usage levels and examine patterns of usage. Taken together, these evaluation methods will provide a holistic gauge of the tool effectiveness.

Probable measures of effectiveness include the following, drawn from the Technology Acceptance Model[20].

- Perceived ease of use

- Perceived usefulness

- Attitude toward using

- Behavioral intentions to use

A further use of the summative data will be to guide future efforts toward integrating library resources in Sakai. The summative report will include not only an assessment of "how things went" but also a prioritized list of recommendations for "how to make things go better."

## C.   Involvement of MIT, Stanford, and selected SEPP Partners

It is important that this project produce results that are beneficial to the larger library and Sakai community. To achieve this outcome, we will involve a designated group of institutions in the design, testing, and evaluation process. We will ask representatives from these partner libraries to participate in the kick-off and pre-deployment meetings, provide input on technical specifications, and pilot test the developed functionality. Pilot testing will involve installation of the tool, testing it with one or two courses, and providing feedback to questions provided by the project staff. In addition to MIT and Stanford, we have received expressions of interest from several other institutions. Yale, Northwestern, and Johns Hopkins are all potential partners.

# XI.   Work Plan

## A.   *Months 1-3 (January-March 2006)*

- Advertise and hire project staff

- Begin exploring interfaces between Twin Peaks and metasearch tools (e.g. MetaLib, SingleSearch) / OpenURL resolvers (e.g. SFX)

- Begin working with Sakai development staff to design interfaces between Twin Peaks and Sakai and to develop requirements for Sakai Resources Tool

- Abstract away elements of the RSS library resources application currently specific to the University of Michigan infrastructure and develop and document the protocols governing interaction between Sakai, library and e-reserve systems, and RSS data output.

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[20] Morris, Michael G. and Andrew Dillon (1997). "How user perceptions influence software use." *IEEE Software,* July/August 1997, pp. 58-65.

### B.   *Months 4-6 (April-June 2006)*

- Conduct kickoff meeting with IU and UM staff (including both library staff and core Sakai development staff) to discuss detailed project planning and schedule, feature requirements, and architecture issues.

- Architect and design interface between Twin Peaks, metasearch tools, and OpenURL link resolvers

- Continue to work with Sakai development staff to define requirements for Sakai Resources Tool

- Package and release the RSS library resource application along with its documentation and API specifications to the SEPP community for local customizations.

- Identify faculty and courses at IU and UM for participation in design and evaluation.

- Gather input from beta testing institutions on functional and technical requirements

- Begin developing functional requirements and designing user interface for revised Twin Peaks Navigator

- Begin analyzing role of library content management systems, Twin Peaks and metasearch/OpenURL for delivering subject research guides to Sakai.

- Investigate mechanism for instructors to request customization of research guides via the Sakai interface.

### C.   *Months 7-9 (July-September 2006)*

- Design revised Twin Peaks user interface

- Implement interface between Twin Peaks and metasearch/OpenURL

- Sakai developers work on enhancements to Resources Tool.

- Continue analyzing technology and  process for subject research guide prototype and begin development.

### D.   *Months 10-12 (October-December 2006)*

- Conduct pilot tests in classes at IU and UM using the metasearch/OpenURL-integrated Twin Peaks Navigator

- Begin implementation of revised Twin Peaks user interface

- Begin implementation of integration between Twin Peaks and Sakai Resources Tool.

- Engage IU and UM librarians and students in research guide interface design.

- Continue development of research guide prototype.

### E.    *Months 13-15 (January-March 2007)*

- Complete revised Twin Peaks Navigator with new user interface and integration with new Sakai Resources Tool

- Conduct meeting at UM with IU, UM staff, as well as additional staff from beta sites and SEPP

- Conduct pilot tests in classes at IU and UM using the revised Twin Peaks Navigator

- Release revised Twin Peaks Navigator tool to beta test sites

- Continue development of research guide integration. Perform initial pilot testing of research guide in courses at UM.

### F.    *Months 16-18 (April-June 2007)*

- Develop plans for release of Twin Peaks Navigator tool.

- Complete final revisions to the Twin Peaks Navigator tool based on pilot tests and beta site feedback

- Work within the new SEPP/Sakai governance framework for distribution and ongoing maintenance/development of Twin Peaks Navigator and other tools

- Write up and disseminate evaluation results

- Demonstrate and document prototype research guide tool at SEPP conference. Engage in dialog with the SEPP community on applicability and further development.

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## Technical Standards and Project Sites

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Sakai Project. "About Sakai." http://sakaiproject.org/index.php?option=com_content&task=view&id=103&Itemid=208

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