

Academic Collaboration Environment

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Executive Summary

The Academic Collaboration Environment (ACE) is an application that allows users in an academic environment to manage information retrieval and organization tasks commonly performed in the modern academic setting. Literature and interviews revealed that information gathering needs are diverse and may include performing research in a library for a research paper, interviewing people for a campus publication, gathering information for a radio show, collecting statistics, or preparing a reading or resource list for a course. The tools needed to find information for this wide range of tasks is beyond the scope of those offered in a traditional library.

Once users locate desired information, they want a way to organize it that allows reuse and sharing. Although we envisioned ACE as being useful to a broad academic community, we targeted our research and development toward a more specifically-defined audience: the International Area Studies (IAS) community. We defined our project scope and functional requirements according to the needs of these users. Our analysis of their needs revealed that although there are a multitude of tools available to them, they are either not aware of them, or have not worked them into their information seeking and organizational practices. The users we interviewed appreciate the ease of using Google and appreciate the value of library catalogs and resources, but expressed that what they want is an easier way to search across available resources and organize their information. Most of those we interviewed use very simple systems to organize their information, such as using their browsers to bookmark resources they find or compiling lists in a text editor such as Word.

We designed ACE to allow a user to search multiple types of sources such as Google, Google Scholar, and library catalogs. A user can organize the items that are returned from these searches. They can save them to a project, annotate them, and share them with others. This allows grouping, reuse, and sharing of resources.

Future phases of ACE will include an enhanced user interface based on iterative design which incorporates user testing and feedback; expanded capabilities for import, storage and viewing; and collaborative functionality, including support for concurrency and versioning.

In addition to our advisor, Professor Ray Larson, contributors to this project included several members of the Electronic Cultural Atlas Initiative group: Anya Kartavenko, Minakshi Mukherjee and Kim Carl. Early conversations with members of the California Digital Library, including Peter Brantley and Patricia Martin, were very helpful in shaping our research and development path.

I. Project Overview

Goal

The goal of the Academic Collaboration Environment (ACE) project was to investigate the information architecture necessary to support members of the academic community in building, managing, annotating, sharing and reusing diverse sets of information resources. We envisioned a system supporting tasks such as:

- Managing resources located using disparate search tools (Google, library catalogs, Google Scholar, on-line journals).
- Adding local resources
- Grouping and regrouping the materials for different purposes.
- Adding metadata (tagging and annotating resources)
- Sharing personal lists and annotations with collaborators or with students
- Reusing or extending material from one course or research project for other purposes

Rationale

Our interest in this project sprang from a joint professional interest in digital libraries and their evolving role in a rapidly changing academic information environment (see the “Affiliations” section). Initially, our project was focused only on the concept of incorporating user-contributed metadata, such as annotations and tagging, into library resources, specifically library catalogs. Not only would this provide direct service to patrons, but a substantial body of annotations and tags could provide data to support highly desirable services such as recommending.¹

We realized quickly that focusing within the library catalog was much too limited; modern academic workflow incorporates all kinds of resources and tools outside of those the library offers, and there would be little incentive for most users to annotate resources within the catalog. In personal and professional experience we observed that modern scholars have access to an amazing array of tools that can be used to manage the networked information resources we depend on for research and teaching: bookmarking tools, blogs, wikis, web sites, reference managers, and much more. But despite this wealth of tools, including many that target the academic community, few span the range of desired functionality. We realized that meeting this information management need could also provide a more subtle and natural way to gather user associations and annotations.

We considered limiting our project to a personal research workspace, rather than considering features designed for sharing and collaborative use. Certainly this would have been simpler and narrower in scope. However, collaboration is essential to scholarly research and teaching, and we were unwilling to limit the project in that way.

¹ UC Libraries Bibliographic Services Task Force Final Report, p. 4

Affiliations

During the development and implementation phases of this project, we were both affiliated with the California Digital Library² (CDL). Colleen was employed as a programmer and researcher on a project exploring retrieval strategies for the library environment,³ and Christine served as an intern. These roles provided us with many opportunities to interact with CDL staff as we shaped our project, gathering information about needs and priorities for development at CDL. Early discussions established that strategies for encouraging and managing user-contributed metadata were of great interest.

While we were in the process of defining our scope, we were introduced to an information retrieval project⁴ associated with the Electronic Cultural Atlas Initiative⁵ (ECAI), which was seeking to build a prototype with some significant overlap in functionality with respect to what we were envisioning. Upon discussion, it became clear that there was strong potential for mutual benefit to working together. We met regularly over the course of the project with members of their technical development group.

Work Plan

Our work plan encompassed a number of activities, described below: investigation of user needs, a survey of existing tools, information modeling, architectural development, and finally the construction of a small-scale prototype demonstrating core functionality. This report describes our work in each of these areas, the challenges we encountered along the way, and future development paths.

II. User Needs

Literature

Over the course of the project we sought out or encountered volumes of literature on topics related to this project, spanning several fields, including current trends and projects in digital libraries, the current role of the library in higher education, networked application development, concepts in Computer-Mediated Communication (CMC) and Computer-Supported Cooperative Work (CSCW), and research on scholarly work practice, with particular focus on use of digital media.

The literature contributed a great deal to our thinking about both technical and human factors that we needed to consider over the course of development. Some of the key principles that we extracted were:

² California Digital Library. <http://cdlib.org/>

³ The Melvyl Recommender Project. http://cdlib.org/inside/projects/melvyl_recommender/

⁴ Support for the Learner: What Where When and Who. <http://ecai.org/imls2004/>

⁵ Electronic Cultural Atlas Initiative. <http://ecai.org/>

Make it modular

Networked applications offer a challenging set of fundamental problems and opportunities.⁶ For example, the ability to search across distributed resources introduces problems due to network outages and latency, but at the same time offers mind-boggling extensibility. We attempted to make our design as modular as possible to accommodate these problems and take advantage of opportunities. For example, the search tools are written as extensible objects, in order to make it easy to add new ones without affecting existing code. And our results are presented asynchronously as they become available, so that users can browse the result sets that come first while waiting for others to arrive. If one resource is unavailable, others can continue to function.

Accommodate different domain needs

The information needs and practices of scholars vary significantly across domains, no matter how domains are defined,⁷ and should be considered carefully in design.⁸ Humanities scholars and biologists use different resource sets and interact with peers in different ways. Rather than attempting to design the prototype for everyone, we chose to narrow the scope of our inquiry to a very well-defined group of humanities scholars (see “Audience Definition” below). But to increase the probability that our design could be tailored to suit biologists or other scholarly communities, we attempted to build in as many alternatives for configuration as possible.

Integrate

The Internet has changed the way that scholars do their jobs. Incorporating access to library resources in a workflow that utilizes Internet searches and course management systems is critical if libraries are to remain relevant.⁹ Rather than managing bibliographic references in one way and links to Web resources in another way, our design makes it possible to manage them together, seamlessly.

Audience Definition

Our first major step in approaching the question of user needs was to narrow the definition of our audience, especially given the abbreviated timeline of our project. Linking our work with that of the ECAI group (see the “Rationale” section) provided a reasonable avenue for defining our target user group. Given their focus, we targeted International and Area Studies, an interdisciplinary program on the UC Berkeley campus incorporating topics in languages, culture, economics, and other aspects of the humanities and social sciences. Since scholars in many of these disciplinary areas continue to rely heavily on materials located in the library (based on feedback from our users), this decision offered rich opportunities for investigating the mingling of bibliographic data from library catalogs with other electronic resources.

⁶ Messerschmitt 2000

⁷ Palmer 1999

⁸ Bates 1998

⁹ Dempsey 2006

Interviews

In order to link the concepts from our literature review with specific practice within our target user community, we elected to interview a small sample of students in our defined audience (IAS), asking a set of questions designed to help us establish priorities for design and development.

We interviewed four undergraduate students. They displayed a wide range of experience and attitudes with regard to how they locate resources and organize the resulting information. Our question set attempted to unearth which search tools they rely on (e.g search engines, library catalogs, article databases), how they decide which search tools to use, and how they organize and share the resources they find.

We also located and interviewed two graduate students. We targeted students who are serving as teaching assistants for large undergraduate courses in International and Area Studies, because we were interested in understanding what role they play with respect to training undergraduate students in information seeking practice. Our question set began with the same set of questions asked of the undergraduate students about their own research practices, and added a few more questions related specifically to the graduate students' roles in teaching.

In addition, we interviewed one library resource specialist with expertise in one of the key geographic regions in the International and Area Studies program. This specialist selects resources for acquisition in that particular content area and maintains a subject resource guide on the library Web site. We were particularly interested in understanding the specialist's role in recommending resources and research strategies, and in working with faculty and graduate students to prepare research guides for course-specific training sessions.

This series of interviews was very valuable in helping us to prioritize our development effort. Following are interview highlights that influenced the development of our prototype. (See Appendix B for a summary matrix of the interviews and Appendix C for a more detailed summary of the interviews.)

Search Tools

General search tools used by all of the interviewees are Google, Google Scholar, library catalogs and article databases. Many other resources were mentioned but were not as common across the range of interviewees. We prioritized which resources to incorporate into the prototype first based on this information.

Management Strategies

The most common tools used for gathering and managing lists of resources, once identified, are Word and e-mail, for both for individual and group work. A few other strategies, such as pencil/paper/sticky notes, bookmarking and placing in "favorites", and organizing in folders on the desktop were mentioned but are far less common. We had initially envisioned offering hierarchical organization within folders, but it became clear that a simpler strategy of a single level of folders will meet the needs of the majority of

users. Enabling more complex organizational structures may be appropriate in a later iteration, but is not a high priority.

Sharing

Students do rely heavily on recommendations from TAs, professors, and librarians to help them understand where to begin their search. TAs work with faculty and library subject specialists to develop course-specific resource lists, and share them with students using course sites, lectures, and e-mail. They are often consulted when students need to find material for papers or assignments. These observations confirmed our understanding that the ability to build a sharable project folder with a tailored set search tools could be very useful for all parties.

Resource Types

Interviewees are primarily using text resources; statistical datasets, images, maps, audio and video were mentioned but are far less common. Given the very short time frame for prototyping, we opted to focus first on manipulation of text resources. Incorporation of viewers for maps and other resource types are desirable, but could be built in later phases.

Tailoring Tools to Projects

Users modify information sources based on the research task: e.g. research for a community radio show uses Google and alternative news sites, while research for a history paper means a trip to the library for books. This finding suggests that it may be valuable for users to have the ability to tailor search tools within a project folder, rather than using the same default set of search tools at all times.

Personas and Scenarios

In order to further define and focus our thinking about user needs and priorities, we developed sets of use cases, personas, and scenarios abstracted from the user interviews.

We defined three personas, each designed to represent users along some part of an abstract spectrum of complexity in search strategies and techniques, and in research experience. The first persona, Lester, is an undergraduate student who primarily uses Internet resources like Google, Google Scholar, and news sites like BBC and the New York Times. The second persona, Allison, is an undergraduate honors student who assists a professor with research, relying on library catalogs and journal databases in addition to general Internet resources like Google and Wikipedia. The third persona, Amit, conducts significant research of his own using a variety of library and general resources, and is also serving as a teaching assistant for a large undergraduate course.

We developed a small set of abstract use cases defining essential functionality that we envisioned having available in the system, and finally wrote scenarios applying the use cases to the personas.

III. Comparative Technology: Tools Survey

Christine conducted a survey of tools in our problem domain that are available to the academic community, especially those tools of potential use to the International Area Studies community. The primary goal was to find the gaps between what users really want and the tools available to meet those needs. A secondary goal was to gather design ideas, and consider the potential that one of the tools could be built upon or extended. (See Appendix D for a summary matrix view of the complete list of the tools surveyed, or Appendix E for the detailed survey.)

We defined the functionality ACE would provide based on the needs of users associated with IAS, and established a set of criteria for evaluating features to support basic tasks such as searching for information, organizing information, sharing information, and collaborating. Keeping in mind what our user needs assessment revealed, we defined functionality that is more narrowly focused than we had originally envisioned for ACE. We shifted our emphasis away from collaboration tools and toward providing more basic search and personal organization functionality. Our priority was to improve the experience of searching and saving the results from multiple diverse resources such as Google, Google Scholar, the California Digital Library, Melvyl, and Journal databases; and to provide easy methods of organizing, annotating, reusing, and sharing search results.

The tools surveyed contain some element of what we seek to provide with ACE, and were assessed based on how well they met the defined needs. Each tool was assessed based on the features and functionality it offers; availability (e.g. open source, proprietary, hosted service); core technologies; and each tool review contains a summary. It should be noted that beyond the intention of this survey to serve as showing what is out there, these tools were considered as providing ideas, or as a potential code base for the development of an ACE proof of concept. If we were designing and building a production scale system, this analytical framework might include other categories such as the activity level of the community supporting an open source tool, or the level of adoption (popularity) of a proprietary tool within academic communities.

Many of the tools contain features we determined would be useful to our users, and some have features that may be nice to implement once basic user needs are met, but none of them offers everything our users need in one package. Some tools demonstrated key aspects of the envisioned functionality particularly well; these are discussed below. (See Appendix E for the full tool survey.)

Search functionality

In the Scholar's Box,¹⁰ one can search multiple, diverse resources simultaneously and get results back from each. It is built as a desktop application, however, whereas ACE is Web-based. The Scholar's Box offers a very modular architectural framework, which inspired significant portions of the architecture of ACE.

¹⁰ <http://iu.berkeley.edu/IU/SB>

Object and/or Project Management

Firefox Scholar¹¹ and Web Scrapbook¹² together embody a solid foundation of functionality specific to working with objects once they are retrieved. Namely, Scholar will allow instructors, students, and scholars to organize and cite materials they have located online. Additionally, users can capture metadata from online objects, sort them, and annotate them from the browser window. Web Scrapbook lets users place images, excerpts, Web pages, or local files into an online repository. This is what we envision being able to do with content in ACE. MyLibrary¹³ is also of interest because of its organization aspects. In MyLibrary, resources are stored in a relational database, and it has the capability to use facets and terms to describe resources. RefWorks and RefShare¹⁴ together provide a great deal of the functionality envisioned for ACE. Features include basic and advanced search functionality. But more important, they provide for importing and exporting of references; capability to build reference lists; the ability to create folders and store reference lists there; group management; and RefShare allows subscribing institutions to post their RefWorks databases or lists to publicly available Web pages or share them with anyone via email.

Sharing, Reusing Content

RefWorks and RefShare also provide a mechanism for sharing folders on-line, as well as sharing by e-mail. GoogleBase¹⁵ provided good ideas for the addition of and tagging of personal content. We also liked StudentVision's¹⁶ ability to organize resources and email them to others. Ning¹⁷ provided an interesting model of reuse: members can copy and extend entire applications. Connexions¹⁸ and Sofia¹⁹ allow users to access content for free and in the case of Connexions, users may reuse and modify content under a Creative Commons license.

Annotating, Tagging, Bookmarking

Both CiteULike²⁰ and Connotea²¹ provide the capability to save links to resources, tag resources, and share them with others. Additionally, in Connotea it is also possible to add a resource using a Bookmarklet. We like this idea as it is a convenient way to add a resource.

11 <http://chnm.gmu.edu/tools/firefoxscholar/>

12 <http://chnm.gmu.edu/tools/scrapbook/>

13 <http://dewey.library.nd.edu/mylibrary>

14 <http://www.refworks.com>

15 <http://base.google.com/>

16 <http://www.juststudents.com/index.html>

17 <http://www.ning.com/>

18 <http://cnx.org/>

19 <http://sofia.fhda.org/>

20 <http://www.citeulike.org>

21 <http://www.connotea.org/>

Collaboration

Sakai²² and bSpace²³ (a UC Berkeley implementation of Sakai) possess several components that would be useful for collaboration such as a chatroom, email archive, a content editor, News/RSS, and a wiki. Academici²⁴ also provides support for collaboration through the contact manager, profile creation, and other tools to build community. Skype²⁵ supports collaboration by allowing users to make phone calls to others using Skype or a standard phone line. These are ideas that could be considered in later development phases of ACE.

Personalization/Customization

Many of the tools allow some level of workspace customization. Several examples, although not as closely related to our core concepts, allow users to roll their own portals in a very easy and flexible way (Zojam²⁶ and Protopage²⁷).

The majority of these tools provided interesting and useful ideas for filling the gaps between what users really want and the tools available to meet those needs. While none of these tools provided a code base from which to work to build ACE, many provided conceptual guidance and further focused our efforts on filling the gaps between available tools and what users want.

IV. Information Modeling: Search Tool Survey

Another critical task was to consider the data to be manipulated and managed in the ACE environment. We surveyed a small set of search tools likely to be of interest to our audience in order to understand how to make queries to each of them, and how to process and store the results of those queries.

Protocols and Standards

We were most interested in identifying available search tools that allow programmatic access to using well-known protocols or standards. Although it is possible to “screen scrape” HTML pages to gather results, this approach requires substantial investment in customization for each tool, limits extensibility, and makes long-term maintenance unwieldy.

We located quite a number of commonly available search tools that are accessible using Simple Open Access Protocol (SOAP),²⁸ Representational State Transfer (REST),²⁹ or

²² <http://sakaiproject.org/>
²³ <https://bpace.berkeley.edu/portal>
²⁴ <http://www.academici.com/>
²⁵ <http://www.skype.com>
²⁶ <http://www.zojam.com/portal/>
²⁷ <http://www.protopage.com/v2>
²⁸ <http://www.w3.org/TR/soap/>
²⁹ <http://www.xml.com/pub/a/2004/08/11/rest.html>

OpenSearch³⁰ (which extends two content syndication formats, RSS 2.0³¹ and ATOM 1.0³²). Several of the most common Internet resources that we were interested in incorporating into ACE use these protocols. For example, Google uses SOAP, and Wikipedia can be queried using OpenSearch.

The library community has developed a parallel suite of standards and protocols for programmatic search and retrieval. Search and Retrieve via URL (SRU)³³ and Search/Retrieve Web Service (SRW),³⁴ maintained by the Library of Congress, build on the more generic REST and SOAP Web services approaches. Z39.50 is a widely deployed client-server approach to remote search, also maintained by the Library of Congress.³⁵ A wide range of library catalogs offer Z39.50 interfaces; an increasing number are accessible via SRU or SRW implementations.

Heterogeneity of Results

The most vexing issue we encountered in modeling the data for this project was the heterogeneity of result sets. Even when using standard access and retrieval protocols results of queries were heterogeneous on a number of levels, each of which introduced new complexity.

Structural differences due to item type. Descriptions of Web pages tend to be minimal, including a handful of essential elements like title, URL, and potentially some portion or portions of the body of the page as a description. Bibliographic records contain a much broader range of descriptive metadata, but typically offer no method of direct linkage back to the record in the catalog. Image searches normally include a thumbnail that can be displayed in the result set. Audio, video, and other multimedia files require different descriptive elements than those used for books or Web pages.

Differing schemas. For very practical reasons, the majority of data providers using SOAP or REST return result sets in specific XML formats tailored to the data at hand rather than using a standard result schema. Therefore, working with Google results requires an understanding of the Google web service; working with Amazon's results requires an understanding of the Amazon web service. Similarly, SRU providers may choose to return results using any schema; standard variations we found include Dublin Core,³⁶ MarcXML,³⁷ and MODS.³⁸ Even implementations of "standards" like Dublin Core vary significantly, making it difficult to generalize search and retrieval operations.

Semantic differences. One way to address the problem of managing schema differences is to "map" the different result set schemas to a common schema for internal

³⁰ <http://opensearch.a9.com/spec/1.1/>

³¹ <http://blogs.law.harvard.edu/tech/rss>

³² <http://atompub.org/2005/07/11/draft-ietf-atompub-format-10.html>

³³ <http://www.loc.gov/standards/sru/>

³⁴ <http://www.loc.gov/standards/sru/srw/index.html>

³⁵ <http://www.loc.gov/z3950/agency/>

³⁶ <http://dublincore.org/documents/dces/>

³⁷ <http://www.loc.gov/standards/marcxml/>

³⁸ <http://www.loc.gov/standards/mods/>

manipulation. This is, in fact, the approach we chose. In the course of creating the mappings to the common schema, we were forced to consider very carefully how elements from one schema relate to those in the common schema. In some cases this was very easy to do; in other cases it was not. For example, bibliographic records normally contain notes fields that have widely varying content making them very difficult to characterize.

Given these findings we chose to model search and retrieval in our system with a generic SearchTool class, which is extended to provide specific query formation and result parsing capability for each new tool added to the system. Result schemas are mapped to an internal representation that contains a substantial number of elements in common with the Dublin Core schema, but does not completely mirror it.

V. Definition of Functionality

After considering user needs, modeling data, and undertaking the comparative tool survey we enumerated and prioritized the functionality we envisioned. Some key definitions we used in expressing this functionality are:

- Item: A distinct object (e.g. Web site, journal article, image, bibliographic record, tabular dataset) suitable for use in the project or area of inquiry.
- Search tool: A location tool used for finding items of interest (e.g. Google, Library Catalogs, Databases, Journals).
- Project: A personal collection of selected items and search resources customized to support a specific project or area of inquiry.
- Collection: A set of items saved within a project.

We created the table on the following page, which records the actions a user should be able to take within the ACE system, and assigned priority levels. “Core” features are the most critical portions of the system. “Important” features are secondary portions of the system. “Desirable” denotes peripheral features that can be added in later phases. “Nice” features are enhancements to the system. For development of the prototype, we focused on core functionality.

<i>No.</i>	<i>Description</i>	<i>Priority</i>
1	Log into a personalized workspace	Core
2	Search multiple external resources (e.g. Google, Google Scholar, CDL archival collections, library catalogs)	Core
2.1	Select subsets of items from lists of search results	Core
2.2	Annotate one or more items from lists of search results	Core
2.3	Save one or more items from results lists to personal projects(s) within the workspace	Core
2.4	View selected items from results lists in multiple formats (e.g. Map, timeline, list)	Important
3	Create a default list of searchable resources	Important
3.1	Customize the default list of searchable resources by adding, editing, and deleting resources	Important
3.2	Optionally customize project-specific lists of searchable resources.	Desirable
3.3	Add annotations about searchable resources	Desirable
3.4	Locate new searchable resources by browsing or searching	Nice
4	Manage personal projects within the workspace	Core
4.1	Create new projects	Core
4.2	Copy existing projects	Core
4.2	Add annotations about projects	Core
4.3	Share projects with one or more groups (read, read/write access)	Desirable
4.4	Delete projects	Core
5	Manage an item collection within a project	Core
5.1	Search for and add new items from within the project	Core
5.2	Annotate the item collection	Core
5.3	Export metadata for one or more selected items (multiple formats, customized by resource type)	Important
5.4	Sort list of items	Important
5.5	View one or more selected items from the collection in multiple formats (e.g. Map, timeline, list)	Important

<i>No.</i>	<i>Description</i>	<i>Priority</i>
6	Manage items within a collection	Core
6.1	Mark an item for export, annotation or other action	Core
6.2	Add a new item to the collection (from search results or direct entry)	Core
6.3	Delete an item from the collection	Core
6.4	Annotate an item	Core
7	Search the workspace (within or across projects) for specific items	Important
8	Manage groups of users for sharing or collaboration	Desirable
8.1	Create a new group of users	Desirable
8.2	Edit an existing group (add/delete members)	Desirable
9	Invoke a browser bookmarklet to add a new item to one or more projects while browsing	Desirable

VI. Architecture

We approached the architecture by envisioning the application as a set of objects, which capture the basic entities and behaviors: search tools, items, annotations, formatters, projects, groups, and managers. The bird's eye view (see Appendix G) shows the objects and the flow of interaction between them.

Search Tools and Search Tool Manager

Search is a significant component of our application. We created a general search object that contained properties and behaviors common to all search tools. We then extended this object for all the search tools to allow them to implement their own methods and to accommodate the differences between them. This design allows all search tools to take advantage of properties and behaviors in the generic search tool parent object and additionally implement their own unique properties and behaviors. The additional benefit to this design is that it removes redundant implementation of code and allows for easy addition of new search tools.

Our design also incorporates a Search Tool Manager. As the number of available search tools grows, the Search Tool Manager will allow users to record preferences for default search tools, and to create custom tool sets for specific projects as desired.

Items

The item is central to the application. It is the result of a search and it is the object being viewed, saved, annotated, imported/exported, and possibly shared with others.

Items presented a similar architectural challenge as the search tools. Items are returned as search results from a diverse set of search tools. They share some common metadata, e.g. an identifier, a title, and notes or a brief description of the item retrieved. There are, however, a multitude of differences that range from the type of information they return (e.g. some resources such as library catalogs may return more fields from a bibliographic record, such as publisher and publication date, that are not in the results returned from another resource such as Google) to the format in which they return the result. We structured a generic Item in the same way we did the search tools, and can extend it to accommodate the differences between the types of items.

Annotations

In our design we envisioned users wanting to add annotations not just to specific items, but to search tools and projects. For example, we can imagine wanting to add a general note to a project before sharing it with a group. Hence we created an annotation object that can be associated at any of these levels.

Formatters

We created formatter objects that work with the item classes to apply formatting. In the prototype text and HTML formatters are available. Formatters can be added in a modular fashion, providing a great deal of flexibility. Formatters could easily be plugged in to present items or sets of items on maps or timelines, for example.

Projects and Project Manager

A project provides a way of allowing a user to create and manage custom collections of items and search tools designed to support specific tasks. From the home page, the user can choose to work within a particular project folder. While working in a project, he or she can conduct searches from the default search tools or can use sets of search tools customized for the specific project, and can view a collection of items related to that project.

The project manager allows the user to create, edit, or delete projects, much in the manner of a file system in which the folders are equivalent to projects. The project is associated with an owner, contains a collection of items (although in the future, we intend to allow a project to contain multiple collections), and may be associated with one or more groups. The group may be given a designated level of access (read or write) by the project owner.

Groups, Group Manager and Permissions

The group manager is very similar in concept to the project manager in that it allows a user to create a group of users, edit a group (add, edit, delete members), or delete a group. We built this object into our design, and although we did not include it in our prototype, it will be implemented in the next phase.

To give us maximum flexibility, we created a permissions object to allow us to associate a user group with a project and set their level of access for a particular project. This design allowed us to elegantly handle the potential of many to many relationships between user groups and projects.

Storage

We used a relational database to store item metadata, references to items, and thumbnails associated with an item (where they occur). Based on user feedback, we determined that users want to annotate items, and access the items by author, title, description, or any other standard bibliographic field. So for internal storage and manipulation, we developed a schema based on the core Dublin Core fields, with some additional fields generally found in bibliographic records such as publication date and publisher.

In addition to saving items returned by searching, we envisioned providing capability to import local files from a file system. (This functionality will however, require that a repository be available to store the imported local objects; it is therefore marked for inclusion in a later phase of the project.) Whether items are imported or returned as the result of a search query, it is necessary to extract metadata and store it; the metadata for local files would be stored with metadata for items located by searching.

VII. Prototype

We used HTML, CSS, Javascript, PHP, and MySQL to implement our design. We used CSS, HTML, Javascript and PHP for the interface, which provides the user with a web client. We used AJAX to connect to search tools, in order to take advantage of asynchronous calls over the network. For each tool, we tailored the approach based on the available API. We used object oriented PHP to build the back end, building out the objects modeled in our architecture. Wherever possible our implementation incorporated PEAR extensions to PHP and other available libraries such as nusoap³⁹ and tinyajax.⁴⁰ The metadata and pointer to each item are stored in a MySQL database.

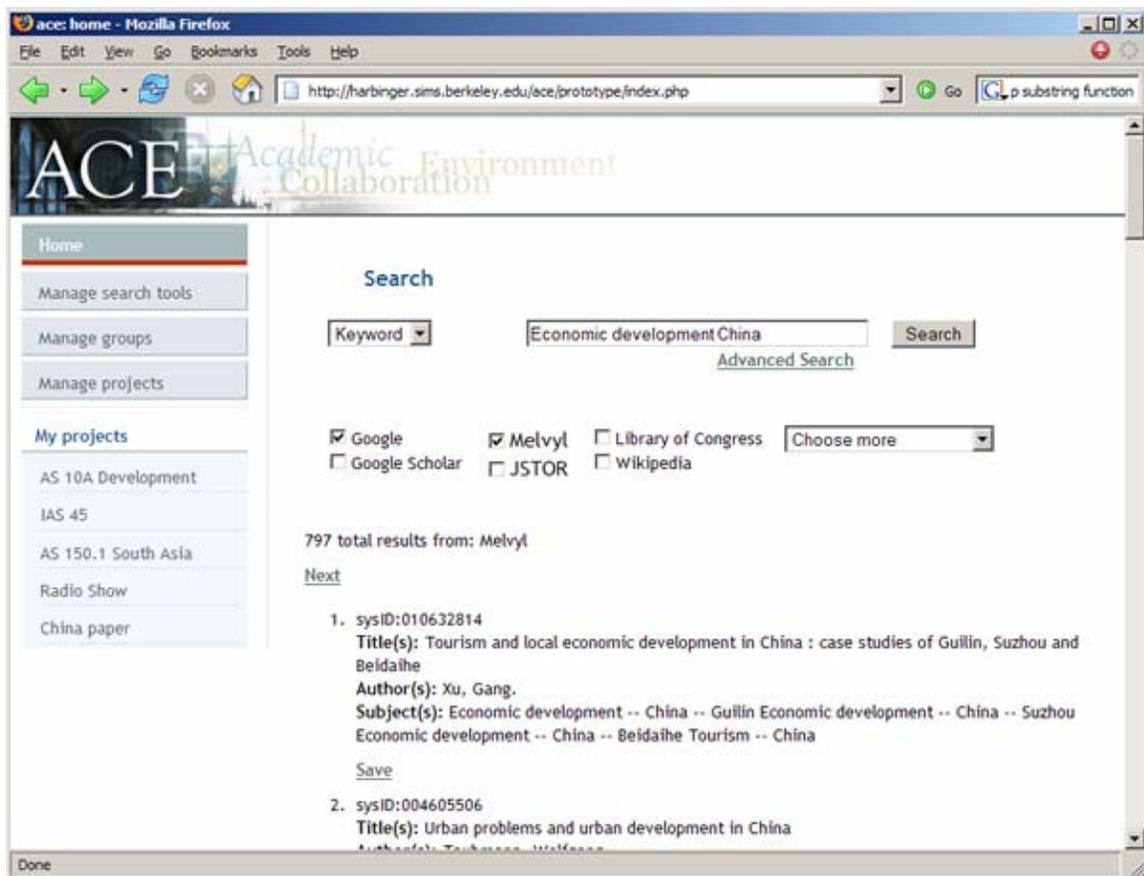
³⁹ <http://sourceforge.net/projects/nusoap/>

⁴⁰ <http://www.metz.se/tinyajax/index.php>

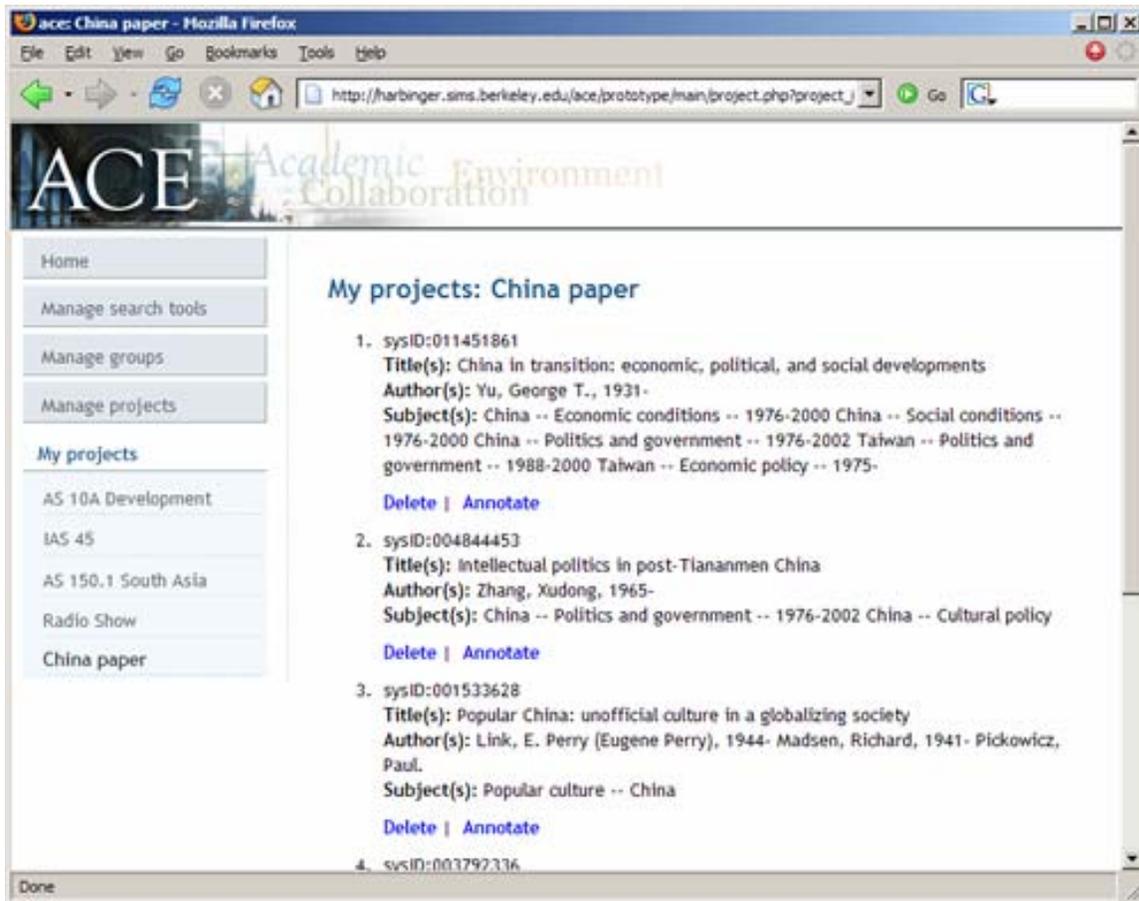
User Interface

We implemented a very light weight, Web-based client through which the user can interact with the application. It demonstrates only core functionality identified in our requirements document. The prototype has a very shallow navigational structure. All views are readily accessible from the home page.

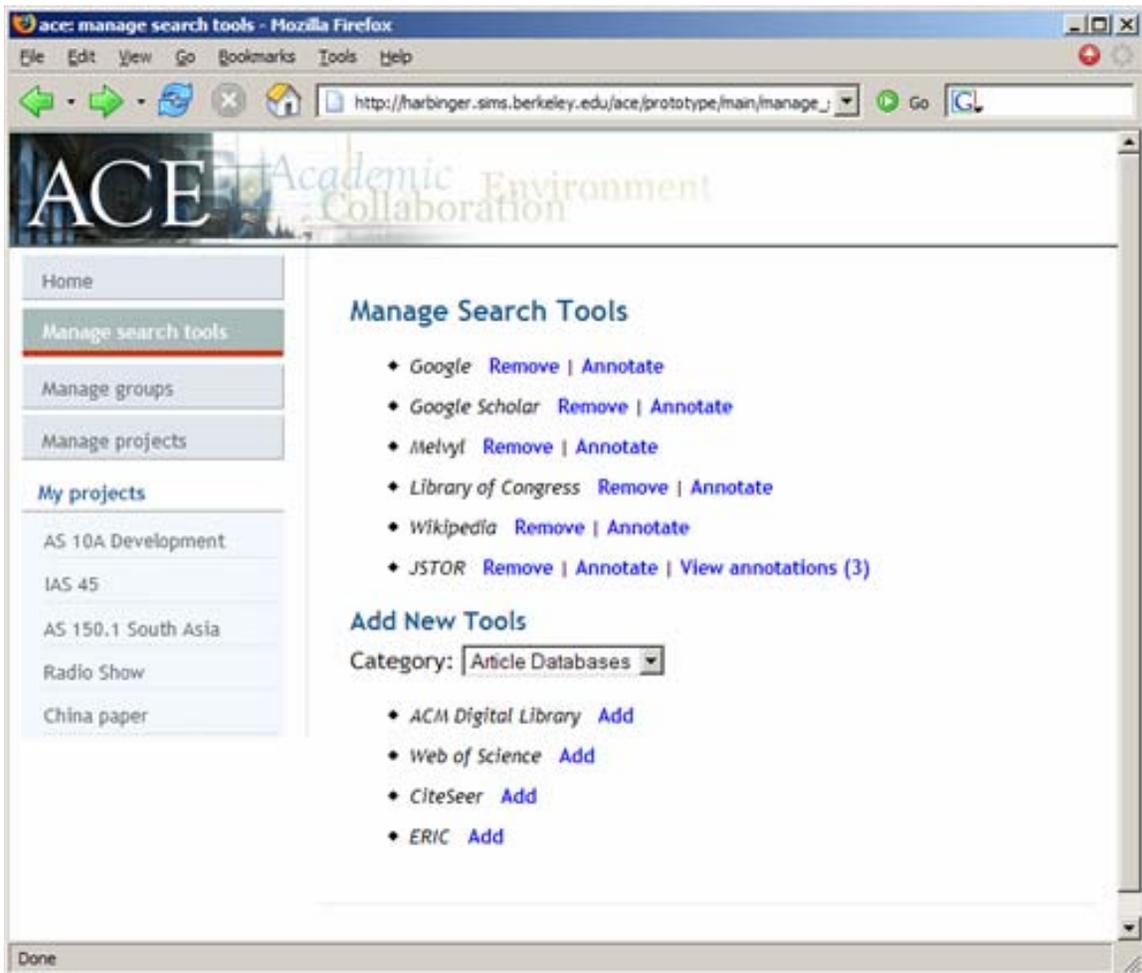
A user may conduct searches from default home page view, which shows a list of their projects and the default list of search tools with which they may perform searches. We present a brief listing of results with links to the full result set returned by each search tool. In the view below, the user is paging through a full set of results from Melvyl. A save button is available; when clicked, a dialogue box asks which project or projects to save to.



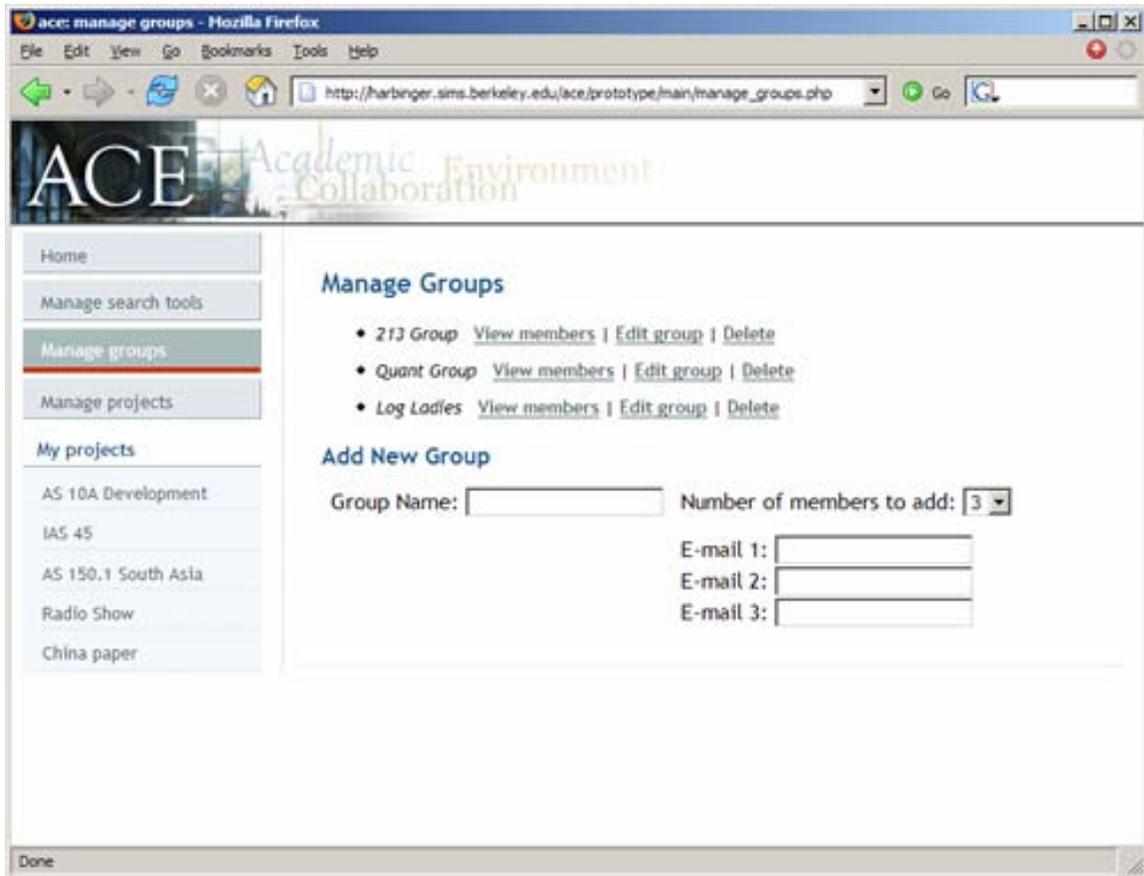
Alternatively, a user may work from a project view that presents a saved collection of items (if they have created one). In later phases of development, the user would also optionally see a list of search tools tailored for that project, and would have the ability to launch searches and save to the project collection with a single click.



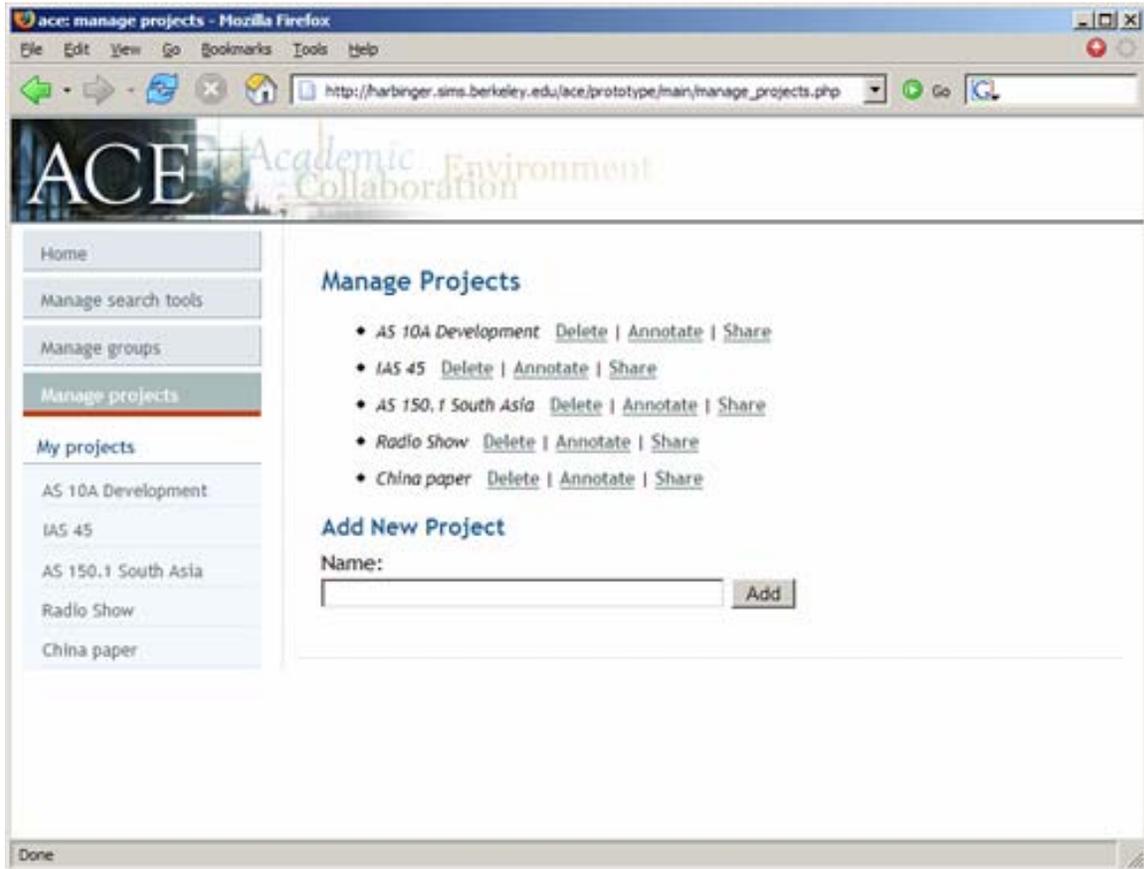
Although the ability to create custom sets of search tools is not yet available in the prototype, we mocked up the page to demonstrate essential functionality. From the manage search tools page, a user could remove a tool from his default tool set, annotate a tool (noting, for example, that it is particularly helpful in one topic area), view annotations associated with a search tool, or add to the default list of tools from a list of those available in categories such as library catalogs, article databases, or general reference.



In the interest of sharing resources, a user may want to create a group, delete a group, add group members, or associate a group with a project. This can all be done from the Manage Groups page. Although the ability to create groups and share resources is not yet available in the prototype, we mocked up the page to demonstrate essential functionality.



Finally, the manage projects page allows a user to delete, annotate, or share existing projects, or to add a new one.



Storage

During the implementation of the prototype, we came up against the issue of how best to deal with search results before they are saved. We considered creating a table in the database to store the temporary results, or serializing them to a file. We decided to manipulate them as session variables, which use a temporary file on the server to maintain the state of the application.

Prototype vs. Production

There were a number of choices we made during implementation that were driven by our short timeline and our choice of prototyping technology. In some cases, we might have made different choices if implementing a production system. For example, we debated how far to normalize the data in the database for fields that may return multiple values (for example, bibliographic records typically contain multiple subject and notes fields, and main contain many other repeated elements). We chose to denormalize the item table for the sake of speed and simplicity. More sophisticated searching within projects would require more normalization.

In defining the schema for storage of item-level metadata, we looked at a small sample of result sets from a few tools that were identified during user interviews. For a production

system, we would have employed a more comprehensive modeling approach, harvesting instances from a wider range of search tools to identify candidate fields, then defining and merging synonyms to identify commonalities, and finally deciding which fields to support in a comprehensive item schema. In addition, because in concept the system is extensible to any number of search tools, we might have opted to store the XML result sets as native XML for greater future flexibility.

VIII. Challenges

Scope

Our most significant challenge was defining the scope of the project. As we began to explore tools and high-level scenarios (i.e. those focused on what an Learning Management System (LMS), Course Management System (CMS), or what a Content Management System (CMS) might provide), it became apparent that there were several tools for collaborating on writing papers, sharing notes, etc. Considering the multitude of needs of a diverse academic community muddled our scope. We realized early on that we needed to narrow our audience and focus our project scope on the needs of that particular audience. When we decided to collaborate with the IMLS/ECAI project, it was a natural choice to focus on humanities scholars, drawing upon the same academic audience they were targeting: the International Area Studies program.

With the specific audience defined, we conducted a more directed user needs assessment set of tasks. It was not until we finished interviews, and created personas, use cases, and scenarios, that we were able to concretely define the scope of our project. Before assessing user needs, we had incorporated too many features that were beyond the basic user needs of our audience. After completing the user needs assessment, we returned to our initial vision of providing users less in the form of collaboration tools (beyond sharing access to projects, and annotation) and emphasizing more in the form of search, annotation, saving resources, and compiling resources lists.

Common language

With our scope defined, we set out to write a requirements document outlining application features and the level of priority of each. This presented the challenge of definition of terms. For example, we had been using the term “resources” to refer to different things. Where one of us was using the term to refer to search tools, the other was using it to refer to the items being returned. Before continuing with the definition of the application requirements, we defined a set of terms we could use to refer to the search tools, the items being returned, and the sources being searched.

Technical Challenges

We developed the application architecture and database schemas at the same time and were able to bring these together with minimal adjustment. We had spent a significant amount of time on the design and discussed each system component at length so it was a smooth process making minor adjustments to the architecture. A few adjustments were made during implementation as we experimented with how to handle multiple values in a

few fields (title, creator, description); and with how to manage temporary results and sessions. The design was flexible enough to handle these changes with minimal impact to the overall architecture.

There were, however, inevitable challenges to our design once we began implementing it. We had to decide between storing multiple values in a field or normalizing all data as much as we could. Storing session information for a Web application provoked some extra thought and discussion.

A more complex problem was handling the heterogeneity of standards, protocols used, results, and ranking of those results. Ranking and sorting was particularly difficult because each of the search tools uses a different ranking method. Ideally, we would like to allow users to reorder mingled sets of results from several search tools. Given our timeline to complete the project, we decided to separate the results and allow the user to rely upon the ranking algorithm of each search tool separately. Items can be reordered once saved to a collection.

When it came to designing the user interface, we discussed how to arrange the search tools and how to display the results. One significant challenge was organizing multiple results from multiple search tools in the limited space available on a Web page. Related to this issue is how best to display the results without overwhelming the user. Reviewing and discussing mockups of two different styles of displaying results was useful in arriving at a decision on how to display them.

Priorities

We proposed this project in December and began working in earnest in January. Within this short time frame, two people could not reasonably expect to undertake a full development cycle and deliver a finished product. This forced prioritization. We opted to focus more on development and delineation of the architecture, and less on implementation. Our prototype demonstrates only the core concepts, and can be considered a “moving wireframe” without significant and careful development of the user interface.

IX. Future Work

The ACE prototype demonstrates just a small core slice of the functionality that could be offered to meet the needs of our audience. There are many areas where ACE could be built out or enhanced. Expanding the roster of search tools, and providing more advanced search capabilities would be a primary development goal.

Further development should also encompass the aspects labeled "important", "desirable", or "nice" on our requirements list. One major suite of features would support one-way sharing or collaborative use of project folders. The critical components in sharing and collaboration would include adding group management functionality; supporting permissions; and enabling concurrency and versioning support.

Another rich feature set surrounds import, export and rendering capabilities. Importing items from a local filesystem (including interaction with a repository), exporting selected groups of items, and viewing items or lists of items in formats other than text would provide users with a more integrated experience. Adding an optional bookmarking tool to allow users to easily add link while browsing the Web outside of the ACE environment would also be a significant enhancement.

We see immense value in building out the ability to interact with the Electronic Cultural Atlas Initiative's What, Where, When and Who⁴¹ project, and with the California Digital Library. Further development could incorporate ECAI's tools that provide an interface for enhanced search and viewing of timeline data, geographic location data, and data associating events, locations, and people. Another interesting avenue for exploration with the California Digital Library is to consider the possibility of capturing user-generated groupings of items to underpin recommending and other services for library patrons.

Most of all, we would like to focus much more attention on the user interface, using iterative design based on user testing and user feedback. This effort will be particularly important as the roster of features and supported search tools increases.

⁴¹ <http://www.ecai.org/imls2004>

Appendix A: Interview Questions: Undergraduates, Graduates and Resource Specialists

Interview questions used for International Area Studies (IAS) Undergraduate Students

I. Introduction

1. Grad/Undergrad/Faculty
2. Major (if student)
3. Research interests (if applicable)

II. Individual materials/tools/management

1. What types of information gathering tasks do you do most often individually? (e.g. literature searches, research, course planning, other?)
2. What resources (databases, library catalogs, journals, Google, Amazon, other) do you use most for these tasks?
3. What approximate percentage of the materials you obtain for your research or coursework are obtained from the library? Purchased from Amazon? Articles downloaded from the Internet? Other?
4. What is the format of materials you generally work with (e.g. images, video, text, shape files, other)? Do you save and annotate them?
5. What tools do you use for managing the information you find? (E.g. End Note, Web site, Wiki, blog, text files, spreadsheets, other?) Which of these tools works best for you? Which are least effective? Why? Are there features missing from these tools?

III. Group materials/tools/management

1. Does your work often require collaborative group work? What proportion, on average?
2. What types of information gathering tasks do you do most often do as a group? (e.g. literature searches, research, course planning, other?)
3. What is the format of materials your groups generally work with (e.g. images, video, text, shape files, other)? Do you save and annotate them?
4. What resources (databases, library catalogs, journals, Google, Amazon, other?) do you use most for locating these materials?

5. What approximate percentage of the materials your group obtains for your research or coursework are....Obtained from the library? Purchased from Amazon? Articles downloaded from the Internet? Other?
6. What tools do the groups you work with use most for keeping track of and sharing what you find? (E.g. Web site, Wiki, blog, text files, spreadsheets, other?) Which of these tools works best for you? Which are least effective? Why? Are there features missing from these tools?
7. Would you be willing to show me how a group you've worked with has organized its materials?

IV. Differences

1. When you think about the way that you manage the information you use for individual work and the way that you work with a group, are your strategies similar? If not, why not?

V. Relationship with the library

1. Have you ever taken a class, workshop, or tour at the library geared toward helping you locate research resources? When? Voluntary or required?
2. Have you ever used resource lists generated by the library (posted on sites, handed out in training sessions)?

Interview questions used for International Area Studies (IAS) Graduate Students

I. Introduction

1. Grad/Undergrad/Faculty
2. Major (if student)
3. Research interests (if applicable)

II. Individual materials/tools/management

1. What types of information gathering tasks do you do most often individually? (e.g. literature searches, research, course planning, other?)
2. What resources (databases, library catalogs, journals, Google, Amazon, other) do you use most for these tasks?
3. What approximate percentage of the materials you obtain for your research or coursework are obtained from the library? Purchased from Amazon? Articles downloaded from the Internet? Other?
4. What is the format of materials you generally work with (e.g. images, video, text, shape files, other)? Do you save and annotate them?
5. What tools do you use for managing the information you find? (E.g. End Note, Web site, Wiki, blog, text files, spreadsheets, other?) Which of these tools works best for you? Which are least effective? Why? Are there features missing from these tools?

III. Group materials/tools/management

1. Does your work often require collaborative group work? What proportion, on average?
2. What types of information gathering tasks do you do most often do as a group? (e.g. literature searches, research, course planning, other?)
3. What is the format of materials your groups generally work with (e.g. images, video, text, shape files, other)? Do you save and annotate them?
4. What resources (databases, library catalogs, journals, Google, Amazon, other?) do you use most for locating these materials?
5. What approximate percentage of the materials your group obtains for your research or coursework are....Obtained from the library? Purchased from Amazon? Articles downloaded from the Internet? Other?
6. What tools do the groups you work with use most for keeping track of and sharing what you find? (E.g. Web site, Wiki, blog, text files, spreadsheets, other?) Which of

these tools works best for you? Which are least effective? Why? Are there features missing from these tools?

7. Would you be willing to show me how a group you've worked with has organized its materials?

IV. Differences

1. When you think about the way that you manage the information you use for individual work and the way that you work with a group, are your strategies similar? If not, why not?

V. Relationship with the library

1. Have you ever taken a class, workshop, or tour at the library geared toward helping you locate research resources? When? Voluntary or required?

2. Have you ever used resource lists generated by the library (posted on sites, handed out in training sessions)?

Interview questions used for Resource Specialists

1. How would you describe your disciplinary specialty?
2. Tell us more about your role with regard to resource acquisition.
3. Tell us more about your involvement in user training, resource recommendation.
4. What resources do you consider to be core/foundational for resource location in your discipline? What do you recommend to people who are new to research in this domain?
5. What is the relative balance of materials (electronic vs. print) acquired in your domain?
6. What discipline-specific training courses are available? How is the course curriculum developed? How do you (or others) decide what training opportunities to offer/
7. How are discipline resource lists compiled?
8. Do you have a sense of user experience with various resources that are available to them? Do you field more questions on some systems more than others? Do you get feedback regarding systems/resources that researchers/users find particularly difficult to use or particularly valuable?

Appendix B: Summary Matrix From Interviews

Individual Tasks		
	Papers/assignments	6
	Grant writing	1
	Discussion prep	1
	Articles	2
	Radio/novels/other personal	2
	Course prep	2
Individual Tools		
	Word/Word Perfect	6
	Wiki/blog	1
	Webfiles	1
	Refworks	1
	"Favorites" folders	1
	E-mail	4
	Pencil/paper	2
	Download/print	1
Format (indiv & share)		
	Text (Word, PDF)	6
	Images	1
	Graphs/charts	1
	Audio	2
	Video	2
	Statistical data	1
Resources		
	Google	6
	Pathfinder/Melvyl	6
	Google Scholar	3
	Professor	3
	Course/professor site	1
	UN/UNESCO databases	1
	CIA World Factbook	1
	Wikipedia	2
	Encarta	1
	Medline	1
	CNN/News sites	3
	Interviews	2
	Journal article dbs	4
	Lexis/Nexis	2
	Citation chasing	1
	Library resource pages	1

Sharing Tools		
	Word	6
	E-mail	6
	G-Mail	1
	IM	1
	Listservs	1
	Yahoo Groups	2
	Blackboard/CMS	2
Individual vs. Sharing		
	More selective, combine/consolidate	3
	More organization, labels	2
	Less organization	1
	Write more down	3
	Make bulleted lists	1
Library		
	General/Intro courses	2
	Tailored courses	3
	Subject-area lists	3
	Class-specific lists	3
	Reference librarian consult	2

Appendix C: Detailed Summary of Interviews

Summary: Interviews with Undergraduate Students in IAS Program

I. Introduction

1. Grad/Undergrad/Faculty

We interviewed four undergraduates two of which are in their fourth year.

2. Major (if student)

Their majors were Development studies with a focus in French, PEIS, Political Economy of Industrial Society, and Latin American Studies.

3. Research interests (if applicable)

Their research interests include development and women in higher education in Africa (specifically Senegal), immigration from northern Africa to France; economic development and international law with a region of specialization is the Middle East and Africa; political economies of east Asian countries; and entrepreneurship, training and development in Chile.

II. Individual materials/tools/management

1. What types of information gathering tasks do you do most often individually? (e.g. literature searches, research, course planning, other?)

All four students indicated that one type of task they each perform most frequently individually is writing research papers. Other tasks they perform frequently include research for class assignments, grants, writing articles for the Political Review, and work for undergraduate research apprenticeship in the department of education, research in preparation for travel or for NGOs for which she works or plans to work.

2. What resources (databases, library catalogs, journals, Google, Amazon, other) do you use most for these tasks?

The interviewees identified both online tools such as Google; Google Scholar; RefWorks; Encarta; News sites such as the New York Times, CNN, and BBC as resources they use either to begin their searches and narrow them down, or to gather information for some of their tasks such as writing articles for the Political Review. One student indicated she uses Google for the bulk of her work and another student indicated that she uses Google, Google scholar, Altnet, Common Dreams, Lexis Nexis and other news sites for academic papers because she finds the library catalogs difficult to use and doesn't think the library has the most current information. Two of the four students said they found the library difficult to use and said they use Internet resources for the bulk of their information gathering tasks. The four students do use the library although each of them

uses it differently. One student, the most frequent user of the library, uses several resources and seeks reference help much more than the others. Specifically, she uses several tools such as Pathfinder, UN and UNESCO databases, CIA world factbook, Medline, she reads monographs, journals and reference material (to get statistics); has made appointments to learn to use tools she did not know how to use; and seeks reference help when she needs it. Another student focuses her use of library resources to monographs. She looks up what she needs writes a list (with pen/pencil and paper), retrieves the material, then reads it there at the library. The other students only mentioned they used the library for academic research, but did not elaborate and emphasized that they prefer using Internet resources. Although, one of these two students did say she uses library material via the UC e-links on Google.

Three of the students indicated that with the library they could assume the sources were credible, whereas with Google they either depended on the number of cites as an assessment of the credibility of a source or do not think sources from Google are very credible.

Beyond online and library resources, some of the students indicated that they talk to professors and/or get recommendations on research material from them or the professors' Web sites.

When asked if they buy books from online (e.g. from Amazon or another online resource), all of them said no.

3. What approximate percentage of the materials you obtain for your research or coursework are obtained from the library? Purchased from Amazon? Articles downloaded from the Internet? Other?

The first student indicated that her library usage is changing, and estimates she uses the library 50% of the time and uses downloaded journal articles the other 50% of the time, and never buys books. Another student indicated she uses Internet resources for writing articles for the Political Review and the library for writing academic papers. A third student uses the Internet for 80% of her research, the library for 10% and recommendations from professors or others for the other 10% of her research. The fourth student uses the Internet almost exclusively for her research.

Again, the four students do not buy books for their research although some of them may buy them for personal use.

4. What is the format of materials you generally work with (e.g. images, video, text, shape files, other)? Do you save and annotate them?

All of the students predominantly use text and work with it in PDF, html, or as text saved to Microsoft Word, or as a WordPerfect document. They all have some sort of system in which they copy text from an html or PDF page into a text editor. Some of them work

with video, graphs, and posters. Only two of the students said they work with images, but that work is minimal.

5. What tools do you use for managing the information you find? (E.g. End Note, Web site, Wiki, blog, text files, spreadsheets, other?) Which of these tools works best for you? Which are least effective? Why? Are there features missing from these tools?

All of the students use email to send themselves links to resources. Other than this commonality, they each have their own method of organizing information. One student saves links to resources in her browser favorites (whenever she encounters something that is useful at the moment or may be of use for a future research project), uses RefWorks, and emails from Pathfinder. She also compiles resource lists and modifies those she gets from Pathfinder then saves them as WordPerfect documents. The student expressed some dissatisfaction with this system because it is difficult to organize the lists in WordPerfect and because RefWorks and Pathfinder are not integrated. She also feels her information is too spread out when she is involved in multiple projects. The other students seem to expend less effort on organizing their information. The second student we interviewed does not save resources that may be of interest for future research; if she finds a resource that is interesting, she reads it at that moment. For the most part, she reads everything she needs and then writes from memory and embeds notes in her paper (e.g. see quote in blue book on page 34). She looks up resources at the library, uses pencil and paper to write a list of call numbers, retrieves the material, and reads it there in the library. She did not seem to have any other methods for organizing information. When working on academic research, the third student we interviewed prints articles out and marks them up with notes written on post-its. Additionally, she takes notes and creates lists of resources in Word. She uses a Wiki and a blog for work related to her sorority. The fourth student uses Word almost exclusively. She adds references in footnotes while she is writing then compiles those footnotes into a bibliography. She noted that this works well for small projects, but that for larger project, she may need a more efficient system. She also expressed interest in having somewhere on the Internet to organize her information.

III. Group materials/tools/management

1. Does your work often require collaborative group work? What proportion, on average?

Overall, the four students do not do much group work. One student occasionally collaborates on a paper. Another student occasionally works with other students on an article for the Political Review, and that the nature of the collaboration is for each of them to write their own piece and integrate them as a final step to producing the joint article. If there is overlap in their efforts, and one finds a useful resource another writer can use, they Instant Message or email each other the link to the resource. One student said 25% of her work is group work for research and for her sorority. The fourth student we interviewed indicated 40% of her work is group based. She often sends links on useful resources to friends or other students doing work in a different area.

2. What types of information gathering tasks do you do most often do as a group? (e.g. literature searches, research, course planning, other?)

We skipped this question for one of our interviewees because it did not apply.

Of the students we posed the question to, the focus of group work seems to be doing research for a paper although one student's tasks for group work is to find people to interview. One student described a range of collaborative research tasks from finding and sharing single resources or resource lists to writing a joint paper. She is learning about new features of the tools she uses to collaborate (such as track changes in Word) and seems very open to learning new tools that improve her information gathering and sharing tasks. Another student spends the bulk of her collaborative work on background research for group papers, but did not elaborate on the tools or techniques she uses to collaborate.

3. What is the format of materials your groups generally work with (e.g. images, video, text, shape files, other)? Do you save and annotate them?

We skipped this question for two of our four interviewees because it did not apply.

One student deals with text and audio files (recorded interviews). She will take notes during an interview and if the interview is recorded, she will transcribe the audio after the interview. The other student deals primarily with text in electronic format. She does not like to have to print files because her printer does not work well.

4. What resources (databases, library catalogs, journals, Google, Amazon, other?) do you use most for locating these materials?

We skipped this question for three of our four interviewees because it did not apply.

The student to whom this question was applicable frequently uses Google Scholar and uses the number of citations associated with a resource as an indicator of the resource's credibility. Specifically, if it has hundreds or thousands it is probably credible (this is the range of citations that have been associated with papers assigned for classes), on the other hand, if it only has a few it could have been written by anyone and is a less credible source. She really likes and frequently follows the UC e-links links to UCB resources. She feels Google Scholar makes it easier to get to the library material (via UC e-links) than trying to use the library catalogs. Other resources she uses include recommendations from professors and course reading lists. She likes the course reading lists because they list resources that often succinctly summarize a topic she is researching.

5. What approximate percentage of the materials your group obtains for your research or coursework is....Obtained from the library? Purchased from Amazon? Articles downloaded from the Internet? Other?

We skipped this question for three of our four interviewees because it did not apply.

The student we asked said that she obtains 90% of the materials she uses for group work from the Internet. As mentioned above, she uses UC e-links to get to UCB library material.

6. What tools do the groups you work with use most for keeping track of and sharing what you find? (E.g. Web site, Wiki, blog, text files, spreadsheets, other?) Which of these tools works best for you? Which are least effective? Why? Are there features missing from these tools?

We skipped this question for two of our four interviewees because it did not apply.

Of the two students that responded, both use Word documents to format and share information. They save the files locally to Word (or download PDFs) and send them via email to other group members. One student puts everything into a Word document and even prefers to send information as a Word attachment rather than put text directly into an email. She also uses listservs and said students groups use them over other tools such as Yahoo Groups. She is subscribed to approximately eight listservs and likes the convenience of being able to easily remove herself from a list by 'unsubscribing.' The other student uses Word, but also sends PDF files.

7. Would you be willing to show me how a group you've worked with has organized its materials?

We skipped this question for all four interviewees because we did not have an Internet connection at the interview location.

IV. Differences

1. When you think about the way that you manage the information you use for individual work and the way that you work with a group, are your strategies similar? If not, why not?

Our interviewees have very unique approaches to organizing information for group work. One student spends more time filtering and organizing information she shares with a group than when she is working alone. She filters, combines, consolidates, and makes sure resources are clearly organized. She would also find it useful if she could mark resources she has saved with a 'for group' tag. Another student writes more down when she is working in a group. She resorts to bulleted lists to organize information she shares with a group. The third student feels that working individually requires more organization because the individual is responsible for reading everything, remember it all, and perform all other research tasks. Conversely, when working in a group, she assumes that if she does not know something, someone else will. The fourth student feels that when working in a group it is important to label things clearly and so that everyone does not need to read everything, things should be summarized. To accomplish this, there must be a way to summarize a document and point others to it.

V. Relationship with the library

1. Have you ever taken a class, workshop, or tour at the library geared toward helping you locate research resources? When? Voluntary or required?

The students' answers varied widely here. One student has not had any introduction to the library while at Cal, the other three students received instruction on various library tools because one or more courses required it. Two of the three students who received this instruction were either indifferent to the training or thought it was boring. One of the four students has made additional appointments with reference librarians to receive personal instruction on tools she did not know how to use, and asks reference questions when she needs help doing her research. She has been introduced to and has begun using reference material such as Bib reviews on Africa and just found another whole section on Africa.

2. Have you ever used resource lists generated by the library (posted on sites, handed out in training sessions)?

After some discussion (and definition) of resource lists, three of our interviewees indicated they had used resource lists when handed out in class. None of them knew about the resource lists compiled by subject specialists and available on the library Web site. The three students that used the lists they received for classes found that they helped in focusing their research. Specifically they removed the need to wade through large amounts of material and they listed resources that did a good job of summarizing a research topic. The one student who did not know about them thought they would be useful.

Note: There still may have been some confusion on what constitutes a resource list because clearly one student had referred to a document that was a resource list, but did not think she had used one.

Summary: Interviews with Graduate Students in IAS Program

I. Introduction

1. Grad/Undergrad/Faculty

Both students are graduate students, one a PhD student and one a masters student completing his second year of graduate work and will be pursuing a PhD following his masters work.

2. Major (if student)

The PhD student is a history and international area studies student with a degree in Public Policy, and the master's student is a Latin American Studies major.

3. Research interests (if applicable)

One graduate student is studying International law and multinational institutions. The other student is focusing his research on Brazil. For his PhD, he will be working on literature produced by marginalized groups.

4. Teaching experience (if applicable)

One interviewee TA'd for Eastern Europe in the 20th century, International/Diplomatic History (this course is accepted by multiple disciplines such as PEIS, Sociology, etc.) so the students' backgrounds and research interests and approaches varied. For example: history students use monographs and go to the stacks; political science and sociology students use more modern approaches to their research. The other interviewee is currently a TA for a Spanish course and has been TA for history and Latin American Studies courses in the past.

II. Individual materials/tools/management

1. What types of information gathering tasks do you do most often individually? (e.g. literature searches, research, course planning, other?)

Both of the graduate students interviewed, perform information-gathering tasks for writing papers, and for developing courses/course syllabi. Beyond these common tasks, the two students do information gathering for other types of tasks. One graduate student also does research for articles, and directs students in their research (provides various levels of assistance). The other student does literature searches on cultural and political issues, for novels and short stories he writes and the radio-show he hosts.

2. What resources (databases, library catalogs, journals, Google, Amazon, other) do you use most for these tasks?

Beyond using Google for some tasks, these two graduate students differ in the resources they use. Both also use Melvyl, but one student said he only uses it when he has to and

has a book title. In addition to this, one student uses the law school resources, Google Scholar (although he finds its coverage thin), Wikipedia,(he noted it is good entry point into material and is better in some areas such as economics than others such as history) and performs journal searches using citations for Econ and Social Science work to work back to journal resources). Additionally, He uses the Wall Street Journal for topics in economics, and uses Lexis Nexis when the topics are contemporary. For data, he talks to the designer of the library resource page for Development and Economics. He uses this page heavily. He will also get references to books from professors. He noted in particular that in history, scholars use a more standard set of sources prescribed by the professor.

The second student interviewed uses Pathfinder and article databases (JSTOR and two major Latin American Studies journals including HAPI) in addition to Google and Melvyl.

3. What approximate percentage of the materials you obtain for your research or coursework are obtained from the library? Purchased from Amazon? Articles downloaded from the Internet? Other?

Both students primarily use library resources for their research. For one student, 80% resources are obtained from the library and 20% from the Internet. He purchases books frequently from Amazon because the books are cheap, but when not on a budget, prefers to go to Cody's. The other student tends use approximately 60% books and 40% articles, with minimal use of resources located on Google for academic work. For other tasks other than academic (e.g. for the show he hosts), he, relies heavily on Google and other Web sites; e.g. Searches for independent media sites to support radio show.

4. What is the format of materials you generally work with (e.g. images, video, text, shape files, other)? Do you save and annotate them?

The two students deal with text for the most part, but had different answers for this question. One student uses mostly text (PDF), data (ASCII) that he then converts to statistical files. He does not really work with maps, but would like to have, for example, a customized map produced from raw data. He hasn't used the tools and doesn't know whom to go talk to to get started. Instead he has used a pre-generated map from the data provider. He doesn't work with video much. The other student uses text (articles) and books for academic work and primarily text and audio, occasional video for his radio show.

5. What tools do you use for managing the information you find? (E.g. End Note, Web site, Wiki, blog, text files, spreadsheets, other?) Which of these tools works best for you? Which are least effective? Why? Are there features missing from these tools?

The students both use Word in some respect, one more extensively than the other; email themselves links or references to information useful to their research; and neither uses End Note.

Beyond these in common, one student seemed to have a more elaborate system of organizing the information than the other student, who primarily relies on Word and email. Specifically, he uses a filing system on his desktop. On his desktop, he maintains a folder for each project as well as folders that are theme-based in which he will deposit resources that relevant to research interests broader than a specific project. He doesn't use EndNote because it is licensed. He puts resources in his 'favorites.' If he needs something, he will download it, or will email the link and indicate in the subject of the email the title of the resource. He doesn't create/use any ad hoc bibliographies, although he does maintain a master bibliography in a Word document. Some of the resources in the Word document have hyperlinks. (Although he doesn't worry too much about maintaining links as long as he knows what he is looking for because it is very easy to search again.) Friends have recommended that Excel might be a better tool to use. He seemed ambivalent about switching tools for this task.

As mentioned above, the other student relies almost exclusively on Word documents and e-mail. Will e-mail himself items located in catalogs. When searching Google, he will e-mail himself links or paste them into Word file. He has never used EndNote or other bibliographic data management tools.

III. Group materials/tools/management

1. Does your work often require collaborative group work? What proportion, on average?

One student participates in a very limited amount of group work, and the other does a greater amount.

One student does a small amount for the radio program he hosts, and nothing beyond that. The other student engages in school projects, which beyond those for the Public Policy program, are not collaborative; and individual projects, which are all collaborative. He also noted that public policy, work is done more collaboratively, and is supported using Yahoo Groups.

2. What types of information gathering tasks do you do most often do as a group? (e.g. literature searches, research, course planning, other?)

One student only engages in a limited amount of group work for his radio show and will email links and other resources to those with whom he is collaborating. The other student performs research for drafting papers. The nature of collaborative efforts in which he is involved is to divide the project into sections, each researcher develops their section, and they are then combined. On a side note, he commented that version control is an unresolved issue.

Interviewee #6: Skipped questions 3 - 7 given so little group work.

3. What is the format of materials your groups generally work with (e.g. images, video, text, shape files, other)?

The one student to whom this question was applicable, generally works with text and data (the same as he uses for individual research).

4. What resources (databases, library catalogs, journals, Google, Amazon, other?) do you use most for locating these materials?

The resources he uses vary from individual work and by type of project; they have to be tailored to the project and can be broken down by popular versus scholarly. For example, when writing a manual for nonviolence, he predominantly uses Internet resources because most of the Civil Rights material is on the Internet. He uses scholarly article databases. For Public Policy, he uses government Web sites and other resources.

5. What approximate percentage of the materials your group obtains for your research or coursework are...Obtained from the library? Purchased from Amazon? Articles downloaded from the Internet? Other?

The student to whom we posted this question, responded that he obtains 80% of material he uses from the library and 20% is obtained online. He doesn't make any purchases from Amazon for group work.

6. What tools do the groups you work with use most for keeping track of and sharing what you find? (E.g. Web site, Wiki, blog, text files, spreadsheets, other?) Which of these tools works best for you? Which are least effective? Why? Are there features missing from these tools?

The student to whom this question was posed responded that the group members in groups he works with generally 'cc' each other with Gmail and chat. They keep drafts in Gmail. Gmail is a better choice than Yahoo because there is a satisfactory amount of space for storage allotted; there is group email; he can use threaded messages, which really cuts down on the amount of stuff to sift through; and he can easily have conversations via chat. It is a more stable system than the University system, allows more space than the 100MB allotted by the University system, and is faster than the University system.

7. Would you be willing to show me how a group you've worked with has organized its materials?

We skipped this question.

IV. Differences

1. When you think about the way that you manage the information you use for individual work and the way that you work with a group, are your strategies similar? If not, why not?

For one student, the main difference between his approach to group and individual work is that for individual work, he is trying to build a detailed archive that can be returned to

as needed. In a collaborative effort, he needs to be concerned that everyone else is not maintaining an archive, therefore he will send only the latest revision, i.e. he does not send all versions of things. He noted that when working collaboratively he is mindful of the differences in personal styles and tries to be parsimonious in what he sends.

The other student felt that it is necessary to place more emphasis on communication for a group, but it depends on the magnitude of the group. For small projects, he feels his current method of relying predominantly on e-mail is sufficient. For larger projects, something Web-based might be very helpful, but this is speculative as he has never used such tools.

V. Teaching/Mentoring (If applicable)

1. In your teaching role, how often do you direct students toward resources they will need for their coursework?

The answer to this question for both graduate students depended on whether there was a research component to the course and the type of course.

One of the graduate students defines standards and keeps the communication channel open so students can seek the amount of direction from him they need. He directs them to the course Web site (the professor defines the core resources that remain consistent from semester to semester) and resource Web site and if they have referred to those, but are still more interested in digging deeper into a subject, he will go with them to the library to do article searches and help them filter the results. (He says this does not occur very often, maybe 10% of the time.)

The other graduate student frequently directs students to resources when they ask for help with specific research projects as TA for Latin American Studies and history courses. Students as for often ask for help when there is a research component to the course.

2. How do you identify appropriate resources to share with students?

Both students rely upon what the professor defines and on subject specialists to define the core resources. Each student elaborated on this and had additional resources and tools they used to identify and share with students.

For the courses one student has assistant taught, the professor defines a set of core resources and those remain constant. There are also the resources defined by subject specialists and the 10% of the time that he helps interested students filter results of searches performed on journal article databases. He also uses Avalon, the BBC, and a really good Web site on the Cold war. He stated that most of the resources are standard core resources that don't change from semester to semester.

The other student primarily identifies library resources. For one course, he consulted with professors and with the library subject specialist to identify a set of resources for the

course Blackboard site and for a resource list that was distributed during a course session on library resources. He added more resources to the Blackboard site as found over the course of the semester.

3. What tools do you use to share resource suggestions with them (e.g. e-mail, Web site, Word documents)?

Both students rely on a combination of online and more traditional methods of communicating resource suggestions with students.

One of the graduate student interviewees posts on course Web site or uses email, lectures, and face-to-face conversations to share resource suggestions with students. He notices a generational difference in that the students are very comfortable using chat and email to communicate. They chat amongst themselves, but he does not use chat to interact with them. He does use email to communicate with them, but suspects they would like him to be more responsive to their email (he checks it twice a day and not on weekends).

The other graduate student interviewee uses the Blackboard resource list and handed out a paper resource list in class.

VI. Relationship with the library

1. Have you ever taken a class, workshop, or tour at the library geared toward helping you locate research resources? When? Voluntary or required?

It appears that some departments require the students to do this, or at least do have an orientation available, but this was not true of the history department. Additionally, it sounds like some programs emphasize the use of the library to different degrees. Where as the History scholars are expected to use it heavily, in public policy, library use was not encouraged and most students did their research online. History students did not get an orientation to the library; they were expected to know how to do research in the library and the students in the program are very library oriented. Conversely, in Public Policy, they give students a tour of the library and bring in a librarian. However, in public policy it wasn't encouraged to use the library. He maybe checked out 10 books while in the program. Everybody did his or her research online. In the history program it is very different. He frequently uses the librarian's for various things including data, or if he needs help on something.

The other graduate respondent attended a brief orientation session in the 1st semester.

2. Have you ever used resource lists generated by the library (posted on sites, handed out in training sessions)?

Both students have used subject pages.

Additional Notes:

Graduate Student #1:

This interviewee notices that his students do not use the library until panic sets in around a deadline. History majors are exposed to the library quite a bit. For the thesis course, they go to the library and for the courses he has assistant taught, the professors encouraged library-based research, but no librarian visited the classes. In sum, he feels that the degree of student orientation toward the library is built into the major.

Graduate Student #2:

This interviewee really liked Blackboard as a resource for teaching because he is able to put up links to resources, chat, and use discussion lists. He believes Blackboard is very valuable for students, and worked well in combination with face-to-face interactions. He also found that the library resource lists were very effective for students. The biggest impediment is the multitude of interfaces, and wide dispersion of available resources. Needs to be more directed and standardized in order for students to use them effectively.

Appendix D: Personas, Use Cases, and Scenarios

Persona One: Lester

Lester is a third year International Area Studies major. His research interests are in Economic development in East Asia. He also writes for a campus political newsletter and is in a fraternity for which he participates in and organizes a multitude of group events. He and the other fraternity members use a wiki for communicating.

His information gathering tasks range from sifting through the BBC, New York Times, and CNN news sites online and performing other Google searches to come up with material for the Political newsletter to doing academic research. His academic research consists of writing papers and completing class assignments. He also does research for grant proposals, or when assisting professors on research projects. He uses Google Scholar and Google to do some searches because from there he can access material at UC Berkeley by following the "UC elinks" to material which is subscribed to by UC Berkeley.

Lester uses a variety of methods to organize his information when doing individual and modifies some of these slightly when he is doing group work. When he is doing online searches using Google or Google Scholar, he adds things to his bookmarks when he thinks their useful for his general area of study, but if he is working on a specific project, he opens a Microsoft Word file and creates a list of resources containing links to the relevant results of his Google/Google Scholar searches. If he is in the library conducting searches using library resources, he emails the information to himself and adds it to his list later. Occasionally he will plan to spend his research time in the library and will look up resources, write a list of call numbers, gather the materials, read them there, and write his paper there at the library.

When working with a group, he emails links to resources, or the resources if they are in PDF, text, or HTML format, to the person/people with whom he is collaborating. He feels his system of organizing information could improve, but this system works well enough for him for now.

Use Case: basic search, annotating, and saving from ACE home

A user logs into his ACE home page. The home page contains a list of default search resources including Google, Google Scholar, California Digital Library (CDL) links, some library Databases, and Melvyl. On the home page, the user can also see a list of the projects he has created. Additionally, he can manage his projects, groups and search resources. The user can configure the resources he uses to search by checking a box next to each of them.

The user wants to do a search from the home page, so he clicks three of the search resources: Google, Google Scholar, and CDL. He types in a keyword phrase and hits the 'go' button. The search results are returned to the user as a list of document titles with brief descriptions and links to read more (Google-style). He selects five of the results by checking boxes next to them and clicks 'save.' He chooses a project and clicks 'save.' He is returned to the result page with the items still selected. He then clicks 'annotate.' He

adds comments about the topic and potential usefulness of each article. He clicks 'done' to save the annotation after annotating each item. He can then view annotations, repeat the process to save to another project, or conduct another search or exit the application.

Lester Scenario: basic search from the ACE home

Lester logs into ACE successfully. He ends up in the default home view which shows him a list of search resources including Google, Google Scholar, Amazon, CDL catalogs; and the list of his projects (shown as folders each named with the name of the project). He selects Google, Google Scholar, and CDL. He wants to do a basic keyword search of these resources, so he types 'economic development korea' into the search box and hits the 'go' button. The results from each source are returned to Lester and shown on a single results page (each with a check box next to it). He goes through the list and checks the boxes of those he is interested in. He clicks save resources to save the selected resources. He is prompted to choose from his existing projects, or to create a new project. He chooses the 'korea-economy' project and presses the 'save' button. He does not want to save the results to another project, and so clicks the close button on the results page. He is returned to the 'Home' view where he can conduct another search or manage his projects (, or groups). He clicks logout to exit the application.

Lester Scenario: annotating a new results list

Lester logs into ACE successfully. He ends up in the default home view which shows him a list of search resources including Google, Google Scholar, Amazon, CDL catalogs; and the list of his projects (shown as folders each named with the name of the project). He selects Google, Google Scholar, and CDL. He wants to do a basic keyword search of these resources, so he types 'economic development korea' into the search box and hits the 'go' button. The results from each source are returned to Lester and shown on a single results page (each with a check box next to it). He goes through the list and checks the boxes of those he is interested in. Next he clicks the annotate button so he can annotate each item. A new window containing the selected resources each with a text box (for the annotation) opens. He adds a comment to each selected result. He clicks save resources to save the selected annotated resources. He is prompted to choose from his existing projects, or to create a new project. He chooses the 'korea-economy' project and presses the 'save' button. He does not want to save the results to another project, clicks the close button on the annotation window. He is returned to the 'Home' view where he can conduct another search or manage his projects. He clicks logout to exit the application.

Lester Scenario: annotating an existing result objects

Lester logs into ACE successfully. He ends up in the default home view which shows him a list of search resources including Google, Google Scholar, Amazon, CDL catalogs; and the list of his projects (shown as folders each named with the name of the project). He selects the project 'korea-economy' from his list of project. That project's objects are displayed. Lester uses the check boxes next to the objects to select five of them. Next he clicks annotate so he can annotate each item. A new window containing the selected resources each with a text box (for the annotation) opens. He adds a comment to each selected result. Lester clicks the 'save' button to save the annotated resources. He clicks close to close the annotation window. He then clicks close to close the 'korea-economy'

project window. He is returned to the 'Home' view where he can conduct another search or manage his projects. He clicks logout to exit the application.

Persona Two: Allison

Allison is a fourth-year undergraduate student, majoring in the Political Economy of Industrial Societies. She is in the honors program, and is planning to stay an additional semester to work on an honors thesis focusing on political and economic issues surrounding immigration from North Africa to France. In addition to taking courses and doing thesis work, Allison is a research apprentice to a professor in another department. The research isn't closely related to her own interests, but she enjoys the work, and the opportunity to meet people outside of her own program.

Allison uses the library a great deal for schoolwork and for her research apprenticeship. She makes appointments with reference librarians to help her locate good resources, and she finds that about half of the materials she uses are books she checks out or uses at the library. The other half are located through Internet searches, including on-line journal articles located through Google Scholar as well as general information from Wikipedia, Encarta, or other sources found on Google.

She bicycles about 2 miles to campus from her apartment each day, so although she has both laptop and desktop computers, she rarely brings her laptop to campus (it's just too heavy). She takes notes on paper during class, and tends to use library or other public computers when she needs to use a computer on campus.

Use Case: Project-centric searching and saving

A user logs into her ACE home page. She opens one of the project folders she has created. In one area of the page, she sees a list of search resources that she likes to use for this project. In another area, she sees a list of useful items she has already found for this project, along with brief notes on each of them. She adds an annotation to one, and edits the annotation for another. She conducts a few more searches, marking items that she wants to save to her list as she goes. (Each time she saves, she has the option of adding an annotation.) When she is finished searching, she reviews the list and deletes an item or two that no longer seem useful. She marks a selection of resources, and exports them to print or share. When she is done, she closes the folder and opens another one, or logs out.

Allison Scenario: instance of project-centric use case

Allison is working with her apprenticeship supervisor on a literature review. The topic is AIDS in Africa, a subject she knows little about. She sits down at a shared computer in her supervisor's lab, goes to her ACE home page and finds a project folder she created yesterday, labeled "AIDS in Africa". She looks at the list of search resources. It includes some resources she always uses: Google Scholar and Google, as well as the Melvyl catalog. It also includes PubMed; she doesn't normally use it, but for this project her supervisor says she'll need it. He has given her a few notes on specific journal references to start with, as well as some pointers on keywords to look for.

She starts by going to Google Scholar and searching for the specific references given by her supervisor. She finds these items quickly, and marks them to add to the list. She follows the citation links from those items and finds several more things that look useful; again she adds these to her the list.

Next she searches Google and Wikipedia, looking for general references that will help her build background knowledge to help her understand the issues better. She's running out of time for the day, but wants to see if she can find a few books to pick up at the library before she goes home. She searches the Melvyl catalog, marking each one she's interested in as she goes. When she's found enough, she marks the Melvyl items and exports a list to print, which includes the call numbers and circulation status so that she can get in and out of the library fast. PubMed will have to wait until next week. She logs out and heads to the library.

Allison Scenario: another instance of project-centric use case

It's mid-semester, and Allison is enrolled in a research methods course that requires completion of a research paper on a topic of her choice. Just before spring break, students are required to turn in an outline of the paper, along with a bibliography supporting the outline. Given her plan for an honors thesis, Allison is using this opportunity to examine changes in French immigration policy in the decades since the end of World War II, which will be useful in developing her thesis next year.

When she started the project, she created an ACE folder labeled "French immigration policy 1940s – present", where she has saved several helpful journal articles. During two appointments with a reference librarian, she added links to library records for several key volumes from the library. She also chased down references from two professors, and used Google Scholar and Melvyl to locate and add the recommended books and articles to her list. At 2 am the night before the outline and bibliography are due, Allison finishes the outline. She logs into ACE, opens the "French immigration..." folder, skims the list of items, chooses "select all" and exports them as a text file in her chosen citation format. She opens the file on her desktop, cuts and pastes into the Word file containing her outline, and saves. Done.

Persona Three: Amit

Amit is a first year PhD student in the Asian Studies program and is a teaching assistant for a course in Political Economy of East Asia in the International and Area Studies (IAS) program. Amit received his undergraduate degree in Political Science with an emphasis in Political Economy in East Asia, so is well equipped to TA the IAS course. Although Amit has TA experience gained in his undergraduate career, this is the first course Amit will TA at UC Berkeley. He plans to use online resources to organize course reading lists, and would like to make them available to students. He would also like to have an area where students can comment on resources. Amit uses many online tools himself and is convinced that they can be useful for promoting student/TA, student/student, and student/Professor interaction. He knows UC Berkeley uses things like BSpace and Blackboard, but he is not sure how popular they are with the undergraduate students in general, and more specifically, the IAS students.

His first task as a TA is to come up with a reading list based on previous years' readings. The professor has emailed him Word documents that contain citations to course readings for previous years. Amit sets off to find a tool that will allow him to compile course resources such as reading lists and other objects, save them, and make useful comments on them.

Use case: creating an account, creating a project and performing a broad keyword search and a search on a single resource

A user creates an account and logs into ACE. On the ACE homepage he sees a list of search resources including Google, Google Search, links to the California Digital Library (CDL) collections, and links to some library databases. He notices that the search resources have check boxes next to them so that he can choose which ones to use for each search. He sees there is an area for creating, editing, and deleting projects; and an area to manage groups that allows him to create, edit, or delete a group.

He can create a project and perform searches from the home page or from the folder and add search results to the folder. He can then annotate the results, which will give others allowed to view the project more information about each project resource. He can conduct multiple searches for potential course readings using Google, Google Scholar, and library databases. When he gets results he can annotate them, or not, or he can view them to get a better sense of whether or not they will be useful. He can then save the selected results to one or more selected project folders.

Amit Scenario: creating a project and performing a keyword phrase search using multiple search resources

Amit creates an account so he can use ACE. He is automatically logged in after creating his account and ends up at the ACE home page. On the home page he can manage his search resources by choosing those he would like to search or annotating them. He can also manage projects and groups from here. He currently has no projects so he decides to create his first project. He uses the create project button and is prompted to name the project and associate it with a group. He has not created any groups yet, so decides to simply create and name it. He types in IAS103 (the course number) and saves the project. He then clicks on the folder to open the project. Here sees only a list of search resources with checkboxes next to them. He wants to do a broad search over Google, Google Scholar, and Melvyl. He sees he can do this if he uses a keyword or keyword phrase. He types in 'Political Economy Japan.' He gets a list of results formatted as titles with short descriptions of the documents below them. He selects three of them and saves them without annotating them. He figures he will compile a list of resources, print them out, sit down and read them, and then if he decides to keep them, he will annotate them later. He does four or five more searches then decides to search some of the library databases.

Amit Scenario: searching a library article database from a project

Amit is still logged into ACE and is in the project he named 'IAS103'. He decides to search for articles in one of the Political Economy of Industrial Societies article databases. He chooses EconLit. He types his query: 'economics japan korea.' A list of

results is returned. He sees citations for journals, books, and dissertations. He selects two links to books and annotates them with call numbers so he can easily look them up later. He then chooses an additional five resources and clicks 'save' to save all seven of the resources (two annotated and five not annotated). He clicks 'close' to close the project folder and is returned to the home view. He clicks 'exit' to exit the application.

Amit Scenario: working within a project to modify a resource list

Amit logs into ACE two days after creating his account and setting up a project for IAS103. He ends up at the ACE home page. He clicks on the IAS103 project and a list of objects is displayed. He decides to delete three resources that he did not think were going to be of much use to the class. He will keep the remaining objects and clicks on them one by one to annotate them. He adds notes such as 'core,' 'case study, korea and japan,' etc. He clicks save to save the updated list of objects. He clicks 'close' to close the project. He is returned to the home view. He clicks 'exit' to exit the application.

Appendix D: Summary Matrix From Tool Survey

Tool Survey for ACE: Functional Groupings						
Tool	Search	Object/ Project Management	Sharing/ Reusing Content	Annotating/ Tagging/ Bookmarking	Collaboration	Personalization/ Customization
Refworks & Refshare http://www.refworks.com	X	X	X		X	
Academici http://www.academici.com					X	
Skype http://www.skype.com					X	
MyLibrary http://dewey.library.nd.edu/mylibrary		X	X	X	X	X
Studentvision http://www.juststudents.com/index.html	X (limited)	X	X		X	X
CiteULike http://www.citeulike.org	X (limited)	X	X	X	X	
Connotea http://www.connotea.org/	X (limited)	X	X	X	X	
Sakai http://sakaiproject.org/			X		X	X
Bspace https://bpace.berkeley.edu/portal			X		X	X
Firefox Scholar & Web Scrapbook http://chnm.gmu.edu/tools/firefoxscholar/ http://chnm.gmu.edu/tools/scrapbook/	X (limited)	X	X	X	X	
Scholar's Box http://iu.berkeley.edu/IU/SB	X	X	X	X	X	

Tool Survey for ACE: Functional Groupings						
Tool	Search	Object/ Project Management	Sharing/ Reusing Content	Annotating/ Tagging/ Bookmarking	Collaboration	Personalization/ Customization
Google Base http://www.rashmishin.com/archives/05_11/googlebase-categories-facets-tags.html	X			X		
Ning http://www.ning.com/			X		X	X
Connexions http://cnx.org			X		X	
Sofia http://sofia.fhda.edu/			X		X	

Appendix E: Tool Survey Detail

Tools Surveyed

RefWorks & RefShare

<http://www.RefWorks.com>

Overview: RefWorks is a Web-based bibliography and database manager that allows users to create personal databases of references by importing them from text files or online databases (using Import filters). One can automatically format a paper and a bibliography using these references. Search is supported by automatically created indexes for author, descriptor, and periodical, making it easy to search by highlighting a term.

Features/Functionality:

- Save references to a folder or personal database
- Export from within the tool you are using (available from ABC CLIO, BioMed Central, BioOne, CSA, Engineering Village 2, EBSCOhost, NISC, Project Muse, OCLC, OVID, ProQuest, Scopus, SFX, H.W. Wilson, and Congressional Quarterly)
- Import from .txt file or from online resources
- Add references and define style (APA, MLA, Chicago)
- Manage references
- Create folders
- Put references in folders using , "put in folder," dropdown (populated with folders, from results page, or from RefWorks database.
- Sort references (select references to sort from , "view," or from folders)
- Globally edit references
- View references (various views and styles (including MLA, APA, Chicago, one line cite, standard cite, full view)
- Format bibliography
- Edit or create new output style
- Write-N-Cite paper & bibliography
- Create in-text citations
- Use MS Word (not sure if can use others)
- Create bibliography from citations
- One Line Cite/View
- View citation (from , "all references," a folder, or search results)
- Drag/drop or copy/paste a citation from a view to paper
- Quick Search
 - Searches all fields
 - All search terms are OR'd together with Boolean ORs.
- Advanced
 - Search a specific field (author, title, publication date, etc.)
 - Results are displayed alphabetically by author

- Can use Boolean operators to connect terms
- Search all references or specific folders

RefShare

Overview: RefShare is an add-on module for RefWorks, which allows users to share research information. It enhances collaborative research by providing a way to share references, folders, or databases with other researchers. To use RefShare, a subscribing institution makes available a central customizable Web page where users can post their RefWorks databases or folders. These resources are then easily accessible from the Web site or they can be shared via email.

Features/Functionality:

- Define access to your folders/databases (restrict access to the users you define)
- Search, download, print, export, and contact the original author by email
- Post course readings on a central Web page
- Create and share databases and folders with a group of any size
- Publish an internal database
- Accessibility from anywhere (Web-based application)

Availability/Cost/Core Technologies (if Open Source): RefWorks is a proprietary, Web-based application (\$100/year, 30-day trial. All upgrades are included in the subscription price. (Upgrades are loaded on the RefWorks server.) RefShare is also proprietary and is available as an add-on module.

Summary: RefWorks and RefShare encompass much of the functionality ACE envisions including basic and advanced search; importing and exporting references (from files or results pages) and building reference lists; the ability to create folders and store reference lists there; group management; resource sharing, and information sharing via email). Considered together, RefWorks and RefShare provide a significant amount of what we seek to provide with ACE. They do not provide the level of search capability we seek to implement, but provide a robust set of features to manage and share information objects.

academici

<http://www.academici.com>

Overview: Academici is a tool for collaborative research. It is proprietary and has two different levels of membership available: free, and a premium membership (5,95 EUR/month). Academici encourages networking between researchers, professionals, and students and community building. It keeps track of connections and assists in various ways with building a community around each user.

Features available with the free membership:

- Search functions
 - Basic search (by first name, last name, city)
 - Power search is not available
- Contact management
- Cannot send messages to other members

- Number of allowed contacts is unlimited
- Event management
 - Number of participants (maximum is ten)
 - Cannot export guest list
 - Can only have one public event per month
- No monthly fee (i.e. free)

Features available with the premium membership:

- Search functions
 - Basic search (by first name, last name, city, Industry, organizations, positions, postcode, state/province, country, companies (current/former), universities, interests, knowledge)
 - Power search: search for members who have viewed your profile, members whose profile you have viewed, members who have clicked on your company home page, members who have viewed your “About me” page, colleagues or former colleagues, fellow alumni, contacts of your contacts, birthdays of contacts, etc.
- Contact management
 - Enabled
 - Number of possible contacts is unlimited
- Event management
 - Unlimited
 - Can export guest list
 - Can have up to ten public events per month

Availability/Cost/Core Technologies (if Open Source): Academici is proprietary and is a hosted service. It can be used for free with a more limited feature set (see feature description with free membership section above), or by subscribing to the fee-based service (see feature description above for paid membership).

Summary: Academici seems like a great tool for networking. It is very similar to a computer matching/dating service. If one is looking to build a community of researchers, professionals, or students, this is a very useful tool. While it allows one to create a profile, manage contacts, and build one's contact list, it does not offer any functionality for research (individual or collaborative), beyond meeting other researchers and finding out about conferences.

For the purposes of our project, it does not offer anything in the way of open source code nor does it have functionality that applicable to what we envision for ACE.

Skype

<http://www.Skype.com>

Overview: Skype is a program for making free calls. Skype is a free program that one can download and install and then use to make free calls over the Internet.

Features/Functionality:

- Make calls to or receive calls from another Skype user
- Make calls to or receive calls from traditional phones
- It also offers voicemail.

Availability/Cost/Core Technologies (if Open Source): Skype is a proprietary application that can be freely downloaded for use on anyone's computer.

Summary: Skype is a great application for voice over IP (voip), but is not applicable to what we will provide with ACE.

MyLibrary

<http://dewey.library.nd.edu/mylibrary>

Overview: MyLibrary is a user-driven, customizable interface to collections of Internet resources -- a portal. Primarily designed for libraries, MyLibrary's purpose is to reduce information overload by allowing users to select as little or as much information as they desire for their personal pages. This application allows a user to describe and organize sets of information resources in a database application. The resources can be links to licensed databases, descriptions of physical items, or links to HTML pages. MyLibrary provides means to run reports against the database. The application is concerned with data regarding electronic resources from the end-user's point of view; it does not manage license agreements, concurrent users, and doesn't trouble shoot specific resources. Electronic resources tools are expected to export their data into a readable format and then it can be imported into MyLibrary for use, display, and syndication. (<http://dewey.library.nd.edu/mylibrary>)

MyLibrary uses a combination of user-defined facets and terms to catalog resources. There is no limit to the number of facets and terms that can be defined and they can be applied to an unlimited amount of resources. Additionally, pseudo hierarchic facets can be defined using MyLibrary syntax (punctuation between facets). For example, facets for person, event, and place could be created. (<http://dewey.library.nd.edu/mylibrary>)

MyLibrary is designed to allow a user to catalog each resource with a title, description, location, and any number of facet/term combinations.

Information can be pulled in from a library catalog or via a Web-based administrative interface.

Features/Functionality:

- Import MARC data from your library catalog after converting it to RDF/XML
- Include any type of resource (analog or digital) into your Web pages
- Organize your resources by subjects, formats, reference tool types, genres, audiences, geographic regions, etc. All you have to do is define a set of facets and terms used to describe your holdings. If you can think of a facet and a number of terms to be associated with it, then you can describe your resources in that manner

- Allow any resource to have multiple locations (call numbers, URLs, etc.)
- Provide a free-text as well as sophisticated search interface including a "Google-like Did You Mean?" service by exporting MyLibrary content to an indexer (swish-e)
- Use an HTML form to maintain the data

Availability/Cost/Core Technologies (if Open Source): The source is freely available from CVS. MyLibrary is built using perl modules and scripts.

Summary: The Perl modules offer easy implementation and the resources are stored in a relational database. This may be useful as a base for importing, exporting, and storing resources (objects). Additionally, the capability to use facets and terms to describe resources might be useful to expert users (graduate students and/or faculty, and may be useful for viewing IMLS/ECAI project resources). MyLibrary's support for managing objects is robust, but the search is less than we envision.

StudentVision

<http://www.juststudents.com/index.html>

Overview: StudentVision is a hosted application for students, which provides a place and tools for students to manage their course content; manage their personal calendar; take notes, share files, and course info; perform integrated online Web research; and collect and organize Web content for offline use.

Features/Functionality:

- Course Management
 - View courses on a dashboard (organize them by folders or terms)
 - Organize courses in folders (create folders for terms, projects, etc. and track courses from within them)
 - Automatically download courses (A student can download courses from the dashboard view. The courses are downloaded from the StudentVision server and show up in the student's application.)
 - Create courses (create course outlines, track and manage coursework, and calendaring)
 - Add course activities (define and create course activities and calendar will be automatically updated)
 - Track syllabus (copy/paste content from course Web pages, other documents or manually add content to a syllabus)
 - Enter assignments (Cut and paste assignment details or drag and drop files into the attachment area. Calendar and grade book are automatically updated when an assignment is entered.)
 - Track grades (The grade book is automatically updated when assignments are entered. Students can keep track of their grades and class averages.)
 - Build course resources (Right click on any page displayed in Internet Explorer's web browser and select the "Save to StudentVision" option. Save the Web page or URL directly into a course folder for later reference,

- or send it to a friend. Drag and drop files from Windows Explorer or the desktop into the Resources area.)
 - Take notes (Allows use of keyboard input, mouse, or pen to create documents. Paste content into the StudentVision note editor from other documents. Drag and drop images from Web pages directly into notes.)
 - Manage instructors (Choose and add instructors to course activities.)
 - Drag-and-drop academic content (Any kind of file can be dropped into the “assignments” attachment area, and the “resources” section.)
- Manage Calendar
 - Self-updating (adds assignment and course activities automatically)
 - Track course schedule (tracks all course-related activities, including assignments and due dates.)
 - Reminders (provided by calendar and reminder section on the home page)
 - Manage personal and recurring appointments
 - Send schedule to mobile device
- Notes
 - Input from keyboard, mouse and pen
 - Capture screen shots and clipboard content, and edit them
 - Drag and drop images and/or cut and paste content from other documents and Web pages.
 - Share notes with friends by right-clicking on any item in the course resource section
 - Import images or text
 - Export the notes
 - Insert pre-defined objects
 - Auto generate document name
- Research
 - Search Internet or limit to education-related Web sites
 - Save links or save complete Web pages for offline viewing (can view Web pages in tabular form)
 - Organize and store Web-based search results into course and general folders
 - E-mail saved resources to others

Availability/Cost/Core Technologies (if Open Source): StudentVision is a free but proprietary, hosted service.

Summary: This is a hosted application that is free and targeted toward students. Student information is stored on a JustStudents, Inc. server and they simply register for a login id and download a client application. The product is proprietary, so the code base is not available.

The ability to limit searches or to search the Internet is useful, and the saving of links or resources is something ACE seeks to implement. The organization of resources and the ability to email them to others are also functions ACE will provide. Calendaring,

managing courses, and note taking are useful, but beyond what we seek to provide in the initial phase of ACE.

CiteULike

<http://www.CiteULike.org>

Overview: CiteULike is a free service that allows academics to share, store, and organize the academic papers they are reading. When you see a paper on the Web that interests you, you can click one button and have it added to your personal library. CiteULike automatically extracts the citation details, so there's no need to type them in. (<http://www.CiteULike.org>) The application is Web-based.

Features/Functionality:

- Stores links to papers (The papers themselves remain in the archives in which they reside.)
- The system supports: AIP Scitation, Amazon, American Geophysical Union, American Meteorological Society, Anthrosource, Association for Computing Machinery (ACM) portal, BMJ, Blackwell Synergy, CiteSeer, HighWire, IEEE Xplore, IngentaConnect, IoP Electronic Journals, JSTOR, MathSciNet, MetaPress, NASA Astrophysics Data System, Nature, PLoS Biology, PubMed, PubMed Central, Science, ScienceDirect, SpringerLink, Usenix, Wiley InterScience, arXiv.org e-Print archive (Other things can be posted, but the citation details must be entered manually.)
- Export a library to either BibTeX or Endnote to include it in a bibliography

Availability/Cost/Core Technologies (if Open Source): The source code is freely available and can be checked out from CVS. (<http://cvs.sourceforge.net/viewcvs.py/CiteULike/>). CiteULike is built using Perl, Python, Ruby, Tcl, and uses a Web-based interface.

Summary: CiteULike has some great features such as being able to save links to resources, tag them, and share them. It might be useful to have a look at the source code.

Connotea

<http://www.Connotea.org/>

Overview: Connotea is a free, online reference management tool targeted to academics and clinicians. It allows users to save links to resources on the Web and access them from anywhere, or direct others to them. Users can add articles to their libraries using the Connotea add form or using bookmarklets. Connotea can save a URL or a Digital Object Identifier (DOI). When links to resources are bookmarked (saved) they are available to every user (including visitors), but they can be marked as private so they and the associated tags are only visible to the individual. User's libraries are linked together by using common tags or bookmarks. Users can assign any and as many tags as they want to each resource link. Tags can be single terms or phrases. These tags are then used to classify and organize a user's library of documents. (This is an alternative to using

folders.) Anyone can search all libraries, their own library, perform a Google search, as well as a few other types of searches. (<http://www.Connotea.org/>)

Features/Functionality:

- Search all libraries, by tag, by user, or via Google
- Save resources to a central location (using a Web form or bookmarklet)
- Tag resources with descriptive, user-defined terms or phrases (These are used to organize and classify the collection.)
- Discover other resources through browsing other libraries: all libraries or those defined by user or tag
- Mark a resource and its tags as "private," to hide it from others
- Automatically capture bibliographic information from certain Web sites (Nature.com, PubMed, PubMed Central, Science, Supported EPrints repositories, Supported Highwire Press publications, Blackwell Synergy, Wiley Interscience, Amazon, HubMed, D-Lib Magazine)

Availability/Cost/Core Technologies (if Open Source): Connotea is open source and freely available for download under the GNU General Public License (GPL) at Sourceforge. http://sourceforge.net/project/showfiles.php?group_id=133040&package_id=146096 It is programmed in Perl and has a Web-based user interface.

Summary: This application is similar to CiteULike and offers some key functionality we seek to offer in ACE like being able to save, annotate and share a resource; or add a resource via a Bookmarklet.

Sakai

<http://Sakaiproject.org/>

Overview: A collection of open source tools for the academic community. Sakai is an extensible Java-based enterprise framework for building collaborative teaching and research tools and services. Sakai can be comparable to Black Board and WebCT, but is more comprehensive. Sakai's Service Oriented Architecture embodies a service interface (API) composed of two-layers: presentation code and service code. The complete four-layered architecture consists of browser, presentation code, service code, and persistence. (See presentation for more on the framework, Web services and Web applications, and the Sakai Presentation Service Abstraction (www.sakaiproject.org/presentations/AboutSakai.ppt, slides 29 - 31))

Features/Functionality:

- Collaborative Learning Environment Toolset supports: announcements, assignments, chatroom, threaded discussion, drop box, email archive, gradebook, Melete content editor, message of the day, news/RSS, preferences, presentation capability, profile/roster, quizzes and tests, resources, RWiki, schedule, section management, SU tool, syllabus, TwinPeaks, Web content, Worksite setup, and WebDAV
- Component based

- Flexible presentation (HTML, Portals)
- Support for Web services
- Cross-language support
- Production-ready

Availability/Cost/Core Technologies (if Open Source): Sakai is open source and freely available from version control (Subversion). <http://www.Sakaiproject.org/release>. Nightly releases. The core technologies used for Sakai include Java, Apache, SSL, mod_jk, WEBISO, virtual hosting, Tomcat 5.5/JBoss, Sakai Spring Hibernate, Java Server Faces, Velocity (legacy), MySQL 4.1 or Oracle 9i/10g.

Summary: Sakai offers a number of tools for collaboration. Since it is open source and designed as components, it is possible to select the components needed and configure Sakai to an organization's needs. Some of the components may be useful in later phases of ACE when we are more concerned with building more functionality to support collaboration.

bSpace (powered by Sakai)

<https://bSpace.berkeley.edu/portal>

Overview: The UC Berkeley implementation of Sakai includes support for announcements, course documents, discussion board, chat, email, links to Web sites, RSS feeds, Section/Group management, gradebook, online quizzes/surveys, online assignments, automatic roster, drop box, syllabus tool, profile. UC Berkeley plans to transition from supporting three course management systems (Blackboard, WebCT, and CourseWeb) to Sakai.

Excerpted from the bSpace Web site:

The new system will be based on the Sakai framework. Sakai is a community-source effort driven by University of Michigan, MIT, Stanford, Indiana University, and uPortal. UC Berkeley has been a member of the Sakai Educational Partners Program (SEPP) since December 2003 and on the board since June 2004. We have had the opportunity to contribute to and define the tools available in the Sakai framework, and are developing an online grade book tool that allows instructors to display grades to students throughout the semester, as well as calculate and submit final course grades to the Registrar. This tool will be available with future versions of Sakai. (<https://bSpace.berkeley.edu/portal>)

Features:

- Easy-to-use interface
- Automatic course roster
- Notify users of new content via email
- Export calendar events as PDF
- Create online assignments: allows a student to submit text-based assignments or upload a file for review
- Subscribe to RSS feeds: allows an instructor to display syndicated content from other Web sites

- Manage multiple files simultaneously: allows an instructor to upload or delete more than one file at a time
- Easily move uploaded files into folders
- Apply standard formatting to announcement text and course resources (bold, bullets, text color, etc.)
- Automatically organizes student drop-box submissions in folders
- Display web content from within the course site: provide easy access to web resources by adding links to the navigation pane

Availability/Cost/Core Technologies (if Open Source): bSpace is powered by Sakai. Sakai is open source and is freely available from version control (Subversion). <http://www.Sakaiproject.org/release>. Nightly releases. The core technologies used for Sakai include Java, Apache, SSL, mod_jk, WEBISO, virtual hosting, Tomcat 5.5/JBoss, Sakai Spring Hibernate, Java Server Faces, Velocity (legacy), MySQL 4.1 or Oracle 9i/10g.

Summary: bSpace offers a number of tools for collaboration. Since it is based on Sakai and Sakai is open source and designed as components, it is possible to select the components needed and configure Sakai to an organization's needs. Some of the components may be useful in later phases of ACE when we are more concerned with building more functionality to support collaboration.

Firefox Scholar & Web Scrapbook

<http://chnm.gmu.edu/tools/firefoxscholar/>,

<http://chnm.gmu.edu/tools/scrapbook/>

Firefox Scholar

Overview: This is pre-beta application (scheduled for beta release in the summer of 2006) being developed by the Center for History and New Media (CHNM). The application will allow instructors, students, and scholars to organize and cite materials they find online. The application consists of a set of browser extensions that allow researchers to recognize and capture metadata from online objects, sort them, and annotate them from their browser window. The application is open source and extensible. (<http://chnm.gmu.edu/tools/firefoxscholar/>)

Web Scrapbook

Overview: This application allows researchers to place images, excerpts, Web pages, or local files into an online repository. These can then be annotated, and sorted into folders, which can have comments attached to them. Within these folders, a user can annotate or comment on resources; and can share, copy, or move them.

Web Scrapbook also allows collaboration by allowing a user to define group access to resources, which allows group members to collaboratively build, sort, and annotate a list of shared resources.

Features/Functionality:

- Store images, excerpts, Web pages, or local files in a repository
- Annotate any object stored in the repository
- Sort objects into folders
- Share objects
- Allow others to access, annotate, or sort a list of resources

Availability/Cost/Core Technologies (if Open Source): The Web Scrapbook project Web site states the application is open and extensible, but there is no indication where the source code is located, nor is there anything on the project available on Sourceforge.. A contact (Dan Cohen) is listed and can be contacted for more information. Web Scrapbook uses MySQL, PHP, and JavaScript (for Web pages).

Summary: The tools listed on the CHNM site offer a nice set of functionality that are parallel with our vision for ACE. We could gain much from digging into Web Scrapbook, Firefox Scholar, and possibly some of the other tools on the site.

Scholar's Box

<http://iu.berkeley.edu/IU/SB>

Overview: This Interactive University project envisions much of the same functionality as ACE. It allows users to search multiple resources simultaneously and displays the results along with a thumbnail.

Excerpt from the IU Web site:

Early versions of the IU's "Scholar's Box" tool already demonstrate the promise for faculty, students, and the public to create, manipulate, annotate, and share personal collections of digital cultural objects gathered from multiple digital repositories. The IU is building both a Scholar's Box tool as well as an abstraction framework that defines functionality and APIs for other possible implementations. (<http://iu.berkeley.edu/IU/SB>)

Features/Functionality:

- Allow users to search multiple resources at once
- Save results from searches and build collections of digital objects
- Users can then , "produce," various products using one of the available Scholar's Box tools

Availability/Cost/Core Technologies (if Open Source): This is an Interactive University project being worked on by Raymond Yee. We have discussed the project with Raymond and may contact him if there is any interest in taking a closer look at the code base. The Scholar's Box was built using Python.

Summary: The architecture is flexible and allows the tools to be added at anytime. The idea is to also be able to allow search resources to be easily added through APIs. The application exists as a set of prototypes currently, but is a nice foundation from which to

base ACE's search capability and display of results. The architecture and other notes posted on the project wiki were helpful during the conceptual stages of defining ACE's architecture. (http://raymondye.net/wiki/ScholarsBox_2fTechnicalSpecification)

Zojam

<http://www.Zojam.com/portal/>

Overview: This application provides a way to create a lightweight portal. It is built using Ajax and stores your settings in a cookie on your computer. You can add content such as images, news, or RSS or Atom feeds, to your portal, move it around, resize boxes, etc. (<http://www.Zojam.com/portal/>)

Features/Functionality:

- Design your own portal
- Receive news or feed content (RSS or Atom)

Availability/Cost/Core Technologies (if Open Source): This is a service where you can create your own portal that is then yours. The core technology used is Ajax.

Summary: Zojam is an interesting idea, with an emphasis on customizing an your own portal with all information you want readily available. However, in the initial phases of ACE, we do not foresee focusing on personalization and customization. Rather we are focusing on providing some more basic needs focused around information seeking, information organization, and sharing information.

Protopage

<http://www.Protopage.com/v2>

Overview: This is another application to build your own portal. It allows a user (with one click and no registration) to build their own portal, which may include a place to add feeds, add links, bookmarks, photos, email, create and use sticky notes, and add widgets to their page. Everything is very easy to configure and use.

Features/Functionality:

- Design your own portal
- Receive feeds
- Use sticky notes
- Add links and/or bookmarks
- Add widgets to the portal

Availability/Cost/Core Technologies (if Open Source): This looks to be proprietary, so no source code available as far as I can see. The core technology used for Protopage is Ajax.

Summary: Protopage, like Zojam, is an interesting idea, with an emphasis on customizing your own portal. It offers more than Zojam in the way of allowing a portal designer to use sticky notes and add widgets. However, as mentioned above, in the initial phases of ACE,

we do not foresee focusing on personalization and customization. Rather we are focusing on providing some more basic needs focused around information seeking, information organization, and sharing information.

Wowbar

http://www.commerce.net/wiki/Wowbar_notes

Overview: Wowbar is a platform supporting Web page annotation and presenting results in a browser sidebar. Annotations (what individuals, communities, organizations, and their software agents have to say about a Web page) are displayed alongside the page arranged/prioritized according to the individual's preferences. WOW-AA is the collection of protocols and conventions by which otherwise uncoordinated parties can make their annotations available to others as a service on the Web. When one finds out about such services, s/he can plug them into her/his Wowbar.
(http://www.commerce.net/wiki/Wowbar_notes)

Features/Functionality:

- User preferences -- include a source-list (list of annotations) and a mixer, which orders the items according to its own notions
- User Wow-wiki (each user has his/her own), which displays the lists of annotations once they are output by the mixer.
- Annotations are associated and displayed with each Web page they describe

Availability/Cost/Core Technologies (if Open Source): Wowbar is a proprietary application being developed by Commerce.net. There is no cost information on the project wiki as Wowbar is in the early stages of development.

Summary: The idea of being able to annotate Web pages and view those annotations when the Web page is displayed is a good one. It is not clear, however, how much control the user has over editing annotations, ordering them, or over saving pages anywhere beyond their own bookmarks.

Google Base

http://www.rashmishinha.com/archives/05_11/googlebase-categories-facets-tags.html

Overview: This is a beta Google service that allows a user to add content he or she wishes to have show up in Google by filling out a Web form. Anyone can add an item or batch-add items by filling out the Web form. Google categorizes the information using facets which it defines, or which it allows you to define. There are twelve categories from which to choose when one classifies the content he or she is adding. These categories are based on the most popular facets. Search and browse are integrated and allow a user to search using multiple facets (attributes). An individual can use the query preview to see how many results are available for each attribute. Google Base also uses tags which, when clicked on, essentially perform a keyword search.

Features/Functionality:

- Add your own content to Google
- Personal content is categorized according to the most popular Google categories
- Search/browse using multiple facets
- View number of results available for each category

Availability/Cost/Core Technologies (if Open Source): This is a beta Google service and is therefore, proprietary and free for anyone to use.

Summary: This service is beta, but it raises some interesting ideas with respect to considering how users choose tags for items or projects and how those tags may contribute to ranking results. We have considered how to rank a set of results that come from multiple search tools such as Google, CDL, and Melvyl for example, but found that because systems use different algorithms to rank results that this is a complex problem that will take more time than we have to tackle it.

Ning

<http://www.ning.com/>

Overview: Ning is an application that allows users to create and share social applications. Ning is free to use to create configurable applications that then belong to the user who created them.

- Features/Functionality:
- Browse available applications
- Download any application on Ning's code base
- Adapt an application to make it your own

Availability/Cost/Core Technologies (if Open Source): Ning applications are free and configurable. The core technologies used are HTML and PHP.

Summary: Ning has some applications that may be cloneable and configurable enough to act as base components such as for bookmarking, but the applications look to be mostly small-scale. The idea of being able to customize and reuse an application is a good one. This is a way to offer reusable tools and application components.

Connexions

<http://cnx.org>

Overview: Connexions is a collaborative environment containing a growing collection of scholarly material and tools that are freely available. Collaborative developing, sharing, and rapid publishing of scholarly works are encouraged. Connexions is grassroots-organized, interdisciplinary, and offers a wide range of courses. Connexions organizes chunks of knowledge into modules, which can be accessed directly or combined as a complete course. As of April 13, 2006, there are 3141 modules and 148 courses. The courses range from music to biodiversity, covering topics such as bioinformatics, the British Parliamentary papers, Fundamentals of Computer Engineering, and World

History. Modules and courses are offered in various languages such as Chinese, Japanese, Italian, Portuguese, Spanish, and Thai. All the materials are available under the Creative Commons "attribution" license and can therefore be adapted, then submitted under the Creative Commons license. According to the Connexions Web site, there are over one million users from 157 countries using the resources. (<http://cnx.org>)

Tools freely available for download from Connexions include Math fonts, Rhaptos 1.5 requires PostgreSQL (another RDBMS can be used, but no others have been tested), pycopg (Python bindings for PostgreSQL), Zope application-based server (Python based), CVS, pvcvs (Python bindings for CVS), XML (for content), XSLT and DTDs can be used to improve performance.

Features/Functionality:

- Supported in the Content Commons area of Connexions:
 - Free content (modules or courses) can be downloaded and modified. The courses can be sorted by course title, course author, or submitting institution.
 - Submit content
- Tools:
 - Connexions content management system is available for free download
 - Guidance for using third party tools with Connexions
 - Access to technical blog created by acting system architect, Ross Reedstrom

Availability/Cost/Core Technologies (if Open Source): All content is freely available and downloadable. The content management system (Rhaptos) Connexions runs on can also be downloaded for free. There is also some support for using third party tools and may be some useful tips and information on the technical blog, although it does not contain interactions between or postings from developers using Rhaptos. Rhaptos is a plone-based content management system. Other core technologies Connexions is built with are Python, XML, and XSLT.

Summary: Connexions is easy to use and the content is so easily available that course developers and learners should find it very useful and easy to use and contribute. The wide range of knowledge available from this Web site is plenty to choose from and the fact that it is published on Connexions under the Creative Commons "attribute" license allows reuse and modification of the content. It is difficult to see how much collaboration is occurring, and if there is an active community. It seems like a wiki would greatly help build community and fuel adoption of Connexions by other institutions (e.g. having a place where those installing or managing a Rhaptos content management system could discuss challenges, issues, or improvements).

Sofia (Sharing of Free Intellectual Assets)

<http://sofia.fhda.edu/>

Overview: Sofia is an open content initiative. It was launched by Foothill-De Anza Community College in March, 2004 and is supported by a grant from the William and Flora Hewlett Foundation. The goal of the initiative was to publish exemplary community college-level content that will be freely available over the Web. The long-term goal is to promote initiative, openness, sharing, and collaboration. There are currently eight freely available courses published on the Web site. The publication process consists of six steps: contributions, review process, conversions, publication, and evaluation. Contributions are called for annually, and material appropriate for publication on the project Web site is selected and peer reviewed. Material that has been reviewed and accepted is then repurposed and formatted according to the system template. It is then goes through a quality assurance process and copyright clearance is secured before the content is published to the Sofia site. The content is published under whichever Creative Commons license the contributor(s) chose. A contributor chooses a Creative Commons license specifying whether attribution is required, whether commercial use of the work is allowed, or whether modifications to the work are allowed.

Features/Functionality:

- Publish course
- Use course content (anyone can use the course content)
- Review content (sign up to be a reviewer)

Availability/Cost/Core Technologies (if Open Source): Although it is clear how to contribute content or sign up to be a reviewer, no information is listed regarding how to contribute the development of the system or tools. This is an open content initiative intended to use the Sofia system rather than allow others to download the system to use for their own open content initiative. The core technologies Sofia uses are HTML and other multimedia formats.

Summary: Sofia is based on MIT's OpenCourseWare and its product is something ACE seeks to promote by offering sharing, saving, and annotation of resources, but it does not offer anything directly pertinent to what we are seeking to do with ACE. When comparing Sofia to a resource such as Connexions, it seems less likely to gather as much content as Connexions. While Sofia offers \$1000 USD to a course contributor whose course content is accepted (Connexions does not offer any financial incentive for contributing content), the requirements of Sofia contributors seem too extensive for simply submitting course content to a system. To contribute content (assuming it is accepted) to Sofia, contributors are required to do the following:

Provide a URL and access to course materials to be reviewed for publication

- Verify authorship and originality of the course materials submitted
- Choose a creative commons license and specify terms of use
- Agree to a phone and email interview for a feature story on the development and evolution of the materials and best uses for adopters and learners
- Grant Sofia permission to re-purpose the contributed content for a wider audience
- Grant Sofia permission to reformat content to standard presentation format
- Review and sign off converted course materials prior to publication

- Participate in a phone interview on the evaluation of the project

At the very least the requirements for phone and email interviews could be omitted to reduce the requirements for submitters. Depending on the goals of the project, these requirements may be appropriate, but for building a significant collection of online course content, they are not.

Appendix F: Search Resource Survey

Notes on standards and formats supported by resources of interest to our audience. For each resource, we note:

1. Standard interfaces/protocols supported (e.g. SOAP, REST, Z39.50, OAI, SRU/SRW)
2. Input/return formats
3. Location of further info/documentation
4. Scope/topic areas

General information on common standards/interfaces:

- SRU: <http://www.loc.gov/standards/sru/>
- SRW: <http://www.loc.gov/standards/sru/srw/index.html> (SOAP over HTTP)
- SOAP: <http://www.w3.org/TR/soap/> (implementations will vary)
- REST: <http://www.xml.com/pub/a/2004/08/11/rest.html>
- OAI: <http://www.openarchives.org/documents/index.html>
- Z39.50: <http://www.loc.gov/z3950/agency/>
- OpenSearch?: <http://opensearch.a9.com/spec/1.1/> (draft...)

Amazon Web Service

1. Supports REST and SOAP interfaces. Requires developer acct (free registration). Some limits on number of accesses unless you have a paid account.
2. Input: construct REST url or SOAP message according to Amazon's specs. Returns XML in a well-documented format. See WSDL: <http://webservices.amazon.com/AWSECommerceService/AWSECommerceService.wsdl>
3. More info: <http://www.amazon.com/webservices>
4. Scope: almost unlimited in topic areas, formats, etc. Includes basic descriptive data (title, author, subject areas, etc), cover art, reviews, user-constructed lists, references to similar items, etc.

Note: Few respondents said they use Amazon. Easy to access and work with, but should probably be lower priority.

Google Web Service

1. SOAP. Requires developer acct (free registration). Some limitations...e.g. daily limit of 1000 queries.
2. Input: construct REST url or SOAP message according to Google specs. Returns XML in well-documented format. See WSDL: <http://api.google.com/GoogleSearch.wsdl>
3. More info: <http://www.google.com/apis/>

4. Scope: search Google index, cache, or get spelling correction.

Library of Congress, Other Library Catalogs via z39.50 Gateway.

1. Standard: Z39.50
2. Input/output: See specs for Z39.50 protocol
3. More info: <http://www.loc.gov/z3950/gateway.html>
4. Scope: Bibliographic records, almost unlimited in terms of topic areas.

CDL Mets Repository

1. Supports OAI-PMH 2.0 for harvesting, METS for object encoding, ARK persistent identifiers
2. Input: CGI syntax [link](#); Output: XML [link](#)
3. More info: <http://www.cdlib.org/inside/diglib/repository/>
4. Scope: images, texts, finding aids; significant archival collections

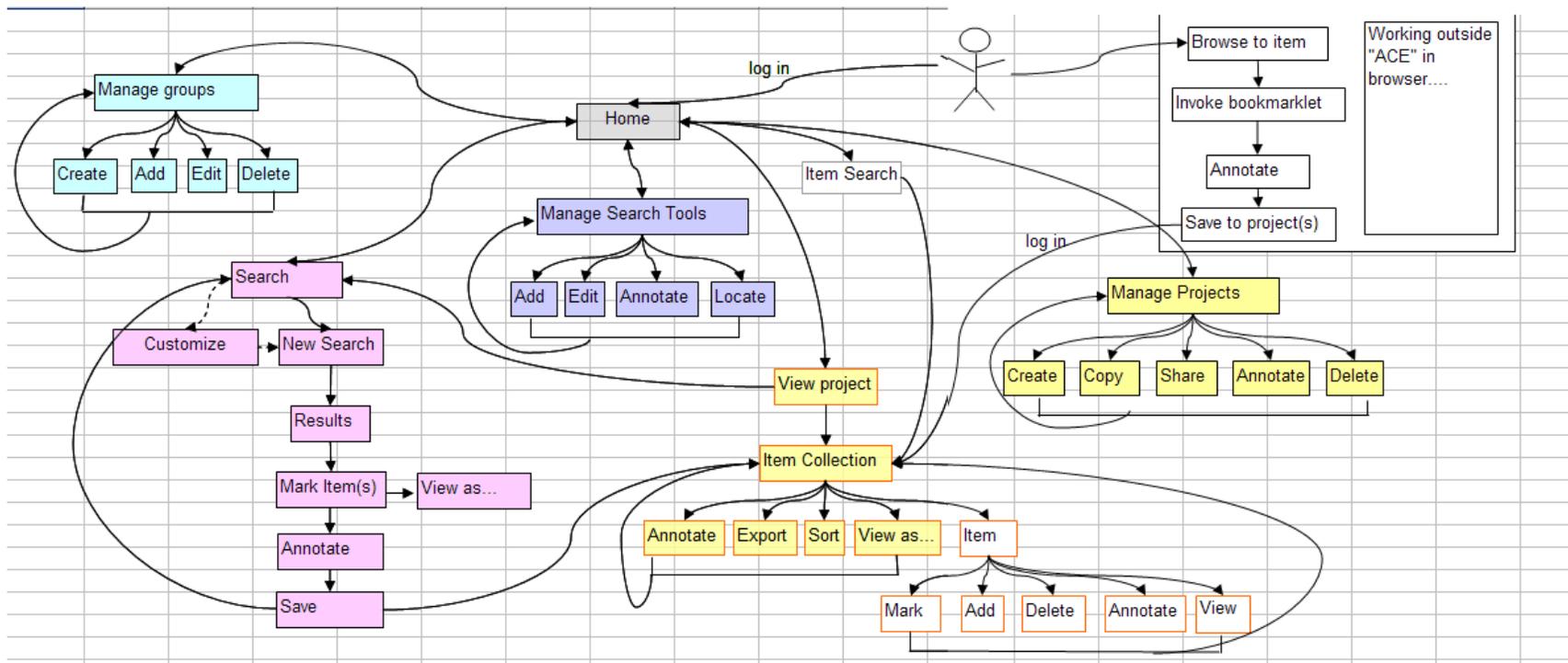
Internet Public Library

1. Can formulate URL to send keyword query via CGI.
2. Input: base URL plus keywords; can limit by collection. Output: XHTML
3. More info: <http://www.ipl.org/>
4. Scope: internet resources in many topic areas, organized into defined collections

Wikipedia

1. Supports [OpenSearch?](#) queries
2. Input: Templated HTTP query. Output: XML response (extension to ATOM or RSS)
3. <http://opensearch.a9.com/spec/1.1/>
4. Scope: encyclopedia, vast scope in terms of topic areas

Appendix G: Bird's Eye View of ACE



Appendix H: Bibliography

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