Stanford University
LIBRARIES & ACADEMIC INFORMATION RESOURCES

SEQ2 Library Vision: The Information Collaboratory

Stanford University Libraries & Academic Information Resources

June 7, 2006

SEQ2 Library Executive Summary

The SEQ2 Library—currently envisioned to be a major program element within the proposed School of Engineering Center building—will be a forward-looking facility that reflects the preeminent reputation of the Stanford School of Engineering. The purpose of this facility, its services and its collections will be to provide an environment for information discovery, utilization, creation, and management. It will be a library, but in the most advanced definition of that term. It will be a gathering place that will foster a sense of community for the School of Engineering, a place where a student could spend the entire day, meeting colleagues and professors, and not feel the need to leave. The space and the services provided in it will foster collaboration among students and faculty, support discovery and retrieval of information resources resident (temporarily) in the new facility, as well as digital ones. It will allow instruction and discussion opportunities, provide quiet, comfortable individual and group study space and areas where users can socialize with food and drink. Of course, the space will have networked computers, wireless access, and multi-media tools to allow students to complete their assignments and projects, discuss ideas and problems, and facilitate their research using these resources.

As the information environment and literatures of engineering disciplines become more complex – a trend we do not see slowing down – successful engineers will increasingly rely on new kinds of lifelong learning skills. Critical among these is what we refer to as an "information heuristic," a skill set that SULAIR information professionals inculcate in their clients, most effectively through formal instruction in the library. Therefore, space for library/information instruction will be essential. The SEQ2 Library will be well staffed by engineering librarians and a few support staff. The librarians will provide reference services, select information resources for acquisition and licensing, and publish specialized guides to the literatures of the fields on the web for the many communities of specialists in the School. They will be knowledge managers, both responding to and anticipating the information needs of the scholars as teachers, the scholars as researchers, and the scholars as students.

Three themes permeate this program statement for this new style library as service organization: human contact, mediation, and mutability. The new engineering library will succeed to the extent it supports and encourages contact among users of all kinds in many ways–as well as between users and the expert staff–also in many ways. It is safe to predict that the specific forms of contact will evolve, and the library will need to be flexible over time, but the need for a "high-touch" environment will remain. Just as the current facility has dealt with changing programmatic needs, the new library will have quite different needs over time: the first day requirement for shelving, for example, will be much greater than the ten year requirement.

High Touch

Users of the new facility, whether students or faculty, have continuously evolving needs as they progress through their time at Stanford, and as the world of information resources and library services develops around them. Many students do not know how information flows within a discipline. It is becoming increasingly clear that "information literacy" and understanding by students of the organization of the literature of science and engineering is declining. Yet, in a time when the literature of the fields is growing globally and by inter-disciplinary engagements, a contributor to career success will be the ability to sort and select the most appropriate information source, the most pertinent data, or the best theory on which to build. Learning those skills will happen in the library as well as in the classrooms and labs of the School.

The library facility will contribute to student retention and student life by playing a central role in the intellectual, social, and cultural spirit of the campus. The library will continue to be a focal point for students and a provider of quiet spaces for serious study, and will play a larger role in other activities of the academic community such as holding lectures or displaying student design projects. Engineering courses will increasingly include a tightly integrated information discovery and retrieval instruction component, and librarians will work with and for instructors to achieve this.

A key recommendation is to increase the number of subject specialists to a ratio of one subject specialist for every two departments; these specialized librarians will work out of the new engineering library, but as well, if office space is available, work out of the departments they are meant to serve. Thus to start, a minimum of four specialists will allow increased interaction with the current eight School of Engineering departments to assure that information needs are well served and, perhaps, more importantly, that information services and products are effectively communicated to users. We plan to increase the Engineering Library staff in the professional ranks to accommodate more such subject specialists while the cadre of para-professional staff decreases in parallel, due to the decline in the quantity of books on the library's shelves. We are aiming for a bookless library.

Expert staff service intervention

Managing vast amounts of information from myriad sources and ensuring that users can easily discover those source materials will be even more important in the largely online information environment. A particularly crucial service performed by library information professionals will involve creating and maintaining specialized online "reading rooms" or publishing iteratively on-line guides to the specialized literatures of the fields that , pull together a vast array of information resources serving particular research teams, communities, and curricular programs. Information Instruction services and orientation sessions for new members will be critical; science librarians are increasingly encountering students who have missed out on valuable information sources because they assumed that a quick Internet search was sufficient. We intend through recurrent contact with engineering library subject specialists (librarians) to help students develop an

information heuristic that will be useful to them throughout their personal, professional, and academic lives.

Considerable staff expertise will be required for managing online information sources and repositories, while the traditional need to manage physical collections will diminish over time. In addition, determining and managing copyright status will be increasingly critical to providing services to users. Intellectual property management will require increasing sophistication as librarians negotiate often-complex license agreements for access to online information. We expect librarians in the new engineering library to offer assistance to faculty and students on various intellectual property matters.

Another key activity of subject specialists will be as editors of subject and topical guides. They will serve as "channel editors," creating customized knowledge environments including subject portals, information toolkits, and specially-curated online collections and services. Subject portals are highly specialized in order to help researchers come up to speed quickly as well as to stay current with new advances, but the portals will need constant updating to remain relevant and valuable. Increasingly, library staff will be responsible for establishing topic- and subject-based knowledge environments to support their client communities, "pushing" content to readers, providing an FAQ for basic reference assistance, and compiling/creating instructional materials. They will be successful "channel editors" to the degree to which they are in contact with the faculty about substantive curricular and research matters as well as with the literature of the fields and the attendant information industry products. Such guides should be available to students and faculty wherever they need them, but we envision "pushing" them through display technology in the new engineering library to let the users and passers-by know what's new and different in the virtual collections and actual services.

Curated collections—collections targeted to meet core research and instructional needs of the engineering departments—will remain important. The scope of collecting and archival efforts must be expanded to include publications and data sets produced by research centers and laboratories at Stanford. The new engineering library will need to rely heavily on online services and collections to support increasingly multidisciplinary research. The entire staff of the engineering library will serve as customer advocates in obtaining required documents through many different means, whether owned or leased by Stanford or not.

Flexible Facilities

There has been much discussion of the new facility as a "bookless library." In fact, the day-one requirements for shelf space, while substantially lower than the configuration of the current facility, will initially be significant—there simply are not digital surrogates available for much material in current use. However, space configuration within the facility will change markedly over time. Resources will be needed to support this transition stage. And eventually, the book collection will disappear altogether, the space that it occupied being re-configured for more study space, more collaborative spaces and perhaps more spaces for consultation. Regardless of initial configuration and need for

housing some physical collections, there will be an ongoing need for study / gathering / collaboration spaces that can be differently configured as needs require and as the physical collection onsite shrinks. Given the fact of a substantial book collection on opening day (persisting, if shrinking, for a decade or so), we need to have appropriate security for that collection, both for operational efficiency and for protection of the physical assets of the university – i.e., the books – as long as they are housed in the new library. Appropriate security for other university property – computers, printers, and the like – needs to be taken into account too.

Matériel transport will remain a significant operational necessity for many years to come, and the new facility must accommodate that. Books will be re-called from remote storage facilities, so some staging space will be necessary. There will be a new service model for printing and scanning facilities; rather than situating them in a centralized location, it will be both practical and beneficial to users to site multiple small scale service points throughout the facility. It is highly desirable that one of these sites be designated to host a particularly rich media development and poster-size printing zone.

The SEQ2 Library—Envisioning an Evolving Facility

> *"…when they build a new engineering building with a new engineering library, can you make sure the interior of the new library actually looks like a library. The current engineering library … creates a stultifying miasma that suffocates all hopes of creativity. Granted, we are engineers and not beauty pageant contestants, but something a little more homey might make it a more attractive arena for doing work."*[1]

Our assessment of the program needs for the SEQ2 Library—over the expected life of the facility—are best expressed in terms of three stages of development. The first stage, facility activation and opening day, is described in subsequent pages in sufficient detail to serve as the programming statement for the initial library presence. The second stage, encompassing the succeeding ten years or so, we see as a period of transition, where we will take advantage of the digitization of collections and continue to re-think the environment of library services accordingly. In the third stage, we project forward to the year 2020—ten years beyond the opening of the facility. By this time we expect the vision of a bookless environment to be fully realized.

Activation of the SEQ2 Library in 2009 – Program Description

As is true today, the primary goal of the new SEQ2 Library will be to provide for the informational needs of the (currently) 4367 students, faculty, and researchers in the School of Engineering (SoE). Materials will be acquired and services provided to support the research and teaching of the following SoE departments:

Aeronautics and Astronautics
Bioengineering (in conjunction with Lane Library)
Civil and Environmental Engineering
Computer Science
Electrical Engineering
Management Science & Engineering
Materials Science and Engineering
Mechanical Engineering

Managing vast amounts of information from myriad sources and ensuring that users can easily discover those source materials will be even more important in the largely online information environment. A particularly crucial service performed by library information professionals will involve creating and maintaining specialized online "reading rooms" or knowledge environments, which pull together the online information resources that serve particular research teams, communities, and curricular programs.

[1] Engineering graduate student comment – Spring 2003 User Survey

Projected 2009 Knowledge Environment

SEQ2 Library users will have different needs at different times, and will use the Library for research, for learning and study, or for helping with their instruction. Faculty may primarily use the library for research; teaching faculty may use the library as an aid to instruction, while students will most likely be involved in studying and learning at the library. All groups will have evolving needs as they progress through their tenure at Stanford, and as the world of information resources and library services develops around them. User survey responses for the Engineering Library in 2003 speak directly to the strengths and challenges of this library today, and foreshadow both future user needs and desired direction of research support services.[2]

The Engineering Library 2000 and 2005 self-studies, and the 5-year statistical trends for Science and Engineering Libraries on campus also give us some insight into the changing needs of library users. The 2000 self-study notes that inadequate facilities have been a major issue in the Engineering Library almost since it opened in 1977 when the Terman Engineering Center was completed. When the library opened, it served a user community of 2100 and was designed to accommodate 20 years of growth. Between 1977 and 1990 there was a 59% increase in the size of the engineering community. In the late 1980s, approximately 1,000 sf. of study/stack space was reallocated for videotape viewing stations, the computer cluster, and additional computer workstations. A 1990 study of the Engineering Library performed by Operations Research students as a class project concluded that "...the long term and best alternative is to build a modernized and much larger Engineering Library…The space in the Engineering Library is almost fully utilized: therefore, a new library is essential for the future."[3]

When the SEQ2 Library opens we can expect an information environment—as is the case today—where users own their own computers and rely primarily on electronic resources for information. With electronic resources a given, they also put a high priority on having access to up-to-date computers and software at computer clusters, wireless networking everywhere (but particularly in the Libraries), and ubiquitous and robust printing and photocopying services. Across the campus we see a constant demand for private study spaces as well as more or less public ones, for group study rooms as well as collaboration spaces and tools. We have observed in other facilities we have re-modeled how much students and faculty value a variety of seating styles (ranging from bolt upright on hard chairs to softer seating to lounge chairs and sofas) in a variety of settings (from entirely enclosed carrels with doors, to semi-private carrels, to big tables in open rooms).

[2] See Appendix A: User Needs Assessment – Background, for more detail.
[3] *Stanford Engineering Library Facility Layout Alternatives*, June 6, 1990.

Services to SEQ2 Users

SEQ2 Library services will include combinations and subsets of the following as needs are articulated by users, and interpreted and programmed by library professionals:

- Knowledge management services — provided by engineering library subject specialists — will include such specific services as the creation of on-line guides to fields and sub-fields down to topic levels in engineering.
- Information literacy programs — an expanded online information literacy program for undergraduates or graduate students, perhaps through traditional face-to-face classroom instruction, but as likely through online tutorials, such as we pioneered at Stanford in the Program for Writing and Rhetoric.
- Reference services — available in person at a designated service point, by appointment with librarians in their offices, or via e-mail. Such reference services are aimed both at satisfying an immediate need for information assistance (as in locating a particularly arcane bit of data), but as well in inculcating a sense of information heuristic in students.
- Course services — e-reserve and support for use of course management systems, such as Coursework (and its successors).
- Circulation services — assistance identifying and retrieving desired books from remote storage locations. As we pursue mass digitization of our collections, improved searching will reveal books of interests owned by Stanford or perhaps other institutions, but reading them online while the books are still protected by copyright may be problematic. We will therefore expect to see an increased flow of books from remote storage.
- Document delivery services — self-service as much as possible via the library Web pages. Library staff will assist with obtaining materials beyond the scope of the central Libraries' document delivery services.
- Management of the community spaces designated for collaborative work, instruction, or individual research or study.
- Technology user support services to allow users to make best use of the available high technology equipment.

Physical Collections – Virtual Collections

At opening day, with the transition to online materials well underway, there will be a greatly reduced need for on-site physical materials in the SEQ2 Library. The reduction in required shelf space, while significant, will initially be less than one might expect however. Unique materials in computer science (currently held in the Math/CS Library) will require housing, and to some extent will replace the engineering materials moving out.

The journals and indexes are the formats that are migrating most rapidly away from the physical volume, towards online versions. The following table shows, for the two collections expected to merge into the new SEQ2 Library, the number of journal and index volumes currently held, the number currently available online at Stanford, and an

estimate of the number of further volumes available in online format for purchase. If all currently available online versions are purchased, then only 34,306 volumes will remain to be housed in the SEQ2 Library.

	# journal & index volumes	#held online	# available for purchase	# remaining in SEQ2 Library
Engineering Library	55,796	14,345	10,125	31,326
CS collection	7652	2230	2442	2980
Total	63,448	16,575	12,567	34,306

In addition to the journals, technical reports, theses, and reference materials, there are approximately 57,000 books currently in the engineering and computer science collections. The chart in Appendix B illustrates the effects on this combined collection of moving books out according to their level of use. To take two possible cases, withdrawing all books with less than 5 recent uses would leave approximately 18,500 volumes to be housed in the SEQ2 Library, while a ruthless weeding program aimed at books with fewer than 10 recent uses reduces the book collection to 10,000 volumes. As the Appendix B chart illustrates, further increases in the use level criteria lead to diminishing returns in terms of number of volumes that can be shipped off site, and are therefore not recommended.

Engineering has 867 linear feet of technical reports and there are a further 830 linear feet of computer science technical reports in the Math/CS Library. Although very few of these are available currently online many are Stanford University publications and could be digitized. Use of technical reports is generally low, so they could be stored off-site. In addition Stanford University theses, which are available online from 1989 onward, will no longer be held in physical format in the SEQ2 Library.

To summarize, at current estimates, we estimate there will be a need for 8,100 linear feet of shelving space in the SEQ2 Library at least for the first few years of its operation for the high use books (18,500 volumes), and the journals and indexes not yet available online (34,300 volumes).[4]

Changing Nature of SEQ2 Library Staff Roles

The nature of tasks and the skill sets required of library staff have been changing continually over the past four decades. Even a rapid review of library staffing in Stanford's principal competitors in engineering research and teaching shows that Stanford employs too few librarians with training in the fields of engineering. We propose to increase the number of subject specialists supporting the programs of the

[4] Space requirements in the SEQ2 Library will vary significantly depending on the format of the materials considered. Materials formats currently held in the Engineering and Math/CS Libraries include journals, monographs, technical reports, Stanford theses, and indexes. Other formats (microfiche, CD-ROM or DVD, videos, star charts etc) will not be considered in this analysis as they take up minimal space in the Library.

School of Engineering while decreasing the number of paraprofessional staff. Our program of knowledge management that we discuss in this paper, after all, depends upon knowledge of the fields under consideration. Thus, we would expect to hire subject specialists: for electrical engineering and computer sciences; one for aeronautical, mechanical, and industrial engineering; one for management science and materials science; and another for civil and environmental engineering. We expect that bio-engineering would be covered variously by this staff, by the staff of the biology library, and the staff of the medical library. This pattern of assignments is of course subject to the advice of the faculty involved.

As more and more information resides on and is accessible from the user's computer or other communication device, it is tempting to assume that the need for the expertise residing with information professionals is diminishing. On the contrary, science librarians are increasingly encountering students who have missed out on valuable information sources, because they assumed that a quick Internet search was sufficient. Indeed, some Stanford professors recommend to their students that they conduct research queries without Google and other search engines, in order that they might experience the precision and depth of retrieval possible through specialized information resources and through the mediation of expert librarians.

Many students do not know how information flows within a discipline and so struggle, usually too briefly, to identify where it might be located. Increasingly, patrons are failing to search obvious information resources, such as the library catalogue, or are searching a completely inappropriate database for their topic; in some of the more complex databases, such as those containing chemical information, they simply lack the skills required to construct good search strategies. Paradoxically in the Internet age, there is much evidence that "information literacy" and understanding by undergraduate and graduate students of the organization of the literature of science and engineering may be declining. The Internet makes all information appear to have the same level of authority. Peer review and credibility of a source are unknown concepts to much of the student population. Thus, we intend that expert librarians engage with students not merely to point them to the information or source they need at that moment, but as well to subtly lead them to deeper information literacy and perhaps eventually to develop a personal information heuristic.

SULAIR professionals will continue to look for new and effective ways to combat this decline, and to support students in their knowledge seeking goals. Students might best be served if information literacy is integrated into the curriculum so that Stanford Engineering and Science graduates leave the university with basic information research skills that allow them to compete in industry and academia.

The primary role of librarians is to *make information and knowledge accessible* regardless of format. The need for this expertise exists now and will continue to exist during SEQ2's lifespan.

SEQ2 Library Facility Features

We fully expect that space configuration within the facility will change markedly over time. Regardless of initial configuration and need for housing some physical collections, we believe that there will be an ongoing need for study / gathering / collaboration spaces that can be differently configured as needs require and as the physical collection onsite shrinks.

The SEQ2 Library will provide spaces for individual study. Some of the individual study spaces will be set up to facilitate study using a portable computer connected to a wireless network. Perhaps other individual study spaces ('electronic carrels') will come already equipped with a large ergonomic display/input screen, and a simple front end providing easy access to commonly used tools such as documents in the latest Courseware, and classic texts.

There will be a generous number of group study areas designed for small groups of 3-5 people and for larger groups of 6-10 people.[5] Removable dividers could separate the rooms so that larger groups can be accommodated if desired. Ideally, the study rooms will be acoustically isolated, and will feature large display screens and white boards (both with the ability to connect to a computer), for use with collaborative workspace tools such as TeamSpace,[6] as well as videoconferencing capabilities.

A space suitable for conducting information instruction activities (as enumerated earlier) is essential. Ideally, this area will be designed as flexible, multipurpose space, which can also be acoustically isolated and will be large enough to accommodate a class size of 15 to 25. Furniture in the instructional area will be modular and light, so that it can be easily rearranged and the room can be repurposed when instruction is not ongoing. Other library areas will feature comfortable lounge style furniture, suitable for quiet reading, conversation, and other activities typical of an information commons.

All of these spaces can benefit from being freed from the need to be located close to the library stacks. Study and reading areas can be located in quiet niches, or in areas with inspirational views. Noisy areas where collaboration is encouraged and various communities are interacting can be grouped together. Librarian offices can be located in close proximity to the communities that they are serving, rather than close to the physical materials. Technical library staff can be located close to the computers that they are servicing.
Initially, the SEQ2 Library will require installation of library shelving sufficient to house approximately half the current combined Engineering and Computer Sciences collections. Several shelving configurations are possible and should be considered. Given the reduced and diminishing physical collections, we recommend the library stacks be centralized in an area of the building visible to the public (albeit with some security controls) and not

[5] For example, the recently renovated Jackson Library (GSB) incorporates 26 group study rooms, which are heavily used by a student population of 700.
[6] TeamSpace is a web-based collaborative workspace system for managing shared work processes and maintaining shared artifacts in a project typically spanning months or years.

tucked away out of sight or relegated to basement areas subject to water intrusion. We expect these collections to be high-use. Therefore, we also recommend that the shelving ranges be relatively short (i.e. no more than 30 feet), to facilitate access from either end of the range, and with frequent aisles, to accommodate a large user population, and to act as noise buffers.

The library stack area will be comprised of ranges of fixed double-faced sections installed according to current mandated accessibility standards and clearances as well as fire protection regulations. Given our experience with the type and size of materials likely to be shelved in such an area, we recommend 90" high shelving units, typically six shelves per section, spaced at 13" between shelves. While such spaces will have to meet appropriate floor-loading metrics (i.e., live load capacity of 150-175 pounds per square foot), installing ranges with an eye to future re-use of the space will enable them to be removed and replaced with user seating or other functions without renovation other than patching of flooring.

SEQ2 Library Infrastructure and Auxiliary Services Support

Shipping, Receiving, and Paging of Library materials. Transport of incoming library materials (books, journals) to the SEQ2 from the shipping point in Green and Meyer libraries, via delivery vans, will continue for a number of years, even as more materials become available on line. Likewise, shipment of printed materials out of the SEQ2 facility to remote storage locations will continue over several years. And, as more books and serials reside in remote off-campus storage locations, daily paging of requested materials back to campus must be accommodated. Access to a conveniently located covered loading dock (with dock leveler), temporary storage (parking) space for book trucks, and adequate covered pathways (and freight elevators) to move book trucks to and from the shipping/receiving point are required to support these collection transport activities. A typical loaded book truck can weigh 700 lbs, and needs a maneuvering radius of 6 feet, and a graduated ramp sufficient to accommodate movement of trucks up and down. Mail or shipping room space sufficient to support sorting, packaging and distribution, of materials will be important.

On-demand scanning, printing, electronic document delivery. Rather than a single printing and scanning facility sited in a centralized location, multiple small-scale service points sited throughout the facility will be most beneficial.

Events staging and public presentation space. In close adjacency or integrated with the building's public areas, flexible and multipurpose spaces for library-sponsored events and presentations is needed. Spaces should be accommodating of a cross-spectrum of typical users, have varied technological capabilities, and be appealing to the public for specific events.

Food service. There will be increasing expectations and demand for access to food and drink services—if not integrated within library spaces—at the very least in close proximity. Care must be taken in planning of spaces in order to minimize opportunities

for damage to library materials, furnishing and technology, while accommodating user desires for comfortable and flexible study and conference areas. Availability of a food preparation and serving area (for catering purposes) should share adjacencies with events and public presentation spaces.

Years of Transition and Development (2010-2020)

Anticipated Knowledge Environments

Research: Exponential growth of the literature will continue in science and engineering. While retrospective conversion to digital formats continues, all core and current resources are expected to be available online, at least for keyword searching and perhaps equipped with other modes of searching (taxonomic, associative) and more features enhancing reading and research (hyperlinking citations to cited references, alerting and recommendation services, among others). Students and faculty will browse and search all journals online but will still prefer to read most books in print format. Digital textbooks will become common, but will be disabled for use after the period of instruction has concluded. Digital reference works will likely dominate. Publishers will continue to enhance publications so that physical property data, images, and text may be searched more effectively. Deep linking to an array of resources and services will be common. More links to live data-collecting instruments will appear. Search interfaces will continue to evolve at a rapid rate, will have intelligence and be able to learn from users. Tools to data mine and visualize information will become popular. More research will be conducted collaboratively, often by teams or communities in disparate locations. Software tools that aid communication and collaboration over distance will become widespread – many of these tools allowing for online documents to be retrieved, displayed, and edited by a geographically dispersed group, communicating in real time over the Internet. Subject portals will be specialized and help researchers come up to speed quickly and keep current with new advances.

Teaching and Learning: CourseWork or another course management system will likely be used for all classes on campus. Instructors will be able to select images, demonstrations, textbooks, and problem sets, from a growing library of open source materials. Virtual instrumentation as well as a "software library" that contains products for computation, simulation, modeling, and visualization will be available for faculty to use in classes and through the web. A large proportion of assignments will involve collaborative document creation and project-based learning, virtual model building, and simulations with numerous parameters for testing. Information toolkits to help with course assignments will be available. Engineering Library staff will be conversant with and be able to assist in exploiting the features and potential of these course management systems. Students and faculty will have e-portfolios of their work for review, for self-analysis and improvement, and for posterity.

Evolving Library Contributions

Services: Top priorities will include establishing discipline, field, sub-field, and topic guides or knowledge environments to support communities on campus; making document delivery self-service; providing an FAQ database for basic reference assistance; and compiling, creating and constantly updating instructional materials that include a collection of sample searches that users could use as models. Orientation sessions for new members of the Stanford community and course-specific information toolkits will be offered. Other possibilities include a document center which will print books on-demand and offer a poster printing service, and an "in silico" laboratory which could function as a test-bed and discovery zone for new information products.

Digital Collection: With the completion of initial collection moves into the SEQ2 Library, efforts will turn toward next steps in migrating to a completely digital collection. Building curated collections – a collection selected to meet the present and anticipated research and instructional needs of the Stanford community – will remain essential. New, general search instruments such as Google Scholar may help to expose some information resources valuable to the Stanford engineering community. Other digital resources, such as the incomplete Internet Archive, may eventually complement our collections, but they currently lack reliable retrieval algorithms and are not sufficiently comprehensive to meet the expectations of the Stanford faculty and students. Because of the size and complexity of the scientific and engineering literature, it will be essential to continue acquiring access to core abstracting and indexing services because of the in-depth indexing they provide. Furthermore, it is most unlikely that all of them will open their proprietary contents to indexing by the various general Internet search engines, such as Google.

The scope of collecting and archival efforts should be expanded to include publications and data sets produced by research centers and laboratories at Stanford. Locally produced materials would be deposited into the Stanford Digital Repository. Ideally, our institutional repository would include all publications published by Stanford authors, as well as datasets from research projects and remote instrumentation, retained for potential long-term data mining. The new engineering library should build a software library of applications from discovery and visualization tools to products that support educational efforts, all relevant to engineering fields.

Staffing: Depending upon decisions made by the School of Engineering about academic computing clusters and services, professional information technology staff may be necessary to support academic computing in the new Engineering Library.

Student positions will continue to be needed for staffing of the library. Student workers are essential in support of day-to-day operations and are able to perform a wide range of special projects. For example, they might test new discovery tools under consideration or compare publications listed on personal web pages with those in an institutional repository.

SEQ2 Facility Spaces in Transition

Reconfiguring User Areas. An evolving mix of user spaces will be needed throughout the life of the SEQ2 Library. Laying out the space with several possibilities—some changeable in situ by users—will be desirable. Spaces capable of being used for two or more purposes would also add flexibility. For example, freestanding group study rooms like those in Bio-X could be added as needed. The facility will need to accommodate display panels that cover a wall or can be hung wherever desired. Certainly, spaces for colloquia, seminars, and receptions must be incorporated in the mix, or at the very least, nearby and available.

The types of user spaces required will include:

- quiet space for individual study
- comfortable lounge-style seating for reading or contemplation
- community space for discussion
- group spaces designed to facilitate interaction in small groups of 3-5, including enough table space for problem sets, blueprints, designs, or objects to be laid out and shared with the group
- enclosed group spaces for collaboration in larger groups,
- private enclosed spaces for intense work

Technology and infrastructure requirements for user spaces will include:

- Conduit for power and signal that will anticipate increased needs for bandwidth and electrical power over time
- Ubiquitous wireless computing
- Modularity and flexibility as hallmarks of the space
- An area sufficient in size and conducive to support large digital commons with many computers, large-format printers, and media development facilities
- Electrical power and communications access for all individual and quiet spaces for reading and reflection

Staff Redeployment. We believe that subject specialists should be housed in their assigned departments as well as in the new library; they will interact in the field with professors, post-docs, and grad students, while seeing undergraduates as much in the library as in the field. Within library space, offices for subject specialists should be readily accessible to patrons. Specialists might also conduct “office hours” in semi-public space within departments they support. Workspace for paraprofessionals and students might be best sited in or adjacent to semi-public areas as well.

Projecting Ahead – SEQ2 in 2020

The National Academies Press book *The Engineer of 2020: Visions of Engineering in the New Century*[7] provides us with a vision of how engineers will be working in 2020, and how educational institutions should best be preparing students for work as members of the engineering profession in 2020.

In 2020, engineers will be tackling an increasing number of large scale and high complexity systems problems. The typical engineer will likely be working as part of an inter-disciplinary team, collaborating across subject fields, borders, and cultures. In response, the engineering curriculum is likely to continue to emphasize teamwork, and increasingly incorporate cross-disciplinary research. More non-technical content will be incorporated into the curriculum – including communications, business, economics, social sciences, and cross-cultural studies. As the engineering discipline matures, more emphasis will be put on promoting a professional identity for engineers and a sense of tradition. These changes will necessitate a longer period of study beyond receiving the Bachelor of Science degree – by 2020 engineers may be looking at a 5 or 6 year professional degree.

We can anticipate the effects of some of these changes in engineering education by looking at other highly cross-disciplinary areas of study - GIS is a good example that has recently come to prominence. Engineers use GIS tools in a myriad of fields, from civil engineers planning optimum water provision systems to electrical engineers situating telecommunications towers. The GIS community at Stanford is widely distributed and is served by a largely online library, which includes GIS software, datasets, and user support. It is instructive that core support service for GIS at Stanford is provided by the staff of the Branner Earth Sciences Library. As with all campus libraries, Branner staff recognize that they serve the entire campus with their specialized knowledge sets, data sets, and facilities. Just as Earth Sciences faculty and staff have recourse to the resources of all the campus libraries, whether physically or virtually, so engineers can and do make use of the whole range of services and collections.

Likewise, the new engineering library will need to rely heavily on online services and collections to support increasingly multidisciplinary research. The Library will continue to build a strong and focused engineering collection, while putting an even greater emphasis on student-centered and personalized learning services. Instruction and information literacy programs will become core library services. Services and spaces will need to be flexible and customizable; instruction will be easy to tailor to the departmental or even the course level, and delivered through a variety of mechanisms including in-person classes, online delivery, and sessions offered on a 1:1 basis. Search environments will be likewise tailored to specific groups with specialized needs. Early examples of specialized search environments include the HighWire knowledge

[7] Washington, DC: National Academies Press, c2004.

environments[8], which make use of specialized taxonomies to generate precise result sets, geared towards researchers in a particular field. Another contemporary example is Grokker, a search engine that provides visually oriented search results. We need to provide search and retrieval services that enable Stanford faculty and students to quickly and precisely sort through large results and complex information topographies.

By 2020 we do not expect to have print materials held on site in the SEQ2 Library. Older material will have been digitized, and more current academic information will be produced online, purchased in online format, and consumed online. The online information environment may have evolved to the point where products are compatible, allowing libraries to provide powerful search engines that can cover all relevant resources, and to provide extensive hyper-linking between relevant resources. User interfaces will have evolved and improved also, making the information search (if not its evaluation and utilization) a much-simplified process.

The library, freed from the need to store print copies of books, will contribute to the research and curricular programs of the School with highly specialized information services, with tailored knowledge management and presentation programs. The library will continue to be a focal point for students and a provider of quiet space for serious study. In addition, the engineering library may play a role in student retention and student life as a center for the intellectual, social, and cultural spirit of the campus. It will also support other activities of the academic community, such as holding lectures or displaying student design projects. As the various engineering disciplines mature and focus more on their own history, e.g., through case studies, the library will support this focus by providing displays and information relevant to the history of the profession. Engineering courses will include tightly integrated discovery and retrieval instruction, and librarians will work with instructors to achieve this.

By responding to faculty and student information needs and even anticipating those needs to the extent possible, engineering library professionals will remain valued members of the research and teaching communities here. Library staffing will not change dramatically in terms of head count, but the work that librarians do will change significantly. As channel editors, they will create customized knowledge environments, subject portals, and information toolkits, and curate specialized collections. Librarians will spend more time interacting with students and faculty.

The larger library environment in 2020 will have changed and stabilized as well. In 2020, the library will offer access to specialized online collections, housed at many institutions, through federated search and retrieval tools currently being conceived.

The library facility at this point will have reached the culmination of a gradual journey. Space formerly dedicated to print materials will have been gradually repurposed to community space, exhibit space, spaces for individual and group study, often equipped

[8]Examples include: AAAS' Signal Transduction Knowledge Environment at http://stke.sciencemag.org/ ; its Science of Aging Knowledge Environment at http://sageke.sciencemag.org/ ; the International Bone and Mineral Society's BoneKEy-Osteovision at http://www.bonekey-ibms.org/

with information technology. Librarians will be selecting digital information resources; assisting and instructing users in navigating information resources; developing policies, tools, and support for digital collections and network information services that will be more and more seamless and ubiquitous; providing instruction in research methods to undergrads, grads, faculty and staff; outreach to alumni, and managing library staff and budgets. The SEQ2 Library facility and the librarians' involvement in the lives of the departments they serve are among the catalysts that bring students, instructors and faculty members together and ultimately improve the learning and research experience of all parties.

APPENDICES

APPENDIX A: User Needs Assessment—Background

The Stanford University Libraries and Academic Information Resources use a number of methods to keep abreast of user needs and to project future needs. The latest Residential Computing survey (2004/05) shows that 99% of graduate students and 98% of undergraduate students own a computer, with 82% of graduates and 83% of undergraduates owning a laptop. The top ranked location suggested for wireless network access on campus was the Libraries (by 83% of Graduate students and 73% of undergrads).

In 2003 SUL/AIR conducted a comprehensive survey of Library users and their priorities. Results showed that online resources are the most heavily used library resource, closely followed by print resources. Physical books remain important to 77% of faculty and 67% of graduate students. Though online resources are integral, the relevance of the physical library was also emphasized, as 68% of respondents visit a library in person at least once per week. The top priorities suggested for the future were first to focus on increasing library online resources and secondly to build library print resources.

Survey comments made by respondents from the School of Engineering were analyzed in more detail, and again the top issues emerged as online resources followed by print collections. The other most frequently suggested priorities were to improve library photocopying and printing services, to upgrade library computers, to increase study space both for individual and not-so-quiet group work, and to (improve) enhance the libraries' resource discovery system (Socrates and the e-journals list). Interestingly, it was clear from the survey comments that most engineering students use other libraries on campus, rather than the Engineering Library.

Other needs and desires highlighted in past Engineering Library annual reports and in the 1998 Science and Engineering Resource Group (SERG) User Survey include the need for more study space, for group study space, and in particular for quiet areas, and more comfortable seating in the Library.

Even though total use has grown considerably, the 2005 self-study notes that circulation of print materials has decreased markedly in the Engineering Library in recent years, as more resources become available online. At the same time, the importance of the pay-for-print system in the library has increased; and more library users are requesting improvements to the pay-for-print system as well as additional computers in the library. Inadequate shelf space is no longer an issue, as many documents have been transferred to storage. However, study space is still inadequate.

Engineering Library Spring 2003 User Survey Extracts

Faculty

- **89%** of engineering faculty indicate that the library's physical resources are important or very important
- **96%** of engineering faculty indicate that the library's electronic resources are important or very important
- **86%** of engineering faculty indicate that print books are important or very important to their work
- **91%** of engineering faculty indicate that electronic journals are important or very important to their work

Quotes:

> On-line access to journals is great, but access to older journal issues at Stanford is really terrible, and those won't be on-line for most journals for a long time. Older issues of journals could sure use expansion, most of all.
>
> I tend to use E-journals more than anything else. When I can avoid going to the library, and instead get something over the internet, I do.
>
> It would be extremely helpful for my research if document delivery of journal articles were available for a much wider range of journals and years than currently. This service could be provided by scanning the requested article and sending it to the requestor electronically. I would be happy to pay on a per-article basis for this service. This might of course also provide a source of revenue for the libraries. Such services exist elsewhere (e.g. Caltech).
>
> We need a comprehensive catalogue of all electronic journals. University of Texas at Austin has the best catalogue and widest variety of e-journals and e-books I know. We should take a look at what they have and make sure we have the same access online. Many journals that they have available online until the 1970s we only have 2-3 years back. Their e-book collection is also impressive. Jackson business library materials should be better integrated to the general library system. I'm in the field of business in the engineering school and would like to have access for example to Compustat from my office computer but don't know how to get that.
>
> We are turning into an e-journal research world. and this is okay with me.

Graduate

- **83%** of graduate engineering students indicate that the library's physical resources are important or very important
- **88%** of graduate engineering students indicate that the library's electronic resources are important or very important

- **66%** of graduate engineering students indicate that print books are important or very important to their work
- **79%** of graduate engineering students indicate that electronic journals are important or very important to their work

Quotes:

> Subscribe to as many e-journals as the library could possibly afford. IMHO, the library should spend more money in this area than to waste them on fancy hyped-up but rarely useful projects.
>
> Provide as many books as possible in a electronic version
>
> The Reference librarians have been absolutely phenomenal. They go above and beyond to help us out, especially some of the staff at Branner. Thank you!
>
> If electronic journals are used rather than print journals, be sure that the electronic versions can be archived. Eliminating redundant databases to cut costs would be OK. The research librarians are great! Thanks to them for all their help!
>
> Please don't cut back journals unless electronic versions are available. They are very important.
>
> More E-journals! More E-journals! More E-journals!
>
> I am quite satisfied with the libraries and staff. I should like the status quo to be maintained.
>
> If you transition from print journals to electronic versions, make sure that more than 1 year of material is available online. This is a problem I have encountered with some of Stanford's e-journal subscriptions.
>
> I think one way to cut cost could be to combine several different libraries. For example, there are many students who would prefer having Engineering, Math & CS and Earth Sciences libraries at the same place; rather than having them at different places. I think there is an excessive categorization of libraries.
>
> I know they are planning on tearing the Terman Engineering building down, so when they build a new engineering building with a new engineering library, can you make sure the interior of the new library actually looks like a library. The current engineering library, with its dizzying, dirty 70's hospital layout creates a stultifying miasma that suffocates all hopes of creativity. Granted, we are engineers and not beauty pageant contestants, but something a little more homey might make it a more attractive arena for doing work.
>
> Electronic journals are greatly preferred to paper, but do not phase out paper copies unless Stanford libraries are somehow enabled and entitled to maintain backup copies of past electronic journals.
>
> In my area (CS) it seems that traditional libraries have become all but obsolete. In the last year I did an extensive literature survey, however all of the publications were available online. The key resource in CS these days is

CiteSeer/ResearchIndex (www.citeseer.com). The two large scientific organizations (IEEE/ACM) both have their publications online. Additionally most publications are present on researcher's or departmental web pages, or in eprint archives.

If I can do it on-line from my home computer I pretty much want to. The more the merrier on increasing on-line services.

Undergraduate

- **66%** of undergraduate engineering students indicate that the library's physical resources are important or very important
- **81%** of undergraduate engineering students indicate that the library's electronic resources are important or very important
- **54%** of undergraduate engineering students indicate that print books are important or very important to their work
- **50%** of undergraduate engineering students indicate that electronic journals are important or very important to their work

Quotes:

I'm always amazed at the resources we have available here...

Coursework is Tremendous. Great work. The Meyer multimedia studios are a great resource, . . . Any development in multimedia education is well served.

The Stanford Media Collection at Green is a wonderful resource, a clear process should be founded to order more DVDs and other media.

E-journal selection is poor. I constantly find journals that aren't available online. The university should have more online subscriptions.

APPENDIX B: Shelving Requirement Estimates

Current collection size, future relocation to remote storage, and anticipated availability of print materials in online form at some future point are used to estimate shelving space requirements. Calculations are based on recent (2005) collection measurements for the Engineering and Math/CS libraries, combined with projected growth estimates. Current online usage estimates, and projections for future availability of online resources require more conjecture as detailed in the following paragraphs.

Monographs:

The number of monographs in Engineering was obtained by running a usage report for every volume in the library (report run August 2005) and extracting all the monographs from this report. The number of monographs in Computer Science was obtained by running a usage report (report run August 2005), and extracting only the monographs which fall into the following call number ranges: Q180 - Q390 (inclusive); QA75 - QA76; QA402 - QA403; all T's; all Z's.

Note that usage includes circulation and recorded in-house use, but not online use. Monographic usage is calculated for the 5-year time period beginning January 2000 though end of December 2004.

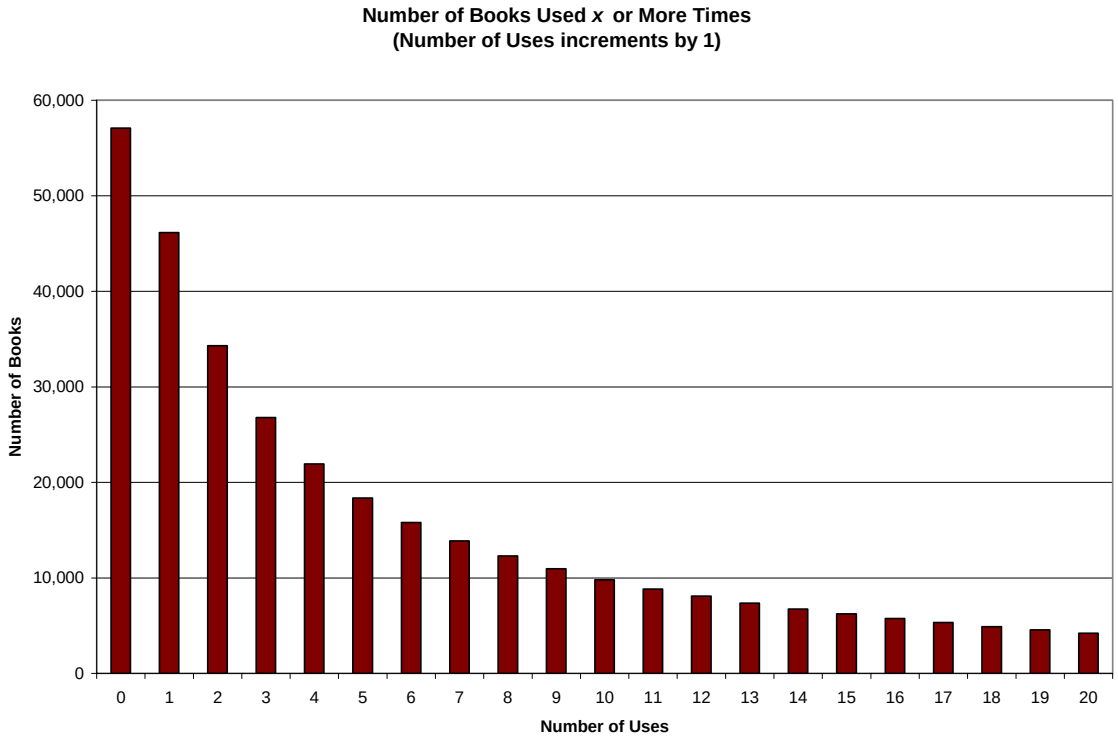
Journals and Indexes:

The number of journal and index volumes currently in Engineering was arrived at by running a usage report for every volume in the library (report ran August 2005) and extracting all the periodical and index volumes from the list.

The number of journal volumes available online in Engineering was arrived at by generating a list of the online journals in Engineering and the years covered by each title, and counting (for each title), the number of print volumes this represents. This work was done over a period of several months during the summer and early fall of 2005.

The number of journal volumes in Engineering available for purchase in online format was obtained from publisher's literature or websites advertising their online products. Products available or forthcoming as of August 2005 are included.

Usage Chart for Engineering and CS monographs:



NB: Overlap between the Engineering Library collection and the CS collection: the exact extent of the duplication between the two collections was not factored into the calculations.

APPENDIX C: Staffing Configuration

A proposed staffing plan for SEQ2 opening in 2009:

Head Librarian for the Engineering Library:
The head of the new Engineering Library will also be the Associate University Librarian for Science and Engineering Libraries, a strategically important leadership position recognizing the fundamental importance of engineering to Stanford's very identity.

Librarian/Information Specialists (4):
Subject specialists to serve as Channel Editors and Liaisons to Depts/Institutes/Labs.

- Computer Science/Electrical Engineering & Engineering
- Mechanical Engineering/Aeronautics & Industrial Engineering
- Civil & Environmental Engineering
- Materials Science & Management Science

Key librarian/information specialist job functions will include:

- Selection of relevant resources in appropriate formats to meet the needs and preferences of the Stanford community.
- Work with vendors and technology specialists to make access to those resources and tools seamless and user-friendly.
- Act as a user advocate during the development of information products and systems.
- Understand information-seeking behaviors and facilitate the user's successful information retrieval via development of search tools, reference consultation, and instruction.
- Plan, develop and deliver outreach and instructional programs to both individuals and groups.
- Design and build subject portals and knowledge environments.
- Mediate access to information not held at Stanford via document delivery and interlibrary loan services.

Nonprofessional Staff & Students:
Paraprofessionals will still be needed in the SEQ2 Library to manage and supervise 18-24 hour operations and services. Over time the efforts of staff that provide materials support will migrate from working with print materials to digital resources and service pages.

Operations Manager / Evening Supervisor (2)

Library Materials Specialists (2)

- Document delivery orders/paging
- Reserves
- Materials ordering/receipt

- Materials record maintenance
- Serials/Technical Reports/Undergraduate Theses
- Bindery/Repair

Students (FTE to be determined by Library hours and other staffing)

- Circulation
- Reshelving
- Special Projects