

# Library Services for Distance Learning Programs in Engineering

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## **Abstract**

As engineering schools in the United States continue to offer both graduate and undergraduate degree programs by distance education, they must address the question of providing information and library services to support those programs, in order to assure the parity of the on-site and the distance degrees. This paper reviews the various areas of library support needed in engineering, and suggests methods by which this support may be obtained for distance learning engineering programs.

## **Introduction**

Applying knowledge to work is the job of the engineer. While scientists use information to produce more information, engineers use information to produce some physical change in the world. (Allen, 1988) For this reason, the engineering curriculum emphasizes the instruction of an ever increasing body of technical information. Moreover, as pointed out by deans of U.S. engineering schools, "We must educate engineers for a life of change. To do that we must ensure that they have a breadth of knowledge that will enable them to cope with the changes inherent in the future." (Miksdal et al., 1996) Thus, engineering faculties, already tasked with the duty of imparting a coherent body of knowledge within a limited time frame, are also asked to prepare the student engineer with the underlying skills of information research and retrieval that will sustain an engineer's lifelong ability to learn and grow professionally.

Libraries of their institutions support engineering faculties in this endeavor. These libraries "must be both technical and nontechnical, [and should] include books, journals, and other reference material for collateral reading in connection with the instructional and research programs and professional work ... The library collections, whether centralized or decentralized, should be readily available for use with the assistance of a trained library staff, or through an open-stack arrangement, or both. The ultimate test of the library is the use made of it by the students and faculty." (ABET, 1998)

At the same time, in order to make education available to a wider population, and to maintain the quality of engineering expertise in the U.S., both consortia and individual academic institutions are expanding their programs by offering engineering degrees (both undergraduate and graduate) and professional development classes through distance education. The simultaneous emphasis on the need to teach information skills in addition to fact and method, the importance of library support for engineering programs, and the push to expand engineering degree programs into distance learning

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brings to our attention the need for improved library support of distance learning programs in general, and of engineering distance programs in particular.

### **Distance Learning Needs**

A distance learning program can be solely the responsibility of the parent (originating) institution, without the cooperation of other institutions. However, the logistical requirements of distance learning make it far more simple if two or more institutions cooperate to provide the proper facilities, including: satellite time; video and audio equipment, and other delivery mechanisms; classrooms equipped to receive satellite transmissions; electronic mail and other means of communication. For science and technology courses, the major obstacle is often the provision of on-site laboratory facilities. In order to be considered the equivalent of a degree earned "on-site," a distance learning program must be rigorously similar to its on-site counterpart. However, except in a very few programs, the provision of library support is overlooked as a legitimate program need. Those institutions that do provide such services do so either because it is their mandate to support distance learners (Deakin University, Victoria, Australia) or because they have provided for library support services by contract with another institution (Walden University, Minneapolis, MN and Boca Raton, FL). (Weaver and Shaffer, 1995; Walden, 1998) In most programs it is assumed that the host institution (i.e., the distant site) will provide library services. This assumption is frequently not fulfilled. Bazillion and Braun (1992, 68) state that "Perhaps one of the greatest obstacles for these [distance] students is their remoteness from an academic library and the expertise of its professional librarians."

The Association of College and Research Libraries, out of an increased concern that all students in higher education receive equitable library services, in its most recent Guidelines for Extended Campus Services (1990) took as its philosophy that "The parent institution is responsible for providing support which addresses the information needs of its extended campus programs. This support should provide library service to the extended campus community equitable with that provided to the on-campus community." (ACRL, 1990, 354)

With the foregoing in mind, the remainder of this paper will discuss the use of information by engineers, the perceived need for library and information skills to be taught throughout the college careers of engineers, and the possible methods by which engineering faculties can incorporate the services of libraries and information professionals to support those aspects of engineering education.

### **Engineers' Information Needs and Use**

In the past 30 years, many studies have been done to determine how the engineer seeks and uses information. (King et al., 1994) These studies have approached the problem from a variety of angles: studying the varying needs of the "research engineer" and the "practicing engineer;" the needs of the various engineering specialties, from aerospace to systems; and at what career stage the engineer might be, i.e., student, faculty, junior or senior engineer, and management.

There seems to be a general conformity in how an engineer goes about getting information and the types of information an engineer needs. According to studies by Allen (1977) and Shuchman (1981), engineers are most likely to use oral sources of information over written sources, for instance, informally consulting their co-workers and supervisors, rather than seeking an article or book. Engineers look for sources that are highly accessible, making greater use of internal than external sources of information, and, unlike scientists, tend to seek information on a project- or task-specific basis, rather than for general knowledge building. (Pinelli, 1991) When written sources are used, engineers, unlike scientists, tend to use textbooks, technical reports, handbooks, manuals, catalogs, and trade journals, i.e., sources of technical data and methods, over scholarly journals and general

materials. (Leckie, Pettigrew, and Sylvain, 1996) A survey of chemical engineers listed their top ten information resources as: (1) personal files and books, (2) technical magazines and newsletters, (3) other engineers in department, (4) employer's databases, (5) raw material/equipment vendors, (6) design software, (7) employer's main library, (8) departmental library, (9) on-line bulletin boards/e-mail, and (10) internal engineering consultants/clients/customers. (Rosenzweig, 1994, 55)

### **Teaching Information Skills**

A survey of "higher degree by research students" (i.e., masters and doctoral students) at Deakin University asked the question, "What services would you expect the Library to provide to enable the satisfaction of your research related information needs?" The most frequently requested services were the following: loans of books, photocopies or articles, etc.; electronic database searches; inter-library loans; reference support; assistance with dial-in services and modem installation; post-graduate research contact/liason librarian; reader education; access to theses; dial-in access to the library's catalog, electronic databases, Internet, etc.; and fast turn-around time for requests. (Macaulay, 1997, 191-192)

A study by Leckie and Fullerton (In press) has revealed that science and engineering faculties generally think that undergraduate students' skills in "finding, retrieving, using, and evaluating information were poor in the lower years, and improved somewhat by the upper years. ... [F]aculty generally believe that students ought to know how to do library-based research and that the development of such skills is an important part of their education." When faculty were asked when library instruction was necessary for their students, 78% thought it was necessary at the 3rd-4th year level; 69% also stated that it was necessary at the 1st-2nd year level.

It is sometimes assumed that undergraduates' information needs can be supplied by a textbook and photocopied notes. Leckie and Fullerton point out that all the engineering faculty in their study designed assignments to enhance critical thinking skills, and expected students to use scholarly journals, monographs, review articles, electronic indexes and abstracts, handbooks and manuals, government documents, and print indexes and abstracts in these assignments. Access to library facilities and assistance are apparently as valuable to undergraduates as to graduate students. However, faculty did not have a concrete understanding of how students learn library skills, and assumed that students learned these skills independently, by exposure to the library. Many faculty members were unaware that librarians could provide library instruction in their classes.

In the library world, there is some dismay at what is perceived as declining levels of library skills among engineering students. The modern research library is a complex entity that needs practice to negotiate successfully. Electronic catalogs and databases often allow a user to perform what may seem to be miraculous searches — retrieving hundreds of citations. However, electronic resources can also mask the lack of library skills by retrieving citations from searches that are imprecise or too broad. What may not be recognized by the faculty member is that he has been trained to do research and is experienced at it. Library research methods and information strategies that seem obvious to the faculty member may not occur to the inexperienced undergraduate. (Leckie, 1996)

What is it that the librarian believes a student needs to learn in order to find and use information effectively? Mary W. George, Head of the General and Humanities Reference Division, Princeton University Library articulated a "wish list" of information skills in 1988, among them: (1) Understanding the difference between knowledge, information, and opinion, (2) The ability to create an overall research plan, (3) Understanding the concepts behind Boolean logic, and how to use them in forming a strategy for online catalog and database searching, (4) Knowing the principles of selecting and evaluating sources, (5) Knowing the differences between information sources and reference

tools (dictionaries, manuals, textbooks, etc.) and how and when to use them, and (6) The importance of accurate citations and keeping a research log. (George, 1988)

It is clear that the engineering faculty and the academic librarian have the same aspirations — producing a well-educated population of future engineers to take their place in our knowledge society. The only question is how to promote the incorporation of teaching information skills into the engineering curriculum, whether for on-site or distance learning programs. And, although much of what is proposed in the following section could refer to on-site academic programs as well as distance learning programs, it is true that distance education students have their own special difficulties in finding support for information needs.

### **Library Support Services for Distance Programs**

Engineering students in on-site programs have ready access to well-developed information systems, including a large academic library, trained librarians, and library computing resources. Students enrolled at remote sites, if they are fortunate, may have the resources of an academic library nearby — however, it is unlikely that they will have the privileges of enrolled students at that library, thus preventing use of services such as interlibrary loans, document delivery, the privilege of charging out more than a minimum number of books, and some of the more sophisticated reference services such as subsidized online searching. Some distance learners are employed by technology companies which often provide library services to their employees. The unlucky distance learning student will have only a small college or public library at his disposal; these are institutions which probably do not own the specialized engineering materials needed for the support of the engineering curriculum. It is for these reasons that the responsibility for library support for distance programs falls upon the parent institution.

In the past, the major problems to providing library support at a distance have included (1) Costs (staffing and management, cost of documents, and postage and shipping), (2) Mailing problems (postal slowdowns, losing documents in the mail), and (3) Communication problems (postal slowdowns and losses, unavailability of fax machines and electronic mail) (Cavanagh and Lingham, 1994)

While library services on campus appear to be “free,” in reality it costs millions of dollars to provide a trained staff, computers and systems, and books and other materials for the use of the academic community. Because of cost-cutting measures and rising expenses, most libraries strictly evaluate the cost-benefit of all new services to prevent cutting into funding for existing services. At most institutions, library support for distance students can only be added by infusions of new money into the system or by removing an existing service. Arrangements must be made with library management to create and staff a new program. It takes advance planning and close communication between the engineering schools and the library to make the distance learning initiative work.

### **Coordinator of library support programs**

A key player in the success of a distance education library support program is the coordinator of library support programs. This position, usually a faculty-status librarian, works with the engineering school to ensure that all library needs are met. The coordinator will evaluate services needed, plan for staffing and other resources for those services, and ensure that all aspects of the program are carried out. The coordinator provides reference services, library instruction (at the parent institution or at the host sites), and problem solving for distance students. The coordinator will also be able to negotiate cooperative agreements between the parent institution and libraries at the host site, allowing the student use of facilities and resources that may have been previously unavailable.

### **Access to the library catalog**

The majority of academic libraries have an online catalog available to the library's users. Many online catalogs are based on client-server software, and are accessible via the WorldWideWeb; others are available via telnet connections. Examples of such online catalogs can be found at the University of Virginia (<http://www.lib.virginia.edu/>) and Clemson University (<http://www.lib.clemson.edu/>). Libraries often provide links to other libraries on their home pages. Membership in library consortia and other cooperative groups offer access to a variety of resources that a single library could not afford. The Virtual Virginia (VIVA) consortium offers its member libraries access to electronic texts, government and statistical data, journal indexes and full-text journals, full-text news sources, and special collections (<http://www.viva.lib.va.us/>).

An academic library's catalog is most often available to the public at-large, while access to specialized services is controlled by a validation scheme that recognizes only members of the academic community. At some institutions, the status of distance or continuing education students is in question. It is important to make sure that students in a distance learning program are given the status of undergraduates or graduates, which allows them entrée to a variety of academic services not offered to non-students. These services can include a higher limit to the number of items which may be charged out of the library, access to reserve materials, and the use of the interlibrary loan and document delivery services.

### **Access to journal indexes and abstracts**

As mentioned above, many library catalogs also offer access to journal indexes and abstracts. In engineering, some of the major indexes include Engineering Index (called Compendex in Dialog and BRS search services, and Ei Compendex\*Web online at <http://cpxweb.ei.org/> and requiring a subscription); INSPEC (computing, electrical engineering, and physics; available through OCLC's FirstSearch or by CD-ROM and requires a subscription); NTIS (the National Technical Information Service available on the web as part of a package of government databases at <http://grc.ntis.gov/index.html>); and the Cambridge Scientific Abstracts collection of indexes (available on the web at <http://www.csa.com/> by subscription): Aluminum Industry Abstracts, Corrosion Abstracts, Engineered Materials Abstracts, Material Business File, Mechanical Engineering Abstracts, METADEX, WELDASEARCH, and World Ceramics Abstracts. Other available indexes cover areas such as environmental science, computing, aerospace, and other engineering specialties. Although the resources listed above primarily offer indexes, full-text access to technical information is rapidly increasing on the Web. It is the academic library's job to provide this information for its users and to make sure that the users know how to find and use this information.

### **Access to full-text information**

Some distance education students will have access to printed copies of necessary handbooks and manuals for technical data. For those who do not, or who have only older versions of those titles on hand, the library can provide access to full-text online versions of the publications. Other full-text data online includes IEEE Standards On-Line ([http://standards.ieee.org/catalog/olis/text\\_index.html](http://standards.ieee.org/catalog/olis/text_index.html)), ASTM Standards (<http://www.astm.org/>), SAE Technical Papers ([http://www.sae.org/PRODSERV/papers/papinfo/pap\\_indx.htm](http://www.sae.org/PRODSERV/papers/papinfo/pap_indx.htm)), the U.S. Dept. of Transportation's Web Index (<http://search.bts.gov/ntl/>), and WebCASPAR, statistical data on science and engineering enrollments in U.S. colleges and universities from the National Science Foundation (<http://caspar.nsf.gov/>). In some cases, the full-text information is provided free, in others the library must subscribe to the online version separately from the printed version, and in other cases, the online subscription is carried along with a subscription to the printed version.

### **Access to documents and services**

Libraries provide a multitude of services for their users, among them circulation privileges, interlibrary loan (ILL), document delivery, and reserve services for specific classes. Typically, circulation is the first service thought of in the library context. In spite of the distance between the parent institution and the host site, it is possible to deliver materials that the library owns to the distance student in a timely manner by using an overnight delivery service such as Federal Express to ship the materials.

Many undergraduate courses depend on the reserve materials on file at the library to supplement the textbook. Electronic reserve services are being implemented at a number of libraries around the country. Instead of requiring the student to go to the library and compete for a single print copy of an article, the article is scanned and made available as a .pdf document or image file on a library's Website. This allows any number of students to retrieve the needed document at the same time, at any time of the day or night, from any location they happen to have a computer. The introduction of the Web into the reserve service puts the distance student on an equal footing with his on-site colleague. For examples of electronic reserves, see the University of Texas at Dallas (<http://www.utdallas.edu/library/reserves/>), the University of Pennsylvania (<http://www.franklin.library.upenn.edu/>), or the University of Virginia (<http://www.lib.virginia.edu/reserve/index.html>).

Interlibrary loan and document delivery provide materials to students that a library does not own. As with circulation, the impediment to the use of ILL has been getting the items delivered in a timely manner. Now, books borrowed through interlibrary loan may also be shipped to the distance student by overnight delivery service. As with reserves, articles or other documents that would be delivered as photocopies can be scanned and delivered on the Web in electronic form. Electronic document delivery offers the same advantages as electronic reserves, making remote site delivery fast and easy, and relatively inexpensive. This is a relatively rare innovation at this time -- examples of electronic document delivery are found at the University of Virginia and the Virginia Polytechnic Institute and State University.

Other document delivery options for the distance student include services such as the CARL Company's UnCover and OCLC's Article First, which, for a fee, will fax a requested article to any location. A number of libraries are turning to such outside sources to give their patrons access to journal titles they do not own, in some cases subsidizing the cost of the service. These services can be used to serve the distance student in a more timely fashion than traditional methods of document delivery and ILL.

### **Access to library instruction and reference assistance**

The ABET criteria for library support emphasizes a "trained library staff" for important reasons. Library professionals are trained to know how to find and evaluate the best sources of information for their customers, and to teach the patrons the most efficient methods of using these sources. While it is within the capability of every faculty member or student to do this individually, it saves time and effort to be assisted by a specialist in the information business. To facilitate consultation with the library staff, an e-mail contact address and a telephone contact number (preferably an 800 number) should be provided for the use of distance students.

In general, many of the resources the library has created for the use of on-campus students can be used by the distance student. For instance, Bridgewater College, Bridgewater, VA, has made its Library Research Guide available on the Web ([http://www.bridgewater.edu/departments/library/guide/intro\\_research.html](http://www.bridgewater.edu/departments/library/guide/intro_research.html)), which allows the stu-

dent to learn to use library resources at her own pace and time. The Science and Engineering Library at the University of Virginia has created an extensive website, with detailed information on resources for each engineering discipline (<http://www.lib.virginia.edu/science/>).

It is also important to remember that the academic librarian is able to provide hands-on library instruction, to assist the user with the technical details of setting up his computer workstation, and to work with the engineering faculty to integrate the learning of information skills into the curriculum. Librarians have become a key component in the mechanical engineering design course at MIT, with each design team assigned a librarian as an integral member. (Weiner, 1996)

## **Conclusion**

“The knowledge society is a society in which many more people than ever before can be successful. But it is therefore, by definition, also a society in which many more people than ever before can fail, or at least come in second. And if only because the application of knowledge to work has made developed societies so much richer than any earlier society could even dream of becoming, the failures ... are seen as failures of society.” (Drucker, 1994)

New technologies have removed or ameliorated many of the obstacles mentioned by Cavanagh and Lingham. Most research libraries have online catalogs available on the Internet. Many of these catalogs offer online databases for searching to the students of the institution. Federal Express and other overnight delivery services operate around the world. Most universities in the U.S. offer electronic mail and other online services to enrolled students. In order to plug into an extensive library support network, the distance student need only have a computer workstation with access to the Internet and communications software *and an awareness of the library support available to her.*

There is no need for the students enrolled in a distance learning engineering degree program to receive substandard library support. By making use of the technological innovations of the past five years, the distance student may employ any of the library services offered to the on-campus student. We cannot afford to allow our future engineers to prepare for the next century with less than superior information skills.

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