The Information-Seeking Habits of Engineering Faculty

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Many studies of information-seeking habits of engineers focus on understanding the similarities and differences between scientists and engineers. This study explores the information-seeking behavior of academic engineering faculty from twenty public research universities. This investigation includes an examination of how frequently engineering faculty seek or access information, how they keep abreast of current developments in the field and find less recent journal articles, how often they visit the library in person, and how important library services and resources are in meeting their information needs. The responses from the survey participants emphasize the importance of electronic access to current and archived scholarly journals for meeting the research and information needs of engineering faculty.

Academic librarians continuously strive to meet the information needs of their users. This requires an understanding of their users' information needs and information-seeking behaviors. This study examines the information-seeking behavior of engineering faculty at twenty academic institutions from across the United States. To better understand how engineering faculty are responding to changes in the information environment, the researchers examined how frequently engineering faculty seek or access information to complete specific tasks, how engineering faculty keep abreast of current developments, how they discover less recent journal articles in their field, how often they visit the library in person, and how important library resources and services are in meeting their information needs.

Understanding the nature of the user community and the information-seeking habits and practices of the users are common themes in library literature. With improved understanding of the information-seeking behavior of engineers in academic environments, librarians can better develop information services and resources, implement policies that help engineering faculty access quality information, and improve collection development practices.

Literature Review

Engineers as Practitioners

King, Casto, and Jones compiled a comprehensive literature review of engineers' information needs, noting that "the 1960s yielded a plethora of STI [scientific and technical information] user studies and surveys largely funded by the federal government."[1] The information-seeking

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behavior of engineers within the corporate and government environment has been well documented since that time. Many of these studies illustrate the differences between scientists' and engineers' information-seeking behaviors. Several studies of engineers as practitioners indicate that engineers do not use library resources or libraries as a primary information source for their work.[2] In a study that identified accessibility as the key factor that influenced an engineer's information-seeking behavior, Fidel and Green aptly stated, "The information-seeking behavior of engineers is a complex phenomenon."[3]

Thomas E. Pinelli documents forty years of information-seeking behavior among engineers and compares and contrasts their behavior to scientists'. He asserts, "Engineers, unlike scientists, work within time constraints; they are not interested in theory, source data, and guides to the literature nearly as much as they are in reliable answers to specific questions. Engineers prefer informal sources of information, especially conversations with individuals *within* their organization."[4] In the early 1990s, Cynthia Steinke wrote, "Despite an abundance of studies, we still don't understand the information-seeking habits of our user communities well enough and thus, we probably are not meeting them. In addition, different fields have developed varying systems of communication which must be identified and recognized."[5] Jean Poland reviewed engineers' communication behavior with an emphasis on informal communication.[6] She concluded that "[l]ibraries are in effect part of the formal spectrum of information transfer, and as such, among the last places scientists and engineers look for information."[7]

Holland and Powell investigated the habits of engineering graduates who had taken a technical communications class during their senior year as compared to engineering graduates who had not taken the technical communications class. They concluded that engineers in both groups showed similar information-gathering preferences and "prefer word of mouth and their own library of information when they seek information."[8] In a subsequent article, Holland discusses the value of current engineering information and engineering back files within the engineering user community. She asserts that "[t]here is also mounting proof that engineers and their students pragmatically select the closest source of information."[9]

In a study of two product development companies, Hertzum and Pejtersen investigate the information-seeking habits and practices of engineers and suggest that engineers value timely access to information that did not waste their efforts. They write, "[w]e find that engineers search for documents to find people, search for people to get documents, and interact socially to get information without engaging in explicit searches."[10] They confirmed earlier research work about the information-seeking behavior of engineers: "Previous work has repeatedly found that engineers' primary source of information is their colleagues within the organization and that the major reason for this is that colleagues are easily accessible."[11]

An investigation on how aerospace engineers and scientists select information providers confirmed a strong preference to gain information from their colleagues and collections within their own organizations.[12] Lishi Kwasitsu examined the information sources used by design, process, and manufacturing engineers within one corporate environment. The researcher discovered that the higher the respondents' academic degree, the less likely they were to rely on colleagues or their own personal files for information and the more likely they were to rely on the corporate library. Kwasitsu notes, "Many of the respondents had used libraries extensively for their degree work and were not only aware of library resources but had acquired a culture of finding and using reliable, published information."[13]

Mueller, Sorini, and Grossman studied one corporate firm with an engineer-

ing function and suggested that the tight delivery times and a distributed workforce may provide different challenges to engineers' information-seeking behavior in the corporate environment than in the academic environment.[14] The best practices identified by this research group include development of personal relationships with the engineers, balancing virtual and physical library services, and integrating library services into the engineering Web models developed by their engineering constituents.[15] Madely Du Preez provides a review of studies concerning the information-seeking behavior of engineers. The author confirms the observation by other researchers that engineers prefer interpersonal communications and information from their trade journals as opposed to information found in scholarly journals.[16]

Engineers as Faculty

In 1993, Barbara D. Farah surveyed engineering faculty at eight universities and asserted that computer engineering faculty chose accessibility as the most frequent reason for selecting an information provider.[17] Farah concluded that "[a]cademic computer engineering faculty showed a clear preference for consulting their own academic library to assist them with their information problems in work-related situations."[18]

Steve Hiller investigated the similarities and differences between scientists and engineers and other academic areas in library use and information needs at the University of Washington. He concluded that "[t]he decrease in physical visits to the library was most pronounced among faculty and graduate students in health sciences, sciences and engineering."[19] Hiller further asserts that faculty in the sciences and engineering were more likely to use library resources remotely and viewed desktop delivery as the highest priority for library support.[20] In a subsequent conference presentation at the American Library Association/ Canadian Library Association meeting in 2003, Hiller reaffirmed this position: "Many recent studies confirm strong preference for remote access to electronic information."[21]

In 2004, Finn and Johnston surveyed index use and other primary information sources by engineering faculty and concluded that journals were selected as the most important resource.[22] M. Doraswamy conducted a case study of 126 engineering faculty in India and concluded that the engineering faculty used monographs more in teaching than in research and used journals significantly more in research than in teaching.[23] In a recent investigation of the information-seeking behavior of academic researchers in natural science, engineering, and medical science, the researchers identified that the most often used resources were journals, Web pages, and personal communications.[24]

Comparison of Engineers as Practitioners and Engineers as Faculty

According to Leckie, Pettigrew, and Sylvain, studies of information-seeking behaviors of engineers have illustrated the preference for oral communication in both universities or corporate research and development settings.[25] The literature suggests that accessibility is the key issue for practitioners. Tenopir and King provide an in-depth analysis of the literature on how engineers communicate, with an emphasis on information resources used by engineers to perform their work.[26] The researchers conclude that "[e]asy access is an engineer's top priority, particularly for practitioners."[27] A consistent theme among the studies of information-seeking behaviors of engineers as practitioners is that they rely on their own knowledge base, interpersonal communication with colleagues, or information from within their own organization. In contrast to the engineers in corporate organizations, Tenopir and King assert that "[i]n academia, engineers tend to be more aware of the services available through formal sources like libraries."[28]

Methodology

The researchers surveyed engineering faculty members at twenty large research institutions from across the United States. The 12-item survey consisted of demographic, open-ended, and close-ended questions (see Appendix). The survey gathered both qualitative and quantitative data and was designed to take less than ten minutes to complete. In September 2009, an e-mail invitation to participate in an online survey was sent to approximately 4,900 engineering faculty members at twenty public research institutions. The institutions were selected as a purposive sample and represented different regions of the United States with engineering programs and relatively large libraries. Student assistants gathered e-mail addresses of all faculty listed on the institutions' Web sites for their Engineering department or college. This typically included both tenured and nontenured faculty as well as researchers and faculty emeritus; the survey was sent to the entire population as denoted on the institutional Web sites. Faculty members were given three weeks to respond; a reminder e-mail was sent after two weeks.

Results and Discussion

About the Respondents

Of the 4,905 e-mail invitations sent, 903 engineering faculty members responded, for a response rate of 18.4 percent. The majority of the respondents were ranked as professors (35%), associate professors (24%) and assistant professors (23%). The remaining 17 percent of respondents were ranked as adjunct faculty, instructors, lecturers, professors emeriti, and "other." A total of 45 percent of the engineering faculty members and researchers had been in their position for sixteen or more years, followed by 22 percent who had been in their position for five years or less, 19 percent who had been in their position six to ten years, and 14 percent who had been in their position for eleven to fifteen years. Thus, almost 60 percent of the respondents had been in their positions more than eleven years.

Meeting Research Needs

The survey found that engineering faculty rely heavily on scholarly journals, Internet resources, and face-to-face discussions with students and colleagues to assist them with their research (see figure 1). It is not a surprise that scholarly journals

FIGURE 1
Percentage of Respondents Reporting the Following Information Sources as Very Important, Important, Neutral, or Unimportant

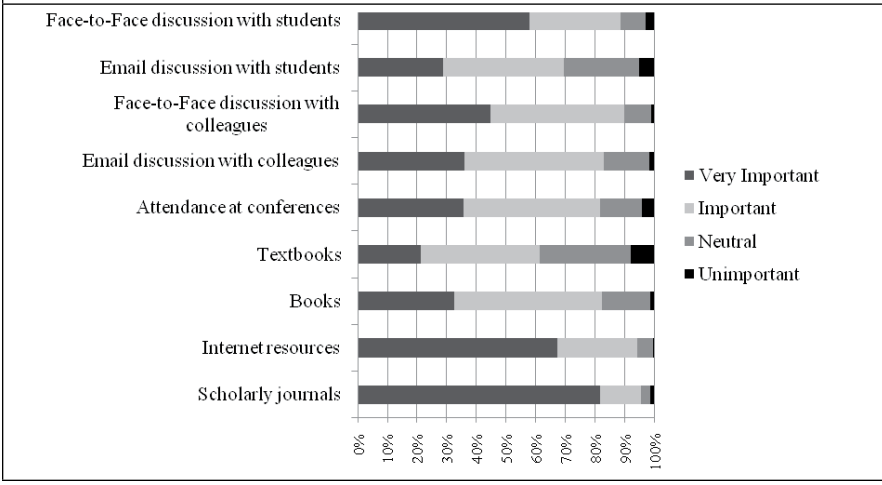


TABLE 1
Percentage of Respondents Reporting the Frequency of Seeking or Accessing Information to Complete the Following Tasks

Tasks	Daily	Weekly	Monthly	1-2/ Semester	Annually	N/A
Prepare for student lectures	32%	49%	5%	5%	1%	7%
Prepare for a conference presentation	2%	11%	32%	39%	11%	6%
Determine protocols for laboratory procedures	4%	13%	15%	17%	13%	38%
Research patents	1%	3%	8%	13%	21%	53%
Write/research for publication	23%	30%	21%	16%	5%	5%
Prepare a new research proposal/grant application	4%	12%	28%	35%	12%	8%
Professional development/ remain current in the field	25%	34%	18%	11%	8%	5%

and Internet resources are the two most important resources for the engineering faculty. In many studies about information- gathering behaviors of faculty, the reliance on and demand for electronic journals and desktop delivery of materials has increased exponentially in the last five years.[29]

The results from this study indicate that the third and fourth most important resource for engineering faculty was face-to-face discussion with students and face-to-face discussion with colleagues. The reliance on personal communication among the engineering faculty closely mirrors the reliance on personal communication for information among practicing engineers in the corporate environment.[30]

Frequency of Information Seeking and/or Accessing Information

Engineering faculty were asked how frequently they sought and/or accessed information to complete seven tasks: preparation for student lectures, preparation for a conference presentation, determining protocols for laboratory procedures, researching patents, research or writing for publication, preparing a new research proposal or grant application, and professional development. In this question, respondents were asked to choose daily, weekly, monthly, once or twice per semester, annually, or not applicable (see table 1).

The frequency of information-seeking behaviors among the engineering faculty respondents relate to their primary responsibilities as faculty members within research and teaching institutions. Fully 81 percent of the engineering faculty seek or access information at least weekly to prepare for student lectures. Nearly three-quarters, or 74 percent, seek or access information at least monthly to conduct research or write publications; 77 percent seek or access information at least monthly for professional development or to stay current in their field. Almost eight out of 10 (79%) of the respondents seek or access information at least once or twice per semester to prepare a new research proposal or grant application; 84 percent seek or access information at least once or twice per semester to prepare for conference presentations, and 62 percent seek or access information at least annually to determine protocols for laboratory procedures. Fewer than half of the survey respondents seek or access

information to investigate research patents annually. These results closely align with the primary responsibilities of an engineering faculty member, with more than 80 percent seeking and/or accessing information most often for student lectures, secondarily for professional development or staying current in their field, and third for research and writing.

In-person Library Visits

Given the value that engineering faculty place on library services available electronically, the results to the question about how often the engineering faculty had visited the library in person during the past twelve months should not be a surprise. Close to three-fourths of the respondents (73%) indicated that they had visited the physical library fewer than five times in the past year. Only 5 percent of the respondents indicated they had visited the library 24 or more times during the past year. These results are similar to the results from the recent study of academic researchers who reported, with the exception of one university of the five universities studied, that "37%–48% of academic scientists visit their library less than five times a year."[31]

Because engineering faculty increasingly use electronic resources and services, their use of the physical library space has decreased. Of the twenty academic institutions surveyed, fifteen have a separate facility identified as an engineering branch library, although many are combined with other libraries. For example, some of these engineering libraries include a science and engineering library, an engineering and physical science library, and an art, architecture and engineering library. In the current economy that has stressed the budgets of public and private academic institutions across the country, it will be interesting to observe whether these engineering branch libraries remain viable or are closed or consolidated with larger collections in the next five to ten years.

Keeping Current in the Engineering Field

The respondents were asked how they keep abreast of current developments in engineering and allowed to choose all of the options. As shown in table 2, engineering faculty rely on conference attendance, references from an article of interest, current issues of journals, and personal communication to keep abreast of current developments in their field. To a lesser extent, the engineering faculty rely on abstracting or indexing tools, electronic discussion lists, RSS feeds, and current awareness services.

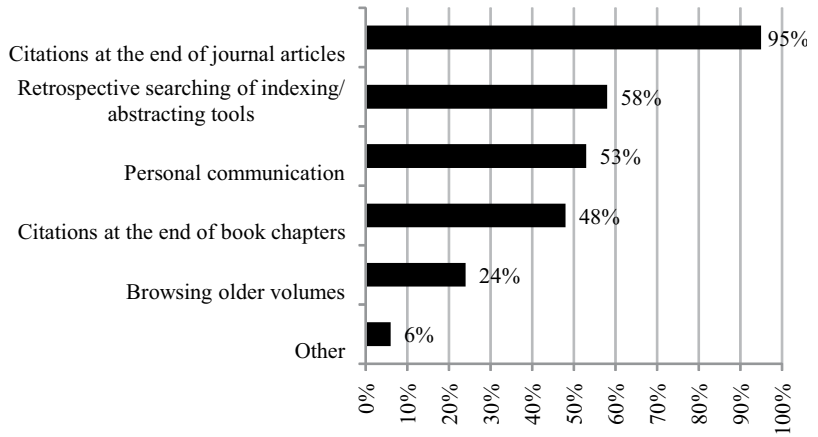
Awareness of Less Recent Journal Articles

The engineering faculty also responded to a question that asked how they became aware of less recent journal articles. This question presented the following options: citations at the end of journal articles, citations at the end of book chapters, retrospective searching of indexing and abstracting tools, personal communication, browsing of older volumes, and "other." As shown in figure 2, engineering faculty rely most heavily on citations at the end of journal articles to track less recent information. To a lesser extent, they rely on retrospective searching of indexing and abstracting tools, personal communica-

TABLE 2
Percentage of Respondents Who Selected Methods to Keep Abreast of Current Developments in Their Field

Methods for Current Awareness	%
Conference attendance	22%
Follow references from an article	21%
Scan current issues of journals	21%
Personal communication	18%
Scan recent abstracting or indexing tools	10%
Electronic discussion lists	4%
Other	2%
RSS feeds	2%
Current awareness service	1%

FIGURE 2
Percentage of Respondents Who Selected Methods to Become Aware of Less Recent Journal Articles



tion, citations at the end of book chapters, and browsing of older volumes.

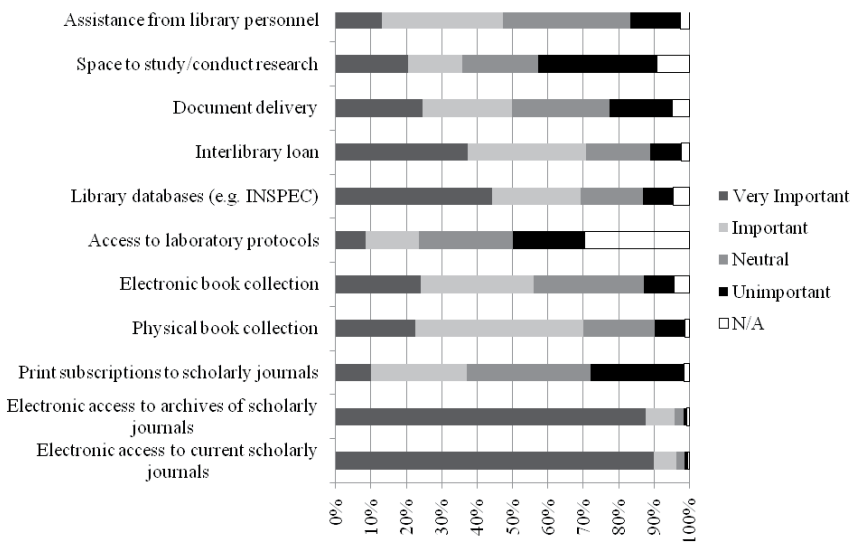
Importance of Library Services

The engineering faculty were asked to rate eleven library services as very important, important, neutral, unimportant, or not applicable to their needs. As illustrated in figure 3, an overwhelming 96 percent of the respondents indicated that electronic access to scholarly journals—both current and archives—is important or very important; maintaining print access to journals is important or very important to only 37 percent of the respondents. The physical book collection is valued as important or very important to 71 percent of respondents, whereas the electronic book collection is seen as important or very important to only 56 percent of respondents. Interlibrary loan services are seen as important or very important by 70 percent of the respondents, whereas document delivery is important or very important to 50 percent of the respondents. Library databases are important or very important to 69 percent of the respondents, but access to laboratory protocols is minimally important to engineering faculty, with only 23 percent indicating it is important or very important. Providing library space to conduct research is seen as important or very important by only 36 percent of respondents. Assistance from library personnel is rated important or very important by 47 percent of respondents.

These results parallel the findings of Hiller, who concludes that faculty and graduate students in engineering rank desktop delivery as the highest priority for library support.[32] He confirms that many recent studies indicate that faculty in the sciences and engineering prefer remote access to electronic information.[33] As budgets allow, most university libraries are working to meet the demands of faculty who consider online access to library resources and materials essential to their research and teaching. The data support the popular belief that the physical space of the library as a repository for materials is of decreasing importance to engineering faculty.

One finding that surprised the researchers was that almost half (47%) of respondents rated assistance from library personnel as very important or important. Particularly in an environment of increasing multidisciplinary research among

FIGURE 3
Percentage of Respondents Reporting the Importance of Library Resources and Services in Meeting their Information Needs as Very Important, Important, Neutral, Unimportant, or Not Applicable



engineering faculty, librarians are continuously reinventing their role in higher education to remain relevant to faculty and students as teachers, as navigators, as procurement agents for the thousands of electronic resources available, and as organizers of these materials to make them relevant and easily accessible to faculty. Almost half of the engineering faculty who responded to this survey found value in the role of library personnel providing assistance in accessing relevant information.

Branch of Engineering and Value Placed on Library Services

The researchers conducted a chi-square test of association to determine the statistical significance of the relationship between the faculty members' branch of engineering and the value they placed on library resources and services for meeting their information needs. Of the eleven library services rated, seven showed a statistically significant relation to a branch of engineering (see table 3). Those that were statistically associated to a branch of engineering include: interlibrary loan ($p<0.001$), physical book collection ($p<0.001$), assistance from library personnel ($p<0.001$), access to laboratory protocols ($p<0.001$), library databases ($p=0.001$), document delivery ($p=0.001$), and print subscriptions to journals ($p=0.002$). This suggests for many services that the importance engineering faculty place on library services is predicated somewhat by the faculty member's discipline and area of emphasis.

As expected, faculty members from all branches of engineering valued electronic access to journals—both current issues and archives. More than 90 percent of the respondents in every branch of engineering rated electronic access to journals as important or very important. Library space to study and conduct research was not valued highly by any branch of engineering. Industrial engineering had the highest number of faculty, indicating that space was important or very important; but, even so, only 45.9 percent of

TABLE 3
Percentage of Respondents by Branch of Engineering Correlated with Importance They Placed on Library Resources and Services for Meeting their Information Needs

Engineering Discipline	ILL	Physical book collection	Assistance library personnel	Access lab protocol	Library databases	Document delivery	Print scholarly journals	E-access current scholarly journals	Space for study& research	E-access archives scholarly journals	E-book collection
p ≤	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.075	0.172	0.189	0.931
Aerospace	71.1%	10.3%	40.0%	14.3%	66.6%	43.2%	36.8%	92.3%	22.9%	92.3%	63.1%
Biomedical/ Bioengineering	64.7%	44.9%	33.0%	43.7%	65.9%	44.9%	24.7%	100.0%	41.4%	100.0%	66.2%
Chemical	78.2%	74.0%	59.3%	27.3%	73.4%	54.6%	36.4%	97.5%	36.4%	96.2%	48.8%
Civil	71.5%	67.8%	62.3%	34.0%	71.9%	51.7%	42.7%	94.1%	35.7%	93.2%	57.4%
Computer Science	53.2%	51.0%	22.3%	8.7%	44.6%	34.5%	21.3%	92.7%	37.6%	93.7%	56.3%
Electrical	63.3%	75.3%	37.0%	14.9%	74.1%	46.2%	29.7%	97.5%	30.1%	96.6%	53.9%
Environmental	77.6%	75.5%	49.0%	36.9%	75.8%	55.1%	36.8%	98.3%	36.9%	98.3%	52.5%
Industrial	86.2%	67.5%	47.2%	13.9%	64.9%	56.7%	34.2%	92.1%	45.9%	92.1%	57.9%
Mechanical	79.2%	80.0%	50.5%	20.6%	76.0%	56.1%	50.9%	99.2%	38.3%	99.1%	60.1%
Petroleum	75.6%	74.3%	62.4%	20.3%	74.8%	56.8%	44.2%	95.3%	36.2%	93.0%	51.6%
Other	87.5%	62.5%	50.0%	28.6%	62.5%	37.5%	75.0%	100.0%	37.5%	100.0%	50.0%

respondents gave it this rating. A mere 22.9 percent of the aerospace engineering faculty members rated space to study or conduct research as important or very important.

Longevity in the Field and Value Placed on Library Resources and Services

The researchers conducted a chi-square test of association to determine the statistical significance of the relationship between a faculty member's longevity in the field and the value placed on library resources and services for meeting information needs. Of the eleven library services rated, four showed a statistically significant relationship to the number of years in the field (see table 4): access to laboratory protocols (p=0.002), document delivery (p=0.003), interlibrary loan (p=0.003), and print subscriptions to journals (p=0.011).

The data illustrate that the longer a faculty member has been in the field, the greater the importance he or she places on print access to scholarly journals. However, only 44 percent of those with more than sixteen years in the field indicated that it was important or very important to maintain print subscriptions. In addition, those with eleven to fifteen years in the field value assistance from library personnel more than other groups, but only 52.6 percent of them indicated that it was important or very important.

Electronic access to journals continues to reign supreme for both current and archival content; it was valued as important or very important by over 90 percent of the respondents in every longevity category. Electronic access to monographs was ranked as important or very important by 62 percent of the faculty respondents who had been in the field less than five years, as compared to the low of 52 percent of the faculty respondents who had been in the field sixteen or more years. Access to physical book collections was ranked important or very important by all respondents at approximately 70 percent. It would appear that electronic access to journals is more

TABLE 4
Percentage of Respondents by Longevity in the Field Correlated with Importance They Placed on Library Resources and Services in Meeting their Information Needs

Library Resources & Services	p=	0-5 years	6-10 years	11-15 years	16+ years
Access to lab protocols	0.002	27.1%	27.2%	33.6%	18.5%
Document delivery	0.003	53.9%	51.8%	61.5%	46.0%
Interlibrary loan	0.003	72.8%	72.6%	80.7%	66.4%
Print subscriptions scholarly journals	0.011	29.0%	30.0%	39.0%	44.4%
Electronic book collection	0.058	61.9%	56.9%	59.3%	52.3%
Space to study/conduct research	0.096	34.8%	37.6%	40.2%	35.3%
E-access to current scholarly journals	0.181	98.0%	95.8%	99.0%	92.6%
Library databases	0.224	62.0%	75.1%	77.7%	68.7%
E-access to archives scholarly journals	0.413	97.5%	94.6%	98.3%	94.7%
Physical book collection	0.726	70.5%	70.5%	71.8%	70.1%
Assistance from library personnel	0.814	42.6%	44.5%	52.6%	49.9%

TABLE 5
Percentage of Respondents by Longevity in the Field Correlated with Selected Sources of Information for Research

Sources of Information for Research	p=	0-5 years	6-10 years	11-15 years	16+ years
Face-to-face discussion with students	0.026	89.3%	90.2%	89.2%	87.3%
Face-to-face discussion with colleagues	0.071	89.8%	92.2%	91.7%	88.2%
E-mail discussion with colleagues	0.072	84.3%	84.2%	83.3%	82.0%
Attendance at conference	0.072	89.4%	95.0%	85.,1%	77.2%
E-mail discussion with students	0.316	42.1%	67.0%	74.0%	68.3%
Books	0.337	80.8%	80.7%	80.9%	85.5%
Internet resources	0.473	96.5%	95.3%	95.0%	92.7%
Scholarly journals	0.605	96.5%	94.7%	97.5%	94.9%
Textbooks	0.872	63.1%	67.2%	62.5%	60.1%

highly valued than any other information resource. The recent Faculty Survey 2009 issued by ITHAKA confirmed that faculty members in many disciplines are increasingly comfortable not only with current scholarly electronic journals but also with electronic journal back files.[34]

> Faculty attitudes suggest that a tipping point has been passed for journal current issues, and, with certain narrow exceptions, that print editions of current issues of scholarly journals are rapidly becoming a thing of the past. And although faculty attitudes on journal backfiles have not yet experienced the same nearly-complete shift, they are changing in parallel with library resources constraints such that backfile print collections will increasingly be replaced exclusively by digitized versions.[35]

Longevity in the Field and Sources of Information for Research

The researchers also compared the association between a faculty member's longevity in the field and the importance placed on selected sources of information for the member's research. Of the nine information sources provided in the survey, only one showed a statistically significant relationship to longevity in the field—face-to-face discussions with students (p=0.026) (see table 5). However, while there may be a statistically significant relationship between longevity in the field and the value placed on face-to-face discussions with students for research, an in-depth examination of the responses would indicate that there is little differentiation, even in this area, between those with more than sixteen years in the field and those with less than five years. For faculty with more than sixteen years in the field, 87.3 percent indicated that face-to-face discussions with students was important or very important for their research; for those with less than five years of experience, 89.3 percent indicated it was important or very important.

Engineering Faculty Narrative Comments

The researchers included an open-ended question in the survey that asked the engineering faculty whether there were services or improvements that their library did not currently provide that would assist them in meeting their information needs. Of the 903 respondents, 167 (18.4%) answered the open-ended ques-

tion. The researchers coded the responses by category such as collections, services, compliments, complaints, and communication (see table 6). Not surprisingly, 34.5 percent of the narrative responses indicated that the engineering faculty wanted more journals, more electronic access to journals, or more electronic access to journal archives. The second most frequently requested improvement was in document delivery services, with 11 percent of the respondents making statements to this effect. The remainder of the open-ended questions represented 10 percent or less of the total responses to the open-ended question.

The narrative comments showed a wide range of compliments and complaints from the engineering faculty that are not surprising to the researchers. For example, "I am not aware of any colleague whose library provides more resources than ours. As such, I am very pleased with the library's offerings" and "Our library is excellent" to "The books our library has in my research area are mostly too old. Many of those books were published in the 1980s" and "The library is woefully lacking in recent online access to many journals in which I'm interested." While few (2.9%) of the narrative responses indicated that the engineering faculty needed assistance from librarians in their institutions, those who commented were specific in their requests for personalized services, such as, "There's basically too much information available. I need librarians to come to my office to assist [me].… Now that faculty access all the archives from their offices, librarians need to go to faculty offices to have the wonderful impact that they used to have before the [I]nternet." The wide range of responses also addressed the physical space of the library and ranged from "There is NOT enough space in the library or elsewhere so I resort to coffee shops to do my research and meet with students!!" to "I wish they'd dispense with the physical library and use the cost savings to subscribe to more e-journals and buy more e-books. The leather-patched-jacket-wearing professor smoking a pipe at the library doesn't work anymore. If it's not electronic access, it isn't useful." In general, the narrative responses reinforced the high value that faculty place on the availability of electronic resources for their research and teaching.

Conclusion

The researchers studied the information-seeking behavior and habits of engineering faculty in academic environments. The responses from survey participants confirmed the findings of other stud-

TABLE 6
Engineering Faculty Narrative Responses

Ranked Narrative Responses	#	%
Increase journals, E-journals, journal back files	47	34.5%
Improve document delivery services	15	11.0%
Compliment (general)	13	9.5%
Increase E-book collections	8	5.8%
Compliment (electronic resources)	6	4.4%
Increase E-access to databases, indexes, citation indexes	6	4.4%
Increase monograph collection	5	3.6%
Complaint (budget)	5	3.6%
Complaint (journal cut)	4	2.9%
Improve communication w/ library personnel	4	2.9%

ies that electronic access to current and archived scholarly journals and Internet resources are important to meeting their research and information needs. Similar to their engineering colleagues in the corporate environment who rely on coworkers as trusted information sources, academic engineering faculty also rely on face-to-face discussion with their students and colleagues to help with their research and teaching.

As the most recent ITHAKA study on faculty attitudes indicated, faculty in all disciplines increasingly rely on electronic resources for their research and teaching. The study verified the trend that "the library's physical edifice and catalog have declined steadily as starting points for research."[36] As a result, faculty are using online services for their discovery path, with the library becoming the 'behind the scenes' procurement agent.[37] Unless branded by the library, it may not be obvious to the faculty member that the library has any role in providing these resources and services for research and teaching. The ITHAKA report asks a relevant question of the academic library community: "Can the academic library reengage with scientists?"[38] The researchers of this paper would suggest a corollary question: "Can the academic library reengage with engineering faculty?"

Is the library becoming more or less relevant to engineering faculty in the academic environment? The mission of the university library is to provide resources and information services that help the engineering faculty meet their research and teaching goals. This study's respondents clearly indicate that electronic access to journals, journal back files, and even monographs are important to their research and teaching. The library has a unique opportunity to develop its role as the procurer and curator of the electronic resources that engineering faculty demand. Simultaneously, the physical space of the library is less important to the engineering faculty surveyed. Librarians are thus challenged to expand and promote their role as educators, onsite research consultants at the engineering faculty members' point of need, procurement agents, and organizers of access to electronic resources that will continue to serve the needs of engineers within their universities.

Further research on engineering faculty must be conducted to answer additional questions. Do the information-seeking behaviors of academic engineering faculty mirror the behavior of researchers in other disciplines, or do they more closely mirror that of their peers in engineering corporate environments? In addition, how have academic librarians used Web 2.0 applications to integrate new models of information discovery through blogs, RSS feeds, Facebook, Twitter, and other social networking tools for engineering faculty? Is the information-seeking behavior of academic engineering faculty influenced largely by what is available at their local university library? Further research will help address these questions and assist librarians in fulfilling the core library mission of supporting the research and teaching needs of academic engineering faculty.

Appendix: Information-Seeking Habits of Engineering Faculty Survey

1. What is your status within your university?
   - ❑ Professor
   - ❑ Associate Professor
   - ❑ Assistant Professor
   - ❑ Adjunct Professor
   - ❑ Instructor
   - ❑ Lecturer
   - ❑ Professor Emeritus
   - ❑ Other (please specify):

2. Which branch of Engineering is your area of emphasis? (Please select the answer most closely aligned with your area.)
   - ❑ Aerospace
   - ❑ Biomedical/Bioengineering
   - ❑ Chemical
   - ❑ Civil
   - ❑ Computer Science
   - ❑ Electrical
   - ❑ Environmental
   - ❑ Industrial
   - ❑ Mechanical
   - ❑ Petroleum
   - ❑ Other (please specify):

3. How long have you been a faculty member/researcher in your area of study?
   - ❑ 0-5 years
   - ❑ 6-10 years
   - ❑ 11-15 years
   - ❑ 16+ years

4. Which of the following are included in your departmental duties? (Select all that apply.)
   - ❑ Undergraduate Instruction
   - ❑ Graduate Instruction
   - ❑ Laboratory Research
   - ❑ Field Research
   - ❑ Commercial/Proprietary Research
   - ❑ Supervision of Doctoral Research
   - ❑ Grant Preparation
   - ❑ Other (please specify):

5. How many of the following have you completed within the last 5 years?

	0	1-3	4-7	8-11	12+
Refereed journal articles or book chapters					
Non-refereed journal articles or book chapters					

Conference proceedings					
Grant applications					
Patents/commercial projects					
Books					

6. How frequently do you seek and/or access information to complete the following tasks?

	Daily	Weekly	Monthly	1-2 times/ semester	Annually	N/A
Prepare for student lectures						
Prepare for conference presentation						
Determine protocols for laboratory procedures						
Research patents						
Write/research for publication						
Prepare new research proposal/ grant application						
Professional development/ remain current in field						

7. How important are the following in helping you with your research?

	Very Important	Important	Neutral	Unimportant	N/A
Scholarly Journals					
Internet resources					
Books					
Textbooks					
Attendance at conference					
Email discussion with a colleague					
Face to face discussion with a colleague					
Email discussion with a student					
Face to face discussion with a student					

8. How do you keep abreast of current developments in your field(s)? (Please check all that apply.)

- ❑ Scanning current issues of journals
- ❑ Scanning recent issues of abstracting/indexing tools
- ❑ Personal communication

- ❑ Attendance at conference
- ❑ Follow references or leads from an article or item of interest (citation trail)
- ❑ Electronic discussion lists
- ❑ RSS feeds
- ❑ Current Awareness service
- ❑ Other (please describe):

9. How do you become aware of other less recent journal articles? (Please check all that apply.)

- ❑ Citations at end of journal articles
- ❑ Citations at end of book chapters
- ❑ Retrospective searching of indexing/abstracting tools
- ❑ Personal communication
- ❑ Browsing through older volumes
- ❑ Other (please describe):

10. How often did you visit the library in person in the last 12 months?

- ❑ Never
- ❑ 1-2 visits
- ❑ 3-5 visits
- ❑ 6-12 visits
- ❑ 13-23 visits
- ❑ 24 or more visits

11. How important are the following library services in meeting your information needs?

	Very Important	Important	Neutral	Unimportant	N/A
Electronic access to current scholarly journals					
Electronic access to archives of scholarly journals					
Print subscriptions to scholarly journals					
Physical book collection					
Electronic book collection					
Access to laboratory protocols					
Library databases (e.g. INSPEC)					
Interlibrary loan					
Document delivery					
Space to study/conduct research					
Assistance from library personnel					
Other (please specify)					

12. Are there services your university library does not currently provide, but you wish they did? If so, please explain how these services would assist you in meeting your information needs.

Notes

1. Donald W. King, Jane Casto, and Heather Jones, *Communication by Engineers: A Literature Review of Engineers' Information Needs, Seeking Processes, and Use* (Washington, D.C.: Council on Library Resources, Inc., 1994).

2. Thomas J. Allen, *Managing the Flow of Technology: Technology Transfer and the Dissemination of Technological Information within the R&D Organization* (Cambridge, Mass.: MIT Press, 1977); Hedvah L. Shuchman, *Information Transfer in Engineering* (Washington, D.C.: The Futures Group, 1981); Thomas E. Pinelli, Ann P. Bishop, Rebecca O. Barclay, and John M. Kennedy, "The Information-Seeking Behavior of Engineers," *Encyclopedia of Library and Information Science*, eds. Allen Kent and Carolyn M. Hall (New York: Marcel Dekker, 1993), vol. 52: 167–201; Donald O. Case, *Looking for Information: A Survey of Research on Information Seeking, Needs and Behavior* (San Diego, Calif.: Academic Press, 2002); David Ellis and Merete Haugan, "Modelling the Information Seeking Patterns of Engineers and Research Scientists in an Industrial Environment," *Journal of Documentation* 53, no. 4 (l997): 384–403.

3. Raya Fidel and Maurice Green, "The Many Faces of Accessibility: Engineers Perceptions of Information Sources," *Information Processing and Management* 40 (2004): 563–81.

4. Thomas E. Pinelli,"The Information-Seeking Habits and Practices of Engineers," *Science & Technology Libraries* 11 (1991): 5–25.

5. Cynthia Steinke, *Information Seeking and Communicating Behavior of Scientists and Engineers* (Binghamton, N.Y.: Haworth Press, 1991).

6. Jean Poland, "Informal Communication among Scientists and Engineers: A Review of the Literature," *Information Seeking and Communicating Behavior of Scientists and Engineers*, ed. Cynthia A. Steinke (Binghamton, N.Y.: Haworth Press, 1991), 61–69.

7. Ibid., 69.

8. Maurita Peterson Holland and Christina Kelleher Powell, "A Longitudinal Survey of the Information Seeking and Use Habits of Some Engineers," *College & Research Libraries* 56 (1995): 7–15.

9. Maurita Peterson Holland, "Modeling the Engineering Information Professional," *Science & Technology Libraries* 17, no. 2 (1998): 31–43.

10. Morten Hertzum and Annelise Mark Pejtersen, "The Information-Seeking Practices of Engineers: Searching for Documents as Well as People," *Information Processing and Management* 36 (2000): 761–78.

11. Ibid., 776.

12. Claire J. Anderson, Myron Glassman, R. Bruce McAfee, and Thomas Pinelli, "An Investigation of Factors Affecting How Engineers and Scientists Use Information," *Journal of Engineering and Technology Management* 18 (2001): 131–55.

13. Lishi Kwasitsu, "Information-Seeking Behavior of Design, Process and Manufacturing Engineers," *Library & Information Science Research* 25 (2003): 459–76, available online at doi:10.1016/S0740-8188(03)00054-9 [accessed 18 March 2010].

14. Britt K. Mueller, Greg Sorini, and Elizabeth Grossman, "Information Seeking Behavior of Engineers in the Corporate Environment: Implications for Information Delivery," *2005 Contributed Professional Papers, Special Libraries Association Annual Conference, Toronto, Canada* (June 5–8, 2005), available online at www.sla.org/content/Events/conference/ac2005/contribpapers/index.cfm [accessed 18 March 2010].

15. Ibid., 7.

16. Madely Du Preez, "Information Needs and Information-Seeking Behavior of Engineers: A Systemic Review," *Mousaion* 25, no 2 (2007): 72–94.

17. Barbara D. Farah, "The Information-Seeking Behavior of Academic Computing Engineers," in *Looking to the Year 2000: Information Professionals Chart the Course: Professional Paper from the 84th Annual Conference of the Special Libraries Association, June 5–10, 1993, Cincinnati, Ohio* (Chicago, Ill.: Special Libraries Association, 1993): 65–101.

18. Ibid., 95.

19. Steve Hiller, "How Different Are They? A Comparison of Academic Areas of Library Use, Priorities and Information Needs at the University of Washington," *Issues in Science & Technology Librarianship* 33 (2002), available online at www.istl.org/02-winter/article1.html [accessed 18 March 2010].

20. Ibid., 12.

21. Steve Hiller, "How Scientists and Engineers Find Information and Use Libraries," *ACRL-STS Program Partners in Science: An Exploration of a Scientist-Librarian Relationship,* ALA/CLA Annual Conference, June 23, 2003, Toronto, Canada, available online at www.lib.washington.edu/assessment/conferences/STSjune2003Hiller_files/frame.htm [accessed 18 March 2010].

22. Bette Finn and Pat Johnston, "Index Use by Engineering Faculty and Students," *Georgia Library Quarterly 41*, no. 3 (2004): 5–15.
23. M. Doraswamy, "The Relationship of Academic Role and Information Use by Engineering Faculty," *Library Philosophy and Practice* (2009): 1–9, available online at http://unllib.unl.edu/LPP/doraswamy2.pdf [accessed 19 March 2010].
24. Xi Niu, Bradley M. Hemminger, Cory Lown, Stephanie Adams, Cecelia Brown, Allison Level, Merinda McLure, Audrey Powers, Michele R. Tennant, Tara Cataldo, "National Study of Information Seeking Behavior of Academic Researchers in the United States," *Journal of the American Society for Information Science and Technology* 61, no. 5 (2010): 869–90, available online at http://dx.doi.org/10.1002/asi.21307 [accessed 24 May 2010].
25. Gloria J. Leckie, Karen E. Pettigrew, and Christian Sylvain, "Modeling the Information Seeking of Professionals: A General Model Derived from Research on Engineers, Health Care Professionals, and Lawyers," *The Library Quarterly* 6, no. 2 (1996): 161–93.
26. Carol Tenopir and Donald W. King, *Communication Patterns of Engineers* (Hoboken, N.J. : John Wiley, 2004).
27. Ibid., 58.
28. Ibid.
29. Hiller,"How Different Are They?" 12; Hiller, "How Scientists and Engineers Find Information and Use Libraries,"10.
30. Anderson et al., "An Investigation of Factors," 151; Hertzum and Pejtersen, "The Information-Seeking Practices of Engineers," 761.
31. *Xi Niu et al., "National Study of Information Seeking Behavior," 878.*
32. Hiller, "H*ow Different Are They?" 12.*
33. Hiller, "How Scientists and Engineers Find Information and Use Libraries," 5.
34. Roger C. Schonfeld and Ross Housewright, *Faculty Survey 2009: Key Strategic Insights for Libraries, Publishers, and Societies* (2009), available online at www.ithaka.org/ithaka-s-r/research/faculty-surveys-2000-2009/Faculty%20Study%202009.pdf [accessed 22 April 2010].
35. Ibid., 15.
36. Ibid., 5.
37. Ibid.
38. Ibid., 14.