Librarianship at the Intersection of Engineering and Business

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Introduction

Oregon State University has initiated two programs that engage engineering students in entrepreneurship. The first program is an entrepreneurship minor available through the College of Business that enrolls engineering and science majors in the same courses with business students. The second is the Austin Entrepreneurship Program, a residential program offered through the College of Business and designed to give engineering and other students with entrepreneurial interests a chance to "live, dine, work and dream together in an incubator community." It is scheduled to open in a renovated historic residence hall in Fall term, 2004.

OSU Libraries is looking for ways to positively impact the entrepreneurship program by understanding the information needs of the community. The nature of information-seeking behaviors and information needs of engineers and business students presents a number of challenges, as do the as yet unknown needs of the entrepreneurship program. This paper explores ways OSU Libraries can address these challenges and contribute to the new focus through collections, services, instruction and research. Also addressed are the roles librarians can play to further the success of the entrepreneurship endeavors.

Austin Entrepreneurship Program at Oregon State University

Oregon State University (OSU) is a land, sea, and space grant institution with a student population of around 20,000. It is one of four universities in the Northwest to be granted a ranking of Carnegie Doctoral/Research-Extensive. There were over 3,000 undergraduate students in engineering and over 2,000 undergraduates in business as of Fall term, 2002.[1] In 2003, the university completed a strategic plan emphasizing five multidisciplinary themes. One of the thematic areas is "optimizing enterprise, technological change and innovation."[2] To capitalize on this theme, university administrators are looking at greater levels of collaboration across disciplines, departments and colleges within OSU, with other universities in Oregon and elsewhere, and with the public sector, especially business and industry. The College of Business and the College of Engineering each bring strengths to the implementation of the theme.

The College of Business has been charged to provide business education to other academic units, especially those with a strong technology focus, so that the University can build capacity and success in transferring knowledge and research to various industries and to develop start-up companies.[3] The College of Engineering is collaborating with the College of Business through the Austin Entrepreneurship Program. The program currently has two components, an entrepreneurship minor, and the residential college.

In 2003, the College of Business created an entrepreneurship minor. The Entrepreneurship Minor consists of existing classes offered by the College of Business and adds three unique entrepreneurship courses. Students who minor in entrepreneurship are required to take twenty-eight credit hours in accounting, business law, entrepreneurship, finance, marketing and venture management.[3]

The centerpiece of the program is the residential college at Weatherford Hall, an historic structure that is being renovated to serve as the home of the entrepreneurial community. It will be one of two entrepreneurial residential programs in the country. The community includes a live-in entrepreneurship professor and living quarters for visiting industry leaders who will interact with the students. Weatherford Hall is designed as an inclusive community unit including a dining hall, collaborative workspaces for students, a cyber-café, a boardroom and a library. The library is envisioned as a reading room of current periodicals relating to entrepreneurship, and may have a small core collection of reference materials and books chosen by visiting scholars, entrepreneurs, and alumni.

As a partner in the success of this program, OSU Libraries has been grappling with questions concerning how best to serve entrepreneurial students, faculty, and visiting researchers. Once the program is in place, the library will respond to information gathered from needs assessments, surveys, use statistics, conversations with users, and feedback and suggestions from the community. However, some anticipatory effort is required to ensure success prior to the launch of the program.

Best practices and models currently used in academic libraries will inform OSU Libraries' efforts, and examples of information services from the corporate environments these students will enter as graduates can offer direction. Trends in the general "social landscape" can be examined for insights. The rapid evolution of web-based goods and services, and the comfort that many users have with this form of access, suggests that libraries need to acknowledge and support independent information-seeking in new ways.[4] Students in the Austin Entrepreneurship Program will constitute a unique community on campus with needs that will challenge traditional approaches to library collections, services and instruction.

Background

Engineering education increasingly includes opportunities for students to study business and entrepreneurship concepts. Courses are offered within engineering programs, in cooperation with business schools, or through collaborative units, such as an entrepreneurial center on campus.[5] Some authors suggest that an entrepreneurial focus in engineering represents a paradigm shift in engineering education and practice.[6] This shift may be attributed to pressures in the marketplace including rapid technological development, globalization of manufacturing and services, shortening of product development cycles, and improvement of information management systems for production, distribution, supply, and logistics. The ability to quickly and effectively gather the right information is a key predictor of success in the fast-paced, high-tech, medical, and consumer goods markets.[7]

Another factor in the rise of entrepreneurship in engineering education is the promise of financial benefit to institutions of higher learning and the economic regions they serve. Colleges and universities seek to augment diminishing budgets through alternative forms of income. Leveraging research strengths into financial gain through technology transfer and partnerships with industry is an attractive option, and can lead to synergistic regional economic development.

Although there is disagreement about the place of entrepreneurship content in engineering curricula,[8] there seems to be consensus that skills beyond the scientific and technical are needed for success as an engineer in the current and future market environment. Some of those skills are interpersonal, such as the ability to work in multi-disciplinary groups and to communicate well with customers, suppliers, and co-workers. Other skills can be gained through training in business concepts such as business plans, finance, product design, marketing, sales, and distribution. Because many engineers will ultimately work in product and/or project management roles, managerial skills are also important. In a Canadian study, engineers who had at least one course in entrepreneurship were found to be more likely to start new business ventures. Taking an entrepreneurship course was also a strong predictor of moving into top management.[9] For graduating engineers who do not immediately start a new venture, entrepreneurship courses prepare them to be more "intrapreneurial" within a larger company as they bring a greater degree of business awareness, innovation and creativity to their future employers. Also, more engineering graduates are now finding employment in smaller, start-up companies, where flexibility and business savvy are highly prized.[10]

Information-seeking behaviors and information needs in engineering and business

The information-seeking behaviors of engineers have been extensively studied and offer insights into the information skills needed by engineering students. The information-seeking habits of business students have also been studied, and can shed light on the information needs of budding entrepreneurs. Are there commonalities between these two groups that would aid academic librarians in their interactions with future engineering entrepreneurs?

Studies of the information-seeking behavior of engineers show that two major obstacles are the cost and time involved in searching for and obtaining needed information.[11] Related to time pressures is the propensity of engineers to choose the most easily accessible information sources and to depend heavily on colleagues for information.[12] Engineers tend to follow the principle of least effort when gathering information, and have been found to use their personal technical collections, or consult with coworkers and others outside organization, before using corporate information centers or librarians.[13]

In a recent study of practicing design, process and manufacturing engineers, Kwasitsu found that work roles were an important factor in information-seeking behavior and that the top three types of information needed were product and technical documentation, specifications, and conference proceedings or white papers.[14] Because many of these documents are proprietary, they are not always available through corporate libraries. Often they are collected on internal project web sites. It is interesting to note that manufacturing engineers rated the corporate library of lowest use to them as an information source, while design and process engineers rated the library as moderately important or highly important as a source of information. Another intriguing finding

of the study was that the higher the level of education the engineer had, the greater was the use of the corporate library. This seems to imply that graduate level work gives engineers a greater level of familiarity with what kinds of information are available in libraries. Conversely, it may show that undergraduates do not become familiar with library information, and therefore do not know what value it may have to them.

Rodrigues describes the industry expectations of future engineers.[15] Engineering firms are looking for the "work-ready engineer," an employee who can "hit the ground running" and add to the productivity of the company early in their employment. Employers assume that new engineers know how to gather, evaluate and use the information they will need for their projects, whether or not they have access to a library within the company. Engineers are expected to organize research information in laboratory notebooks or other formats and to communicate research and results in a meaningful and coherent manner. For engineering entrepreneurs, the information they will need to communicate is likely to include not only technical and product information, but information on business and marketing as well.

Atkinson and Figueroa studied business students' information seeking behavior.[16] Their findings confirmed conventional wisdom that business students spend little time in the library, that they prefer electronic resources to print, and that indexes and citations are not often used as a means to further research. Business students tend to "commodify" information and have a clearly defined sense of the break-even point between the time they are willing to expend in the search and retrieval process and the amount of relevant information gathered. In a study conducted by Morrison, Kim and Kidd, [17] business students' urgent and immediate needs for information were found to influence their preference for the World Wide Web. In both studies, students were far more likely to gauge the utility of information by the perceived ease and immediacy of access, rather than by any inherent quality of the information gathered. Business students showed a distinct preference for using the World Wide Web and perceived it more favorably than other information tools.

Business students tend to have a great deal of confidence in their searching abilities when confronted with an information need, but this confidence does not extend to using specialized library resources for their topics; the library itself may produce anxiety that students tend to avoid. Cunningham asserts that, "too often, students are unaware of the wide range of business databases or specialized publications available through their libraries, until they stumble upon them or see them presented in a library instruction session."[18]

Patterns and preferences

Commonalities in the way engineers and business students interact with information are likely to apply to the entrepreneurship community. Both groups have strong preferences for resources available on the World Wide Web. Each group tries to strike a balance between speed or ease of access and the quality of information that is likely to be gained. A resource that is "good enough" is worth more to them than spending time to find an excellent resource. In both their academic and professional careers these students will need to gather and evaluate and analyze information to support both collaborative and independent work.

Despite the fact that both groups will need strong information skills for professional success, they are disinclined to come to the library to seek out those skills or resources. If these patterns and preferences prove to be applicable to the entrepreneurship community, then it will be vital to find ways to bring the library to the users. To serve them well, the library will have to focus on ways to deliver collections, services and instruction at their point of need.

Library collections and services

If academic departments are becoming more like small business enterprises, as in the Austin Entrepreneurship Program, perhaps academic libraries should selectively adopt some of the strategies of corporate libraries. Corporate or special libraries differ from academic libraries in collections and services as well as mission. Where academic libraries have historically supported disciplines with broad, "just-in-case" collections, corporate libraries have more tightly focused core collections with strategic collection development targeted to support current business needs. As the business environment changes, so too will the focus of students and faculty in the Austin Entrepreneurship Program. To keep pace with these changing needs, collection development efforts will need to be tied to the curriculum and current use of collections and services. Alternatives to the standard acquisition processes for library materials need to be in place to accommodate special requests for market research, standards and specifications, or other specialized information resources not owned by the library.

Corporate libraries use technology extensively to deliver information to the desktop. The aim is to provide a user-driven, seamless environment of internal and external information resources in multiple formats. For example, at Ford Motor Corporation, users can customize an intranet service offered by Library Systems and Information Research to deliver their own mix of daily information, choosing from internal and external news feeds, current awareness services, handbook, patent and standard information, technical reports, online subscription databases, market research and user-initiated document delivery service. [19] Part of the library's role in this environment is to enable independent information-seeking by easing access to quality content.

Instruction

Morrison, *et al*. state that "being able to obtain the best information in the shortest amount of time is the workplace skill of the future."[20] Successful engineering entrepreneurs will need sophisticated skills for independent information searching, selection, and evaluation in an increasingly global and electronic environment. They will not only need to know how to find information quickly, but they will need to understand how to utilize the best sources to make their information-seeking and decision-making efficient and effective. Developing information skills does not have to be left to chance. Rodrigues suggests that the best time for engineers to develop information gathering and evaluation skills is during their college years, when they have access to academic libraries and librarians.[10]

Both engineers and business students use information in practical and pragmatic ways and, to a large degree, the information they need within their respective programs is supplied to them in the form of textbooks, experiments, case studies, course packs, and through course management software. However, there are points in the curriculum where further information resources are

clearly needed, and where targeted library instruction is valuable to improve the quality of student projects and research papers. Examples include technical and professional writing courses, design, capstone or synthesis courses for which students seek external sources of information, and thesis or dissertation work requiring a comprehensive literature review. Also, certain pedagogical frameworks such as active learning or problem-based learning provide opportunities to introduce students to the literature and research tools of their field. Ideally, information skills would be integrated into the entrepreneurship curriculum. [21]

Librarians assist in integrating information skills into the curriculum by collaborating with teaching faculty to design research assignments and to progressively build student's information skills. [22] Involvement can vary greatly according to the needs of the course. MIT librarians were intensely involved in a senior mechanical engineering design course when they were assigned to one of the student teams.[23] Librarians attended class lectures and became an information resource for the students beginning with idea generation and market analysis, moving through the design process and finishing with the presentation of prototypes to potential investors. One of the lessons learned in the course was that students were unfamiliar with the analysis of business information; therefore they did not always know what to do with the information they requested and received from the librarian.

An example of cross-disciplinary library instruction comes from the University of Arizona Library, where the business librarian and one of the science librarians have collaborated for several years to deliver business research instruction to a senior-level materials engineering design course. [24] In this course, students go through the entire design process from preliminary research on prior art and properties of materials, to determining markets, competitors, costs and profitability. The librarians tailored an instruction session and created a web-based research guide to familiarize the students with business research. Library instruction such as this is successful because it targets a specific need, is tied to a particular class assignment, gives the students a guide for later referral, builds on a continuing relationship between librarians and faculty, and is responsive to changes in the focus of the course.

OSU Libraries relationship to the entrepreneurship program

In the summer of 2003, the head of collection development at OSU Libraries and the liaison librarian for business and engineering met with the faculty administrators of the Austin Entrepreneurship Program. The meeting gave the librarians an opportunity to learn about the focus and scope of the new program and to understand the nature and structure of the collaborative efforts between the College of Business and the College of Engineering. The residential part of the program was still in the planning and fund-raising stages, and the vision of how the community would develop was (and is) still evolving. Establishing a relationship between the library and the new program early in the process has had positive effects. It has been beneficial to have time to think, plan ahead, brainstorm, and discuss how the library can interact with the new program and its community. The librarian also had ample lead time to begin collecting recommended entrepreneurship books and conference proceedings and to prepare new journal requests from core lists of resources provided by the entrepreneurship professor. When the time came for entrepreneurship faculty to write a grant proposal for funds

to furnish and stock the entrepreneurship program's library, the librarian was already up to speed on the project and could furnish information for the proposal.

OSU Libraries is well positioned to craft collections, services and instruction to enhance the development of the Austin Entrepreneurship Program. The Libraries has excellent physical facilities, an expanding collection of online resources and services, and a growing expertise in digital collections. The physical environment of the main (Valley) library offers wireless network access, quiet and group study areas, an information commons, a collaborative learning space, and two computer teaching labs. There are over 1.4 million volumes and over 7,000 serial titles held by OSU Libraries. If the entrepreneurship community follows the patterns and preferences described above, the physical environment of the library may be of little concern to these users whose primary concerns will be speed, ease of use and convenience. Why should a self-contained program venture out to the library, no matter how close the buildings are to one another? The entrepreneurship community may be regarded as a remote user population.

Remote access to library resources is constantly improving. The OSU Libraries online access to full-text content is growing and is currently at roughly 12,000 serials and approximately 2,000 electronic books. Link resolving software and meta search engines based on the OpenURL framework, while not yet providing seamless delivery that librarians and users hope to see, will facilitate access to online content.

One way to tailor content for the entrepreneurship program would be for the librarians to collaborate with students and faculty on the design of a desktop interface for the residential program. The design might be modeled on a corporate intranet, where library information is accessible through the Austin Entrepreneurial Program portal. The Libraries' information becomes more relevant and valuable for being placed in the context of other community-oriented information. This interface could be customizable so that users could center it on their interests and information needs and should allow students to share resources with others in the community. Collaboration and sharing of information could be accomplished through the use of web log (blog) software or a feature such as communities on Blackboard™ course management software. Current awareness needs could be met by incorporating RSS (Really Simple Syndication) technology to include headlines from relevant web sites and news feeds. Delivery of information to mobile devices such as cell phones and PDAs should be considered.

Librarians can consult with remote library users over the phone, via e-mail, and also through synchronous virtual reference services. OSU Libraries has been part of a statewide pilot project for virtual reference services using chat technology and librarians are pursuing options to continue this as a regular service to the OSU community. A service such as this could be of great benefit to the entrepreneurship community. An online video-conferencing tool such as NetMeeting could be used to put a face on online reference and support, with the ability to push web pages to students, and share desktop applications to help them with searching challenges. Another strategy librarians have used to provide reference service to students and faculty who are unlikely to venture into the library building is to offer office hours within departments, in dining halls, or other areas where students congregate.

Electronic delivery of library instruction matches the preference of engineering and business students to use online information. Students involved in the entrepreneurial program will have information needs that are not tied to the standard curriculum but may arise as they begin to explore ideas for new products and business ventures. Online tutorials should be short, highly focused and easily available at the point of need, while the student is using the tool. Library tutorials could be designed to serve specific aspects of the design process, such as preliminary patent searching or the use and location of specifications and standards. For longer or more structured sessions, a Webinar (web-based seminar) or Blackboard class space for online instruction could be effectively used.

Research opportunities and future considerations

The entrepreneurship program offers a tremendous opportunity for OSU librarians to study the information needs and information-seeking behaviors of entrepreneurial students. Inter-disciplinary research, partnering OSU library faculty with entrepreneurship program faculty, as well as librarians from corporate and special libraries, can extend greatly our understanding of the unique needs of this group.

Observation and assessment of student projects would give the library needed feedback about collections and delivery formats. Anonymous tracking of the use of library web pages, tutorials and subscription databases could influence plans for instruction and refine the collection of online resources. A study of the use of electronic content in the subject areas of business and engineering would aid OSU and other academic libraries in collection development decisions such as those concerning the mix of print and electronic resources. New library services might be tested as pilot projects in the smaller entrepreneurship community before implementing them across the university.

There are also possibilities for OSU Libraries to partner with the Austin Entrepreneurship Program to build a digital library of entrepreneurial research. OSU Libraries has had success with digital content creation in projects such as the Linus Pauling research notebooks and a photographic collection of Braceros workers in Oregon, and has the capacity in place to expand the range of digital content.[25] Using collaborative tools for information sharing and research, such as MIT/Hewlett-Packard's DSpace™ or proprietary content management software, a digital library could capture and provide access to student projects, white papers, streaming-videos of guest lectures, and other information products.

As students graduate from the Austin Entrepreneurship Program, their needs will change. Alumni support as well as business success for these young entrepreneurs may largely depend on their ongoing access to business critical information and the entrepreneurial community at OSU. The Harvard Business School Library created the HBS Working Knowledge web site and newsletter to provide a current awareness tool for alumni and the public. The HBS Library has offered fee-based research services to alumni for some time and has recently negotiated add-on license agreements with some database vendors so that alumni could continue to have access to important search tools after graduation.[26] This service is especially useful to entrepreneurs and to those whose companies do not have corporate information centers. OSU would be wise to explore such post-graduate access strategies to continue the relationship with alumni.

Conclusion

Academic librarians can play a role in preparing entrepreneurs to efficiently use their research time to locate quality information, to develop critical thinking skills, and to have an awareness of the information marketplace. The relationship between the program and the library will evolve over time as librarians learn more about the information needs of entrepreneurs and align library collections, services, and instruction to the environment and needs of the entrepreneurship program. It is possible that librarianship at the intersection of engineering and business will take the academic library out of the building and to the desktops of its future users. This move will likely benefit the library as much as it does the entrepreneurial community it serves by providing useful data for the evolution of collections and services and by building valuable relationships with the Austin Entrepreneurial Program and its new generation of entrepreneurs.

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