Collaborative Teaching and Learning

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Abstract

In 1991, the National Research Council (NRC) identified the lack of training and education in design as the principal cause of declining competitiveness of American industry. In reviewing undergraduate engineering curricula, the NRC wrote: (University) curricula as a whole lacked the essential interdisciplinary character of modern design practice and did not teach the best practices currently in use in the most competitive companies.[1] As it turns out, many who teach design have little direct experience. Overall, only about one-half of engineering faculty have had some work experience in industry[2] and are typically unaware of the most recent design techniques. Agreeing with the NRC's analysis, participants of the Engineering Coalition of Schools for Excellence in Education and Leadership (ECSEL) found that faculty without experience in industry typically are less prepared to teach design.[3] Added professional experience is clearly an important factor in the growth and development of a faculty member.

Collaborative teaching and learning refers to faculty who are teaching at a university and learning while working in industry. Research has shown that cooperative settings produce positive results in elaboration of ideas, analysis, and problem solving.[4] This conclusion, while drawn during research on students could also apply to faculty. Many professions require continuing education credit to maintain licensing or other certifications; it is only logical that educators should require the reciprocal of themselves. There is tremendous value in life-long learning that builds a collaboration between education and practice. The two should be integrated, continual, and less fragmented. The obligation the faculty takes on is to prepare students for their profession. They should do this by staying abreast of current developments in industry as well as academia, and allowing this knowledge to influence what they teach and how they teach it. Collaboration with industry provides sound and practical solutions for faculty growth. Moreover, using industry to meet the professional development needs of faculty is a highly viable solution.[5]

I. Introduction

The half-life of an engineer's technical skills - how long it takes for half of everything an engineer knows about his or her field to become obsolete - is strikingly short. According to the National University Continuing Education Association, for mechanical engineers it is 7.5 years; for electrical engineers it is 5 years; for software engineers, a mere 2.5 years.[6] Keeping in mind the pace of change and growth since these estimates were developed almost 10 years ago, these half-life figures are undoubtedly even shorter today. So as technological changes gain momentum, architectural and engineering professionals must be prepared to treat their careers as

dynamic entities that need continuous upkeep and upgrading.[7] How then can faculty hope to stay abreast of current developments? Just as professionals must stop thinking of education as what they did in college many years ago, educators must stop thinking of industrial experience as what they did with a company many years ago. Everyone must start seeing both academic education and employment experience as a project of life-long learning.

Other studies have also shown that faculty with industrial experience spend a greater percentage of their time on teaching. Furthermore, studies have also shown that work experience positively affects faculty attitudes toward teaching and research. Establishing experience in industry as an important criterion in hiring new faculty may be fundamental to changing the existing culture and to placing greater emphasis on teaching.[8] Schools are being asked to enrich the education of students, and this can be done by increasing the numbers of faculty with relevant industrial experience. Integral to accomplishing our educational goals is having the participation of practitioners in the educational process. It cannot hurt to have faculty with practitioner experience in the classroom on a daily basis. Engineering education must reflect the conditions of practice.

According to many, the cornerstone of building a strong education curriculum is balancing practical experience based knowledge with academic inquiry.[9] Then why should not the same required of the faculty, that is, a blending of industrial experience with academic knowledge, thereby fusing practical applications with theory. This would strengthen the ties, and redefine the boundaries between education and practice in the preparation of professionals. A more professionally involved faculty would also improve the interaction between industry and academia, and improve a relationship that is at times lacking in trust and respect.

Architectural and engineering educators have a vital interest in enhancing their industrial experience, as it would enrich the schools, support experience and sustain learning. Those educators teaching professional courses should not only have currency in their fields but should also be properly credentialed. Experience in the field would provide faculty with first-hand exposure to and knowledge about advanced and creative uses of technology, current trends and cycles that affect the industry, and prevailing professional developments.

II. Advanced and Creative Usage of Technology

A. New Professional Office Layout

In an effort to amplify communication, many offices, some as early as 1989, discarded all drafting tables. The new office has PCs at every station that are linked to all other staff stations, the library, the conference rooms, and project teams' tables with a data network, telephone and modem. The network supports both electronic mail and the Internet, while the telephone system supports voice mail. Discarding all drafting tables also meant re-inventing many the traditional mechanical skills of drawing with pencil and paper. The new artist's palette includes CADD, rendering tools, desktop publishing and black-and-white and color output devices. Someone who has not been in an architectural and engineering firm for 10 years would not recognize the place.

B. The Electronic-Information Era

According to Dennis Neely, vice president of Industry Marketing for Softdesk ASG, we are now deeply into the electronic-information era. Unlike other major changes in the field (professionalization at the end of the 19th century, the increased specialization of practice after W.W.II, or even the Industrial Revolution of the mid 1800s), the changes being wrought by electronic information are moving at blinding speed. Practitioners must embrace these tools, or others will be doing their jobs - by the year 2000.[10] The long-heralded electronic-information revolution actually began in 1985 when inexpensive software and hardware became sophisticated enough for architects, engineers, contractors, and owners. You no longer need to know how to draft to make perfectly drawn drawings. Today's software can assist you in making renderings, calculating duct sizes, drawing framing plans, calculating building assembly and energy use. Talent and knowledge are necessary to make good designs and to create proper documents. However, software developers are embedding more data and more evaluation criteria and design methodology within their application programs,. Drawings are "smarter", capable of changing data associated within them as they are changed. Drawings are now able to generate schedules, soon they will be "writing" specifications. A CADD based structural analysis program can evaluate a selected area to be spanned, develop a material schedule, choose details and draw the framing diagram. If the changes that have occurred during this decade are dramatic, the next decade of architectural and engineering practice will be mind boggling. Those close to it will be better able to discuss it and prepare for its future.

C. CADD

A typical office has strong computer capabilities incorporating multiple systems, networking and file translating and transferring. They use AutoCAD as their primary drawing system, for both two-dimensional and three-dimensional applications. One of the most important features is AutoCAD's interrelationship with database software, which allows it to both count and manipulate objects. Many use multi-XREF schemes that allow for architects and engineers to view each other's drawings simultaneously. As drawings are revised or altered, updated drawings are immediately available to the other disciplines working on the project. The integration of CADD capabilities with other software, including spread sheets, databases and word processing packages continues to expand. Many firms belong to file transfer networks, an inexpensive and effective national network that allows them to send drawings, or any type of data electronically instead of via express delivery. Architectural and engineering firms are committed to computer technology to improve not only efficiency and coordination ability, but also communication. Unless one has had first-hand workplace experience with CADD, it is difficult to realize how effective it is as a tool for design, documentation and delivery.

D. Professional Collaboration By Wire

Architects and engineers are increasing their use of modern electronic communications, particularly the Internet, to collaborate. This has allowed the design process to be accelerated as design professionals can exchange documents more quickly, or work on the same document at

the same time. More documents are exchanged when you use CADD and collaborate over a network, particularly in the early stages of the project, when the design is modified more often. The Internet helped popularize this way of working, and most of the newer tools are Internet-based. Students appear to accept, understand, and be excited about the fact that computer networks, particularly the Internet, have made it easier, faster, and more cost-effective for architects, engineers, other design professionals, and clients to work together even when they are apart.

E. Managing the Project Team

A Web page was the answer for many firms when they were trying to get their project information flow under control. After faxing and overnight deliveries to the tune of tens of thousands of dollars a year, they were looking for a way to distribute project information that was significantly less expensive. Working with an Internet service provider, they developed a low tech Web page. The Web page contained enough information for the consultants to find out what was going on with the project, without having to continually send out faxes. Team members can look at announcements, the meeting schedule, the project schedule, the current phase work plan, the overall project calendar, a list of drawings, an electronic file repository of drawings, all meeting minutes, the project directory, and a message center. This is one of many innovative uses of computer systems and new technologies in architectural and engineering firms that improve management and communication.

F. Licensing and Registration

In January 1997, the National Council of Architectural Registration Boards, which administers the architectural registration exam, launched its computerized registration exam to mixed reviews. In any case, the way exams are given to professionals in many disciplines will never be the same. As the format of licensing and registration exams change, it is critical that faculty understand the challenges that this creates for young professionals.

III. CURRENT TRENDS AND CYCLES

A. Market Trends

Although most sectors of the construction industry are performing well at present, architectural and engineering firms place the institutional sector at the top of the list. According to an AIA survey, when asked to list the hottest construction sectors currently, 43% of the firms listed institutional sector projects, led by education and healthcare.[11] Within recent years many firms have also developed more comprehensive practices. Faculty members that are intimately involved in actual projects can bring real world discussions, issues, projects, clients and professionals into play in the classroom, lab or studio. Reading a book about current trends or projecting from dated experiences is helpful but is in no way comparable to having fresh real world experiences with a demanding building type. Students of faculty with current experience have a tremendous advantage over those without. Prevalent experience is also a source of

antidotes and stories which can give them some casual and refreshing insights into the profession.

B. Construction Costs and Activity

Construction costs rose approximately 4% between mid-1996 and mid-1997, according to the Turner Construction Company index of nonresidential construction costs.[12] This is the highest annual increase this decade. Those who work in industry are more concerned with the even greater cost increases in areas where the construction market is particularly active. Nonresidential construction costs that were at $100/SF in 1992 are at $116/SF in 1997. Speculation has it that 1999 will usher in a period of slightly slower growth for nonresidential construction activity with strong office and institutional market sectors.[13] However, architecture and engineering firm activity can be characterized as strong and getting stronger, and most firms are highly optimistic about the prospects for 1998. Real world concerns regarding construction costs, activity, and their cyclical nature should be shared with the students at every opportunity.

C. Employment Opportunities

With workloads strong at present, many architectural and engineering firms are planning to increase their professional staffing. Large firms are more likely to be contemplating growth than small firms are. The construction sector has also shared in these employment gains. Young architects and engineers are moving easily into entry-level jobs. More seasoned professionals with two to five years of experience are in greater demand.[14] At every level, architects and engineers in search of opportunity are blessed with positive choices rather than the mere survival options of just a few years ago. Many firms are more focused in their search for people with excellent client repoire and good communication skills, and are taking more care with the interviewing process. Faculty with first hand knowledge of these trends can advise their students of how to search for a career opportunity as opposed to just looking for a job. They can also help their students through the interviewing process. Professors who work in an office regularly also have a clearer idea of the salaries and/or benefit issues the students may ultimately have to deal with.

D. Portfolios In Action

Keeping a portfolio of one's work is not a new idea - architects, artists, and writers have been doing it for centuries. More recently, educators in a variety of fields, including many engineering disciplines, are using the portfolio as a way to collect and evaluate student work.[15] Supporters of portfolio assessment contend that portfolios show evidence of skills that exams and standardized tests, or even papers or projects evaluated separately, cannot. At some institutions this portfolio of work is used not only as an assessment tool but also as a marketing device for job searches and a reference aid for students to use in future courses or on the job.[16] It is important to maintain good documentation and keeping a portfolio will help students develop organizational skills that will assist them on the job. Seeing student and young professional portfolios, in an interview setting at the office, provides professors who work in industry with exposure to a wider array of portfolios. This allows them to be better critics and

advisors to their own students, and have a better understanding of the portfolios' long-term usefulness to professionals. The knowledge the professor gains outside the classroom will result in the students developing better portfolios.

IV. PREVAILING DEVELOPMENTS

A. Professional Services

Architectural and engineering firms are as busy as they have been in over a decade. Many firms, however, are busy doing different things than they were a decade or two ago. In 1990, almost 80% of firm billings were generated by construction-related design services: architectural design, engineering, interiors, landscape, and urban design services.[17] Billings have undergone a radical change in the 1990s. Design services accounted for 60% of billing last year, with planning and predesign, construction, post-construction, and other related activity increasing substantially.[18] For architecture and engineering firms, a more diversified portfolio has reduced the firms' exposure when one sector of the economy hits hard times. Some firms are pushing the envelope of services even more. The expanded services might include computer imaging for the film or CD-ROM industries, facility management, real estate development studies, asset management, RFP management or quality improvement programming. This has provided opportunities to take the design professional's problem solving methodology into other realms of the building industry.

Even the most traditional architectural and engineering firms are providing a scope of services which include: planning (master planning, urban planning, design guidelines, land use and zoning analyses, site selection studies, and feasibility studies), architecture (architectural design, historic preservation, equipment planning, facilities analysis, code compliance, specifications, and construction observation), engineering (structural, mechanical, electrical, plumbing, fire protection, and value engineering), interiors (alternative location analyses, facilities programming, space planning, interior design, furniture and fixture selection, equipment selection, graphic design, signage design, and ADA access audit services). The change in services is also a new element of contracts. New documents reflecting these trends were released by the AIA in October 1997. A faculty member with recent experience in industry could accurately share this expanded service picture with the students. Student who were less interested in the traditional architectural and engineering services and considering changing their major could stay in the program and focus on the fringes of their professional training. A better understanding of the options, and there are many, will benefit all the students and reduce some pre-employment stress levels.

B. Design-Build

Design-build is a newly popular method of building delivery where an owner hires one firm to both design and build their project. Until recently, architects and engineers have been somewhat hostile to the design-build concept, classifying it as another encroachment on their status and services since they are usually subcontractors of the design-builder or construction manager. However, design-build has been an opportunity for some architects and engineers to seize the

initiative by agreeing not only to design but also to construct the project. Architect and engineer led design-build or construction management is well suited to smaller projects and especially historic preservation and renovations. With a current understanding of design-build opportunities, this issue could be discussed optimistically.

C. Value Engineering

Originally developed in the 1950s, value engineering has become a fact of life in the US construction industry during the cost-conscious 1990s.[19] It is prevalent in major government projects, for which value engineering is now required, and in complex industrial, institutional, and transportation facilities, for which it is almost routine. Value engineering is a structured method of analyzing and fine-tuning a project to satisfy the owner's functional and aesthetic requirements at the lowest cost. If approached optimistically a true value engineering effort results in a project with the greatest possible long-term value, while considering life cycle costs and the integrity of the building program and design intent. In the past, value-engineering decisions appeared to be strictly aimed at slashing costs, were not sensitive to design, or were started after the design was finished or when the bids came in too high. The process was frowned upon and had limited usefulness. Now however, value-engineering is becoming more common during schematic design, when conceptual changes can be made easily and the owner can alter initial assumptions. First hand experience with a successful value-engineering effort allows professors to present this information without bias.

D. Project Teams

Offices doing larger, more complex projects tend to split the architect's role into three parts: a project manager who guides the project's team and their progress, a project designer who does the creative part, and the technical specialist or job captain who guides the material and construction methods. The dynamics of this shared responsibility for a project can cause some clashes over who talks directly with who, clients and consultants alike. In the 1970s clients were becoming more concerned with who the manager on their project was; in the 1980s clients raised more interest in who was designing their project. Today's reality is that complex projects require organizational, technical, and managerial disciplines that frequently consume more time and skill than creativity.[21] This more complex structure can be confusing for young professionals, especially since the draftsperson has disappeared and has been replaced by educated and licensed architects and engineers who are expected to contribute to the project from the very beginning. Many offices have recently taken the time to develop meaningful and organized approaches to project management and coordination. They are designed to result in significant value added for the client and project. New hires need to be prepared for this. The "Work Plan" approach has enabled some firms to develop, along with the consultants and clients, a complete plan for the project that will serve as a living document, guiding everyone's effort from start to finish.

E. Future Professional Leaders

Principals of successful architectural and engineering firms assert that strategic planning is a tool that has helped them both secure commissions in new markets and manage their own offices more effectively. Strategic planning is the process of complete business tuning, aimed at moving the firm forward by projecting a desired future goal and creating strategies and structures for its achievement.[22] In short, strategic planning is a clear and precise method to visualize and define success and then to systematically remove obstacles to reaching that goal. Some other firms have gone through a Total Quality Management (TQM) program with the net result being an intense refocusing on improving the outcome of their work and strengthening their relationships with clients and consultants. TQM focuses its efforts on delivering products and services more efficiently. Other firms have pursued a Time, Cost and Value Management concept. Regardless of what it's called, the total team approach is an interactive process with the clients and consultants which centers on building consensus for project goals and bringing issues to closure as early as possible. Architects and engineers must overcome a general lack of understanding of business strategy if they hope to gain the full confidence of corporate clients. Future leaders in professional fields need to be more than just talented architects and engineers. They will need to be effective strategic planners, business strategists and team players. The sooner this is understood the better. Many feel that the educational program for architects and engineers simply does not provide either management skills nor the communications and synthesizing skills needed by today's working methods. If so, then students should look elsewhere for those skills, possibly to business courses.

V. CONCLUSION

Studies have shown that faculty with industrial experience spend a greater percentage of their time on teaching above and beyond their work assignments. Adding experience in industry as an important criterion in hiring new faculty may be fundamental to changing the existing culture and to placing greater emphasis on teaching.[23] Schools are being asked to enrich the education of students, and this can be done by increasing the numbers of faculty with relevant industrial experience. Integral to accomplishing our educational goals is having the participation of the practitioners in the educational process. It cannot hurt to have faculty with practitioner experience in the classroom on a daily basis.

Architectural and engineering education must reflect the conditions of practice. It must also be responsive to the needs of the profession. Meanwhile, tenure reviews are forcing faculty away from general practice and into narrowly focused specialties. There is a decreased availability of quality part-time adjunct faculty because conditions of practice are difficult to control and the demands of academia are time consuming. The schools need to provide the direct linkage or 'window to the profession' and this falls upon the full-time faculty. Schools may need to become more flexible with their faculty's schedules in order to make this happen.

In a rapidly changing world, can educational institutions bear the burden of leading the way by teaching all that there is to know alone? Probably not, nor should the active professions have to bear this burden. Industry will always depend on the educational institutions to provide a foundation of knowledge that cannot be attained in the workplace: the knowledge of history, theory, and the path that has led the profession to where it is today. Schools can provide us an

anchor against the wind, remind us of where our roots are, why we are architects and engineers, and what we do in the world. The obligation the school takes on is to prepare us to do it well, by staying abreast of current developments in industry and allowing these developments to influence what is taught and how it is taught.

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