Introducing Engineering Management into Construction – A Five-Year Retrospective

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Abstract

The beginning of the 21st century is witnessing an awareness that the civil engineering industry has become a global industry. The rapid increase in foreign ownership of firms in the United States together with the globalization of economic markets is reminding civil engineering professionals that they must be aware of global events before they impact local operating conditions. In response to these developments, university programs must begin to broaden their focus to include subjects that address new economy realities. Specifically, the time has arrived to require students to have exposure to management topics such as entrepreneurship, financial management, and global economics. This paper examines one attempt to address this issue during the last five years. An examination of new courses in the construction program, industry, academic, and student responses, and a reflection of progress over the last five years are included.

Introduction

The facts are well known to civil engineering and construction industry constituents and often documented and repeated by industry observers. An industry that is conservatively estimated to include over 250,000 companies and generate over $700 billion of annual revenue (U.S. Census Bureau 1997) is attractive to analysts examining the health of the United States economy. However, the growth in these numbers over the last decade masks a looming crisis for industry organizations, the lack of managers prepared to lead and manage the industry into the new economy. Crisis is a strong word, is it appropriate for the current state of the civil engineering industry? The research indicates that it may not be strong enough.

As the world enters a decade that will be defined by globalization, economic interaction, technology integration, and rapid change, industries of all types are facing the challenge of managing these issues as they relate to their specific products or services. Although each industry faces unique concerns, a common thread for success is evident throughout, combining the elements of preparation and the knowledge to respond. The first of these elements, preparation, is the need to have strategic plans in place that address the future of the organization in a number of changing business environment scenarios. Each organization selects a unique path through the changing economy; a strategic plan provides a map for these organizations to follow as the path introduces unexpected turns along the journey. The second element, the knowledge to respond, is the primary focus of this piece. The ability of an industry to foster and promote the development of new knowledge by its workforce is the fundamental basis for its long-term success. As the new economy emerges, the development of new knowledge throughout the business environment is transforming the

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manner in which businesses prepare for long-term success. These success elements are the narrow lifeline that is threatening to snap in the civil engineering industry.

The time has arrived to ask the question, "Where are the leaders that are addressing and being trained to address these issues?" Although individual exceptions exist, five years of study has demonstrated that these issues may receive acknowledgement by companies, but little implementation is occurring to transform words into actions (Chinowsky and Meredith 2000; Chinowsky and Byrd 2001). Similarly, civil engineering programs are progressing very slowly in terms of adopting management related topics as a central component of the curriculum (Russell, et al. 2000). Rather, civil engineering programs are tied by many requirements such as ABET to continue the focus on technical skills and traditional engineering subjects. Although this focus is necessary to produce qualified engineers, the focus on technical skills at the expense of broader experiences is failing to address the question of future industry leadership.

The Education Challenge

Although the traditional positioning of civil engineering organizations is concerning, of potential greater concern is the lack of focus being placed on developing the future leaders of the industry, students and recent graduates, through broader knowledge requirements. In contrast to the broadening of interests being witnessed in many industries, too few civil engineering-related programs are adopting a global, leadership focus (Bonasso 2001). Is this a reflection of the industry direction, or a problem with the education system? In short, it does not matter. What is relevant is the fact that the situation exists and it needs to be addressed and changed. The industry cannot decry the lack of leadership if a demand and focus is not placed on creating these leaders. Similarly, civil engineering educators and graduates cannot decry a lack of industry interest if a demand is not created for a broadening of the knowledge background.

With a global economy changing at a previously unseen rate, arguing over who is responsible for a lack of global vision is a futile exercise. Rather, it is time to implement change in the industry. Specifically, it is time to implement a civil engineering focus on management in university education. University education is the foundation for building a solution to the management crisis. The time has arrived to require students to have exposure to management topics such as entrepreneurship, financial management, and global economics. If the civil engineering industry desires to evolve into a new economy business, then it will require individuals who are as comfortable with the financial and technology components of the business as they are with design or construction fundamentals. Introducing breadth into the university education is the key to this comfort level. Universities must recognize that the civil engineering industry is broad enough to attract students with different views of the same career choice. With many universities witnessing declining civil engineering enrollments, it is time to recognize that supporting these different views may be the path to reversing the enrollment trend. Unfortunately, embarking on such a path will reignite the debate over where this flexibility can be inserted into the curriculum. There are no easy answers to this debate, however the safe path of returning to a tightly controlled, old-economy curriculum is the sure path to a continuation of declining enrollments. In summary, when leveraged with traditional industry knowledge, the increase in management exposure will bring graduates into the civil engineering industry workforce that are prepared to compete in the new economy environment.

In addition to change in the undergraduate curriculum, the time has arrived to establish a construction industry (of which civil engineering is a primary component) MBA degree. Similar to the specialized programs focusing on the legal and medical professions, the construction MBA would place the concerns and concepts of new economy management in a context that is relevant to the design or construction professional. Bridging the gap between management and construction, this new education experience would become the training ground for future industry leaders operating on a global stage. It is time for universities to recognize that the majority of civil engineering industry organizations cannot afford to have employees enter

full-time programs for extended period of times that spend little, if any, time addressing the concerns of their service-oriented organizations. However, there is a significant grass-roots demand throughout the industry for a professional-oriented program that recognizes and addresses the concerns of design and construction. Can this demand overcome the reluctance of many business and engineering schools to work together to provide a new economy education for one of the oldest economy industries? Leadership by the academic community is required to provide this opportunity and accept the challenge to introduce a program that will be the model for others to emulate.

One Example Starting Point

In response to the need for greater management knowledge in civil engineering, the author has introduced two management-based courses for senior and graduate level civil engineering students, *Business Fundamentals for Civil Engineering* and *Engineering Organizations*. The focus of these courses is the study of corporate level management issues through a combination of in-class lectures, case-study analysis, and the development of new engineering industry organizations. Although these courses do not replace the need for a broader integration of management into the engineering curriculum, the lessons learned from these courses may provide a starting point for universities focusing on such an effort.

Engineering Organizations Course Overview

The Engineering Organizations course was the first of the two management courses introduced in the department. Originally limited to 15 graduate students in Spring 1997, the class has now doubled in size and is open to senior-level undergraduate and graduate students (it is now required for graduate students in the construction engineering and management program). The concept of the course was very clear, provide students with an understanding of the strategic management issues related to running a design or construction organization. The course provided students with two primary avenues to study strategic management concepts, classroom cases and a business development project (Figure 1). Through this multifaceted approach, students obtain both a theoretical understanding of strategic management and a practical understanding of what company executives are required to address in developing a strategic plan for their own organizations.

The use of the case studies in the course focuses on weekly analytical papers. After an initial week of introduction to the case method of teaching, the students are introduced to the core of the case study method. In the twice-a-week course format, each week is devoted to the introduction and exploration of a new topic. The first lecture of each week is devoted

Engineering Organizations Topics and Cases

Strategic Topic 1: Long Term Planning
Business Topic 1: The Focus of the Business
Case 1: Successfully Implementing a New Vision

Strategic Topic 2: Identifying Core Competencies
Business Topic 2: Personnel Requirements
Case 2: The Impact of Changing Core Competencies

Strategic Topic 3: Developing Knowledge Resources
Business Topic 3: Market Conditions
Case 3: Integrating Knowledge Resource Systems

Strategic Topic 4: Lifelong Learning
Business Topic 4: Customer Profiling
Case 4: Developing a Strategic Education Focus

Strategic Topic 5: Strategic Finance
Business Topic 5: Competitive Environment
Case 5: Developing a Long-Term Financial Perspective

Strategic Topic 6: Strategic Markets
Business Topic 6: Marketing/Business Development
Case 6: Expanding Traditional Markets

Strategic Topic 7: Competition and Positioning
Business Topic 7: Finance
Case 7: Establishing Strategic Differentiation

Figure 1: Engineering Organizations Topics

to the discussion of readings that emphasize the module focus. Complementing these articles is the selection of case studies. In the second lecture of each week, the students are presented with a case study to read and summarize. Given one week to read and analyze the cases, each student is required to prepare a summary of the case and an analysis indicating how the case relates to current engineering practices. To facilitate discussion of the cases, two students are selected each week to lead the analysis of the issues. This component of the course is critical to ensure that the students become active participants in the discussions. By placing the success of the discussions in the hands of the students, the students are aware that they must show additional effort to obtain the full potential from the course.

In addition to analyzing industry cases, students are provided with the opportunity to develop a business plan for a new engineering industry company. This company may be focused on any part of the industry that the group of four students decides to pursue. Following the outline of the course modules, the students must complete everything from a market needs assessment to a financial plan and budget. At the conclusion of the course, the students make two project presentations. In the first, the students present to their class for a formal critique of their plan by their peers. In the second, the students present their businesses to a panel of industry executives who critique the plans and select the top-rated business plan. This latter component has proven to be invaluable to getting the students to perform at a top level in all facets of the presentation and project preparation.

Business Fundamentals Course Overview

In contrast to the five-year history associated with Engineering Organizations, the Business Fundamentals course is a new elective course that was offered for the first time in Fall 2000. However, the two are closely related in that the driver for the Business Fundamentals course was the demand for a greater introduction to basics by the students taking the Engineering Organizations course. The components of the course are based on the central topics typically found in an MBA program. The business fundamentals course does not attempt to replace these in-depth courses, but rather, provides students with a two-three week overview of each of the topics found in a first-year MBA program.

Business Fundamentals Topics

Business Topic 1: Fundamentals of Accounting

Business Topic 2: Fundamentals of Financial Management

Business Topic 3: Introduction to Organization Behavior

Business Topic 4: Introduction to Legal Concepts

Business Topic 5: Management of Technology

Business Topic 6: Introduction to Marketing

Figure 2: Business Fundamentals Topics

Although it is too early to analyze the success of this course, it is interesting to note that all of the students who were not graduating at the completion of the course are taking the Engineering Organizations course as a follow-up. Obviously, this is not a scientific assessment, but it is anecdotal evidence that a significant interest is building in engineering students for more diversity in their education.

Responses

The introduction of the management-oriented courses in a civil engineering curriculum has had mixed responses from students, faculty, and outside industry. These responses are informative for any program debating the merits of introducing management topics into the civil engineering curriculum.

- Students – Student response has been overwhelmingly positive by those students who have enrolled in the management courses. With student evaluations averaging 4.8 out of a 5.0 scale, it has become apparent that students in the courses are enthusiastic about the topics. Of particular importance in this regard is the number of former students who have graduated from the program and now recommend the management courses to new students as a key factor in their current job success. These students provide numerous anecdotal accounts of how their ability to understand financial statements and business planning has set them apart from their peers. Unfortunately, with course requirements currently eliminating many elective opportunities, the number of students who can take management courses that are not a required part of the curriculum is limited. Therefore, although the courses continue to grow in popularity, it is unknown what the potential enrollment would be if students had more flexibility in their schedules.

- Faculty – In contrast to the student response, faculty response has been tolerant at best. Frequently, the faculty response is related to the theme that management does not have a direct place in engineering. Although a number of faculty members endorse the concept of breadth in the civil engineering curriculum, these same faculty are hesitant to reduce the traditional technical emphasis within the curriculum. This difficulty has created an impasse that has no immediate resolution in sight.

- Outside Industry – The greatest response to the introduction of management-based topics in the civil engineering curriculum has come from outside industry professionals. These individuals recognize the importance of management knowledge as a key to long-term business success. As such, the industry professionals that interact with the program have endorsed the inclusion of such topics in the curriculum. These individuals have also assisted in the delivery of the course by providing guest lectures, serving as judges in the business plan competition, and opening their offices to student teams doing business-related studies.

In summary, the responses received from the introduction of the management-based courses have been positive from the industry and students, but neutral from the faculty. This mixed response creates a problem for the long-term continuation of such courses. Although student demand may remain high, the fact that they are outside the mainstream curriculum places them in danger if other priorities are set by the majority of the faculty. This factor should be a lesson that faculty members in other institutions acknowledge if they intend to repeat the introduction of these courses. Although the outside industry may find this subject important to industry health, the university environment is slow to adopt changes to traditional thinking.

Conclusions

It is apparent that a greater focus on management will be required for engineers in the near future. The question of course is how this need will be met given the requirements that already exist for engineering programs. The answer is that a new mindset and approach to engineering education is required. Universities can no longer afford to focus on producing individuals who are competent in a single area. Rather, universities must focus on developing individuals who have the capability to succeed in the changing technical and business world in which they operate. Additionally, universities must understand that the failure to incorporate this breadth will accelerate the drop in enrollments that are currently being seen in civil engineering and other engineering majors.

The civil engineering industry has made it very clear that it desires graduates who have a greater understanding of the business of engineering. Issues such as finance, marketing, and technology management are becoming critical success factors for individuals in the industry. The time has arrived for

universities to determine how they can support individuals who are attempting to capture these success factors as part of their education experience.

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