

Addressing the Management Crisis in Civil Engineering Education

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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. 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.

I. 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 revenue¹ 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, new knowledge is transforming the manner in which businesses prepare for long-term success.

With change happening at a rapid pace in the business environment, the time has arrived to ask the question, “Where are the leaders being prepared to address the new economy business issues?” Although individual exceptions exist, five years of study has demonstrated that these issues may receive acknowledgement by companies, but little is being done at the corporate level to address these new leadership requirements^{2,3,4}. Rather than determining how to aggressively meet the demands of a global economic market, too many companies are adopting a retrenching position that emphasizes defensive over offensive business operations⁵. In a time where markets change in weeks rather than months or years, adopting a defensive mindset does not foster future industry leaders that are willing to demonstrate entrepreneurial behaviors. Specifically, a defensive position will not foster leadership that can identify, focus, and promptly attack a market prior to competitors establishing a competitive advantage.

II. The Education Challenge

Although the defensive positioning of civil engineering organizations is concerning, of potential greater concern is the alarming lack of focus being demonstrated by civil engineering programs on new economy issues. In contrast to the broadening of interests being witnessed in many industries, too few civil engineering-related programs are adopting a global, new economy focus⁶. 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.

III. 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*. Both of the courses are open to senior-level undergraduates as electives. The Business Fundamentals course is a required course for graduate construction management student. The Engineering Organizations course is an elective for graduate students. 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. 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 (See Figure 1).

Module 1: Strategic Planning

Case Analysis Technique, Introduction to Strategic and Business Planning, Current Construction Trends

Module 2: Vision and Mission Development

Company Organization, Vision Statements, Core Competencies

Case Analysis: Urban Restoration and Investment

Module 3: Core Competencies

Building a Strong Foundation, Understanding Strengths and Weaknesses

Case Analysis: Managing Expansion

Module 4: Knowledge Resources

Human Resources, Technology Integration, Technology Planning

Case Analysis: Eliminating Knowledge Islands

Module 5: Education

Corporate Universities, Education Planning, Dissemination and Retention

Case Analysis: Bridging the Management Gap

Module 6: Financial Analysis

Financial Analysis, Reading the Numbers, Economic Trends

Case Analysis: Leading Economic Indicators

Module 7: Market Analysis

Market Analysis, Opportunity Analysis, Emerging Markets

Case Analysis: Corporate Services

Module 8: Competition and Positioning

Competitive Analysis, Barriers, Marketing

Case Analysis: Developing Corporate Barriers

Module 9: Project Presentation

Figure 1: Engineering Organizations Course Curriculum

Module 1: Business Vocabulary

A history of business, Engineering-Business Relationships

Module 2: Accounting

Basic Accounting, Construction Accounting, Financial Statements

Module 3: Financial Management

Financial Analysis, Forecasting, Company Evaluation

Module 4: Legal and Contracts

Areas of Law, Legal Principles, Contract Fundamentals

Module 5: Organization Behavior

Organization Development, Team Behavior, Management

Module 6: Marketing

Strategic Marketing, Electronic Marketing, Customer Analysis

Module 7: Technology Management

Technology Planning, Technology Integration

Figure 2: Business Fundamentals Course Curriculum

Through the multifaceted approach introduced in the management courses, 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.

Classroom Cases

The central component of the strategic management course focuses upon providing students with an overall understanding of the concepts that underlie strategic planning and management. However, rather than relying on a traditional lecture format, this introduction is focused around the use of case studies developed by the author and selected from the Harvard Business School. While these cases are traditionally associated with MBA programs, the large number of cases and teaching materials available in the Harvard Press library (over 7,000) provide a diverse selection which cover cases from throughout the industrial spectrum, including engineering and construction. The selection of these materials as a supplement to personal cases provides a valuable benefit by serving as an added level of credibility for the course. In conversations with students prior to the start of the course, many of them pointed to the Harvard connection as a primary reason for testing the course since they were familiar with the Harvard business methodology and its reputation for management studies.

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 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.

Business Planning

The second component of the engineering organizations course provides students 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 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. As illustrated in Figure 2, 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.

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.

IV. 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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