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Educating Project Managers for the Construction Industry

Abstract

With the increasing complexity of constructing and maintaining infrastructure facilities, there has been a growing need for civil and environmental engineers to supplement their technical and managerial skills through advanced degrees in engineering and management. ASCE has clearly supported this idea by adopting the master's degree (or its equivalent) as the first professional degree. The means to acquire additional technical expertise has been addressed quite adequately by a variety of master's degree programs at many universities throughout the country, but the challenge to impart the requisite managerial skills has not been satisfied very effectively. The latter is based on the premise that an MBA education is not ideal for managing large public and private projects which require managers with considerable technical expertise, as well as managerial skills. The Master of Project Management (MPM) program at Northwestern University has been established in response to this specific need in the construction industry.

The program's multidisciplinary approach combines essential components of civil engineering design with concepts of business management and behavioral science to develop technically qualified individuals for responsible management roles in the design, construction, and operation of major engineering projects. The particular features that make this program particularly responsive to this need are (a) it is taught almost exclusively by a faculty of more than 20 high-level practitioners, (b) the student body is truly global to enhance the multicultural aspects of the current market, (c) the course selections are very flexible and custom-designed to meet the needs and objectives of each individual, (d) the program is dynamic and courses are continually added or deleted as the situation dictates, (e) courses are scheduled to accommodate both full-time and part-time students, and (f) strong emphasis is placed on the development and improvement of communication skills, both oral and written. One of the major impediments to the more widespread implementation of this program is the fact that the industry, as a whole, is not very supportive of employee participation – both in terms of financial remuneration for tuition and time-off to attend classes. In addition to the degree program, individual courses can be taken to earn a credential or to satisfy PDHs for professional registration.

Introduction

After World War II, the increased complexity of construction projects in the mid-1950s provided the impetus for an emerging new field of Construction Engineering and Management (CE&M) within civil engineering. The first journal of the ASCE Construction Division was published in August of 1957, and all five papers in the first issue were case studies related to different aspects of the Navy's Variable-Angle Launcher. In the introduction M. D. Morris, Chairman of the Committee on Publications wrote[1]:

> ***"This is the belated first issue of the JOURNAL OF THE CONSTRUCTION DIVISION. Until now we've been without a JOURNAL in the belief that most construction articles of interest appeared in the trade magazines. Now we know we need papers designed to advance the theory and practice of planned***

engineering construction among construction engineers; papers that will make better engineers by stimulating discussion based on valuable experience."

Interestingly, the second issue of the Journal, published in February of 1959, consisted of five papers about Engineering Education and the Construction Industry. In the 1950s, five universities developed programs in CE&M. By the mid-1990s, the master's degree had become reasonably widespread and about 40 to 50 universities were awarding this degree. However, notwithstanding this progress, the discipline was still early in its evolution (Carr[2]). Some significant issues hampering the development of CE&M programs were (a) construction industry interest (or lack of it in some cases), (b) student interest and enrollment, and (c) outside financial support. Carr[2] stated that:

"…outside financial support of students and research has not been of a magnitude warranted by the size and importance of our industry."

Industry Needs

Louis Berger[3], in his acceptance speech for the Parcel-Sverdrup Civil Engineering Management Award in 1995, outlined the industry's growing needs for civil engineers who have management skills and perhaps advanced degrees in engineering management. He stated that:

"The basis for this argument is that the nature of large projects undertaken by large civil engineering firms and large public enterprises requires project managers who have considerable managerial skills as well as technical expertise."

Berger[3] asserted that about 20% of the engineers in a consulting company must have managerial skills and he proposed a 2-4-6-8 formula to express this need at different levels of the organization. According to this formula, 2% would be capable of running stand-alone offices, 4% could manage large projects or small offices, 6% could handle smaller projects which require good management, and 8% would comprise a pool of young and bright engineers currently able to run a small squad of five to ten technical individuals, but with the potential to move up the ladder as the need grows.

Carr[2] argued that industry attention was operating primarily at the undergraduate level, whereas the research and graduate study nature of civil engineering faculties established the desirable foundation for each program at the master's level. Berger[3], as mentioned previously, leaves open the desired level of management education.

Construction Education

Oglesby[4] stated in 1990 that more than 150 undergraduate construction programs were in existence, and these programs essentially followed three tracks: (a) an engineering base (civil engineering programs), (b) an architecture base (building construction programs), and (c) other nonengineering or nonarchitecture base (construction science or construction technology programs). In his discussion of these programs, he opined that:

> ***"There is no chance, given the crowded curricula of any of the four-year programs, to make substantial additions to them….To cope with this problem there seem to be no alternative but to extend the curriculum to incorporate a fifth year of study, largely devoted to courses but possibly incorporating some electives when they can be made available,…"***

Some years later, Goodman and Chinowsky[5] discussed some of the challenges faced by undergraduate and graduate programs regarding managerial education and stated that:

> ***"At the undergraduate level, university programs are charged with providing students with a broad foundation in both general and technical subjects. With the continuing expansion of these areas, construction programs have been forced to narrow their individual areas of emphasis."***

However, it seems that needed changes are finally on the horizon for university programs. The new criteria for accrediting civil engineering undergraduate programs (effective for evaluation during the 2008-2009 accreditation cycle) states that[6]:

> ***"The program must demonstrate that graduates … explain basic concepts in management, business, public policy, and leadership, …"***

Moreover, ASCE Policy Statement 465[7], which was formulated after a decade long interactive study involving both industry and academic leaders, states that ASCE supports the concept of the master's degree or equivalent as a prerequisite for licensure and the practice of civil engineering at the professional level. The implementation of this policy, however, will take another decade. At the 2006 Annual Business Meeting of the National Council of Examiners for Engineering and Surveying (NCEES), held September 13–16 in Anchorage, Alaska, delegates voted to adopt the position that, effective January 1, 2015, an engineer intern with a bachelor's degree must have an additional 30 credits of acceptable upper-level undergraduate or graduate-level coursework from approved providers to be admitted to the Principles and Practice of Engineering (PE) examination. Modified requirements are set forth for individuals with a master's or doctorate's degree.

Master of Project Management Program

Motivated by the forgoing situation, the Master of Project Management (MPM) program grew from a conviction that there existed a need in the civil engineering profession for a more holistic engineer with an ability to blend a modest breadth of engineering expertise and experience with the management and communication skills required to develop and execute a major engineering project from its conceptual stage through completion and even beyond into its operational and maintenance phases. Although there existed at various universities throughout the country a variety of more focused programs generally addressing the more technical aspects of "how to construct a project", none (to our knowledge) covered the breadth visualized by this program.

Based on the above premise and the challenge to avoid competition or overlap with other management programs on campus (e.g. the Kellogg MBA program and the McCormick Master of Engineering Management program), the **mission** of the Master of Project Management program was established as:

> ***"To prepare technically qualified individuals for responsible management roles in the construction and operation of major civil engineering projects."***

This mission is accomplished by customizing a multi-disciplinary combination of specialized management oriented courses and regular university courses taught by practicing professionals and regular university faculty. From the very outset it was known that this program could not be taught completely by regular in-house faculty and that most of the faculty would have to be forward-thinking successful practitioners. The concept and goal of this program were endorsed strongly by our external Civil Engineering Advisory Committee, who are a diverse group of industry leaders. Within this framework, our **vision** is:

> ***"To be the best program in the world wherein early- to mid-level engineers and architects can complement their technical expertise with the management skills needed to facilitate their advancement in the corporate structure."***

Brief History

Northwestern University is a research-oriented private university with more than 17,000 students enrolled in twelve academic divisions on two lakefront campuses. The Robert R. McCormick School of Engineering and Applied Science has approximately 165 full-time faculty and a number of adjunct faculty serving about 1400 undergraduate students and 1100 graduate students distributed throughout eight departments (Biomedical Engineering, Chemical and Biological Engineering, Civil and Environmental Engineering, Electrical Engineering and Computer Science, Engineering Sciences and Applied Mathematics, Industrial Engineering and Management Sciences, Materials Science and Engineering, and Mechanical Engineering). The Department of Civil and Environmental Engineering, which is consistently ranked among the top ten in the United States, has about 150 undergraduate students and more than 100 graduate students served by 28 full-time faculty and several of adjunct faculty in five different technical areas (Environmental Engineering, Geotechnical Engineering, Structural Engineering, Theoretical and Applied Mechanics, and Transportation Systems). Until the establishment of the MPM program, neither the Department in particular nor the University in general had any established identity in project management from a civil engineering perspective. This fact, coupled with the expensive tuition (especially in light of the generally low pay scale of civil engineers in comparison with other engineers and the poor support that most employees receive from their employers), were impediments to the success of a course study such as the MPM program. However, the overall prestige of Northwestern University and the benefits of the greater metropolitan Chicago area were definite assets and served to offset, to some degree, the foregoing negatives. Notwithstanding this situation and motivated by the conviction that a professional master's degree program in project management emanating from the Department of Civil and Environmental Engineering could be a meaningful enhancement to the department

while simultaneously satisfying a major need in the industry, efforts were undertaken to establish such a program.

In the early 1980s, there were individual meetings with CEOs of six large construction companies headquartered in the Chicago metropolitan area regarding the establishment of a professional master's degree in construction management. At that time, those industry leaders (with one exception) felt that there was no need for graduates with master's degrees; the one exception suggested that a "modified" MBA would be a desirable degree. Furthermore, they stated that they would not support such a program either (a) by sending any of their employees for advanced education or (b) by hiring its graduates. They expressed a preference for hiring bachelor's degree graduates and training them in-house. Based on these results, the idea was abandoned at that time.

However, about a decade later, with interest from students and a growing industry preference for a more specialized education, the Master of Project Management (MPM) program was started in 1989 as a grass roots endeavor with little support from the Northwestern University administration, because the program was in an area where Northwestern had no history and very modest in-house faculty capability. In the early years the curriculum was composed of some carefully chosen regular university courses and an increasing selection of custom-designed courses taught by adjunct faculty. In the ensuing years the program grew from its grass roots beginnings as additional specialized courses, taught exclusively by adjunct faculty, were added. During the early years students were admitted through the Graduate School, but in early 1994 the curriculum was approved by the Board of Trustees as an independent professional degree program administered through the McCormick School of Engineering and Applied Science, after which time students were admitted through the Engineering School.

When the program was developed, two important decisions had to be made regarding the format and duration of the program, and these decisions had a major impact on the target market. The first decision was whether to establish a one-year or a two-year program, and the second was whether classes should be held during the day or in the evening. To maximize the size of the target group and to attract a diversified international student body, it was decided to have an intensive twelve-course program that full-time students could finish in nine months and to hold classes in late afternoons (4 to 6 PM) and evenings (6:30 to 9:30 PM) to accommodate part-time students.

During the first five years after its inception, the program averaged about two graduates per year, but since 1996 the program has maintained a steady-state graduation rate of more than 20 per year. The financial model is one wherein the University administration and the Engineering School administration each receive a portion of the tuition revenue, as well as payment for all program expenses (such as internet access charges for faculty and students), and the remaining monies are used by the Program Director to administer the program.

In general, such a program would probably not be viable in universities located in small cities or rural areas. The proximity to large construction companies as a source of adjunct faculty and employment is considered a "must" for success. Due to the cyclical nature of the industry, the program has experienced periodic fluctuations in both applications and placements, and it is

likely that this situation will continue to prevail. Accordingly, it is necessary to accumulate a reserve fund during the "good" years to offset budget shortfalls during "poor" years.

MBA and Technical MS Degrees versus MS Degree in Project Management

MBA programs typically provide a broad-based education in business and management concepts that are generally applicable to a wide variety of fields. In contrast, the MS in Project Management program focuses on the more specific practical business perspective and planning skills needed by civil engineering project managers to execute effectively the processes required to deliver a quality project on time and within budget Relative to a traditional technical master's degree program in a specific field (structures, foundations, transportation, and so forth), the MS in Project Management program provides a more holistic overview of the civil engineering field within the business perspective needed by a project manager to integrate the variety of technical, financial, and social challenges inherent in the successful completion of a civil engineering project.

Program Components

The program has three components: (a) completion of coursework, (b) attendance at a seminar series, and (c) improvement of communication skills.

Coursework

Students are required to take twelve courses and have a minimum B average for graduation. The courses are a combination of (a) business courses, such accounting, finance, and law, (b) general construction "bread and butter" courses, such as, estimating and scheduling, and (c) construction-related elective courses; the latter group includes some traditional courses, such as business development, business strategy, and cost control, and some *avant-garde* courses, such as sustainability in construction, information technology, and e-business. Overall, about 75% of the courses are traditional construction management courses and the remaining 25% are *avant-garde* courses. The program does not include any technical courses dealing with means and methods, because its focus is to prepare individuals to work in mid-management and executive levels of the industry. Teamwork and mutual interaction are emphasized in many of the courses. The majority of the courses are taught by practitioners who bring a wealth of knowledge and "real world" experience to the classroom, and these courses are supplemented by appropriate courses from the regular University offerings.

Seminar Series

The formal courses are supplemented by a weekly seminar series to add a modicum of "real world" exposure to the students. The seminars are presented by highly respected professionals and normally address issues related to the use of management skills to resolve the complex set of interactive problems associated with a particular project. As a fringe benefit, many of the speakers represent potential sources of employment for our graduates. With about 25 seminars every year, this series is considered equivalent in content to one course, although it is non-credit. As a learning instrument to enhance recognition of the important aspects of public speaking, the

students are required to evaluate speakers by means of a matrix of qualitative attributes and scales (Table 1).

Table 1. Speaker Evaluation Form

	Excellent	Very Good	Good	Fair	Poor
Appearance					
Introduction					
Organization					
Clarity					
Delivery					
Eye Contact					
Visual Aids					
Timing					
Conclusions					
Relevance					
Questions					
Credibility					
Overall					

Communication Skills

Improving communication skills has been a cornerstone of the MPM program from its inception. Students are required to prepare a capstone report on a topic of their choice and present it in accordance with professional standards. To help them achieve this requirement, a series of communication workshops that stress writing and presentation skills is offered throughout the year by communication professionals who are retained by the program. Student reports are prepared with one-on-one interaction with our professional staff and are carefully supervised to insure proper organization and content development. Finally, the presentation is made in 30 ± 5 minutes before a faculty committee which evaluates each presentation and determines acceptability. Although the content of this report must be technically correct, the emphasis of this requirement is aimed toward the "improvement of communication skills" and not the establishment or formulation of some novel research finding.

<u>Credential and Professional Development Hours</u>

In addition to the program of study leading to a Master of Science in Project Management degree, the MPM program offers two other study options which some may find beneficial to their careers. These are the **Northwestern Engineering Credential** and **Professional**

Development Hours. The standards for admission to both of these options are the same as those for admission to the degree program, and tuition is at the prevailing rate for individual courses in the degree program.

Northwestern Engineering Credential

The Northwestern Engineering Credential is awarded upon the successful completion of four courses that form a coherent unit of study and complement an individual's academic and work experience. The courses that comprise this option must be approved *a priori* and they must be completed within two years from the start date of the first course. If the individual matriculates into the MPM degree program within two years after completing this Credential, the four courses taken will be accepted toward the requirements for the degree.

Professional Development Hours

Most professional registration agencies and accrediting organizations require the completion of periodic continuing education credits to maintain registration or certification. Courses in the MPM program offer a wide range of diversification and can be used for this purpose. A full course counts for 30 Professional Development Hours (PDH) and a half course counts for 15. If the individual matriculates into the MPM degree program or decides to earn a Northwestern Engineering Credential within two years after completing any acceptable course, the course can be used to satisfy the requirement for either the degree or the Credential.

Performance Assessment

Throughout the year the program director and associate director monitor student performance in courses and attendance at seminars. In addition, they continuously interact with the faculty teaching the courses to ascertain whether or not there are any problems or student concerns. The adjunct faculty in the program typically participate in one 3-hour workshop per year to evaluate the program, synthesize interactions among course offerings, and recommend future directions for the program. At the end of each year, most of the graduates undergo an exit interview by an external professional regarding their experience in the program. The results are analyzed by the interviewer and a summary report is prepared for the program director. These interviews provide an excellent resource to assess the "immediate" degree of satisfaction with the program and to identify any areas that need attention. In addition, periodic alumni surveys are conducted, usually three or more years after graduation, to solicit "reflective" feedback about the strengths and weaknesses of the program.

Faculty

Although students in the MPM program have access to any appropriate and available course in the University, the "heart" of the program is the 20 plus high-level professionals who comprise our adjunct faculty. In addition to their vast knowledge and experience, these individuals bring to the classroom an enviable degree of enthusiasm in the opportunity to "give back" to the profession by instructing the next generation of project managers. To enhance a spirit of collegiality and synergy, the program hosts two "Extend Your Horizon" dinners per year for

these faculty and their spouses or guests. These affairs feature an interesting and informative talk on a subject unrelated to "business".

Target Markets

Notwithstanding the four specializations offered in the program, the primary interest of the students to date has overwhelmingly been construction management. The program has had relatively few students pursue the environmental management, infrastructure management, and A/E/C business management specializations. Virtually all of our students undertake the program on their own initiative with little or no encouragement from many of the companies for which they work (in fact, some companies make it "difficult" for students to take courses and most only subsidize their employees at a rather low level). This is a continuing manifestation of the previously mentioned lack of the construction industry investment and support for such educational programs. In general, companies do not send students to the program, although in recent years they have readily and aggressively hired graduates of the program.

Student Body

The program is flexible enough to attract both full-time and part-time students, as well as both domestic and international students. At any given time, part-time students comprise about half of the class and the other half consists of full-time students. Since international students must register full-time to satisfy visa requirements, they typically complete the program in half the time of a part-time student. Accordingly, international graduates comprise about two-thirds of the program's 240 alumni.

Social Interaction

To create a sense of collegiality among the students with diverse cultural and educational backgrounds (domestic and international; part-time and full-time; civil, mechanical, and electrical engineers and architects) and varying levels of experience (from one year to more than 20 years, averaging about 3 to 4 years), a social committee consisting of three or four students arranges a variety of social activities, ranging from pizza parties to attending professional sports games and ski trips. In June of each year the program hosts a brunch to which all students, graduates, faculty, seminar speakers, and "friends of the program" are invited. A large number of alumni and alumnae maintain the relationships developed as students through their professional and social activities.

Publicity

Initially, substantial effort went into publicizing the program to targeted audiences (contractors, architects, registered professional engineers, ASCE members, etc.) via a letter-size pamphlet to individuals on acquired mailing lists. Such direct advertising was preferred over newspaper ads to better focus on specifically identified target markets and to hold the cost down. Although these targeted mailings (of which there have been about 100,000) may have contributed to an overall awareness of the program, experience has shown that they have produced few matriculated students. Accordingly, less emphasis is now placed on such mailings, and

considerable effort is directed toward maintaining a comprehensive web site describing the program (including a description of the curriculum, individual course descriptions, faculty involved, a form for receiving additional information, and an application). These World Wide Web pages are accessible globally at:

http://mpm.northwestern.edu

For the past half a decade or so, most of our students have come to the program as a consequence of our web site and/or personal referrals.

Summary

Educating project managers for the construction industry has changed considerably with the increased complexities of the projects and the environment in which we currently operate. Described herein is an approach developed to respond to the need for more knowledgeable construction managers. While there are many construction oriented programs throughout the United States, the MPM program at Northwestern University has some attributes that make it a combination of traditional construction management education and executive managerial training.

The strengths of this program are its high level practitioner faculty, the germane content of the courses emanating therefrom, a dynamic and responsive curriculum, the honing of teamwork concepts, the synergies resulting from an international student body, an emphasis on improving communication skills, a customized program for each individual student, frequent interactive discussions among all parties involved in the program, the prestige of Northwestern University, and the benefits of the greater metropolitan Chicago area. In contrast, weaknesses are the low pay scale of civil engineers relative to other engineers, generally weak company support for employees, expensive tuition at Northwestern University, lack of widespread public and industry awareness of the program, the "newness" of the specific subject area at Northwestern University, and the need for a stronger role in fostering placement opportunities. On balance, however, our 15-year experience with this program suggests a bright future and the potential for meaningful expansion.

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