Educating Construction Safety Professionals

A collaborative model for the 21st century

By Sang D. Choi, E. Andrew Kapp and Wayne M. Cole

THE CONSTRUCTION INDUSTRY is a major contributor to the U.S. economy, employing more than 6 million workers representing about 5.2% of the total U.S. workforce [Bureau of Labor Statistics (BLS)]. The boom in construction is so widespread that project delays and shortage in materials and labor are common (Winn, et al 16). Most construction employees work full-time, with many working more than 40 hours per week. In 2002, about 1 in 5 construction workers worked 45 hours or more per week. Construction workers may work evenings, weekends and holidays to finish a project or respond to an emergency (BLS). This incredible growth has brought many inexperienced workers into the field (Winn, et al 16), which may contribute to its relatively high injury rate compared to the manufacturing and service sectors. According to BLS, the construction industry had the highest incidence rate of any U.S. industry from 1992 to 2002 (Figure 1).

Figure 2 shows the construction industry had the third-leading rate of fatalities among all industries and the highest rate among industries regulated by OSHA (BLS). These injuries are not only devastating for workers and their families, but are also costly for employers. NIOSH reported that 15% of all workers' compensation costs are associated with construction injuries (NIOSH). Considering that construction only accounts for 5% of the workforce, this is a serious overrepresentation.

The industry's dramatic growth coupled with the high injury rate has prompted many contractors to seek safety personnel with knowledge of critical construction safety issues. However, colleges and universities have been slow to meet the challenge of preparing students to enter this field (Hecker and Gambatese). The use of a specialized technical course, either in the classroom or via the Internet, is also of limited value as such a course cannot provide the practitioner with the broad knowledge base needed to handle the construction industry's diverse occupational safety and health requirements (Kapp).

What is needed is a comprehensive undergraduate curriculum designed to produce competent SH&E professionals who understand how to recognize, assess and control the hazards of construction

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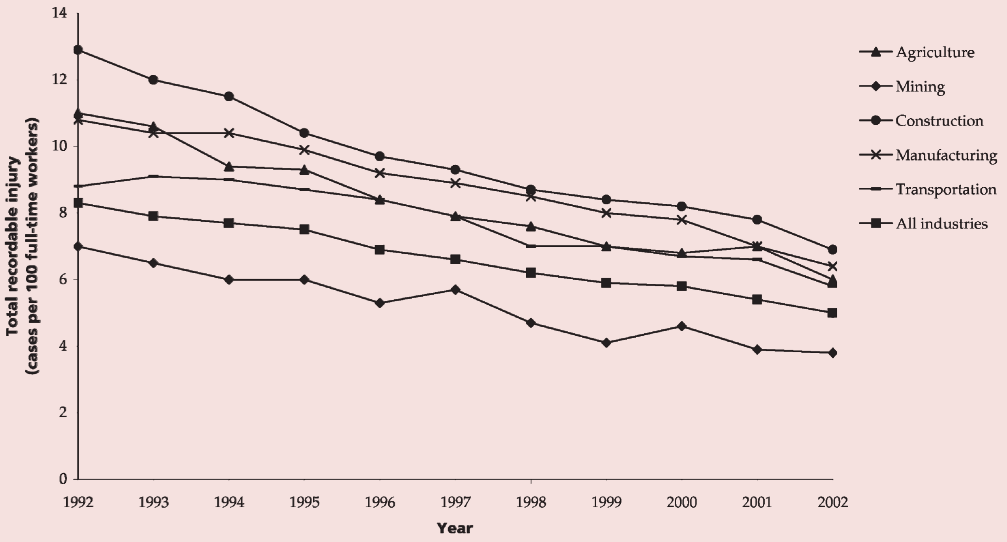
Figure 1

Incidence Rate by Industry, BLS 1992-2002



Abstract: *This article describes a model used by a university in the Midwest to develop a construction safety and health curriculum to meet regional demand for competent construction SH&E professionals in the commercial construction sector. Preliminary evidence indicates that the model has been successful for this university and could be employed at other institutions to meet similar needs.*

sites. The Construction Safety Emphasis and Graduate Certificate programs offered by the University of Wisconsin-Whitewater are designed to meet this need. The program also welcomes returning students seeking to increase their knowledge of construction safety or earn a degree with a focus on construction safety. The program was created through the collaborative efforts of local construction firms, representatives of the area offices of regulatory agencies and the university. This effort responded to a critical community need, creating a great opportunity for the university and community to work together.

Program Development

Phase 1: Establish Program Advisory Committee

In January 2001, representatives of the construction industry and OSHA approached the Occupational and Environmental Safety and Health (OESH) Department and identified the need for competent construction SH&E practitioners to fill a shortage that was projected to increase in the future. The university had an existing degree program in occupational safety, but it lacked content in the area of construction safety. By February 2001, an advisory board was convened to act as a coordinating body for the development and execution of the program. It consisted of 18 representatives from the construction industry, insurance providers, organized labor, government regulatory agencies, safety consulting, and university faculty and staff. Use of such a committee has proven essential to the quality and relevance of academic programs seeking to fill regional needs in other areas (Al-Zubaidy and George).

Phase 2: Establish Program Goals & Objectives, Obtain Resources & Develop a Timeline

The advisory board created a master list of 25 core competencies determined to be essential knowledge and skills for the construction safety practitioner (sidebar on pg. 43). These core competencies were determined by a consensus of the advisory board.

The process began as a group discussion of the skills, knowledge and dispositions a student completing the emphasis should possess—which would dictate the material to be covered in the coursework. Given the wide range of potential competencies, a member of the advisory board volunteered to draft a list to be discussed at a future meeting. This draft list provided a structure for the discussion that followed, and through the input of all board members, this initial list was quickly transformed into the list of 25 core competencies. Key to this process were the unique characteristics and vast experience of the board member who drafted the initial list. This person has more than 19 years' experience in construction safety, is a CSP and served as chair of the Safety Committee for the Associated General Contractors of Wisconsin at the time.

The group then decided to establish an elective emphasis for occupational safety majors; it would consist of three consecutive courses, a comprehensive examination and a semester-long company-based internship. The creation of the emphasis, available only to occupational safety majors, allowed the board to leverage existing required coursework including industrial hygiene, behavioral safety, ergonomics, legal aspects of safety and accident prevention to reduce the number of new courses needed to adequately cover the 25 core competencies.

A timeline was established for accomplishing the objectives including faculty training and coursework development. A $5,000 seed grant was secured to send existing faculty for training at OSHA's national training institute so they could become recognized as OSHA-approved construction outreach trainers.

Phase 3: Implementation

The first course in the sequence was offered in September 2001, and the full program was implemented by January 2003. The advisory board continues to be involved, with members participating as guest lecturers, hosting field visits and sponsoring internships.

The Curriculum

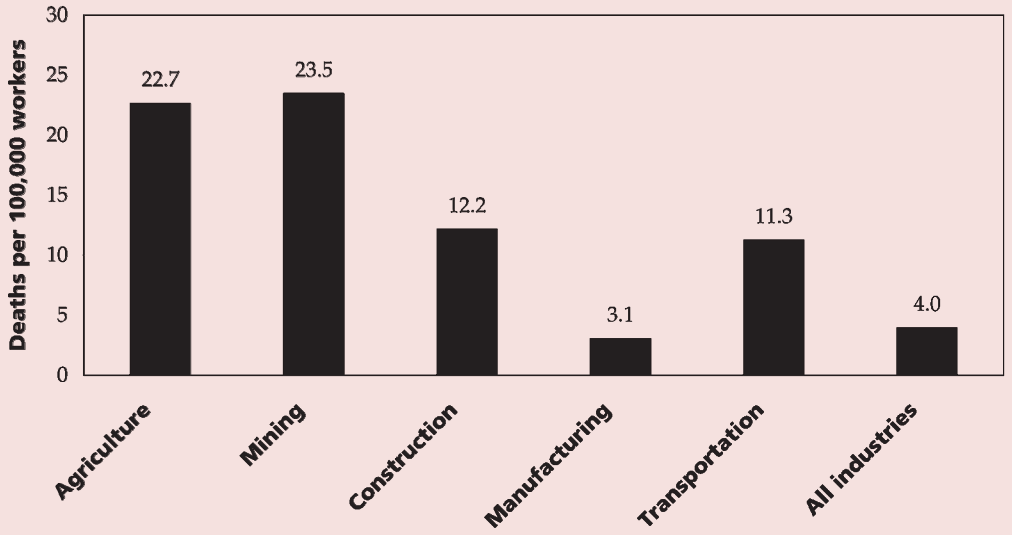
The undergraduate program leads to a B.S. in Occupational Safety with an emphasis in construction safety. The graduate program provides a stand-alone certificate in construction safety. Credits earned in the certificate program may be applied to the course of study required to earn an M.S. in Occupational Safety. The curriculum consists of three sequential courses, followed by a comprehensive exam and a field-based internship. The following discussion provides more details on the three courses.

Course I

The first course introduces students to construction processes and the hazards associated with the construction work environment. It provides an overview of the spectrum of construction projects,

Figure 2

Fatality Rate by Industry, BLS 2002



construction materials and how they are used, and the different work activities involved in the construction process. Course topics include historical perspective, earthmoving, excavation, rock excavation, loading and hauling, grading, paving, concrete work, wood construction, steel construction, electrical work, masonry, roofing, plumbing, and heating ventilation and air conditioning. The course provides students with the background required to understand construction safety standards, which are covered in the subsequent course.

Course II

The second course is designed to help students build a strong knowledge of OSHA's construction standards (29 CFR 1926) and select general industry (29 CFR 1910) standards such as hazard communication. Students learn how to use the standards to build effective safety programs. This course meets the requirements of OSHA's 30-hour construction safety course and is taught by an OSHA-approved outreach instructor. Students who complete the course requirements and record at least 35 hours of class time earn the OSHA 30-hour construction card. Course topics are:

- introduction to OSHA construction standards, General Duty Clause and employer responsibilities (Part 1903, Part 1904);
- inspections, recordkeeping, general safety and health provisions, and competent person (1926 Subparts A-C);
- health hazards in construction, occupational health and environmental controls, and hazard communication (1926 Subpart D);
- PPE and lifesaving equipment (1926 Subpart E);
- fire protection and prevention (1926 Subpart F);
- materials handling and storage (1926 Subpart H);
- hand and power tools and machine guarding (1926 Subpart I);
- welding and cutting (1926 Subpart J);
- electrical (1926 Subpart K);
- scaffolds (1926 Subpart L);
- fall protection (1926 Subpart M);
- cranes, derricks, hoists and elevators, and conveyors (1926 Subpart N);
- motor vehicles and mechanized equipment (1926 Subpart O);
- excavations (1926 Subpart P);
- concrete and masonry construction (1926 Subpart Q);
- steel erection (1926 Subpart R);
- stairways and ladders (1926 Subpart X).

Course III

The third course ties together the knowledge gained in the first two courses and focuses on how that knowledge is applied in the field. It provides students with a comprehensive background in worksite safety management techniques and introduces them to strategies for handling the construction industry's diverse occupational safety and health requirements. Specifically, this course incorporates the financial and human relations facets of construction safety; explains how the SH&E professional fits into the business; covers how to manage subcontractors and their safety performance; and discusses labor unions. The course teaches students to administer the various tasks and processes encountered in managing safety on a construction site. The course also addresses multicultural workforce and women's issues in construction. Course topics are:

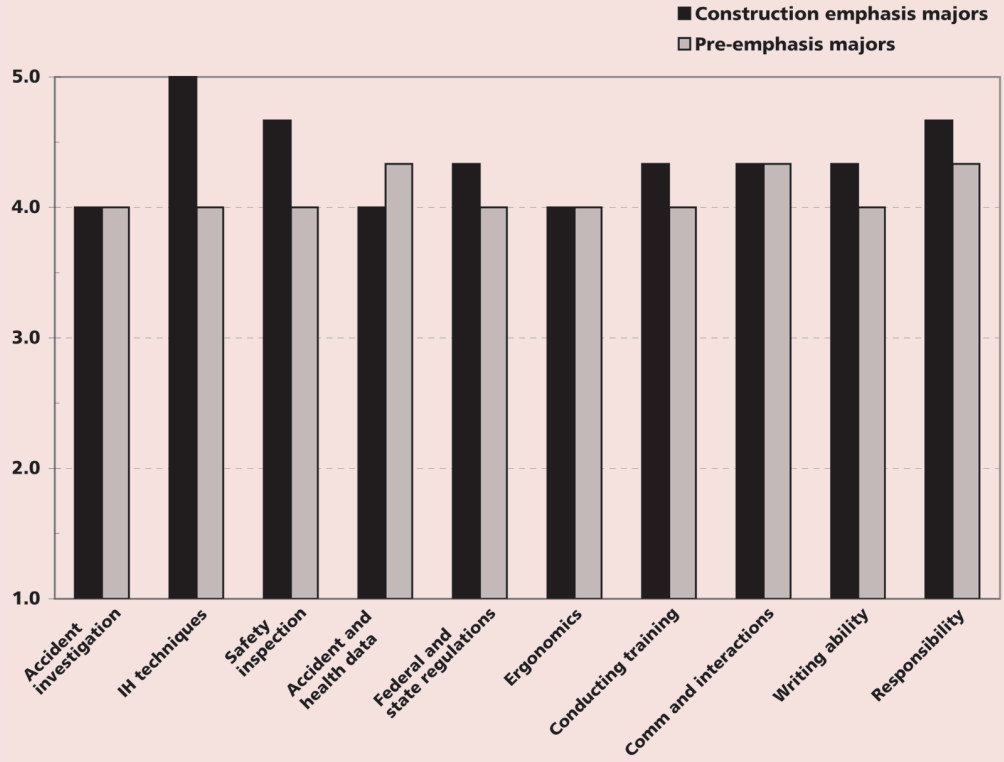
- construction safety management issues, challenges, concerns and rewards;
- foreign-born workers—policies and procedures for safe work environments;
- union role in construction safety;
- trade interaction on the jobsite and responsibility of each trade;
- multiemployer liability;
- subcontractor prequalification strategies;
- insurance on the job (general liability and financial impact);
- crisis management—accident, medical emergency and EPA spills/emergency response.

Master List of Core Competencies

1) Historical perspective on construction
2) Construction contracts
3) Insurance for construction projects
4) Using plans and specifications
5) Basic risk control plans
6) Jobsite planning
7) Making a jobsite visit/audit
8) Excavation
9) Rock excavation
10) Shoring and soil stabilization
11) Foundations
12) Concrete construction
13) Structural steel erection
14) Manual material handling
15) Mechanical material handling
16) Cranes
17) Ladders
18) Scaffolds
19) Hand and power tools
20) Personal protective equipment
21) Occupational health and hygiene (including hazard communication)
22) Transporting construction equipment
23) Driver and equipment operator safety
24) Road construction traffic control
25) Special trade contractors/subcontractors

Figure 3

Evaluation Scores for Students Completing Construction Safety



academic/intellectual rigor than the work of the undergraduate student. In the preliminary course, graduate students must abstract 10 construction safety articles from respected sources on a specialized construction topic not covered by the instructor, then develop a presentation of the material for the entire class.

Third, the course experience for graduate students promotes more self-directed learning and greater use of learning resources than the undergraduate course experience. Graduate students in the final course are assigned a semester-long project with a participating construction company. Either individually or as a member of a team, each student works under the guidance of both the instructor and the company SH&E professional to complete this project and deliver a presentation to the class at semester's end.

- federal work versus private work;
- dealing with workforce diversity;
- setting up an office on site and site security;
- developing a site safety plan and steel erection requirements;
- managing drugs and alcohol;
- workers on site—drivers servicing the site;
- workplace violence and stress;
- public relations;
- personal professional development;
- team-building skills;
- teaching/training skills;
- women's perspective in construction.

The same set of courses serves both the undergraduate emphasis and the graduate certificate. The courses appear in both the undergraduate and graduate catalogs with different course designations. However, the experience for undergraduates and graduates in these courses differs in three ways as required by university policy for dual-listed courses.

First, the graduate student experience in the construction course involves a greater depth and more specialized coverage of construction safety theory and its application than does the undergraduate experience. For example, in the second course, the graduate student performs a construction worksite safety inspection under the supervision of a company safety representative, completes a report of findings for the company, then develops a 30-minute presentation for the entire class detailing the inspection results, including references to federal regulations for each finding.

Second, the work of graduate students must also reflect a more intensive level of study and greater

Outcomes

Through this collaborative model, the university was able to rapidly create a construction safety program with minimal budget implications. The results are superior to academia operating alone and include a curriculum rooted in the realities of day-to-day construction safety and health management, engaging instructional methods including participation by safety practitioners, and improved assessment through comprehensive examination and semester-long internships.

As a preliminary measure of program success, a triangulated analysis was conducted using internship program evaluations, telephone surveys with former students and solicited commentary from advisory board members. More data will be collected in the future to definitively assess the program, but based on these three sources of feedback the program appears to be off to a successful start.

Internship program evaluations from the majors who most recently completed construction internships before the construction emphasis was added were compared with those of construction emphasis students who completed internships with construction companies. All internships are completed in the final semester of the senior year and involve a minimum of 35 hours per week performing SH&E activities in a company setting. These evaluations are completed by the member of the sponsoring company who oversees the daily activities of the intern (often the site supervisor).

To date, of the seven graduates with the construction safety emphasis, internship evaluations were

completed for three. The evaluations measure the professional skills demonstrated by the students during their internships on a 5-point Likert scale (1 = poor to 5 = excellent). Skills assessed are: 1) accident investigation techniques; 2) industrial hygiene techniques; 3) safety inspection techniques; 4) analysis of accident and health data; 5) understanding of federal and state regulations; 6) ergonomics; 7) legal aspects and liability issues; 8) conducting training sessions; 9) communication and interaction with people; 10) writing ability; and 11) acceptance of work-related responsibilities.

Figure 3 provides mean evaluation scores for the three construction emphasis students and the three students who most recently completed internships before the emphasis was adopted. Legal aspects and liability issues are not included as none of the three emphasis student interns used this skill set and the site supervisors all reported "not observed."

Because of the small sample size, there was insufficient statistical power to confirm improved scores on the items from the evaluations through a comparison of means test. However, improvements were noted across 6 of the 10 measures. Higher mean evaluation scores were received by emphasis interns in the areas of industrial hygiene techniques, safety inspection techniques, understanding of federal regulations, conducting training sessions, writing ability and acceptance of work-related responsibility. A slight decrease was found in data analysis, and no differences were reported across the remaining measures.

Thus, the overall trend is toward general improvement across the majority of the evaluation measures by construction emphasis students. This indicates that these students were better prepared to handle the specific work responsibilities of a construction safety professional than those who followed a general occupational safety curriculum.

The program's first five graduates secured employment in construction firms within the region. Surveys of these students further demonstrated the personal benefit of the construction safety emphasis. They were asked what benefit the emphasis program has provided them as they begin their careers. "Covering the construction standards in the emphasis program really helped me find a career by making me more marketable to employers seeking a safety coordinator," said one graduate who is now the safety and health manager for a builder. "Absolutely, no doubt about it," was the reply of another, who now is the safety coordinator of a large electrical contractor. "The skills I learned have benefited me greatly. There is no way I would be in the position I am in without the emphasis program."

According to one recent graduate, "The knowledge and skills I gained through the construction safety emphasis are essential tools for conducting the various safety activities from jobsite inspections to daily safety training sessions." Such responses are a strong indicator of the value of this collaborative education model. According to one advisory board member, who is director of risk management for a large regional general contractor, "The benefits of participating in [this program] are well documented. The benefits are manifested by virtue of the hiring and continued employment of three additional graduates who have shown true professionalism in delivering effective construction risk control services." Long-term measurements must be taken to gauge the learning outcomes over time.

As for potential improvements, respondents suggested the program offer additional time on construction sites; provide more coverage of construction standards; allow for additional contact with practicing SH&E professionals; and be expanded to include another three-credit course to cover the additional material.

As of spring 2006, the program has 22 undergraduate students (emphasis) and 10 graduate students (certificate). Many students who intend to pursue safety careers in industry, fleet or institutional fields are taking the construction safety courses as electives. The resulting improved construction safety knowledge in these other safety disciplines will prove valuable as these individuals get involved in construction projects such as additions or renovations in their work environments.

Student evaluations and internship program evaluations have been positive, as have been comments from alumni and construction industry contacts. This initial success demonstrates that academia, local industry and governmental agencies can partner to fill regional needs in occupational safety and health. Through the leveraging of existing governmental or international occupational safety and health training resources, existing academic programs in occupational safety and related disciplines could develop competencies in areas of occupational safety and health relevant to the industries in their respective regions at a low cost and in a short time. ■

This initial success demonstrates that academia, local industry and governmental agencies can partner to fill regional needs in occupational safety and health.

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