

Building Safety Education into Engineering Curriculum

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“The chapter of accidents is the longest chapter in the book” – John Wilkes

Workplace injury and the associated costs significantly erode employer profit margins. An estimated seven percent of profits are spent, directly or indirectly, as a result of a workplace injury. An effective illustration is that of an iceberg. The tip of the iceberg (the smallest yet most visible part) represents the actual cost of the injury, such as medical care, transport, rehabilitation, and other direct costs. The bottom of the iceberg (the largest and not visible part) portrays lost production, worker replacement, and morale problems, to name a few.

Enlightened educators understand that employers demand educated students with specific skills that will translate into company profits. Profitability concerns aside, we must further acknowledge that it is not ethical to injure or kill our fellow man. Educators have a moral responsibility to include the basic fundamentals of safety in their class design and delivery.

There is a serious need of safety integrated instruction at the university level. A recent report sponsored by the National Institute of Safety and Health (NIOSH) reports that only twenty-nine U.S. schools offer degrees in occupational safety and they only graduate about three hundred students annually¹. This number is extremely low given the number of workplace injuries that occur every day. It is imperative that engineering students receive at least minimal safety instruction specific to their profession and realize the personal long-term impact that they can make in the work environment.

Making a Difference

Well rounded engineering students should graduate with the knowledge and ability to proactively influence safety on a daily basis. It is the responsibility of higher education to instill a principal mindset that reminds students that their professional actions will always affect others. Safety, like education, is a long-term investment that will continue to pay in years to come. In every profession, the engineering team is considered an integral part of the management team. Engineering students instructed with a minimal safety background can enlighten other team members that the majority of injuries are preventable and the associated expenses can be drastically reduced. Resulting savings can then be proactively infused into other highly visible areas such as quality assurance, facility upgrades, and of course, production. The management team will ultimately determine the outcome of any safety and health program. This is the most vital element in the quest for a safe workplace². A thorough engineering program should not only teach necessary technical skills, but should implant the individual ethical conscientiousness essential for this to become a core value as well.

How Much Safety Instruction?

What type and how much time should we devote to safety in the classroom³? We must first ask some fundamental questions before this can be answered.

1. We must ascertain where our students are in terms of their current safety knowledge and skills.
2. We must find out where our students are in terms of safety behaviors required to perform a task.
3. We must find a systematic way to provide effective instruction that will provide the difference.

When the aforementioned questions have been answered, we can determine the amount of safety instruction that is necessary and incorporate it into to a lesson plan. The next section will provide a suggested emphasis regarding proactive safety instruction.

The Three E's

The factors contributing to a work injury can be categorized into three general areas⁴:

1. Environmental
2. Personal
3. Behavioral

These human factors formulate the basic tenets of the safety profession commonly known as the Three E's: Engineering, Education, and Enforcement. An effective engineering discipline should integrate all aspects of this doctrine to some degree.

Engineering

A refrain often heard: "We know what is going to hurt us, but we keep on making the same mistakes". If the process has injured once, and nothing is done, it will injure again! Whenever possible, eliminate safety hazards by applying proactive engineering remedies. Find what is wrong and fix it! Do not wait until a system has caused injury – do it before the process is started. All possible shortcomings should be recognized before any equipment or process is implemented. Every engineering student should be taught the technical elements of a pre-implementation job hazard analysis⁵. The JHA process examines all possible injury causing mechanisms, from concept to end use, and seeks to eliminate them. It is imperative that engineering educators and students understand the overall implications of this philosophy.

Education

Every engineer understands the intrinsic value of a quality education. When building, equipment, or process changes are imminent and the initial designs are being considered, it is an excellent opportunity to educate those that may be inclined to take short cuts. The best approach would most certainly be to advocate a pre-implementation hazard analysis and gather as much

employee input as possible. The collective knowledge of these individuals will prove invaluable to the success of any design agenda. A base knowledge regarding proactive the elements of proactive safety will facilitate this process.

As a result of the input, the design team can then implement many equipment or process features that will not only increase the efficiency and overall profitability, but will lessen the chance for injury as well. Proponents of long-term safety will always “win in the end”.

Enforcement

Enforcement (discipline) is most often associated with the lack of personal accountability. Accountability starts at the top. The management team must not only “talk the talk”, they must “walk the walk” and lead by example. It is not possible to prevent every accident. It is, however, possible to demand individual accountability to act in a safe manner consistent with the system design. Equipment and process design must take this into account. New or existing systems must be evaluated and acted upon to a degree where chance and risk taking are minimized. Engineering staff should also assist in drafting complete and concise safe operating procedures. Upon receiving effective instruction and adequate training, compulsory safe behavior, from top to bottom, should be mandatory.

Building Safety into the Classroom

Ideally, every engineering student should be required to take an undergraduate safety course. In reality, mandated engineering curriculum leaves little room for non-discipline specific classes. I do not advocate that engineering professors become safety instructors. It would, however, be easy to factor some degree of safety into each class module. By doing this, we allow students to broaden their scope of knowledge and teach them to consider the well being of others. If correctly administered, this knowledge will transfer into the workplace where our students can make a significant difference in the reduction of human suffering, and of course, unnecessary company expenditure of the capital resources.

Invite Safety Related Guest Speakers

Guest speakers are an excellent way to introduce your class to safety. The author has utilized a number of excellent speakers, from various backgrounds to enhance a class module. There are several options available to you.

Consult with your campus safety representative. You will find them most helpful in this regard. As the campus safety representative, they possess a broad knowledge of area-specific hazards and compliance objectives of the Occupational Safety and Health Administration, American with Disabilities Act, Environmental Protection Agency, local fire codes, and many other applicable areas

Seek a colleague as a guest speaker. Every college or university campus is filled with knowledgeable instructors eager to share their expertise. Engineering professors from every discipline could possibly enlighten our classes with relevant safety related facts that we have

never even considered. If a professor cannot accommodate you, seek permission to use already prepared class materials to supplement your class.

Inquire among your students. It is not uncommon for many students, especially the non-traditional ones already in the workforce, to acquire a great deal of safety-related experience. Students will usually welcome the opportunity to share their real-world experiences.

There are many avenues available to the engineering professor regarding the dissemination of information related to safety.

Promote Safety Oriented Classroom Discussion

At a very minimum, ask the following questions:

- Can what we are discussing cause harm?
- Is there a safer way to achieve this?

By merely asking the question, we are not only promoting safety, we are prompting creative thinking among our students.

Assign Safety Related Homework

Students can learn a great deal about a hazard by merely submitting an abstract. Safety-related topics should relate directly to the class material being covered. A library keyword search will often provide many research possibilities for the student to investigate. Improvement of the student's research and writing skills is another great benefit of this assignment.

Require Safety Presentations

Require that each student present their research findings to the class. Not only is this a way to increase the dissemination of the information, it strengthens individual public speaking abilities that are essential to the success of any professional.

Encourage Safety Related Group projects

Group projects are a wonderful way to explore any new area. Group forums can perform research and discuss the pros and cons of safety expenditures as it relates to the current coursework or project. Projects of this type also strengthen teamwork skills that are necessary in the modern workplace.

Provide Class Tours

Plant tours are an excellent way to demonstrate real world technology. When you are scheduling a tour, be sure and inquire of safety efforts when you are there. If possible, ask the company safety representative to briefly explain the proactive safety efforts at their facility.

Present Safety Related Multimedia

Videos and DVDs are available specific to most every hazard. Begin your quest by contacting your state Occupational Safety Health Administration representative. Many instructional aids are available at little or no cost. University and college libraries usually have an inter-library loan agreement with the state library, an excellent source for this type of media.

Distribute Handouts Associated With Safety

Handouts containing relevant safety material can offer a great deal of essential safety information. FAQ sheets are usually found ready-made on most safety related subjects and available at many safety related websites. Search engines usually produce a myriad of sites where printable fact sheets can be downloaded.

Summary

In summary, proactive safety integrated instruction is highly desirable and easily achieved. Whenever change is proposed in any organization, remember that a prudent approach will include proactive engineering basics that will not only strive for profitability, but seek to eliminate all preventable injuries as well.

Proactive safety must be viewed as a core value, receiving as much management attention as quality and production. Safety does not “just happen”. A committed team approach that utilizes a safety educated engineering staff will have a dramatic impact, reducing the frequency of injury, ultimately resulting in a safer, compliant, and more profitable workplace.

As educators, it is our responsibility to create a solid base of safety knowledge and also to nurture a lifelong safety mindset within our students. The author makes no claim as to innovation regarding safety related instruction, but I leave you with this final question. What are you doing to ensure the future safety of your students and those they will impact?

¹ Institute of Medicine. Safe Work in the 21st Century - Education & Training Needs for the Next Decade's Occupational Safety and Health Personnel. National Academy Press. 2000.

² Schneid, Thomas D. Modern Safety and Resource Control Management. Wiley & Sons. 1999.

³ Peterson, Dan. Techniques of Safety Management- A Systems Approach. 3rd ed. ASSE. 1998.

⁴ Geller, E. Scott. Working Safe – How to Help People Actively Care for Health & Safety. 2nd ed. Lewis Publishers. 2000.

⁵ Michaud, Patrick A. Accident Prevention and OSHA Compliance. Lewis Publishers. 1995.

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