TEACHING OCCUPATIONAL SAFETY, HEALTH AND ENVIRONMNETAL STUDIES IN THE TECHNOLOGY PROGRAM

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1. OCCUPATIONAL SAFETY, HEALTH AND ENVIORNMENTAL STUDIES

What is safety, health, and environmental (SHE) studies, and how and why are these concepts taught in Technology Programs?

SHE involves the anticipation, recognition, evaluation, and control of hazards for those exposed occupationally and the general population. Failure to control these hazards may result in:

- Severe injury or death
- Economic impairment
- Regulatory violation
- Tort liabilities
- Ethic and moral dilemmas

1.1 Identifying hazards

I know you may be thinking, do these hazards really exist or are they just hype or verbiage from doom-sayers?

All one has to do, is to look at the United States Department of Labor statistics to discover which occupations and industries are continually in the forefront of occupational injuries, diseases and fatalities. Enforcement is alive and well at the Occupational Safety and Health Administration (OSHA). The agency issued citations for over 100,000 violations of federal law in fiscal year 2004. This was a slight increase over 2003. More than 80,000 of the citations were considered serious. Initial penalties amounted to almost $120 million before penalty adjustments.[1]

1.2 Safety in the Northern Illinois University Curriculum

At Northern Illinois University (NIU), the majority of our Technology graduates go into manufacturing (General Industry) or Construction. Technology students become front line supervisors or managers in the early stages of their careers. Not only are they responsible for their own health and well being, they are also responsible for the:

- Health of the employees they supervise
- Safety of product design
- Quality of production
- Impact on the environment

2. SAFETY STATISTICS

According to OSHA, many supervisors are not living up to their responsibilities. Hazards are allowed to exist. People are becoming ill and injured. Medical, Workers Compensation, and legal costs are increasing.

What are the hazards that our graduates may face? According to OSHA[2], the most frequently cited hazards in 2004, and the number of citations issues, were:

General Industry		
*Rank**	*Violation*	*Citations*
1	Hazard Communication	4,373
2	Machine guarding	2,804
3	Control of Hazardous Energy	935
4	Corrosives (Handling and First Aid)	833
5	Walking Working Surface	800

Construction Industry		
Rank [1]	*Violation*	*Citations*
1	Fall Protection	5,052
2	Scaffolding Erection	3,565
3	Excavations	1,411
4	Training	2,678
5	Equipment Operation	1,126 [2]

In General Industry, the most frequently cited hazards include

- Failure to warn people of existing hazards;
- Improperly guarding or not guarding machinery;
- Failure to control hazardous energy;
- Improper handling of corrosive chemicals; and
- Failure to construct or use proper work surfaces.

In the Construction industry, the most frequent cited hazards include:

- Failure to build or use techniques that prevents the collapse of building materials and resulting fall hazards,
- Failure to train employees on proper operating procedures, and

- Failure to operate equipment in a safe manner

OSHA also publishes their ranking of the most dangerous trades as follows:

Table 1: Industry Ranking as a Dangerous Trade

Industry Ranking as a "Dangerous Trades"[3]

1. Mining
2. Construction
3. Agriculture, Forestry, Fishing
4. Transportation and Utilities
5. Manufacturing
6. Wholesale and Retail trade
7. Services
8. Finance, Insurance, etc.

3. CAREERS AND ADDRESSING THE INJURY ISSUES

Unfortunately, our graduates participate in all of the most dangerous trades.

Some of you may remain unconvinced. Our graduates have found employment as Risk Managers and Safety Professionals. Their primary responsibility is to identify and mitigate risk from known hazards. Recently they got some bad news and some good news about serious on-the-job injuries from the latest findings of the annual Liberty Mutual Workplace Safety Index. [4]

First, the bad news: The cost of these workplace injuries continues to soar, even after adjusting for medical and wage inflation. In fact, over half of the 12.1 percent increase between 1998 and 2002 happened in 2002, despite a drop in the number of serious injuries over those four years.

Now the good news: The ranking of the top nine causes of workplace injuries was the same for the past four years, giving risk and safety managers a clear roadmap for preventing the most expensive injuries. "If you want to dramatically cut workers compensation costs, follow the numbers not the headlines," notes Dr. Tom Leamon, Director of the Liberty Mutual Research Institute for Safety, who presented the 2004 Index's findings at the National Workers Compensation and Disability Conference. "Understand why your employees get hurt and address these sources…".

By know, it should be apparent that hazards exist in the work place and people become injured or ill. However, you may be wondering, what is the economic impact of the injuries? The top ten workplace injuries in 2002 and their hard costs (actual dollars paid for medical, workers compensation, and legal expenses) were:

Table 2: *Injury type and cost*

Injury Type:	Cost: (Billions)	Percentage:
Overexertion	$13.2	26.6 %
Falls on Same Level	$ 6.2	12.5 %
Bodily Reaction	$ 5.3	10.8 %
Falls to Lower Level	$ 4.6	9.2 %

Struck by Object	$ 4.4	8.9 %
Repetitive Motion	$ 2.8	5.7 %
Highway Incident	$ 2.6	5.2 %
Struck against Object	$ 2.3	4.7 %
Caught in or Compressed by:	$ 1.9	3.8 %
Assaults	$ 0.4	0.9 %
All Other	$ 5.8	11.7 %
Total	$49.6	100 %

The actual costs of the injuries were approximately 50 billion dollars. This cost figure excludes the soft costs (administrative time, additional staffing, training, regulatory fines, etc.).

There was a total of 5,559 fatal work injuries recorded in the U.S. in 2003, a small increase from the revised total of 5,534 fatal work injuries reported for 2002. The rate at which fatal work injuries occurred in 2003 was 4.0 fatalities per 100,000 workers, unchanged from the rate reported for 2002. For more information on fatal work injuries, see "National Census of Fatal Occupational Injuries in 2003," news release USDL 04-1830.

While fatalities in the work place are extremes, unfortunately they do occur. It is the role of everyone in society to do all within his or her power to address the problem. We in academia must do our part to ensure that our students comprehend their role as managers, technicians and engineers in reducing exposure to situations that can and do lead to accidents and illnesses.

4. THE ROLE OF THE TECHNOLOGY CURRICULUM IN PREPARING SAFETY PROFESSIONALS

The multi-disciplined technology curriculum is ideally suited to assist our students in becoming champions of SHE. For example, a manufacturing process involves metal fabrication that includes the welding of stainless steel. The potential hazards include:

- Exposure to airborne metal components of the stainless steel alloy i.e.,
  - Chromium (a carcinogenic material)
  - Iron oxide
  - Manganese
- Ultraviolet light from the electric arc welding process
- Heat
- Material handling (lifting the metal components poses ergonomic-related strains and sprains)

An effective safety professional should be capable of:

- Recognizing the hazards based on the type of industry and the manufacturing process
- Evaluating or quantifying the hazards
- Evaluating the biomechanics of the job

- Conducting an impact (cost) analysis
- Recommending control measures i.e.,
  - Ventilation systems
  - Personal protective equipment
  - Better material handling or process layouts
- Identifying potential confounding issues, i.e.,
  - Asset reliability
  - Building and utility limitations
  - Cost factors
  - Government permits
  - Human factors

Another task commonly assumed by a safety professional is accident investigation. Some thing bad (usually painful and expensive although some may argue that they are the same) happens. What was the actual cause of the accident? A technology student has the background in:

- Machinery design and use and material strength (Mechanical Engineering Technology)
- Material Handling and Plant Layout (Industrial Engineering Technology)
- Utility, power distribution (Electrical Engineering Technology)
- Life sciences (Physics, Biology, Chemistry)
- Human Factors
- Governmental regulations
- Hazard analysis

4.1 The NIU Curriculum

At NIU, technology students take courses in ergonomics and human factors. Those students that are not safety majors are able to take additional courses in industrial hygiene, risk management, disaster preparedness and safety engineering analysis. In these classes, students have the opportunity to investigate occupation safety, industrial hygiene and environmental issues for which they are likely to have responsibility. Human Error and Soft Tissue Injuries are all part of the ergonomics concepts as well as the human factors concepts that students are introduced in the basic Accident Prevention class. Those students that are not safety majors are able to take additional courses in ergonomics, industrial hygiene, risk management, disaster preparedness and safety engineering analysis. It is in these classes that the student's are exposed to more in-depth aspects of the broad field of occupation safety, industrial hygiene and environmental issues that they will be exposed to in the management positions that they will hold after graduation. The basic technology courses that address plant layout and material handling and time motion study are significant practical application course that use ergonomic concepts while design courses use anthropometry and other human factor concepts in the design of equipment, machines and vehicles.

The sciences involved in the process are:
Air monitoring: Chemistry
Radiation monitoring: Physics
Health Impacts: Anatomy, physiology, biology

Ventilation: Mechanical engineering
Material Handling: Industrial engineering
Utility, power distribution: Electrical engineering
Human Factors: Psychology/Ergonomics
Cost: Business

Accident Investigation is something that no one looks forward to performing. Yet supervisors, managers, technicians and engineers have to participate in this activity. One of the concepts that all students in the Northern Illinois University Industrial Technology program are exposed to is the proper way to conduct an accident investigation. Along with the basic concepts of performing an investigation, students also participate in an accident scenario.

Students are also exposed to the liabilities that they will confront in the areas of worker compensation and product liability.

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