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Integrating Quality, Ergonomics, Human Factors and Safety Engineering Instruction into the Classroom for Enhanced SH&E Synergy

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Abstract

In order to fulfill the mission of developing graduates that can make an impact in an organization from the day they start work has always been a challenge. Further, ensuring that such graduates have applicable skills and carry the appropriate tools in their toolbox is a continuous improvement process. One approach is to attempt to integrate the concepts of quality, ergonomics, human factors, and safety into classroom (and laboratory) experiences for undergraduate students that make the competitive in today's job market. Laboratory experiences often attempt to simulate tasks that have transference to the work environment. Such laboratory experiences might be to develop a quality program-sampling scheme, demonstrating lifting, carrying, pushing, and pulling tasks, using mockups of complex display and control integration stations, using mockups of complex display and control integration stations, and/or to giving students laboratory time to use noise monitoring, heat stress monitoring or data collection equipment. Another approach is to integrate industry into the classroom environment through projects that have real deliverables and a panel of mentors to assist the students in realizing a real-world meaningful project. This approach is used here and is described in detail.

Introduction and Background

Human Factors/Ergonomics/Safety engineering are often given brief mention in Industrial Engineering programs. Some programs may offer an "ergonomics" class, which actually collapses Ergonomics, Human Factors, and Safety into one course, such as the INDE 4337 class at the University of Houston. Further, some programs may actually list an undergraduate class in Safety Engineering, even though it has not been taught in many years.

Most undergraduate students are unaware of the existence of Human Factors Engineering or, if they are, equate it with Psychology. There are those who would argue that Human Factors belongs in the realm of Psychology, while other feel that Psychology is a component of Human Factors Engineering. It could also be argued that almost all Industrial Engineering courses feed off of Psychological concepts, whether they are recognized or not.

"Teaching human factors is consistent with the National Standards for the Teaching of High School Psychology (Shapiro, 2003)." However, Safety is not called out specifically for teaching in high school curriculums.

The International Ergonomics Association (IEA) has published a set of guidelines on standards for the accreditation of ergonomics education programs at the tertiary level (IEA, 2001). These guidelines are similar to those the Council of Higher Education Accreditation (CHEA) and the Accreditation Board for Engineering and Technology (ABET), supported by the ASSE (ASSE, 2005). Specifically, in February of 2005, the Society (ASSE) Board of Directors unanimously approved a motion regarding the Society's position on accreditation of institutions of higher learning.

Education ergonomics, as defined by Smith (umn.com, 1998) is the "field of human factors/ergonomic science concerned with the interaction of educational performance and education design." This was one called educational quality/educational reliability. This author further indicates that student performance to some substantial degree is specific to the educational context. This is what educators have known for a long time (e.g., educational effectiveness). The question is how a diverse range of concepts can be integrated into a whole where the individual and interrelated characteristics of the topics can be brought together and understood at the same time. This has always been the challenge in educational environments that are not focused on one area of concentration.

Results

A new challenge is how to integrate new ABET requirements of assessing educational effectiveness into current curriculum approaches to historically established topics and classes. The ABET outcomes are quite specific and are defined below. Specifically, students must have:

a) an ability to apply their knowledge of mathematics, science and engineering;
b) an ability to design and conduct experiments and analyze and interpret data;
c) an ability to design a system, component, or process to meet desired ends;
d) an ability to function on multi-disciplinary teams (including work outside of class);
e) an ability to identify, formulate, and solve engineering problems;
f) an ability to understand the professional and ethical responsibilities;
g) an ability to communicate effectively;
h) the broad education necessary to understand the impact of engineering solutions in a global and societal context;
i) a recognition of the need for and an ability to engage in life-long learning;
j) a knowledge of contemporary (engineering) issues; and
k) an ability to use the techniques, skill, and modern engineering tools necessary for engineering practice.

A secondary challenge is to ensure that students receive the level of quality in education that will prepare them for licensure and/or certification after graduation (e.g., PE and both the ASP and CSP). The reason for this challenge is that approximately 25%–50% of the undergraduate IE students become involved with some aspect of SH&E within 1–2 years after graduation.

Therefore, this sample flowing syllabus was developed in an attempt to cover those topics most likely to be encountered by graduates:

08-23	Introduction	
08-25	Human Factors and Systems	Chapter 1
08-30	Human Factors Research Methodologies	Chapter 2
09-01	The Concept of the Human-Machine System	Chapter 22
09-06	Labor Day – No Class	
09-08	System Development, Operator Error	Chapter 20
09-13	Laboratory	
09-15	Information Processing	Chapter
09-20	Displays (Static & Dynamic	Chapter 4 & 5
09-22	Displays (Auditory, Tactual, Proprioceptive, Olfactory)	Chapter 6
09-27	EXAMINATION #1	
09-29	Speech & Communication	Chapter 7
10-04	Motor Skills & Control of Systems	Chapter 9, 10
01-06	Laboratory	
10-11	Controls & Data Entry Devices	Chapter 11
10-13	Environmental Factors (Illumination, Temp. & Atmosphere)	Chapter 16 & 17
10-18	Environmental Factors (Noise Vibration & Acceleration)	Chapter 18 & 19
10-20	Laboratory	
10-25	EXAMINATION #2	10-27 Physical
Activities & Manual Materials Handling		Chapter 8
11-01	Workplace Design (Anthropometrics)	Chapter 13
11-03	Workplace Design (Space Arrangements)	Chapter 14
11-08	Design of Buildings	Chapter 15
11-10	Americans with Disabilities	Supplemental
11-15	Hand Tools and Other Devices	Chapter 12
11-17	Vehicular Transportation & Related Systems	Chapter 21
11-22	Laboratory	
11-24	Presentations	
11-29	Presentations	
12-01	EXAMINATION #3:	

As can be seen in the course outline, laboratory experiences are intermingled within the course to integrate concepts through demonstration. Laboratory experiences were conducted either in the Safety, Anthropometry, Human Factors, and Ergonomics Laboratories (SAHFE Lab) or in the field. All topic areas focused on the topic area's impacts on manufacturing/work quality, human factors, ergonomics, <u>and</u> safety. For example, the topic of Human Factors in Systems focused in on the impact of the human operator on the overall productivity of a system and how human operators, through distraction or design, can negatively influence the function of that system and can lead to catastrophic failure of that system, where catastrophic failure is defined as damage and/or injury to the system rendering the system inoperable (i.e., operator injury).

The integration of these concepts was also supplemented by a real-world project in a garment processing facility and a valve remanufacturing facility (shop and office). The purpose of the diversity of projects is to demonstrate that the same principles of sound quality, safety, human factors, and ergonomics cultures within an organization can be applied to any organization regardless of their service focus.

Specific project guidance was provided in the form of an Outline for a technical paper of suitable publishable quality. Students were also responsible for making a formal oral presentation to the class and to representatives of the sponsoring organization. This is important to emphasize both written and oral skills required to communicate within an organization on a professional level. The following is a description of the technical report format and its outline:

Technical Paper

Format. This is a Journal Article. Therefore, the final product must be: Typed, Double Spaced, 1.5 inch Margins. Follow the format of Professional Safety, the peer-reviewed journal of the American Society of Safety Engineers (ASSE). Figures must follow the text in which they are referenced. Do Not place them at the end of the Technical Report. You will turn in a hard copy and a soft copy.

Length.

- Ten (10) to 20 pages of text excluding: Abstract, Figures, Tables, and References and at least fifteen (15) references exclusive of the course text.

Topics. A list of topics will be distributed.

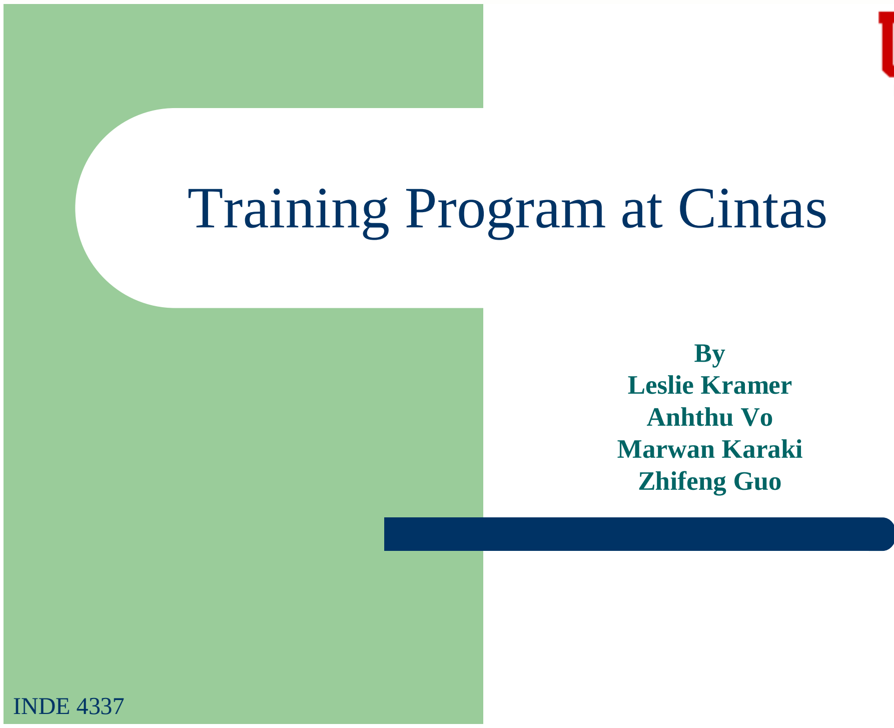
Outline.

- Title
- Abstract
- Introduction (Background, Problem Definition/Objectives)
- Method (Apparatus, Participants, Procedure, Experimental Design, Data Analysis)
- Results & Discussion
- Conclusions & Recommendations
- References

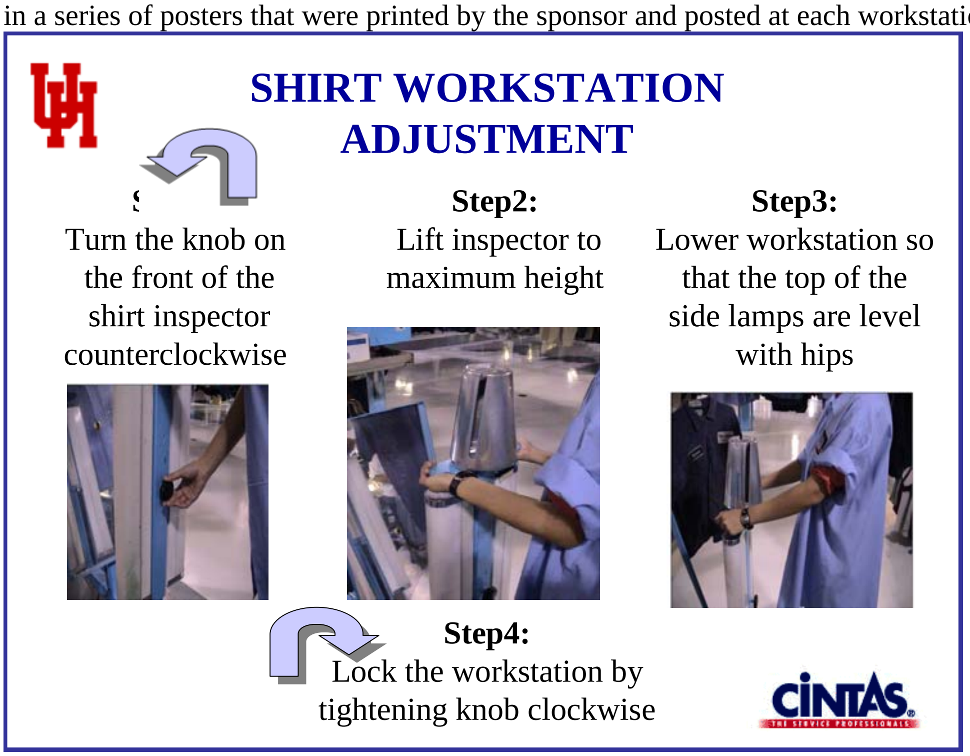
Results

The projects began with the sponsor's technical monitor making a presentation in class, which covered the reasons for the project, the impact of the results of the project, and the importance to the sponsor. In addition, sponsors who have management training programs are particularly sought out so that student participation in the project can also be used as a method for evaluating potential interns and/or employees (partners, in the case of the garment-processing facility).

The first project required the development of a training program for workers for the adjustment of their inspection stations.



The second project dealt with the development of training aids (posters) to be provided at each adjustable inspection station as a reminder to the original training. The preceding training information was provided to new hires through the sponsor's server and available on-line. Due to the bi-lingual workforce, specific guidelines for the posters were limited, focusing on non-verbal communication aids. This effort resulted in a series of posters that were printed by the sponsor and posted at each workstation.



PANT & OVERALL

WORKSTATION ADJUSTMENT

Step 1:
Release latch at back of workstation

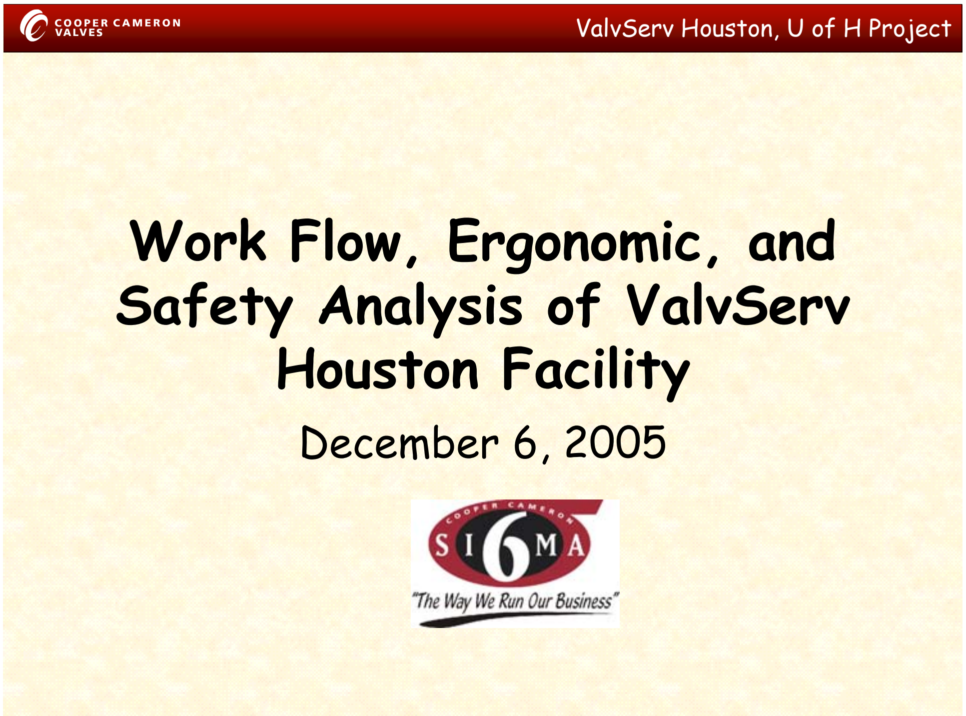
Step 2:
Lift workstation to maximum height

Step 3:
Lower workstation to hip level

Step 4:
Lock latch

As can be seen, two different inspection stations were addressed. However, each poster was limited to 3 frames to be used as an adjustment guide. Both pictorial and verbal (in English here) forms of communication were used. The final versions of the posters were printed in both English and Spanish.

The job shop project focused on a full facility audit, which included the evaluation of office conditions and the application of appropriate local, state, and federal regulations (i.e., NFPA, OSHA, ANSI, DOT, etc.). Recommendations for the correction of each identified opportunity were also accompanied by a costs/benefit analysis and specific product recommendations to enhance the probability of recommendation implementation.



Recommendations

The first and foremost recommendation that can be made is to maintain relationships with your alumni. Track their employment on a yearly basis and provide them with the opportunity to assist them in their projects. In these specific cases, donations were made to higher education to support these and future projects. The donations provided for consumables used in the projects and for equipment modifications and calibrations necessary to complete the projects and ensure project quality.

References

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