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Bridging the Health, Safety, and Environment Risk Management Proficiency Gap for Future Petroleum Engineers

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Abstract

Health, Safety, and Environment Risk Management performance has become essential in the upstream industry due to the evolving complexity of the processes. In recent years, accidents in the oil and gas industries have resulted in catastrophic consequences as they captured the news and had an overwhelming impact to health, the environment, the financial sector, and social aspects of both the companies and their customers. Health, Safety and Environment Risk Management specialists and professionals play a major role in mitigating both risk and consequences of hazards as they assure that companies comply with different standards and perform best-recommended practices. Most of these professionals are engineers who have undergone intensive training courses by their employer as part of professional development programs. Subsequently, they continue their career path as HSE specialists once they successfully complete the program. Unfortunately, there is a gap where academia lacks the adequate educational knowledge base in Health, Safety and Environment Risk Management to establish the necessary knowledge for potential candidates in that field. This paper defines the establishment of “Health, Safety and Environment Risk Management in the Oil Industry” course in the Petroleum Engineering Department at Missouri University of Science and Technology. Not only it is designed

to cover the technical aspects of HSE in the oil and gas industry, but it also enhances soft skills many students tend to overlook such as communications skills, safety awareness, ethical responsibilities, and most importantly, creating safety culture by exposing HSE awareness and knowledge to cater to the oil and gas industry. This course will be the corner stone for establishing a new petroleum engineering focus area where the department tries to expand it into a certificate program by collaborating with other departments on campus which offer different courses on a variety of topics related to HSE.

Introduction

The ongoing industrial evolution has made processes more complex as organizations strive to integrate Environmental, Health and Safety Risk Management as part of their corporate responsibility to their staff (Health and Safety Executives, 2012). As a result, organizations find challenges to continuously manage HSE issues due to cost and duration as they become more liable for any failure that can endanger either their employees or the public welfare (Cheremisinoff & Cnaffia, 1995). The stakeholders in the oil and gas industry, ranging from employees, governments, and communities, are closely monitoring the Health, Safety and Environment Risk Management performance as demand continues for “world-class performance and operational-excellence” (Beull, 2006). British Petroleum’s Deepwater Horizon in the Gulf of Mexico was an example of both management and engineering failure. Hence, it was their responsibility to mitigate any hazardous failure and protect the human health and environment by adequately utilizing their knowledge and proficiency (Kavianian *et al.*, 1993).

The demand for more HSE engineers to be part of the oil and gas industry is increasing. The expansion of the oil industry resulted in a scarcity of these engineers to overlook both the performance of process operations and potential risk management strategies. This paper defines the establishment of a new focus area in Health, Safety, and Environment Risk Management in the Petroleum Engineering Department at Missouri University of Science and Technology. The goal of the program is to meet the job market demand for engineers in that focus area in petroleum engineering. In addition, the availability of the program will enhance student’s communications skills, safety awareness, ethical responsibilities, and most importantly, create an improved safety culture by exposing Health, Safety and Environment Risk Management awareness and knowledge specifically to cater to the oil and gas industry.

The Department of Petroleum Engineering at Missouri S&T approached different professional societies and concerned oil companies to construct a course that fits the industry’s need for highly skilled and qualified petroleum engineers. The goals are to ensure that the suggested curriculum topics meet the job market needs, meeting the required roles and responsibilities of the job description of potential candidates, and to fulfill both societal and legislative demands (Johnson, 2001).

The existence of a professional safety advocacy will introduce students to the importance of safety in the industry as it illustrates to them how it became an indispensable state of mind in numerous industries. Consequently, the new program will bridge the gap between both industry and academia by preparing a new breed of petroleum engineers who are aware of ethics, associated

Background

Accidents in the process industries can result in catastrophic consequences (Rodrigues & Simmons, 2012). In previous years, accidents captured the news and resulted in an overwhelming impact on the health, environmental, financial, and social aspects of both the companies and their customers. The ConocoPhillips' Bohai Bay spill in China's east coast, Pemex's spill in the Mexican Bay of Campeche, and China National Petroleum Corporation's spill in Xingang Harbour are just a few examples of major accidents in the petroleum industry (Anderson & LaBelle, 1994). The most current accident was by BP's Deepwater Horizon, an offshore drilling rig in the Gulf of Mexico, which was performing drilling operations (Davies, 2010). The disaster was caused by a loss of control over the pressure in the well. This loss of control was followed by the failure of the well's blowout preventer; Blowout preventers (BOPs) are standard safety equipment on any offshore facility. BOPs are control system, consisting of both a series of valves and hardened steel sheering surfaces to cut through the pipeline. The accident is considered the largest offshore oil spill in US history (Snow, 2010).

Once an organization syndicates different factors such as HSE proficiency, management systems and processes, developmental psychology, and technology, then it is heading toward establishing an organizational culture (Beull, 2006). Thus, creating a strong HSE culture requires not only commitment but also continuous development, monitoring and improvement in all aspects as part of "HSE cultural maturity level" (Beull, 2006). Hence, the benefit of having this culture will result in a progressive impact on productivity where reducing workers injuries results in less downtime. It also diminishes incapacity expenses and the hidden overheads from lower employee self-esteem (Sandoe, 2012). The oil and gas industry is booming, yet faces both a dearth of technical specialists and an aging workforce (Gould, *et al.*, 2006). The need for more petroleum engineers with HSE focus area is needed to compensate for the shortage in a skilled technical workforce. Thus, as these engineers progress in their career, they embed awareness and safety culture with their acquired knowledge.

The Role of HSE Professionals

HSE professional evaluate and develop recommendations for controlling hazards and advise members of the management team on means to mitigate risk while adhering to regulations. HSE professionals can focus on different areas within their discipline, industrial hygienists, occupational safety, fire protection engineering, environmental safety, human factor engineers, construction safety and institutional safety management are few examples of the potential fields HSE professionals can focus on for a future career (American Society of Safety Engineers, 2007). As a result, these specialties can enhance work place safety by focusing on making the worksite more user-friendly to workers' compensation, turnover, absenteeism, and other major cost optimization (MacLeod, 1994). Such professions requires an extensive knowledge in different health, safety and environment codes along with risk assessment tools to identify and control hazards (Harms-Ringdahl, 2004).

Potential Job Market for HSE Professionals

There are different sectors HSE engineers can engage in; public sectors and federal/state agencies benefit from their expertise, especially in emergency response and crisis management teams. Research and technology institutions are another field to look into for a career. Chemical processing and oil gas companies have an escalating demand for HSE engineers due to the large magnitude of damage these industries can cause in case of an accident. The aviation and commercial aircraft industries demand for HSE engineers includes the airplane manufacturing process, luggage handling and other related aviation activities. These are just some of the tasks that need to be addressed by HSE professionals. The level of complexity and operations in the nuclear power industry strongly benefit from the knowledge and expertise of HSE professionals as they strive to prevent accidents and work for a safe working environment. The HSE profession originated from the industrial engineering discipline. However, HSE has grown tremendously from the 1980s to include several specialties that can enhance the working environment in a safe manner to optimize work performance (Health and Safety Executives, 2012).

HSE Professionals' Background

As the HSE profession developed over the decades to cover different industries, it became a multidisciplinary field requiring broad knowledge in areas such as the physical, chemical, biological and behavioral sciences, mathematics and engineering (Dembe, 1996). However, HSE professionals come from a wide variety of undergraduate and graduate degree programs, including biology, chemistry, management, psychology, occupational safety and health, and engineering. According to the American society of safety engineers, 34,000 members are safety professionals and approximately 1,250 of them are licensed professional engineers.

Approaching the Industry: HSE Education within the South Central Region

Among the four University of Missouri System Campuses; Columbia, Kansas City, Saint Louis, and Rolla, none of them grant a degree in Health Safety and Environment to their students (ASSE, 2007). When looking at other colleges in Missouri, only Metropolitan Community Colleges in Kansas City, MO, offers an Associate in Applied Science (AAS), and not a Bachelor of Science, Environmental Health and Safety. Therefore, Missouri University of Science and Technology will establish a new path for its future students to enroll in a highly desired and sought discipline in various industries such as manufacturing, aviation, maritime, pharmaceutical and biotechnology. In addition, the discipline will create a diverse population within the university campus by attracting more female students seeking a degree in Industrial Hygiene, Occupational Health, or Health Physics (Jennings, 2002).

Establishing HSE Curriculum

Students in the Petroleum Engineering program at Missouri University of Science and Technology undergo intensive courses in oil and gas drilling, production, reserves estimation, and the prediction of future production. Additionally, they study the technology of well logging, well testing, well stimulation, petroleum reservoir engineering, secondary and tertiary recovery and geology. In order to keep up with ongoing changes in the industry, a continuous evaluation of the curriculum

takes place to stay competitive and up-to-date (Missouri University of Science and Technology, 2012). Conferences or symposia represent an excellent opportunity for faculty to hear from experts about the latest innovation in technology. Thus, the open forums in these gatherings are an excellent tool to evaluate the current curriculum to sustain the best practices from some of the leading oil companies.

The Petroleum Engineering department at Missouri University of Science and Technology noticed the importance of HSE in the oil and gas industry. Thus, the shortage in HSE specialists and professionals in the industry was seen as a perceived demand to take this program into consideration (Bihani, 2013). In a vision to bridge the gap between both academia and the oil and gas industry, the department approached different experts in the Health, Safety and Environment Risk Management in major oil companies and professional societies to assist in constructing an introductory course in that field. The goal of the course is to expose students to different essential topics related to Health, Safety and Environment Risk Management in the oil industry. Thus, to provide the industry with a new breed of engineers having safety culture imbedded within. As a result, the department established a new introductory course to be taught in the 2014 academic year.

“Risk Management in the Oil Industry” is an introductory course that exposes petroleum engineering students to different technical aspects of HSE in the oil and gas industry. The overarching goals of the course are enhancing overlooked soft skills that most engineers lack according to a recent study conducted by Altabbakh and Grantham (2012). Communications skills, safety awareness, unconventional problem solving, and ethical responsibilities are some of the skills that the course will focus on. In addition, constructing a safety culture will be featured by exposing the students to HSE awareness topics and broadening their knowledge base to cater to the oil and gas industry (Altabbakh & Grantham, 2012). In order to reach these goals, a new curriculum containing the essential oil and gas HSE topics was developed, in collaboration with Health, Safety, and Environment Risk Management experts in the industry, to be presented to students. The course will cover different important aspects such as working environment and safety. This topic will consist of containing, storing and transporting biohazardous materials. Thus, students will be aware of different occupational safety in terms of allowable exposure and threshold limits of noise, fumes, and other materials existing in the oil field facilities. Moreover, personal safety is another topic of concern, especially in hazardous and highly flammable areas. With the help of a certified Occupational Safety and Health Administrator (OSHA) expert, students will have hands on class on different personal protective equipment and how to use it in case of emergency. The human factors in executing tasks on site, working in heights, and confined space entry are some essential topics students will learn in personal safety aspect of the course (Occupational Safety and Health Administrator, 2014).

Students will be exposed to a range of topics concerned with Process Safety. Assuring operations and process safety, evaluating potential risks, and implementing the proper management of change are some of the topics concerned with assuring safe process operations. Thus, the students will acquire the different risk assessment tools and proper mitigation strategies to minimize resulting consequences. Best practices in work, adapted by professional societies' standards, are a resource of assuring process safety which students will encounter. In addition, the course will cover different managerial skills and corporate responsibilities. Engineering ethics and

case studies in engagement with potential constituent and company's stakeholders will enhance students' soft skills. Thus, they will be able to provide justifiable resolutions to any type of conflict within an organization as they learn different negotiation skills and techniques in organizational leadership.

Thus, the course will satisfy HSE vocational qualifications (VQ's) by offering more practical learning experience to students as they gain the necessary knowledge and skills in that area (Health and Safety Executive, 2009). Moreover, the students will have an advantage in applying their gained skills and knowledge where the industry needs it in quality assurance, risk assessment and mitigation, and management of change where standards and best practices are in continuous evaluation to keep up with human-system interaction technological advancement (Wiegmann & Shappell, 2012).

The topics offered in the this course will be the corner stone for establishing the new HSE focus area in the petroleum engineering department . Thus, the department strives to expand its potential with this initiative to offer a graduate certificate program in HSE. This broader goal can be achieved by collaborating with other departments on campus who offer different courses on variety of topics related to HSE.

There are several courses at Missouri University of Science and Technology that focus on Health, Safety, and Environment Risk Management. Different Departments offer these courses, both on campus and via distance learning. The Department of Psychological Science offers a "Psych-315 Environmental Psychology" class where students learn about environmental attitudes, perception, cognition, environmental influences, crowding, and applying different environmental designs to working environments (Missouri University of Science and Technology, 2012).

Also the Civil, Architectural, and Environmental Engineering offer several classes related to Health, Safety, and Environment Risk Management. One of these classes is "CE-360 Environmental Law and Regulations" where the class exposes students to comprehensive coverage of federal and international environmental laws and regulations concerning smog and wastewater. Hence, the students will learn how the industry performs its operations within compliance protocols both domestically and internationally (Missouri University of Science and Technology, 2012). In addition, the department offers "Remediation of Contaminated Groundwater and Soil" where the students examine case studies in applied remediation technologies. Moreover, the issue of solid waste management and the methods used for their collection, reclamation, and ultimate disposal is the focus of "CE-363 Solid Waste Management." Both "CE 366: Indoor Air Pollution" and "CE 368: Air Pollution Control" introduce students to different applications of controlling emission from fossil fuels and various engineering analyses to minimize exposure to different types of pollutants (Missouri University of Science and Technology, 2012).

Additionally the Engineering Management and System Engineering Department offer courses that focus on reliability, risk analysis, and risk assessment. "EMGT-350 Risk Assessment and Reduction" explores techniques for systematically identifying hazards and estimating risk to improve the safety performance and security of manufacturing facilities. "EMGT-381 Management and Methods in Reliability" provides students with basic concepts in reliability as they apply to the efficient operation of industrial systems. Accordingly, "EMGT-386 Safety Engineering

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Management” focuses on principles of safety engineering applied to the industry in different aspects. Job safety analysis, reduction of accident rates, protective equipment, safety rules and regulations, environmental hazards, health hazards, and ergonomic hazards are some of the topics addressed in this course.

When combining these courses with the current petroleum engineering courses, they become a foundation to form a new Health, Safety and Environment Risk Management engineering focus area within the Petroleum engineering department. Students can take the assigned number of courses as part of science and technology elective courses which can be granted toward a minor in Health, Safety and Environment Risk Management while earning either undergraduate or graduate degree in petroleum engineering.

Conclusion

As the Petroleum industries become systematically more complex, the need for Health, Safety, and Environment specialists has become critical as part of the task force. The proposed launch of Health, Safety, and Environment focus area in the Petroleum Engineering Department at Missouri University of Science and Technology will boost the credentials of both the department and the university as pioneers in that in that field within the South Central region. In addition, students will be exposed to different HSE , as they will enhance their communications skills, safety awareness, ethical responsibilities, and most importantly, creating safety culture by exposing HSE awareness and knowledge to cater to the oil and gas industry.

The Petroleum Engineering Department at Missouri University of Science and Technology has approached major oil and gas companies, as well as experts in the HSE field, to sponsor the program while sharing their knowledge and expertise with the students to gain the utmost from this course. Collaborating with both the industry and safety experts will promote safety culture within young engineers and enhance awareness in decision making, especially when it comes to understanding potential consequences ad associated risks.

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