

Addressing critical needs in the technical energy workforce: Focused certificate and degree programs beyond the associates

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ABSTRACT

The University of Houston, along with consortium partners Lee College, Lone Star Community College and San Jacinto College, propose to develop training and educational programs to accelerate energy-related workforce development in critical areas for the state of Texas through: 1) three certificate programs each consist of 5 courses in advanced petroleum technology, advanced process technology and advanced safety technology, 2) collaboration and articulation between consortium partners to seamlessly develop and deliver the certificate courses, 3) development of stackable credentials for students who successfully complete any two of these certificates an accelerated pathway (i.e., one additional year) towards a BS degree in Organizational Leadership and Supervision program at UH's College of Technology, and 4) a competency-based survey to assess the effectiveness of the program. These goals will be achieved through the formation of a consortium with initially four Houston area community colleges and extending to encompass all community colleges in the Houston area. The introductory courses for each certificate will be offered at the participating community colleges and the advanced courses will be offered at the University of Houston. Once developed and assessed, the proposed three certificate programs will be available for adoption with interested institutions across the nation and worldwide. The highlights of this program are the acceleration of skill enhancement of mid-skill workers and their re-deployment in areas of critical need to the economic development of the state and due to the stackable format the rapid portability and scalability of the program to be expanded statewide and to interested institutions.

<http://dx.doi.org/10.5339/qproc.2015.elc2014.35>

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1. INTRODUCTION

The oil and gas on-shore and off-shore industry has identified a significant shortage of skilled and trained workforce for the ongoing exploration, drilling and production operations. International Association of Drilling Contractors (IADC) has recently performed a Knowledge-Skills-Attributes (KSA) evaluation of the workforce needs for the upstream industry.¹ This KSA evaluation has determined several pathways for the successful training and development of workforce that mainly establishes three pathways: (a) newly-trained workforce for challenging offshore and onshore technologies; (b) updating and certification of existing and retention of current workforce; (c) transitioning existing skilled workforce (such as in aerospace) to critical upstream-related employment. Given the significant needs of the industry and the on-going crew change that is occurring (and likely to continue), there is need for rapid deployment of training methods to update and retain current workforce and transition skilled workforce from other areas to the upstream energy field.

According to “Driving Innovation From The Middle” a report written for Southern Governors’ Associate (2011),² the number of employees facing to fill up middle-skill jobs is all time high. Middle-skill jobs are defined as jobs that require more than a high school diploma and less than a bachelors degree and accounts about 50% of the jobs in the U.S. economy. The demand for middle-skill jobs in Texas is about 51% as shown in Figure 1 and Texas will continue to experience a shortage of middle-skill jobs in the future. Among the top 30 middle-skill jobs forecast 2004–2018, most of them are in advanced technology related jobs such as maintenance (i.e. petroleum technology certificate), computer-controlled operators (process technology certificate), and public safety (i.e. safety technology certificate)

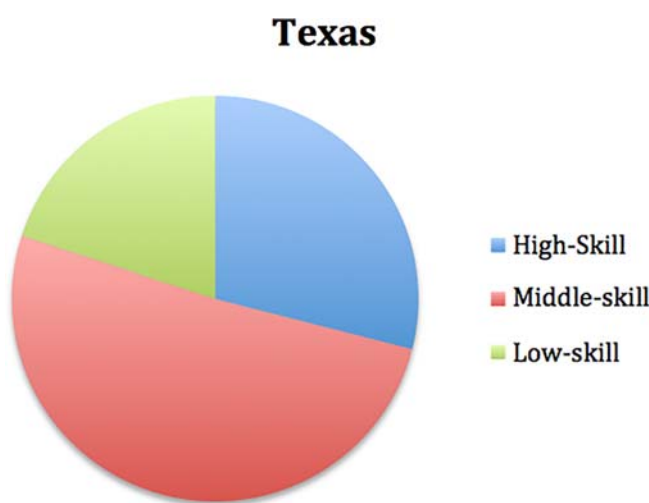


Figure 1. Demand for middle-skill jobs is strong.

The report concludes that:

- Southern states face a middle-skill shortage now and will widen without new initiatives
- It requires strategies to target the K-12 postsecondary pipeline.

In fact this is in line with the Texas Workforce Commission (TWC) initiative to address this shortfall by providing an accelerated certificate programs for the postsecondary training. Moreover, according to the Economic Modeling Specialists Intl. (EMSI) report (2012),³ the six occupations with the highest growth rate (seven of the top 10) are in oil/gas and petroleum areas. Finally, one of the job search engines (www.indeed.com) returns more than 7600 active postings in Greater Houston area with position titles such as process technology, petroleum technology or safety technology combined.

TWC in a recent report noted: “In addition to the problems of demand and attrition in its workforce, the energy industry faces more subtle challenges related to the problem of attracting skilled craft and trade workers.⁴ As cultural values have shifted over the last fifty years, the image of a well-paying skilled job as a desirable career option has faded. A four-year college degree has increasingly become

the preferred outcome for students and families. Technical occupations – even those that are high-paying – have come to be viewed as second rate. According to the paper, the values of younger Americans known as Generation X and Generation Y, do not fall in line with the same notions of lifetime commitment to one industry or company held by older Americans. These generations expect to change jobs several times over their lives. Furthermore, they expect a great deal from their employers including the chance to work with the latest technology at the earliest opportunity, and not necessarily on the condition of spending the time it took the Baby Boomers to “work their way up” to similar privileges.”

The oil and gas industry is poised for increased growth in Texas, not only through additional onshore unconventional resources, but also through the increased off-shore exploration and production not only along the continental shelf but also in the ultra-deep waters of the Gulf of Mexico. There is a critical shortage in the workforce for this industry. Specifically, a report from IHS Global Insight indicates oil and gas exploration and extraction will demand almost 3 million workers by 2020 - up from 1.7 million in 2012.⁵ According to the Greater Houston Partnership (GHP) figures reported in July 2013,⁶ upstream jobs - exploration and production, oil field service and equipment manufacturing - had grown by more than 39,000. Engineering and fabricated metal products contributed another 24,900 jobs. The United States Bureau of Economic Analysis reports every exploration job in Houston supports seven other jobs. Every oil field services job supports another 11 jobs elsewhere in the region.

Thus, it is imperative to develop certificate programs that address the critical need in Texas workforce for now and future. The following sections describe the details of the proposed certificate programs.

2. PROPOSED PROGRAM DESCRIPTION

University of Houston is strategically located in Houston to provide the workforce development opportunities that are essential to the Texas economy. The greater Houston area offers abundant employment opportunities in petroleum, chemical, petrochemical, power plants, refineries, food processing, and pharmaceuticals. There are more than 60 community colleges in Texas that offer associate degrees in either petroleum technology or process technology or safety technology. The majority of graduates from these programs do not have the opportunity to pursue a higher degree within their disciplines. Within Greater Houston, the following community colleges offer one or more degrees in petroleum technology, process technology, and safety technology:

1. Lee College
2. Lone Star Community College
3. Alvin Community College
4. Houston Community College
5. Brazosport College
6. College of Mainland
7. San Jacinto College
8. The Victoria College
9. Wharton Country Jr. College

The College of Technology at UH has already developed articulation agreements with most of these colleges for a seamless transfer of various programs to our college. To this end, the College of Technology at the University of Houston, in collaboration with Houston area community colleges and proposes to develop and deliver an accelerated certificate and educational programs in:

- Advanced Process Technology
- Advanced Petroleum Technology
- Advanced Safety Technology

Each certificate program will include five courses covering introductory and advanced topics for the graduates with associate degrees and industry experienced associate degree holders. Completion of a certificate, typically taking less than one year, will rapidly accelerate the employability and meeting of critical needs in middle skill and highly skilled areas of greatest need in the state of Texas. The courses will be developed jointly by the community colleges faculty, UH faculty, and part-time faculty from industry. Since, the average age in these industries (process, petroleum, safety) of the workforce is over 50 years according to the Gulf Coast Process Technology Alliance, there will be abundant opportunities for individuals (with high skills) who successfully complete the above certificates.

Furthermore, successful completion of any two of these certificates provides an accelerated pathway (i.e. about a year) towards a bachelor of Science (BS) degree in Organizational Leadership and Supervision (OLS) at the College of Technology at UH. For the graduate of associate degree programs, this will provide a significant reduction and opportunity in obtaining a BS degree.

The OLS program allows transfer students to create an emphasis that is composed of at least 33 SH. This will provide an opportunity for those students who have completed at least two certificate programs listed above (five courses each) to substitute 30 SH hours by successful completion of the certificate program. In addition students would take either a Project Management or Entrepreneurship course to meet the total 33 SH requirement for the OLS degree.

The proposed project including the three stackable certificate programs will lead to a BS degree in OLS as shown in Figure 2. It is assumed that students are the graduates of associate degrees and industry experienced associate degree holders.

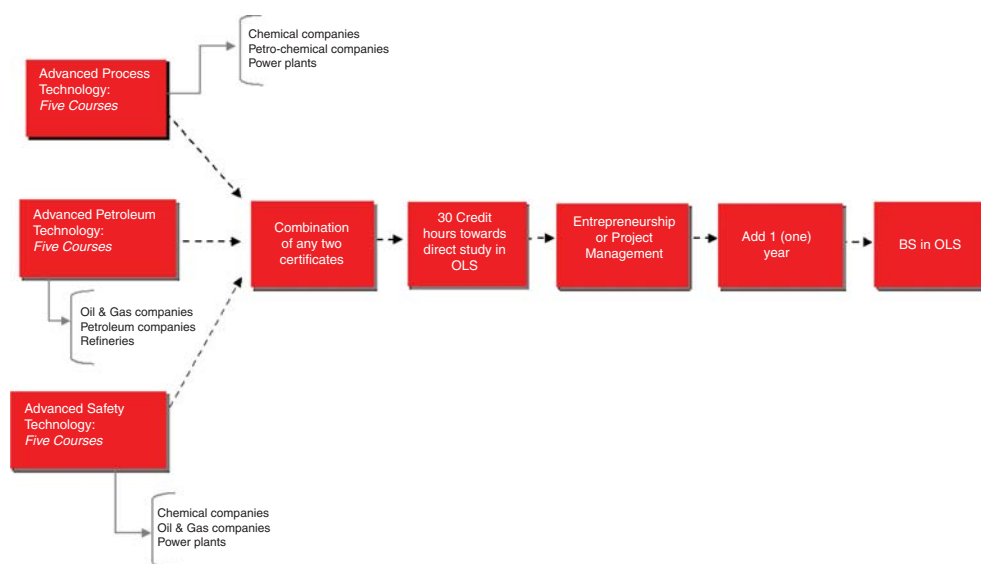


Figure 2. Proposed training and educational programs at glance.

3. PROPOSED CERTIFICATE PROGRAM

The College of Technology at the University of Houston, in collaboration with Houston area community colleges and industries, proposes to develop an accelerated certificate and educational program.

Each certificate will include five courses covering introductory and advanced topics for the graduates with associate degrees and industry experienced associate degree holders. Completion of a certificate, typically taking less than one year, will rapidly accelerate the employability and meeting of critical needs in middle skill and highly skilled areas of greatest need in the state of Texas.

The proposed courses will be developed as academic courses under TECH (technology) rubric so that the can be transferred to the BS degree in OLS program.

1. Advanced Petroleum Technology

- TECH 3501 Fundamentals of Petroleum Industry
- TECH 3502 Fundamentals of Offshore Systems
- TECH 3503 Fundamentals of Pipeline Design
- TECH 3504 Fundamentals of Drilling Technology
- TECH 3505 Fundamentals of Geographic Information Systems (GIS)

2. Advanced Process Technology

- TECH 3601: Process Design and Methods
- TECH 3602: Instrumentations and Sensors
- TECH 3603: Unit Operations
- TECH 3604: Process Control
- TECH 3605: Petrochemical Process

3. Advanced Safety Technology

TECH 3701: Health Safety Environment Fundamentals

TECH 3702: Health Safety Environment Systems

TECH 3703: People and Health Safety Environment

TECH 3704: Process Safety

TECH 3705: Health Safety Environment Capstone

The proposed program will be offered for the graduates of the associate degrees and experienced associate degree holder from industry. The following are examples of the degrees from the participating community colleges in greater Houston area. Houston Community College has an international partnership program with Qatar.⁷ Existing Programs at the Houston Community College that will lead to the proposed advanced certificate and degree program proposed here, include:

1. Instrumentation and Controls Engineering Technology – AAS and Certificate
2. Manufacturing Engineering Technology – AAS and Certificate
3. Electrical Power Engineering Technology – AAS
4. Industrial Automation Technology – Certificate
5. Petroleum Engineering Technology - AAS and Certificate
6. Process Technology – AAS and Process Technology – Process Operator Certificate

Existing Programs at the Lee College that will lead to the proposed advanced certificate and the OLS degree program, include:

1. Mechanical Technology – Associate Degree
2. Pipefitting Technology – Associate Degree
3. Process Instrumentation & Electrical Design – Associate Degree
4. Process Piping Design – Associate Degree
5. Safety Management Technology – Associate Degree
6. Process Technology – Associate Degree
7. Welding – Associate Degree

Existing Programs at the Lone Star College that will lead to the proposed advanced certificate and undergraduate degree, include:

1. Energy & Manufacturing – Associate Degree
2. Engineering Technology – Associate Degree
3. Industrial Technology – Associate Degree
4. Machining Technology – Associate Degree
5. Welding Technology – Associate Degree

Existing Programs at the San Jacinto College that will lead to the proposed advanced certificate and undergraduate degree, include:

1. Safety Technology – Associate Degree
2. Process Technology – Associate Degree
3. Industrial Technology – Associate Degree
4. Welding Technology – Associate Degree

Each proposed certificate program consists of five courses - equivalent to one semester load of 15 credit hours. Since our courses will require the 48 hours academic requirement, it will take 20 weeks (or 5 months) to complete five courses and one certificate. This is similar to one long academic semester. Thus, the proposed program will reduce the length of one-year long certificate by 50% without compromising the quality and also providing academic credits. The 48 credit hours can be divided into ~ 10 hours per week or 2 hours a day or could be divided into two day a week 5 hours per day. This will be attractive for students who want to take another certificate simultaneously or work half time while talking a single certificate program. As a result, the quality of the program will not be compromised since each course is equivalent to one academic course.

The degree plan and course sequence of the OLS program is provided to demonstrate how the proposed certificate courses will be substituted for the direct study section of the degree plan. As noted it require 11 courses which 10 of them will be credited by talking any of the two certificates.

We recommend one more course either in project management or entrepreneurship be added to the degree plan towards the 33 credit hours.

4. COMPETENCY-BASED ASSESSMENT OF THE PROGRAM

Competency-based assessment will be developed for each course to assess the effectiveness and quality of instructions. A sample of such assessment is shown in Table 1. For each course similar competency based assessment will be developed and implemented to measure the effectiveness the certificate programs and update and improve them as needed. A sample of course learning outcomes is shown below.

Table 1. Assessment of Health Safety Environment Fundamentals course.

Course	Course Learning Outcome	Assignment	Assessment Instrument	Benchmark
HSEF	1, 2, 3	Exams	Dichotomous Rubric	70% individual score on exam
HSEF	1, 2, 3	HW Assignments	HW Assignment Rubric	70% individual score on HW assignment
HSEF	1, 2, 3	Papers	Written Communication plus Content Rubric	70% individual score on rubric
HSEF	1, 2, 3	Presentation	Oral Presentation Rubric	70% individual score on rubric
HSEF	1, 2, 3	Final Project	Capstone Rubric	70% individual score on rubric

Course Title: TECH 3701 Health Safety Environment Fundamentals (HSEF)

Course learning outcomes and performance criteria

By the end of the course, students will be able to:

1. Demonstrate a level-setting exposure to the upstream energy industry's health, safety and environment (HSE) practices, regulations, main principles, and vocabulary.
2. Demonstrate an ability to use some basic tools to understand the risks of various actions with respect to HSE throughout the petroleum value chain.
3. Demonstrate the need to make HSE management expertise as a "core skill."

Topics covered

- a. Overview of Petroleum Value Chain
- b. Common terms used in Oil and Gas Industry
- c. Triple Bottom Line: Social (Community), Environment, and Profit
- d. Safety (Phase dependent priority)
- e. Environment
- f. Legal, Regulatory & Governmental Regulatory (Range of Regulations worldwide {why are they different} versus what can happen {what is the regular trying to accomplish})

Assessment activities and performance measures

Table 1 illustrates the relationship between the HSEF course-level learning outcomes and the courses in the Safety Certificate curriculum.

5. CONCLUSIONS

We anticipate that the proposed programs will directly impact the oil and gas exploration and production industry, the petrochemical and refinery industry, the engineering design and project implementation companies that are located in the state of Texas. A recent survey indicated that over 5000 industrial entities in the upstream and midstream energy sectors are located in the Greater Houston Area. Industries and organizations that have provided support are: Technip, Wipro, Wood Group Kenny, Prospect, GE, Greater Houston Partnership, and Texas Workforce Commission – Houston office. The unique aspects of the program are three-fold:

1. It offers a joint program with existing associate degree programs offered by Houston area Community Colleges' that addresses critical and rapid workforce needs in all major oil and gas exploration and production, petrochemical industries, refineries, and power plants in Texas
2. It provides a unique accelerated and stackable educational opportunity for those seeking a BS degree by successful completion of any two of the three certificates and other short turnaround degree requirements.
3. The program offers hands-on, multidisciplinary and experiential learning leveraging existing full-scale and proposed scaled bench-top apparatus. The lectures will be complemented by labs to enhance students learning and collaborative environment.

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