Session #3660

Vision for Preparing the Engineering and Technology Students Concerning Entrepreneurship and International Accreditation for Tomorrow and Beyond Around the Globe

Dr. Rafiqul Islam
Dept. of Engineering Technology
Northwestern State University
Natchitoches, LA 71497
Tel: 318-357-5352
Fax: 318-357-6145
Email: islamr@nsula.edu

Abstract

It has become essential for the engineering and technology students to be an effective leader in the context of a complex, fast changing, highly competitive global economy. In this interconnected economy it will be rewarding to develop a technically literate work force with international exposure in order to maintain the technological leadership of the United States. This paper contributes to the perception of the future engineers and technologists and the competence needed. We must do more to encourage our students to achieve international flavor in their studies as only a few percent of them go abroad as part of their education experience. At the same time the United States is attracting more and more of world's smartest people. As a result twenty percent of our IT (Information Technology) workers are foreign born and fifty percent of them are on H1B visa. In recent years almost sixty percent of the continuously increasing H1B visas are filled up by the qualified engineers and technologists from Indian subcontinent countries. A comparison study of overall core curriculum of engineering and technology programs of those countries to that of the United States towards international accreditation is presented. The future engineers and technologists must be able to interact with foreign peers and customers to fulfill their obligation in global nature. The emerging facts from successful companies, organizations, and universities have established that the real source of power in a knowledge base economy is in combining technical expertise with entrepreneurship. This paper also discusses the current as well as the future need in engineering and technology to integrate high technology entrepreneurship into the curriculum as an essential component. Several means to achieve it are explored. The end result will prepare them to launch tomorrow's successful businesses while earning their degrees. It will definitely have a positive impact on the overall health of the economy.

Introduction

Economic globalization has put a tremendous pressure on our engineering and technology education program to explore several aspects of internationalization. This is vital to maintain

leadership of the United States in this interdependent global economy. The goal is to develop and promote peaceful and fruitful cooperation and collaboration within and across boarders[1]. Today's engineers and technologists are expected to be an integral part of a much boarder society. Also understanding of teamwork in terms of inter-human relations when executing projects is necessary. Only 4% of all engineering and technology students participated in a study abroad experience during 2000-2001 as a part of internationalization of our higher education. An inflexible engineering curriculum that posses the difficulty of obtaining academic credit for work performed overseas needs to be reformed[2]. The growing tendency of globalization must have a widespread impact on undergraduate curriculum. The approach should be to incorporate the international requirements into the undergraduate curriculum without lengthening the program[3]. Global accreditation of engineering and technology programs can ease the transition of foreign-born engineers and technologists to our desperately needed job market. At the same time our engineers find it rewarding and fulfilling to work in a global market through multinational companies[4]. The entrepreneur has created much of our social wealth. The normal tradition of addressing this issue of entrepreneurship in our curriculum by the universities and colleges is the senior capstone project. But the author thinks that the recent tendency of developing courses aimed at teaching entrepreneurship must be accelerated throughout the United States and beyond. The ultimate outcome will enable the engineering and technology graduates to work for someone or to start their own companies. This will benefit the society by reducing burden of unemployment. Entrepreneurship in the engineering and technology curriculum is presented here after studying from different perspectives.

Global Accreditation of Engineering and Technology Program

It is a familiar fact that we are not producing enough engineers and technologists from the segments of our own population. The engineering enrollment lags particularly among African Americans, Latinos and American Indians. The engineering pool is dominated by white males. But according to Census Bureau report the population of white non-Hispanic men is expected to decline by 10 percent by the middle of the century while that of the minority groups will gradually increase with the passage of time. We will keep on loosing on both the accounts until some thing is done about it. For the last several years the US Government had no choice but to keep on increasing working visas for importing engineers and technologists from overseas to deal with the severe shortage. In 1995, 65000 visas were granted while that amount has been increased to 215000 by the year 1999. Even though that number has come back to 65000 again, clearly we are relaying on foreign-born engineers which is risky. It may push us to a human capital crisis like 1973-oil crisis. In recent years about sixty percent of the work visas are filled up by the engineers and technologists from Indian subcontinent countries[5]. Let us look at those countries for reasons of motivation towards engineering and technology professions. As a result of Government policy, public prestige, remuneration and education policy the high school graduates enthousically compete with one another to enroll to limited number of spots. As an example, in India all across the nation, hundreds of thousands of youths sit for two-day qualifying exams to gain the right to 2000 spots in the most competitive universities for the most prestigious engineering careers[6]. Similarly in Bangladesh, out of thousands of applicants only the first 4500 students on the basis of their nationwide 12th grade exams are allowed to sit for entrance exams for 800 spots at the top most engineering university[7]. The other universities and colleges also follow very similar procedures. This is recognition of influence of engineering

education in the society of that part of world. The prestige in the society as well as the engineering friendly high school curriculum provide the means to create this kind of enthusiasm and interest for this remarkable specialties. Here in the US the engineering and technology profession is perceived as isolating and lacking in social relevance. Engineering is not featured in popular television program and usually gets overshadowed in news reporting even though technology dominates the social landscape[8]. But the engineering and technology education in the developing countries (Indian subcontinent countries) has a mismatch between the knowledge, curriculum and skills imparted by universities and colleges and the industrial needs. The curriculum is not planned either to satisfy the ever growing and diverse social needs or the industrial demands. The likelihood of the present engineering and technology curriculum structure in the Indian subcontinent countries is illustrated in figure 1 given below:

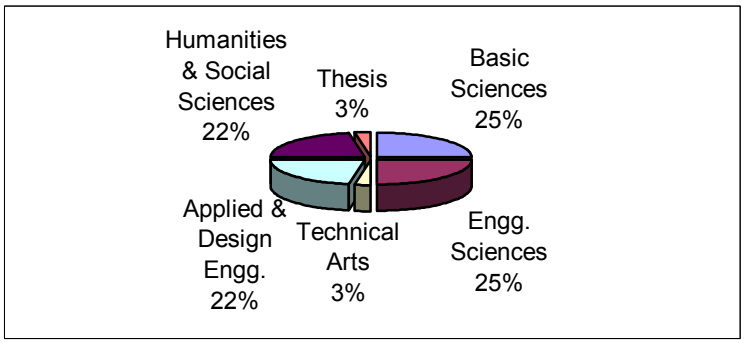

Figure 1 Curriculum structure in Indian Subcontinent Countries.

In the US most of the universities and colleges consider technological changes, industrial demands and social needs while designing the engineering and technology curriculum. The structure of the curriculum is illustrated in figure 2 given below:

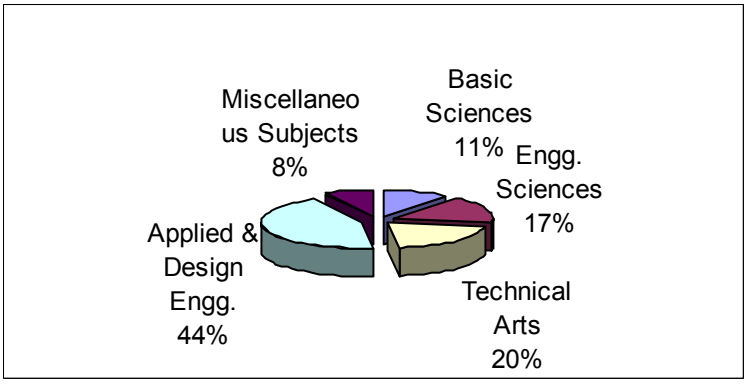

Figure 2 Curriculum Structure in the US.

There are striking differences between the above two structures. In case of basic sciences the percentage is lower in figure 1 than that in figure 2 as the students carry a relatively stronger background from the high school. Time spent in technical arts in Indian subcontinent countries is much higher than that in the US as most of the students here have done some workshop practices

and computer programming at the high school level. In the US many software packages are used for drawing and drafting which cut short the time requirement. In Indian subcontinent countries almost double amount of time is utilized on applied and design engineering subjects which include a fair amount of empirical information. The curriculum in the US spends nearly 22% of the time teaching humanities and social sciences in order to make engineering and technology education more relevant to the society and to satisfy EC 2000 of ABET[9]. A global accreditation can make a balance between these two curriculum structures. The Indian subcontinent curriculum must increase the percentage of basic sciences and humanities and social sciences and decrease that of the technical arts and applied and design engineering. In case of US, more emphasis must be given to the education of basic sciences for engineering and technology students. General conception is that the mathematics and science are hard and boring. Some students have short-term view that good-paying jobs are plentiful, so why take really difficult courses. One positive way is to make useful coordination between mathematics and engineering and technology departments. We should also explore all other ways to turn these negative expressions around. In today's global environment the engineers and technologists must posses not only the technical skills but also cross-cultural knowledge and understanding. In order to increase the global competence of the US technical work force and to train them for leadership positions in the worldwide arena, international education must be incorporated in the engineering and technology curriculum. Interactions in terms of international exchange programs, international internship program, specialized summer programs for engineering and technology students must be included. The curriculum in the Indian subcontinent countries is also very rigid which does not satisfy the needs for different categories of students. At the same time the set laboratory experiments instead of open-ended project type laboratories do not enhance the learning process. So the international accreditation, which makes the curriculum mutually beneficial to all party concerned, must be developed.

A win-win co-operative agreement between the college of engineering and technology at Old Dominion University and Rajagiri College under Mohatma Gandhi University, Cochin, India to flourish global engineering education has paid off. Rajagiri is benefited being able to begin an accredited engineering program whereas Old Dominion University is benefited by attracting high caliber students that otherwise would not come to US for second half of their study time. Even though there has been no physical presence of the students from Old Dominion University to Rajagiri College yet they have been closely linked electronically in today's global village[10]. Both parties have been introduced to each other's systems, which results in awareness of two cultures. The chemical engineering department of North Carolina A&T State University and Bangladesh University of Engineering and Technology (BUET) have collaborated to enhance pollution prevention activities in Bangladesh through joint curriculum.

Entrepreneurship in Engineering and Technology Program

In this time of employment concern society we need to rethink the aptitude and attitude of an engineer in combining technical knowledge with sound-decision making and effective entrepreneurship. The mindset of entrepreneurship is seen, as an essential skill-set for engineers in the new millennium. This mind-set can be established early in the undergraduate curriculum. Unfortunately, a special capstone project course for senior engineering and techchnology students is a form of choice for most of the universities and colleges in the US including the

Northwestern State University. At the same time the number of entrepreneur courses available at American colleges and universities are taught mainly to the business students. The technology entrepreneurship is mostly left out. So, the trend of offering courses/specially targeted on technology entrepreneurship must be accelerated. A multidisciplinary group project approach is worthy of further investigation and development. The goal is to prepare a highly selective group of students to be more than just engineers and technologists. The majority of today's engineering and technology graduates move into management, leadership, entrepreneurship or professinal positions within five years of graduation. Leadership courses like engineering communication, engineering management, technical entrepreneurship and global prospective and information engineering along with the traditional courses will produce a different breed of engineers and technologists who will be prepared for those positions from the start of their careers. The classroom learning of entrepreneurship must be merged with the industry participation for real life applications. During one semester the students can work in teams to study the industry sponsored projects for feasibility, from both a business and technical standpoint. In the following semester the students can design and build a working prototype.

Here in the Northwestern State University the students can have six credit hours of capstone projects in two consecutive semesters if it covers both electronics and industrial engineering technology areas. The faculty advisors mainly help them towards the technical aspect of it, as there is no formal course describing the basics of entrepreneurship. So, the students take all the initiatives in their own time and pace. The entrepreneur sprit of the students is not recognized by the system. The students with contacts (part time employees in the industries) have better luck for project topics. Most of the students are interested in making a prototype to get over with it. All other phases of new product development including innovation, patent law, product liability, business, sales, marketability and venture capital are left out. Eventually most of the successful projects are not pursued further with the goal of making it marketable. The corporate America is downsizing at an alarming rate and forcing the laid off technology workers to become instant entrepreneur with none or very little training in that rank[11]. In this situation the author is convinced that most of the universities and colleges are not doing enough to cope with the recession and subsequent jobless recovery of the economic cycle. So, the author is proposing a course curriculum for one credit hour of introduction to entrepreneurship and two credit hours for technical project development in two semesters as a starting point at Northwestern State University. The major elements should include but not limited to: (1) a set of modules to learn the basics of entrepreneurship, (2) a set of in-depth learning interactions (projects, modules, courses) that provides depth of knowledge in engineering entrepreneurship and (3) capstone experiences in entrepreneurship during the sophomore year and the final year of undergraduate curriculum[4]. The students from business department will be encouraged to team up with the engineering technology students to make it a success. This will educate them to become entrepreneur in their outlook.

A pilot study of technological entrepreneurship initiatives at six universities in the United States can provide guidance for other universities embanking on this process[12]. Engineering division of Brown University has created a two-semester course sequence designed to introduce entrepreneurship to the students. In order to develop team-building skills fifty- percent students are from all advanced undergraduate engineering disciplines whereas the rest are from non-engineering disciplines. Seed ideas and concepts supplied to the team by the local parent

companies are developed and refined to a viable simulated spin-off business or new start-up. Managers from the parent companies serve as board of directors and then eventually become a potential source of start-up capital or possibly a customer for the products of the company[13]. Michigan Tech. University has offered his students an opportunity to be both an engineer and an entrepreneur under enterprise program, which is growing since 2001. It is a collaboration between the college of engineering and the school of business and economics. The students from their sophomore to senior years team up and run an enterprise program which operates as an organization, similar to a real life company in the private sector with a president and board of directors. The goal of each enterprise team is to work with the industry and the government to identify their problems to be addressed. They can also initiate an idea and sell it to the industry. In both cases they can eventually collect royalties if a successful prototype product is delivered. It is essential to complete 20 credits from a selected list of cross-discipline courses from areas such as business, economics, technical writing and spoken art of persuasion and clear presentation. Since 2001 this program has motivated the students to come up with a new product or idea, which will make a difference in the real world. Some of the enterprise teams have started getting royalties. After graduation some of them (if not all of them) will find ways to help people by creating products that are of service[14]. In the long run some of them will have their own company because of entrepreneurial sprit. According to a supervising manager the enterprise team is more autonomous and independent than the capstone senior project team as the former ask for much less help than the latter one. They also act like professional engineers during presentation. The products created by the enterprise team members are judged on design, cost, sales, presentation and manufacturability. It is a different type of learning, which is based on self-motivation and the above examples are showing the successes.

Conclusion

Globalization of engineering and technology program is an important goal for universities and colleges around the world. Global accreditation of engineering and technology program should be the way of future. Today's engineers and technologists must have appreciation for a global perspective. Interaction with more and more Indian subcontinent countries in engineering and technology fields will bring tremendous benefit to our nation even though it is not a permanent solution to our overall shortage of skilled technical labor force. It will definitely provide convenient entry points into foreign academic programs. It is established that the more students are immersed in international experiences, the better their global preparation will be. A comparison study of engineering and technology curriculum between the US and the Indian subcontinent countries is presented here. The benefits of mutually accepted curriculum towards globalization is discussed here. More and more entrepreneurship programs should target engineering and technology students. Some of the recent trends are documented in this paper. The author strongly suggests the accommodation of a basic entrepreneurship course in the senior capstone project as a minimum. Then eventually to adopt a two-semester sequences if possible. The effect of implementing a basic entrepreneur course in the engineering technology curriculum of the Northwestern State University will be presented in the subsequent paper. Some of the success stories of innovative approaches in two-semester sequence of entrepreneur programs are published here. Since the middle of 1980's, the downsizing of large corporations due to technological change and global competition has caused a significant shift in employment opportunities for young engineers and technologists. At this critical moment the author's goal is

to prepare the engineering and technology students with two very clear options. They will either work for some one in a global arena or they will start their own company and eventually employ others worldwide. This process will lessen the burden of unemployment on the society. This is what the society demands and deserves.

Reference

1. Arvid Anderson & Jorgen Hamen, ' Engineers of Tomorrow and Beyond Knowledge, Insight and skills Needed to Work Across Boarders, ' Proceedings of ASEE Annual Conference at Montreal, Canada, June 2002.
2. Jack R. Lohmann, ' Will Our Graduates Be Global Players, 'ASEE Journal of Engineering Education, vol. 92, No. 3, July 2003.
3. J. C. Swearengen, Spencer Barnes etc., ' Globalization and the Undergraduate Manufacturing Engineering Curriculum, ' ASEE Journal of Engineering Education, Vol. 91, No. 2, April 2002.
4. Susan Freholm, James Krejcarek etc., 'Designing an engineering Entrepreneurship Curriculum for Olin College, 'Proceedings of ASEE Annual Conference at Montreal, Canada, June 2002.
5. George Campbell Jr.,'Engineering and Affirmative Action: Crisis in the Making, a Special Edition of NACME Research Letter, Copyright 1997'. Also U. S. Department of Labor, Bureau of Labor Statistics, www.bls.gov.
6. Travis Engen, 'Something to Shout About,' ASEE Prism, December 2000, p 80.
7. BUET-Information on Undergraduate Admission System, www.buet.ac.bd/admission/ugradadm.html
8. Domenico Grasso, 'Engineering a Liberal Education,' ASEE Prism, November 2002, p 76.
9. A Janakio Rao, 'Engineering Education in the New Millennium in India,' ASEE Annual Conference at St-louis, Missouri, June 2000.
10. Stephen Saharan, Sacharia Albin, Willium Swat, 'Global Engineering Education: A Partnership between Rajagiri College (Cochin, India), and Old Domain University (Norfolk, VA),' Proceedings of ASEE Annual Conference at Albuquerque, NM, June 2001.
11. The Editors of CNN and Money Magazine, 'Instant Entrepreneur', March 5, 2004. www.money.cnn.com/2004/03/05/pf/franchise/index.html
12. Terri Standish-Kuon & Mark P. Rice, 'Introducing Engineering and Science Students to Entrepreneurship: Models and Influential Factors at Six American Universities,' ASEE Journal of Engineering Education, Vol. 91, No. 1, January 2002.
13. Christopher J Creed, Eric M. Surbury etc., 'Engineering Entrepreneurahip: An example of Paradigm Shift in Engineering Education,' ASEE Journal of Engineering Education, Vol, 91, No. 2, April 2002.
14. Barbara Mathis-Riegal, 'Blazing an Entrepreneurial Trail,' ASEE Prism, April 2003, p 30.

Biography

Dr. RAFIQUL ISLAM is a faculty of the Northwestern State University at Natchitoches, Louisiana in the department of engineering technology. He had been on the faculty of the DeVry Institute of Technology, Calgary, Alberta, Canada, for five years. He also taught for four years at the West Coast University, Los Angeles, California. He has fourteen years of working experience in the areas of communications and computer applications in power and control systems. His areas of interest include cellular and PCS phones, microwave and satellite systems, fiber optics and wireline and wireless LANs and WANs.