"INDUSTRIAL ENGINEERING EDUCATION AT THE UNIVERSITY OF FLORIDA AND THE NED UNIVERSITY, PAKISTAN"

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Abstract

The science of Industrial Engineering (IE) is concerned with design, analysis, and control of production, service operations and systems. Traditionally, IE had focused on optimizing the operating efficiencies of plants and workers in a manufacturing environment. Today, IE finds itself intimately involved with a wide range of industrial and non-industrial systems. These systems pertain to government, banking, medical, engineering, military sectors, etc.

Nadirshaw Edulji Dinshaw (NED) University of Engineering and Technology is the only university in Pakistan that offers an undergraduate degree in IE. The University of Florida (UF), on the other hand, is among the national leaders in IE education. IE at UF is known for its cutting edge technology, innovative research and distinguished faculty and students.

This paper compares the IE undergraduate curriculum at NED and UF with special reference to the socioeconomic, national and industrial needs of both countries. The paper analyzes current curriculum deficiencies within the NED Curriculum and makes recommendations for a new curriculum track related to the systems aspect of Industrial Engineering.

Introduction

Industrial Engineering (IE) is a field that integrates and manages people, information, materials, and equipment. It finds its applications in almost every industry, including communications, e-commerce, entertainment, finance, food, pharmaceuticals, semiconductors, sports, travel, and transportation. IE has a significant influence on the socio-economic conditions of a country. This field is relatively new in South Asia and is a very novel field in Pakistan.

Pakistan is a region with a great industrial potential, with industries ranging from general manufacturing to those in the defense sector. The traditional engineering techniques used in industries are employed for day-to-day functioning. IE techniques can be employed for optimization of these traditional engineering techniques, but this is yet to be seen in Pakistan. In fact, there are very few facilities in the commercial sector that make use of IE. This is quite different in the west where IE is vigorously employed to achieve optimal outputs.

This paper compares the curricular orientations of the IME at NED and ISE at UF. The paper ends with certain recommendations that should be realized to improve the academic effectiveness of both institutions.

NED University of Engineering and Technology

The NED University was initially founded as Prince of Wales Engineering College in 1921. The College was renamed as NED Engineering College in 1924, in memory of Mr. Nadirshaw Edulji Dinshaw, a well-known philanthropist, whose heirs made substantial donations for its development at the time of his first death anniversary (1).

The university runs various undergraduate programs leading to the degree of Bachelor of Engineering (B.E). The disciplines are Civil, Mechanical, Electrical, Electronics, Computer & Information systems, Textile engineering, Industrial & Manufacturing engineering. It also offers bachelors degrees in Computer Science & Information Technology.

Department of Industrial and Manufacturing Engineering

The IME department is the first and the only department in this discipline in Pakistan. The IME department is located in the city of Karachi, the industrial and manufacturing hub of Pakistan. The department offers a four-year degree course based on instructional education leading to a B.E. in IME. University Grant Commission of Pakistan and the Pakistan Engineering Council, the elite governing bodies of Pakistan's engineering educational sector, accredits the program (1).

The first and second year curriculum broadly covers general and basic engineering introductory courses, those pertinent to humanities and general science.

The third and fourth year focuses on the core IE courses ranging from design, manufacturing, operations research, quality control, and information systems.

The curriculum lacks strength in the areas of operations research and system engineering however it is strong in manufacturing. Furthermore, the curriculum offered by the department constitutes a preset pattern of courses, which applies to all students and they

do not have much flexibility to choose courses to customize their curriculum to suit their career goals.

The University of Florida

The UF is a major, public, comprehensive, land grant, and research university, founded in 1853. The state of Florida's oldest, largest and most comprehensive university, UF is among the nation's most academically diverse public universities. UF has a long and distinguished history of established programs in international education, research and service. It is one of the 17 public, land-grant universities that belong to the prestigious Association of American Universities. Today, with more than 46,000 students, Florida is one of the five largest universities in the nation (2).

Department of ISE at UF

The ISE department at UF is one of the nation's leading IE education center. The graduate and undergraduate ISE programs at UF are ranked in the Top 20 nationally. The curriculum at the ISE department at UF offers a great flexibility to students in customizing their educational goals according to their career plans (3).

A bachelor's degree in and field of Engineering at UF is broken down into two phases: general education/pre-professional and upper division. During the first two years, students take general college and pre-professional courses. Once having completed 64 credit hours, students apply to their desired specialized field. The program of study has been accredited and approved by standards set by the Accreditation Board for Engineering and Technology (ABET) (3).

The upper division education in the ISE department is divided into two segments, IE and System Engineering (SE). Overall, a student needs to complete 125 credit hours if he/she is pursuing the IE option and 128 credit hours, in the SE option. A typical curriculum comprises 26 credits of general science and education courses, 34 credits of courses from mathematics, static and dynamics, 9 credits of economics, 15 credits of technical electives. In addition, IE option requires 41 credits and SE option requires 44 credits (3).

The industrial engineering option prepares students for industrial practice in such areas as product design, process design, plant operation, production control, quality control, facilities planning, work system analysis and evaluation, and economic analysis of operational systems (3).

The systems engineering option emphasizes the integration of knowledge and technology from the engineering, mathematical and physical sciences to carry out the processes of description, analysis, synthesis, control and optimization in industrial and non-industrial settings (3).

For technical electives, students are encouraged to select a set of electives that provide the student with expertise in Industrial and Systems Engineering (3).

The ISE undergraduate curriculum offers students the chance to customize their course work according to their career plans. There are number of courses which a student can take from other departments, such as business administration, statistics, and computer engineering to name some.

Curriculum Comparison Between ISE and IME

Ever since the IE profession was founded by Frederick W. Taylor, credited as the "father of Industrial Engineering, the field has expanded the domain of its application. The western universities, specifically those in the United States, have kept abreast with all the technological developments in this field and have consistently improved their curricula to meet the needs of industries. In contrast, the application of IE has not dominated the industrial development in Pakistan. As mentioned above, IE has just been introduced as a degree program with NED and still it has some deficiencies.

To make a pragmatic comparison between the two engineering programs, it is essential to consider closely the milieu in which they flourish. The United States has long been a leader in engineering. There have always been an increasingly large number of multinationals in the US that need engineers from varying backgrounds to manage their everyday operations. A Majority of these industrial and manufacturing facilities need industrial engineers to perform a range of functions, such as product design and development in a traditional, manufacturing environment, to portfolio optimization for a mutual fund. To ensure that they recruit the best talent, these companies work closely with various national universities, like UF, to make the educational experience compatible with the latest trends and needs of the corporate sector. Similarly, universities are also continuously trying not only to stay abreast with growing industrial needs but they also bring innovative solutions and novel ideas to the corporate sector through extensive active research. UF is not an exception and it has designed their undergraduate program to accomplish such a competitive edge.

Pakistan does not enjoy a healthy industrial arena, especially when it comes to the manufacturing sector. While Pakistan has a number of manufacturing installations, they are mainly related to the textile and steel industries, although some exist in the defense sector. But a majority of industries pertain to the non-manufacturing environment and mainly includes various financial firms. Furthermore, Pakistan government renders its services through out the country and this makes for a substantial part of the service industry. The limited industries described above may make a lot of improvement if industrial engineering is applied to these scenarios. Subsequently, one does not find much of interaction between the corporate sector and educational institutions, when it comes to sharing the technological needs and research advancements. This is primarily the reason for educational institutions in Pakistan for not including the discipline of IE among the degrees offered by various universities. While NED University became the pioneer to include this field into their list of degrees offered, yet due to lack of industrial

development in Pakistan, in general, and lack of interaction between the industries and the university in particular, the program does not fully capture corporate needs.

The curriculum developed for undergraduate study at the IME department is aimed at the traditional manufacturing sector and does not cater much to the needs of non-manufacturing industrial arena. This certainly is not a true reflection of the complete requirements of the entire industrial setup in Pakistan, which is primarily dominated by the service industries. When it comes to manufacturing applications, the curriculum at the IME department specifically includes typical design courses like Computer Aided Design (CAD) and Computer Aided Manufacturing (CAM). This makes the NED curriculum a little more comprehensive than that of the ISE department at UF. Although the IE department at UF does not offer courses in these specialized areas, yet the students have the flexibility to take courses like CAD and CAM, and other similar courses, from Mechanical Engineering department at the UF. Nevertheless, the ISE at UF has a wide range of courses aimed at the manufacturing and non-manufacturing industries.

While it is plausible and necessary for the NED to have a strong manufacturing oriented curriculum, they are neglecting the service industry that forms the major portion of Pakistan's economy. This area needs services of industrial engineers to make their processes more efficient and effective. It is important for IME at NED to offer similar track like the SE option at ISE. This should help to cater to the needs of the financial and service sectors of Pakistan, which dominate Pakistan's commercial sector.

Furthermore, as opposed to ISE at UF, students at NED do not enjoy any flexibility in the selection of courses. This approach not only deprives students from making the choices they want, in customizing their curriculum, but also plays a part in hampering their ability to think independently.

Conclusion

The ISE department at UF has gone beyond boundaries of the shop floor and has succeeded in analyzing and improving the productivity and efficiency in offices as well as manufacturing support systems. The ISE department at UF has embraced this new facet of IE and has developed a strong program that has integrated the knowledge from engineering, mathematical and physical sciences and applied it to the non-industrial settings.

The IME department at NED, on the other hand, has overly focused on the manufacturing needs of commercial sector. Their curriculum addresses various aspects of manufacturing environments like product design, equipment layouts, production control, methods improvements, work measurement etc. However, they have failed to address the needs of non-manufacturing systems of Pakistan's commercial sector. Such sectors need services of industrial engineers the most and may prove to be more lucrative for the economy, if their operations are going to be effectively optimized.

The ISE department at UF offers great flexibility to students in selecting courses from a flexible IE curriculum as well as allows them to take other relevant courses from other departments. These courses may include finance, accounting, and operations management, etc. This approach provides students with an opportunity to orchestrate the best they can get from the business and manufacturing world. The IME department at NED does not offer any such arrangement, which deprives students from customizing their curricula according to their needs and interests.

Recommendations

It is recommended that IME at NED identify and acknowledge the needs for the application of IE methods in non-manufacturing areas, in particular the financial and service sector. Subsequently, they should introduce a separate specialization like the systems engineering option offered by the ISE at UF that include courses like simulation, finance, etc. Furthermore, the department should make arrangements with other institutions (Institute of Business Administration, Karachi) to enable students to take the courses that suit their individual needs. Once, an extended curriculum is in place, the IME department needs to have an arrangement in place that would allow continuous interaction with Pakistan's commercial sector. The curriculum needs to be improved continuously to stay compatible with the growing industrial trends.

References:

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