Engineering Final Projects in a 5-Year Program Higher Education Institution

Omar Barkat, Ph.D., Dr. es-Sc., P.E.
McNeese State University
College of Engineering and technology
P.O. Box 91735
Lake Charles, Louisiana, 70609-1735

Abstract

In this paper, final projects work for engineering graduates in Algeria during the students last year are discussed. The Industrial Chemistry Institute at The University of Science and Technology of Algiers is taken as an example.
The five-year chemical engineering program is discussed along with the impact of the final project on the quality of engineering education in Algeria as a developing country. The students regard the final year engineering project as the most important experience in their education. For the faculty and the institution it is a crucial requirement for the engineering degree. Economical implications, industrial partnerships, faculty point of views, project selection and implementation, students preparation and institution involvement are reviewed and discussed.

1. Introduction

Among the sectors that are viewed as top priority in government budget allocations, education in Algeria has always been ranked first. With one of the highest growth in population, and a large percentage of its population under 30 years old of age, Algeria allocates each year the largest part of its annual budget to education.
There are more than ten major universities located in the North and South of the country. The students body in these major institutions ranges from 15000 to 26000 students. In addition, there are several other campuses with more than 8000 students. Engineering/polytechnique schools also offer engineering degrees. There are 5 main engineering schools which are mainly located in the Northern and Eastern part of the country.

The engineering degree at any major Algerian institution is a five-year program. The students are required to take four and half years of course work and the last semester is reserved for a project work. It is a very important piece of work that a graduating senior has to undertake. The subject can be a project brought from the industry or a research project suggested by a faculty member in charge of the work. All topics require a high level of analytical and design considerations,

involving literature search, problem definition, experimental design setups, and problem solving. The student must have good theoretical, technical, and practical background.
In this paper we will examine some of the engineering curriculum, the selection process of an engineering project, and the faculty involvement in such important part of the engineering degree. University-Industry partnerships, faculty point of views and impacts, and institution involvement and its resources implications are presented.

This paper is organized in a way the reader would understand the engineering curriculum and the important role the final year engineering project plays in the education of Algerian engineers. Section 2 gives some understanding about the engineering curriculum. Section 3 details the engineering thesis process, the project coordination, and the project evaluation. Discussions on faculty impact, benefits and institution involvement are presented in section 4. Conclusions are found in section 5.

2. Engineering Curriculum

The main University offering engineering degrees is the "Universite des Sciences et de la Technology Houari Boumediene," (USTHB), and the most prestigious engineering school is the "Ecole National Polytechnique d'Alger," (ENPA). They are both located on the coast of Algiers. There are only about 3 miles between the two institutions. Both institutions offer Engineering, Master and Doctoral degrees.
The engineering curriculum is common to all schools offering the degree in a said major. They all are five-year programs. During the first two years engineering students take the same courses whether they are majoring in chemical, mechanical, electrical, civil, petroleum, or industrial engineering. This program is known as "Tronc Commun," (TC). The second part is a three year curriculum and directly related to the field of specialty. The engineering curriculum for the first two years was well presented by Barkat[1]. The last three years of the curriculum are very specific for each major. In this paper, it is not the intention of the author to deliver details on various engineering curricula.

3. Final Engineering Project

Engineering graduating seniors in all fields are required to fulfill this requirement which is part of the curriculum. During the seventh semester, students have to choose a project suggested by faculty members. The project work is called the "Engineering Thesis". It provides an opportunity to the student to show his/her intellectual, technical and practical abilities. Engineering thesis in engineering schools are looked as a very useful preparatory study for introducing the student to the professional engineering world. The project must be associated with solving an engineering problem and should involve one of the following:

- Solving an industrial related problem,
- Designing and testing a facility to be used in a local industry,
- Theoretical and/or experimental research study,
- Construction of an experimental apparatus with data collection and analysis,
- Simulation and optimization of an existing industrial plant,

- On-site industrial study.

The student is required to come up with a proposed plan of study during or at the end of the seventh semester or at the latest during the first week of the spring semester. The work undertaken needs not to be an original study but must be a challenging study for the student. In any of these cases the student is expected to have high level of input. He/she is expected to use his/her acquired mathematical and engineering knowledge to analyze and bring a sound solution to the proposed study.

The quality of work and results are presented by the students at the end of the semester to a defense committee. A passing grade must be obtained to graduate.
The final engineering project can be manageable if the number of students is not large. When the graduating class is very large, a certain number of problems could arise. Organizing, structuring, and planning successfully the final engineering project course could become a nightmare when the graduating class is large.

3.1 Engineering Thesis Process

The number of graduating seniors can vary from 50 to 150 per engineering discipline. Any graduating class larger than 40 can affect negatively the organization of the project work process. The process is supervised directly by the Director of Academic Affairs (DAA) of the Institute and coordinated by the department heads. The projects are posed by Professors, Associate Professors (Maitre de Conferences), Assistant Professors (Maitre Assistants), or by Doctoral candidates who are faculty members associated with the institution. Many projects are also obtained from local industry. Companies are initially contacted by the faculty member and later by the administration. The project is proposed officially in writing to the DAA and added to the list of project suggested by the professors. The subjects proposed by faculty can be of practical purpose or can be directly associated with the research of the faculty. All proposed topics are subject to approval by the DAA and department heads. The faculty member suggesting the project or making the connection with the area industry is usually responsible for the supervision of the project. Toward the end of the semester, topics are classified by subject and by faculty. At this time the students can begin their choice. A common practice is that the best students chose first. Arrangements are sometimes made between the professor and the student on the subject chosen. However, the DAA must give his approval making sure that the best students are not interested in the project. At the end of the selection process, each student is affected to his advisor. If the project is an industry related topic, the professor is in charge of all contacts with the company and make sure that all work assignment is made on time. The student is required to start his/her project at the beginning of the following semester.

3.2 Project Coordination

The project coordination is the sole responsibility of the faculty who is directly the student project advisor. In most cases, the faculty who proposes a topic or obtains the project from the local industry is assigned to supervise the work. He/she becomes the thesis director of the student. The faculty engagement in this effort is very important. He/she administers

academically, technically, and administratively the project. Although the role of the faculty is to make the project possible, it is not of his/her responsibility to solve any part of the problem. The faculties play the role of a coordinator between the student and the administration, and give guidance to the student on the project. He/she during the course of the project discusses courses of actions to be undertaken when difficulties arise. The student(s) working on the problem are responsible for the success of the project. Success is not only measured by arriving at the right solution but by the decisions and approaches the students have taken during the course of his/her project. A solution to the proposed problem is not always achieved. It is not uncommon that minimum working conditions are not available. In this case, students are not penalized for not reaching what faculty sees as minimum passing results.

3.3 Project Evaluation

The last two weeks of the semester are reserved for thesis defense. The faculty in charge of the student supervision revise and correct the student's thesis. At that point, the thesis director selects a Jury. The jury must be composed of 4 faculty members including the advisor. In the case the topic is an industrial project, a representative from the industry is added. As soon as this is done a public defense date is scheduled. The presentation takes on the average about 40 minutes, and about 15 to 30 minutes are left for questions. At the end of the questions/answers period, the room is vacated and the Jury deliberates. The final grade is based of the following criteria:

☑ Degree of difficulty of the problem,
☑ Project Analysis,
☑ Solution approach,
☑ Theoretical backgrounds,
☑ Solution process,
☑ Engineering ability of the student as shown by report,
☑ Results achieved taking into consideration the available logistic,
☑ Quality of the report and how it is presented,
☑ Verbal communication
☑ How well questions are answered.

In addition to these criteria, and since the advisor is the person who is most acquainted with the work of the student comments on how the student performed during the semester, and on his/her abilities as an engineer to solve problems. The advisor at last suggests a grade to be discussed by the committee.

4. Discussion

In Algerian engineering institutions the final engineering project is a thesis similar in time and commitment to an M.S. thesis. However, due to some problems that will be discussed later, the final project may not always be an individual piece of work but could be a group assignment. The maximum number of students in a team may not exceed three. This engineering experience is a critical element of the undergraduate engineering curriculum. It develops oral and written

communication skills, team building, and decisions making skills. Students learn project management, coordination, cooperation, work assignments, and how to approach a real life problem. If it is a pure research problem, students learn to make their own path in a dark tunnel, accept time consuming tasks without sometimes any apparent results, and discover how to apply the theory studied in class to real situations. In general, it provides a golden opportunity for the student to combine theory and practice in his/her last undergraduate course to help them make a smooth transition toward an engineering career or graduate school.
Most of the engineering departments graduate more than 50 students per year. It has been very challenging to keep the process of the engineering project a successful one. There are several problems associated with the development of this course in recent years. Based on the author's experience the following improvement must be brought:

➔ Availability of scientific journals,
➔ Availability of engineering textbooks,
➔ University must provide space for project implementation,
➔ Faculty offices,
➔ Computer facilities and software,
➔ Industry-University joint ventures,
➔ Availability of funds to purchase equipment.

It is a reality that faculty are struggling to keep this course in place despite all of the problems they are encountering every semester. Most of the faculty have solid theoretical, practical and research experience and able to carry on advanced design and research tasks. They understand they are trapped in an unfortunate financial turmoil affecting the efficiency of their work. Nevertheless, the faculty understand the importance of their role in the education of engineers in general and their involvement in this course in particular. They see the benefits gained at the end of each semester very rewarding. Some of the faculty benefits can be summarized as follow:

⌦ Tackling meaningful problems,
⌦ Working on a task that would otherwise be beyond scope,
⌦ Obtain student help to perform research,
⌦ Getting some research funds (may be insignificant) that would otherwise not be available,
⌦ View current practices as a result of the interaction with industry,
⌦ Gain further research opportunities and consulting,
⌦ A wealth of examples is offered to the faculty to bring to the classroom.

5. Conclusions

The engineering final project structure and process in a 5-year program Algerian higher education institution have been presented. Although there are many hurdles associated with the fifth year engineering thesis process, the author still sees it very beneficial to all parties involved; the student, the department, the university, and the faculty. It has been and continues to be a very critical phase of an undergraduate engineering student's education in Algeria. It provides

an invaluable experience to the students who at the end of the assignment will be much better prepared to assume engineering responsibilities. For the students who may pursue a graduate degree it also gives them an opportunity to understand the research process.
It is the hope of the author that this final year project be kept in place for as long as these engineering institutions exist. After all, is not the capstone design course being enforced by ABET and adopted by several institution a similar requirement?

6. Bibliography

1. Barkat O., and M. Cherifi, "Engineering Education in Algeria, Part I: Facts and Consequences," Proceedings of the American Society for Engineering Education, pp1599-1603, 1995.

OMAR BARKAT
Omar Barkat is a Professor of Chemical Engineering at McNeese State University in Lake Charles, Louisiana, (obarkat@huey.engr.mcneese.edu), an adjunct professor of chemical engineering at the University of Tulsa, Tulsa, Oklahoma, and an independent consultant in engineering and engineering education. He has taught and worked in North Africa, Europe, and the USA. His principal fields of interest are rheology, multiphase flows, separations, energy transfer equipment and engineering education. Dr. Barkat holds a Chemical Engineering State Diploma from the National Polytechnique School of Algiers, and an M.S. and Ph.D. degrees in chemical engineering from the University of Tulsa. He is a member of the AIChE, SPE, and ASEE and is a registered professional engineer.