A survey of Engineering Education in developing countries - The Lebanese case

NAZIH MOUBAYED[1], MOUAFAC BERNARD[2] and AHMAD JAMMAL[3]
[1]Lebanese University, Faculty of Engineering 1, Tripoli, LEBANON
nmoubayed@ieee.org

[2]Lebanese University, Faculty of Engineering 2, Roumieh, LEBANON

[3]Ministry of Education and Higher Education, Directorate General of Higher Education
Place Habib Abi-Chahla, Beirut, LEBANON
ajammal@ieee.org

Abstract: - Industrial and service providing organizations employ a large number of graduating engineers. They can thus be viewed as important customers of engineering faculties. This paper discusses the major objectives of accreditation which should encourage the institutions to continually strive towards the attainment of excellence. The evaluation processes is designed to facilitate the identification of the strengths and weaknesses of the programs under accreditation. This will help the institutions in improving the quality and effectiveness of their programs. Finally, the accreditation of engineering programs in Lebanon is treated.

Key-Words: - Globalization, engineering education, accreditation, evaluation criterion, grading, quality.

1 Introduction

Over the past ten to fifteen years, the word "Globalization" has become a common word that is heard in many international conferences. "The word 'Globalization' has been used by economists since 1981; however, its concepts did not become popular until the later half of the 1980's and 1990's". A number of definitions of globalization related to the provision of products or services are given and include [1]:

- "Process of designing, developing, and adapting a product for distribution in multiple countries".
- "Process of creating a product or service that will be successful in many countries without modification".
- "Expansion of economies beyond national borders, in particular, the expansion of production by a firm to many countries around the world".
- "Integration of markets on a worldwide scale and could eventually mean worldwide standards or practices for product quality, pricing, service, and design".

An important interpretation of globalization by the World Bank states that [1]: "Globalization can be summarized as the global circulation of goods, services and capital, but also of information, ideas and people".

Faculties of engineering are education service providers. Students of engineering are viewed as either the products or the customers of faculties of engineering [2],[3]. Regardless of how this is looked at, the outcome of engineering education are engineers who are supplied to the market place and should be capable of applying their knowledge in the most efficient way to meet the needs of their employers [4],[5]. Engineering educational systems need to undergo a change to cope with the effects that globalization is having on industry and service providers [6],[7]. New advances are needed to offer a fresh perspective allowing faculties of engineering to remain viable, competitive and able to capture new opportunities [8],[9],[10].

This paper treats the engineering education system and accreditation of engineering programs. Therefore, section two defines the engineering career and represents the list the different existing specialities. Engineering education is illustrated in section three. Section four treats the challenge facing engineering education. Section five discusses accreditation of the engineering program. The case of accreditation programs of engineering educations in Lebanon is detailed and analyzed in section six. Finally, conclusions about engineering education are presented in section seven.

2 Engineering: Definition and branches

2.1 Definition

Engineering is the field of applying science and mathematics to develop solutions that have a practical end. Engineers design and manufacture machines, processes, systems and even economical structures. In a sense, engineers are inventors. They dream up ideas and make them a reality for the rest of us. By utilizing science and math, they improve the quality of life for society. Engineering is a highly rewarding career for creative and innovative individuals around the world. And as you can imagine, there is a great deal of prestige involved with being an engineer. Since engineers are often responsible for directly creating a new product or service, they are in high demand in the corporate world and command fairly high salaries.

2.2 Engineering specialities

The most important existing engineering branches and specialities are listing as follows:

- Electrical engineering,
- Industrial engineering,
- Electronic engineering,
- Computer engineering,
- Communication and network engineering,
- Aerospace engineering,
- Biomedical engineering,
- Mechanical engineering,
- Energizing engineering,
- Mining engineering,
- Manufacturing engineering
- Civil engineering,
- Urban engineering,
- Environmental and Water resources engineering,
- Marine engineering,
- Public works and transportation engineering,
- Structural engineering,
- Chemical engineering,
- Nuclear engineering,
- Petroleum engineering,
- Materials engineering,
- Architecture engineering,
- Surveying engineering,
- Agro-alimentary engineering,
- Agronomy engineering,
- Agricultural engineering,
- etc.

3 Engineering education

Engineering education is the activity of teaching engineering and technology, at school, college and university levels. The goal of engineering education is to prepare people to practice engineering as a profession and also to spread technological literacy, increase student interest in technical careers through science and math education and hands-on learning. The history of engineering can be roughly divided into different phases [11]:

- *Pre-scientific revolution:* The prehistory of modern engineering features ancient master builders and Renaissance engineers such as Leonardo da Vinci.
- *Industrial revolution:* From the eighteenth through early nineteenth century, civil and mechanical engineers changed from practical artists to scientific professionals.
- *Second industrial revolution:* In the century before World War II, chemical, electrical, and other science-based engineering branches developed electricity, telecommunications, cars, airplanes, and mass production.
- *Information revolution:* As engineering science matured after the war, microelectronics, computers, and telecommunications jointly produced information technology.

4 The challenge facing Engineering Education

Globalization has changed the skills and competencies required from engineers being hired by industry and service providers. Consequently, the responsibility of faculties of engineering in educating engineers has changed dramatically. Engineering graduates are now required to have multi-skills, flexibility, managerial competencies and work ethics. Engineering curricula must ensure that graduating engineers can meet the new expectations of industry. Engineers must be capable of learning new skill in fast and discreet way to meet the ever-changing requirements of their employers. Educational systems should offer courses based on e-learning formats using web-based tools. These courses should be offered to the practicing engineers and should be “on a need basis” taking into consideration the engineer’s specific requirements for new knowledge and skills. Faculties of engineering can no longer design their educational programs on their own. It is essential to establish a close cooperation between faculties of engineering and industry in order that they may both participate in the formation of engineers [1].

4.1 Engineering Educational Programs Changes

On 25 May 1998 in Paris, ministers responsible for the higher education in France, Germany, Italy and the United Kingdom signed the Sorbonne Declaration [12] which emphasized that Europe should become the Europe of Knowledge. This document was a predecessor of the Bologna Declaration [13] that was accepted by 29 states on 19 June 1999. The declaration promotes the improvement of the higher education system, recognizing education as a cornerstone in the consolidation of a stable, peaceful and democratic society. Almost a year later the new strategic goal of the European Union (EU) for the next decade was established in the Lisbon Strategy [14]: Europe should become the most competitive and dynamic knowledge-based economy in the world. In turn, in 2005 the Council of the European Union stressed that the Lisbon goals of competitiveness and economic growth can only be achieved if young people coming onto the labor market are properly equipped through qualitative education and training in line with the evolution of society [15].

In other hand, during the last three decades, engineering and technical education in developing countries has witnessed large growth. A majority of the higher education institutes have relatively good infrastructure and qualified teaching staff. However, the general efficiency and effectiveness in utilizing these resources is lacking. Presently, the focus in engineering education in developing countries is on teaching the basics of technology (from textbooks). Only a few institutes can offer their student knowledge pertinent to the needs of industry as a part of the curriculum. Some faculties of engineering have included within their curriculum short periods of time to be spent in the corporate environment. Most other faculties lack a clear vision regarding strategies needed to inform their students about the future needs of industry. Thus, there is an urgent need for an important change in perspective and in the model used of for establishing new curricula [1].

4.2 Universities-Industry

The university-industry cooperation is a process in which industry and universities improve their respective potential by synergistic effects generated through their interactions. These interactions expectation have the potential to bring various effects such as upgrading the quality of human capital and increasing innovation capability.

In this process, it is imperative to facilitate an environment in which universities, as actors in the process, can make and exercise their own decisions.
Lebanese companies are asked to held continual give-and-take relationships with the research laboratories of the different engineering universities by recruiting new graduates, collaborating in or sponsoring research at the laboratory, offering scholarships, and carrying out patent procedures on behalf of the laboratory. Moreover, faculty members at these universities, through their status, were allowed to start their own research projects [16].

5 Engineering program accreditation

5.1 Definition of Accreditation

The purpose of engineering programme accreditation is to ensure that education provided by faculties of engineering meets acceptable levels of quality [17].
Accreditation is a process of quality assurance by which an engineering programme, undergraduate (UG) or postgraduate (PG) in an approved faculty of engineering, is critically appraised at intervals not exceeding five to six years to verify that the programme meets norms and standards prescribed by the accreditation body from time to time.
Accreditation provides quality assurance that the academic aims and objectives laid down by a faculty of engineering are methodically reviewed and effectively implemented by the available resources, and that the faculty has demonstrated capabilities to ensure effectiveness of the educational programme(s) over the validity period of accreditation. Accreditation is not awarded to the institution as a whole, but at the programme level (examples: 12- semester under-graduate engineering degree course and 4-semester Master Degree programme after the Bachelor's Degree). Furthermore, the programmes may be graded into three categories viz., Accredited for five years, Accredited for three years and Not Accredited, depending on the marks achieved on a predetermined measurement scale (say 1000-point scale). This is especially important for promoting a healthy competition for quality achievement among the different degree programmes of the same faculty, as well as among similar programmes in different faculties [18].
One of the major objectives of accreditation is to encourage the institutions to continually strive towards the attainment of excellence.

Another main objective of the accreditation process is to recognize and acknowledge the value-addition in transforming the raw student admitted to the programme into a capable technical professional, having a sound knowledge of fundamentals and an acceptable level of professional and personal competence, ready for employability in responsible technical assignments [19].

5.2 Aims and Objectives

The purposes of the accreditation process are [19]:

A. To assist all the stakeholders (parents, students, teachers, educational institutions, professional societies, potential employers, government agencies) in identifying those institutions and their specific programmes which meet the statutory educational body norms, standards and other quality indicators specified from time to time.
B. To provide guidelines for upgrading of existing programmes and for developing new programmes.
C. To encourage the adoption of a standard of excellence and to stimulate the process of continual improvements in engineering education.

5.3 Accreditation Process Outcome

Individual programmes are subjected to accreditation evaluation may be classified into one of the following categories [19]:

A. Accredited for Five years: Excellent/Very good; meeting all accreditation criteria or exceeding them.
B. Not Accredited: Not ready for accreditation, due to serious deficiencies.

5.4 Accreditation Parameters & Criteria

Parameters and criteria, by which individual programmes will be judged, have been carefully formulated so as to give a clear and transparent indication of the strengths and weaknesses of the programmes. The parameters and criteria are classified into categories in order to measure the quality of different aspects of the programmes (figure 1).

The evaluation processes should be so designed as to facilitate identification of the strengths and weaknesses of the programmes under accreditation. This will help the institutions in improving the quality and effectiveness of their programmes [19].

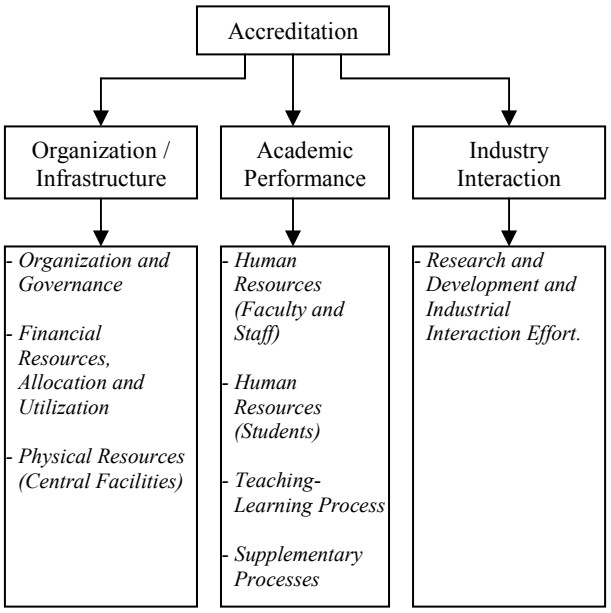

Fig. 1: Accreditation parameters and criteria.

A. Organization/Infrastructure Category

Criterion I: Organization and Governance

(a) Planning and monitoring; faculty/staff recruitment/promotion policies; leadership, motivation, transparency, decentralization, delegation and participation of faculty; efficiency.

Criterion II: Financial Resources, Allocation and Utilization

(a) Capital resources, operational budget, maintenance budget, developmental resources and budget; percentage utilization of allocated grants.

Criterion III: Physical Resources (Central Facilities)

(a) Land, buildings, hostels, support services (water, electricity, communication, other services.), office equipment, internet, canteen, transport and medical facilities.

B Academic Performance Category

Criterion IV: Human Resources (Faculty and Staff)

(a) Faculty: Numbers, students/faculty ratios; Faculty qualifications/experience; workload (teaching, research, consultancy, administration); attitudes, commitment, faculty development (higher studies, conferences, continuing education, professional studies, industrial exposure, sabbatical leave), performance appraisal by students/others.
(b) Supporting Staff (Teaching/Administrative): Numbers, qualifications/skills, attitudes, involvement, skill upgrading.

Criterion V: Human Resources (Students)

(a) Admissions quality, percentage of seats filled; academic results, analysis and performance; performance in competitive examinations, admission to postgraduate courses, employment of graduating students in past years, feedback from employers; intake of highly qualified/deserving candidates, drop-out rate during past years.

Criterion VI: Teaching-Learning Process

(a) Syllabus delivery and contents, contents beyond the syllabus, academic calendar, and continuous evaluation process (mid-semester exams, class tests, assignments, other methods, regularity in conducting/announcing results).

(b) System of students' feedback; Laboratories, Workshops and Equipment (facilities, maintenance and utilization), information access facilities, student-centric learning initiatives; other innovations in teaching learning process.

Criterion VII: Supplementary Processes

(a) Extra and co-curricular activities, counselling and guidance, professional society activities, entrepreneurship development, alumni interaction and students' publications/awards.

C. Industry Interaction Category

Criterion VIII: Research and Development and Industrial Interaction Effort

(a) Institutional budget for research and development, academic/sponsored/industrial research, development and publications.

(b) Industry participation in curriculum planning, continuing education, industrial internship for faculty/students, consultancy, industrial visits and training, students' projects work, extension lectures, placement.

As indicated above, the evaluation process is based on a set of eight broad-based criteria developed through an extensive and participatory process involving participants of various engineering faculties in a country [19].

5.5 Accreditation Parameters Weighting Factors

Each of the criteria described above has been broken down into parameters, and weighting factors have been assigned to these parameters.

The proposed accreditation scheme takes into account various parameters on which an engineering programme may be evaluated/accredited [19].

6 Engineering Educations in Lebanon

Over the past ten to fifteen years, a number of universities have been established in Lebanon in addition to universities that have been in operation for periods of up to a hundred years.

Generally, more than 140,000 students enrolled in Higher Education Institutions (HEI). Half of these students are in the Lebanese University. The other half is distributed over 40 private HEIs that are licensed by the Lebanese Council of Ministers.

A number of fifteen universities offer engineering programs with a variety of engineering fields. Many of these universities have been established less than ten years ago.

6.1 Universities offering engineering programs

The list of licensed universities and institutions of higher education in Lebanon offering engineering programs is shown in table 1 [20]. The different engineering specialities for each university are illustrated in table 2 [20].

6.2 Practicing the engineering profession in Lebanon

Engineers who wish to practice the profession in Lebanon must fulfil a number of requirements. Any engineer working on projects requiring approval by official authorities must be first authorized to practice the engineering profession. To obtain such authorization, the engineer must have an Authorization to practice the profession. It is obtained from the Ministry of Public Works and Transportation (Ministry of Agriculture for Agricultural Engineers). A number of formalities must be completed and documents presented with the authorization application.

In addition, engineers must join the Order of Engineers and Architects (OEA) of Beirut or Tripoli. This is mandatory for engineers to be allowed to sign engineering execution plans and drawings required for construction of various types of facilities. Joining the OEA requires the engineer to provide a number of official documents in addition to documents related to his degrees. The OEA recognizes engineering programs that are not less than five (5) years in duration.

The OEA in Beirut and Tripoli have available information on the requirements and conditions for obtaining the Authorization to practice the profession and for joining the OAE [21].

Table 1: List of universities in Lebanon offering engineering programs.

University	Date	Web Site
Al-Manar University of Tripoli (MUT)	1990	www.mut.edu.lb
American University of Beirut (AUB)	1866	www.aub.edu.lb
American University of Science and Technology (AUST)	1999	www.aust.edu.lb
Antonine University (UPA)	1996	www.upa.edu.lb
Arts, Sciences & Technology University in Lebanon (AUL)	1999	www.aul.edu.lb
Beirut Arab University (BAU)	1960	www.bau.edu.lb
Hariri Canadian University (HCU)	1999	www.hariricanadian.edu.lb
Islamic University of Lebanon (IUL)	1996	www.iul.edu.lb
Lebanese American University (LAU)	1992	www.lau.edu.lb
Lebanese International University (LIU)	2001	www.liu.edu.lb
Lebanese University (UL)	1951	www.lu.edu.lb
Applied Sciences & Economics Institute (UL – ISAE)	1968	www.isae.edu.lb
Notre Dame University (NDU)	1978	www.ndu.edu.lb
Saint-Joseph University (USJ)	1875	www.usj.edu.lb
Saint-Esprit University of Kasslik (USEK)	1961	www.usek.edu.lb
University of Balamand (BOU)	1988	www.balamand.edu.lb

Table 2: Lebanese Engineering Universities: Faculties and specialities.

University	Faculty and specialities
Al-Manar University of Tripoli (MUT)	Faculty of Engineering and Information Technology: - Biomedical engineering, - Communication and Network engineering, - Electronics and computer engineering, - Industrial engineering, - Marine engineering & technology.
American University of Beirut (AUB)	Faculty of Engineering - BE in Civil Engineering, - BE in Electrical and Computer Engineering, - BE in Mechanical Engineering, Faculty of Agriculture: - Agriculture Engineering Faculty of Architecture - Architecture
American University of Science and Technology (AUST)	Faculty of arts and Sciences: - Computer & Communications Engineering.
Antonine University (UPA)	Faculty of Engineering: - Computer and communication engineering
Arts, Sciences & Technology University in Lebanon (AUL)	Faculty of Arts and Sciences: - Computer and Communications Engineering
Beirut Arab University (BAU)	Faculty of Engineering: - Communication & Electronics Engineering - Electric Power & Control Engineering - Civil Engineering - Mechanical Engineering - Computer Engineering & Informatics - Industrial Engineering & Management - Surveying Engineering

Hariri Canadian University (HCU)	College of Engineering: - Electrical and computer engineering, - Mechanical and mechatronics engineering.
Islamic University of Lebanon (IUL)	Faculty of Engineering: - Biomedical Engineering - Computer and communication engineering - Surveying Engineering.
Lebanese American University (LAU)	School of Engineering: - Civil engineering, - Electrical & computer engineering, - Industrial & Mechanical engineering, Faculty of Fine Arts & Architecture: - Architecture.
Lebanese International University (LIU)	School of engineering: - Electrical Engineering, - Electronic Engineering, - Communication Engineering, - Computer Engineering, - Industrial Engineering, - Mechanical Engineering, - Surveying Engineering, - Civil Engineering.
Lebanese University (UL)	Faculty of engineering: - Civil engineering, - Electrical & electronic engineering, - Mechanical engineering. Faculty of Architecture & Fine Arts: - Architecture engineering. Faculty of Agriculture: - Agriculture Engineering
Applied Sciences & Economics Institute (UL – ISAE)	Computer department: - Computer engineering, Mechanical department: - Mechanical engineering, - Energizing engineering, Electrical and electronic dep.: - Electronic engineering, - Power engineering.
Notre Dame University (NDU)	Faculty of Engineering: - Civil engineering, - Electrical engineering, - Mechanical engineering, - Computer & communication engineering. Faculty of Architecture & Fine Arts: - Architecture.
Saint-Joseph University (USJ)	Higher Institute for Engineering in Beirut: - Electrical and Mechanical Engineering,, - Computer and networks engineering, - Electromechanical Engineering, - Civil and environmental engineering. Higher School for Agro-Alimentary Engineers: - Agro-alimentary engineering. Higher Institute for Agricultural Engineering for Mediterranean Countries: - Agronomy engineering.
Saint-Esprit University of Kasslik (USEK)	Faculty of Sciences and Computer Engineering: - Computer and Communication Engineering. Faculty of Agricultural Science: - Agricultural Engineering.
University of Balamand (UOB)	Faculty of engineering: - Computer engineering, - Electrical engineering, - Civil engineering, - Mechanical engineering. School of Decorative Arts: - Architecture.

6.3 Accreditation of engineering programs in Lebanon

The engineering students in Lebanon are earning their degrees through different Engineering Programs in the increasing number of Lebanese universities. Consequently, it is important that these programs as well as the way they are delivered are monitored as to their intrinsic quality, their compatibility with international standards and their response to National needs.

Quality Higher Education in Lebanon was always an attraction for neighboring countries and it is in the national interest to foster this position in agreement with the National, Regional, and International development. For that objective, the "Lebanese Engineering Programs Accreditation Commission – LEPAC" was proposed.

The project LEPAC, financed by the EU Commission under TEMPUS program, aims at putting in place an accreditation system for engineering education in Lebanon [22]. This system should be based on the International Standards and Procedures such as ABET and EUR-ACE.

LEPAC's official starting date was on October 14, 2006 and its official end date was on April 14, 2008.

6.4 The Lebanese Engineering Programs Accreditation Commission (LEPAC)

LEPAC is a consortium of Lebanese and European Private and Public Institutions concerning engineering education. It is to periodically assess engineering programs offered at universities operating in Lebanon and accredit those programs that meet established standards to ensure highest quality of engineering education [22],[23],[24]. The LEPAC major responsibilities were:

1. Define accreditation goals and objectives and processes for assessing them.
2. Assess engineering programs in the context of the specific program objectives and outcomes.
3. Provide feedback to institutions for improvement.
4. Renders accreditation decisions.
5. Identify to all stakeholders the programs that meet the set of standards and criteria.
6. Publish accreditation decision to constituencies.
7. Set, assess, and maintain policies and procedures.
8. Develop, assess, and maintain programs' criteria.
9. Form standing committees to manage details of all aspects of accreditation process.
10. Maintain the integrity of the accreditation process (team formation, timelines, etc.).
11. Act as liaison between institutions, government, and public.
12. Advise the Ministry of Higher Education on licensing new programs.

6.4.1 Background of the Project

A. Need for the project

- Necessity of recognition and accreditation of Engineering Programs (EPs) to unify the standards of the EPs offered in every country.
- Higher Education Institutions (HEI) in the Arab Region are relatively new, some Arab States have established a body concerned with accreditation.
- The Beirut Conference opened a new era of interest in quality assurance among the Higher Education community in the Arab States calling for the establishment of a Regional mechanism for quality assurance and accreditation under the auspices of the Association of the Arab Universities and calling to Member States of the region to establish similar mechanisms at the National level.
- In Lebanon, more than 140,000 students are enrolled in HEIs distributed over 40 private and Public HEIs that are licensed by the Lebanese Council of Ministers.
- Lebanon needs to establish a mechanism for accrediting and evaluating the HEIs.

B. Accreditation criteria:

Accreditation system must examine single EPs such that it:

- Satisfies standard prerequisites on the contents of the study program.
- Shows the capacity to produce completely qualified students, specifically through the definition of a series of cultural, technical and professional requirements that are projected over the entire work life.
- Provides complete documentation on the means used to achieve the training objectives.
- Ensures that the objectives are achieved.

C. Accreditation Board

Accreditation must be done by an Accreditation Board that:

- Approves detailed guidelines and operating procedures for accreditation.
- Oversees all operational arrangements and appoints evaluation panels.
- Receives evaluation reports on EPs and determines whether accreditation should be granted and on what conditions.
- Responds to any complaints concerning the accreditation process and to any proposals for change.
- Oversees the development and operation of accreditation and mutual recognition agreements with other countries.
- Fosters the dissemination of developments and best practices in engineering education.

6.4.2 Specific Project Objectives

The Main goal is to put in place an accreditation board for engineering education in Lebanon, namely the "Lebanese Accreditation Board for Engineering Education – LABEE". This board is based on International Standards and Procedures such as EUR–ACE.

This goal can be achieved by producing an appropriate legislating accreditation system to be adopted by the Lebanese Ministry of Higher Education.

Therefore, the main objectives of the projects are:

- To establish an organizational structure and bylaws for the proposed LABEE,
- To establish a draft of accreditation criteria,
- To establish a draft of accreditation procedures,
- To train Lebanese accreditation specialists,
- To be a consultant to the Lebanese Ministry of HE and the Orders of Engineers for the equivalency of the international Engineering Degrees,
- To identify and classify EPs.

6.4.3 Technical Committee Documents Outcomes

- Lebanese Accreditation Board for Engineering Education (LABEE): Mission, Vision, Responsibilities, Composition, LABEE's Membership, Nominations, Selection, Members for the first Board, Membership Period, Mandate, Funding.
- Accreditation Policy and Procedures: Licensing Policy, Operation Eligibility Policy, Accreditation Policy, Institutional Eligibility for Accreditation, Program Eligibility for Accreditation, Accreditation Procedures.
- Accreditation Criteria: Program, Students, Faculty Members, Facilities, Institutional Support, Program Specific Criteria.
- Accreditation of Established Programs: Full Accreditation, Conditional Accreditation, Major Weaknesses and Severe Weaknesses, No Accreditation, Accrediting New Programs.
- Experts Guidelines and Criteria: Nominations, Selection, Formation of the Visiting Teams, Accreditation Appeals Board.
- Accreditation Process Guidelines.
- Preparation for the On-Site Accreditation Visit.
- Self Study Report (SSR) example.

6.5 The Lebanese Accreditation Board for Engineering Education (LABEE)

6.5.1 LABEE objectives and responsibilities

LABEE is to periodically assess engineering programs offered at universities operating in Lebanon and accredit those programs that meet established standards to ensure highest quality of engineering education. The LABEE major responsibilities are:

- Define accreditation goals and objectives and processes for assessing them.
- Assess engineering programs in the context of the specific program objectives and outcomes.
- Provide feedback to institutions for improvement.
- Renders accreditation decisions.
- Identify to all stakeholders the programs that meet the set of standards and criteria.
- Publish accreditation decision to constituencies.
- Set, assess, and maintain policies and procedures.
- Develop, assess, and maintain programs' criteria.
- Form standing committees to manage details of all aspects of accreditation process.
- Maintain the integrity of the accreditation process (team formation, timelines, etc.).
- Act as liaison between institutions, government, and public.
- Advise the Ministry of Higher Education on licensing new programs.

6.5.2 LABEE composition and Membership Period

The accreditation board is a composite of the major stakeholders of engineering education. It is composed of members that represent the following entities and institutions (Table 3):

Table 3: LABEE membership composition.

Entities and Institutions	Number of Members
Ministry of Higher Education	1
Other Concerned Ministries (Public Works, Agriculture)	2
Order of Engineers	2
Higher Education Institutions: - Lebanese university 2 - Private Institutions 3 (assuming rotation of membership)	5
Industry Representative	2
Consultants without voting right: - International Advisor 1 (selected by LABE) - Regional or UNESCO Representative 1 (nominated)	2

LABEs members serve on a strictly voluntary basis. Membership on LABE should be for a period of 3 years. Membership could be renewed for an additional one three years term only. In case a vacancy on the board occurs, the member that will fill the vacancy shall only serve for the duration of the term. No more than half of the membership is renewed at one time to ensure continuity.

6.5.3 Mandate

1. LABE is mandated by the Council of Ministers.
2. LABE operates with complete autonomy within the context of its rules and regulations.
3. The board has the sole responsibility to render the accreditation decisions.
4. The decisions of the Ministry of Higher Education for Equivalence Committee, Engineering Committee, and Technical Committee conform to LABE's recommendations.
5. The Ministry of Public Works, the Ministry of Agriculture and the Orders of Engineers accept LABE's recommendations and conform to it when attaining permission of practicing the engineering profession.

6.5.4 Funding

The Ministry of Higher Education covers roughly 50 % of LABEs operating budget. The balance of the required budget shall come from the following sources:

1. Institutions seeking accreditation will pay a fee of $ 3000 for each program to be accredited.
2. Universities offering engineering programs shall be charged an annual maintenance fee of $ 500.
3. Annual support from the Orders of Engineers.
4. Annual support from the Industrial Association.
5. Other sources that LABE seeks.

6.6 Accreditation Policy and Procedures

6.6.1 Licensing Policy

The program must meet the criteria set by LABE.

6.6.2 Operation Eligibility Policy

A program to be eligible must satisfy the following conditions:

1. Evidence that the initiation of the program's requirements is met during a visit by LABE's expert.
2. Continuous assessment and audit for all years of study of the program.
3. According to assessment result, programs are eligible to be accredited for a full accreditation cycle of at most 6 years.

6.6.3 Accreditation Policy

A necessary condition to pursue accreditation of a program is that the institution in which the program is offered meets the following criteria:

1. Have an operating license from the Ministry of Higher Education.
2. Meet all standards and criteria established by the Ministry of Higher Education (decree 9274 and Higher Education Law).
3. Has been in operation for at least three years.

A program is eligible for accreditation if it satisfies the following minimum requirements:

1. Licensed by the Ministry of Higher Education.
2. Meets equivalency standards as required by the Ministry of Higher Education.
3. Has been in operation at least for 3 years after graduating the first class. Exception to this applies to a new program in which case probationary accreditation for three years may be granted after graduating the first class.
4. Meets the program criteria set by the LABE.
5. Offers a curriculum that satisfies by experience the stated outcomes.

6.6.4 Accreditation Procedures

Once accreditation eligibility is met the accreditation process (figure 2) is as follows:

1. Form a team (board members serve on accreditation teams)
2. Eligibility Assessment
3. Evaluate Self Study Report
4. On-site visit
5. Visit Report
6. Accreditation Action
7. Appeals – accepted only if there is evidence that decision is not based on merit or team did not have all the information needed to make a decision.
8. Public Release of Accreditation information.

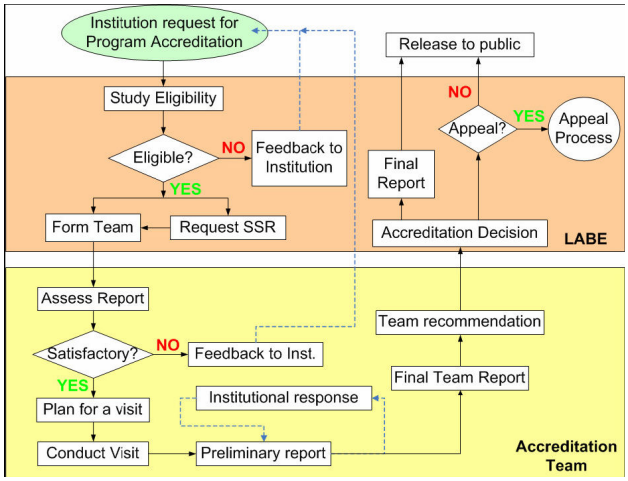

Fig. 2: Accreditation Process.

6.7 Results of the 'Lebanese Accreditation Board for Engineering Education' Tempus program

The Tempus project on engineering accreditation in Lebanon (LEPAC) has been completed. Following are presented the most important results of the project:

- Training of 12 experts from different schools of engineering in Lebanon on the assessment of Engineering programs,
- Standards, Criteria, Process for accreditation was defined,
- Technical Committees was created from specialist in the field,
- Guide for Evaluation and Accreditation of Engineering programs was also defined,
- Proposal of Bylaws for the creation of a board of accreditation LABE (Lebanese Accreditation Board for Engineering Programs).

7 Conclusions

In this paper, the engineering education and accreditation of engineering programs was treated. In fact, engineering program accreditation is a measure of the quality of the program. Institutions seeking accreditation of their programmes are expected to satisfy each of the criteria individually. They are expected to adhere to these criteria during the validity period of granted accreditation. Institutions are also encouraged to periodically review the strengths and weaknesses of their programmes and strive for their continuous improvement. Accreditation is specific to countries, where each country has its own accreditation criteria. Therefore, the case of accreditation programs of engineering educations in Lebanon was presented and discussed. As consequence of the work of the Lebanese Engineering Programs Accreditation Commission (LEPAC), the Lebanese Accreditation Board for Engineering Programs was created.

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