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Faisal Aqlan [a], Omar Al-Araidah [a] & Tarek Al-Hawari [a]

[a] Industrial Engineering Department, Jordan University of Science and Technology, Irbid, 22110, Jordan

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Quality assurance and accreditation of engineering education in Jordan

Faisal Aqlan, Omar Al-Araidah* and Tarek Al-Hawari

Industrial Engineering Department, Jordan University of Science and Technology, Irbid 22110, Jordan

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This paper provides a study of the quality assurance and accreditation in the Jordanian higher education sector and focuses mainly on engineering education. It presents engineering education, accreditation and quality assurance in Jordan and considers the Jordan University of Science and Technology (JUST) for a case study. The study highlights the efforts undertaken by the faculty of engineering at JUST concerning quality assurance and accreditation. Three engineering departments were accorded substantial equivalency status by the Accreditation Board of Engineering and Technology in 2009. Various measures of quality improvement, including curricula development, laboratories improvement, computer facilities, e-learning, and other supporting services are also discussed. Further assessment of the current situation is made through two surveys, targeting engineering instructors and students. Finally, the paper draws conclusions and proposes recommendations to enhance the quality of engineering education at JUST and other Jordanian educational institutions.

Keywords: ABET; accreditation; engineering education; JUST; quality assurance

1. Introduction

Nowadays, throughout the world, there is a move toward mass higher education accompanied by a large increase in the number and size of higher education institutions and the diversity of programmes offered. This expansion and development in higher education poses challenges for the efficacy of institutional quality assurance and accreditation, which requires a system of methods and techniques that guarantee monitoring and coordination of processes and consistency of university institution outputs. Among the many programmes, engineering has become a more global profession due to the development in communication, travel and trade. This globalisation necessitates the need for efficient quality assurance issues of engineering education to provide engineers with adequate qualifications and training to perform well in their profession. Moreover, engineering programmes should be tailored to meet the needs of the markets, and educators must support the strengthening of career counselling and advising services at all educational levels. Hence, educators themselves should be well prepared to train a technically competent graduate. Accreditation of engineering programmes has become one of the most influential tools

*Corresponding author. Email: alarao@just.edu.jo

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of quality assurance. It is used to enhance engineering education and the engineering profession and is necessary to maintain the quality and the status of engineering graduates and, hence, the technical workforce. In some countries, accreditation is conducted by a government organisation. In others, the quality assurance process is independent of government and is performed by private companies or associations. Several international accreditation associations exist and can provide accreditation services to parts of the world where no accreditation agencies exist.

In Europe, the European Network for Accreditation of Engineering Education (ENAEE) was founded as an international not-for-profit association in 2006 by 14 associations concerned with engineering education throughout Europe. Four more organisations joined ENAEE later, three full members and one associate member (ENAEE 2010). The purpose of accreditation is to evaluate engineering education programmes against standards agreed upon and accepted by the academic community and possibly other stakeholders. Members of ENAEE include the Accreditation Agency for Accrediting Degree Programmes in Engineering, Informatics, the Natural Sciences and Mathematics (ASIIN), Engineering Council of the UK (ECUK) and the Council of Associations of Long-cycle Engineers of a University or Higher School of Engineering of the European Union (CLAIU-EU). ASIIN is a non-profit, registered association that has been accredited by the German Accreditation Council (Akkreditierungsrat) since 2002 (ASIIN 2009). It provides local (inside Germany) and international (outside Germany) accreditation of engineering programmes in addition to other programmes such as physics, chemistry and mathematics. Universities outside of Germany can be accredited if compliance with the ASIIN requirements and subject-specific criteria can be demonstrated. Successfully accredited degree programmes offered at higher education institutions outside of Germany will receive a certificate of substantial equivalency with the ASIIN requirements. ASIIN, as a member of ENAEE, has been authorised to award the label of the European accreditation system of engineering programmes, which is launched by ENAEE (EUR-ACE®-Label) in addition to its own accreditation certificate if accredited programmes fulfil the standards associated with these labels (ASIIN 2009). ECUK was incorporated by Royal Charter in 1981 to regulate the engineering profession in the UK, reformed in 1996 and created in 2002. Currently, ECUK is the regulatory body for the engineering profession in the UK. In addition, it sets and maintains internationally recognised standards of professional competence and ethics (ECUK 2010). ECUK is authorised to award the EUR-ACE®-Label (ENAEE 2010). CLAIU-EU, which joined ENAEE in January 2010, is an international non-profit association that has its office in Brussels, Belgium. CLAIU-EU serves to promote the interests of engineers who have followed a more theoretically oriented education and who are concerned with fundamental concepts and their practical application (CLAIU-EU 2010).

In the USA, the Accreditation Board for Engineering and Technology (ABET), formerly the Engineers' Council for Professional Development, is a professional accrediting organisation that accredits engineering, technology, computing and information science and engineering-related programmes in the United States and internationally (ABET 2009). The new developed criteria of ABET for accrediting engineering programmes EC2000 have changed the way that engineering programmes prepare their graduates (Bai and Pigott 2004). The philosophy of EC2000 is to allow institutions and engineering programmes to uniquely define their mission and objectives to meet the needs of their constituents. In addition, the new ABET system focuses on the continuous improvement of a programme based on the results of the assessment process for programme objectives and outcomes and on the input of constituents (Whiteman 2003). In the Arab world, the Arab Network for Quality Assurance in Higher Education (ANQAHE) was established in June 2007 as a non-profit non-governmental organisation. In total, 10 Arab countries are members in this network, including Jordan. The network is working in association with the International Network of Quality Assurance Agencies and in connection with the association of Arab Universities. ANQAHE focuses on all higher education programmes including engineering programmes (ANQAHE 2010).

In this study, quality assurance and accreditation of higher education in Jordan is discussed, focusing on engineering education. Jordan University of Science and Technology (JUST) is considered for a case study. The study clarifies the purposes, methods and intended outcomes of the quality assurance and assessment system and investigates the impact of such issues on the university outputs, management and decision making. The various efforts and policies undertaken to improve the quality of engineering education at JUST are also discussed. Furthermore, two surveys are taken, targeting engineering professors and students, to further assess the current situation of the faculty of engineering. The paper is organised as follows. Section 2 presents facts about engineering education in Jordan and discusses the accreditation and quality assurance efforts. Section 3 presents quality assurance, improvement activities and accreditation of engineering programmes at JUST. Section 4 provides feedback assessments from students and instructors about the learning quality. The final section provides concluding remarks.

2. Engineering education in Jordan: quality assurance and accreditation

Higher education in Jordan started in 1951 with a 1-year post-secondary teacher-training programme. The present university system, however, dates back to 1962 when the University of Jordan was established. Yarmouk University followed in 1976. In 1986, JUST was detached from Yarmouk University to become a new university and then more public and private universities were established in different parts of the kingdom since that date. Today, there are 10 public universities and 14 private universities in addition to several community colleges (Ministry of Higher Education and Scientific Research 2009). Engineering education is offered by nine public and six private universities and most of the community colleges. The institutions attempt to avoid duplications in their engineering programmes to attract students. The structure of engineering studies offered in Jordan includes: Intermediate Diploma (2 years); Bachelor's Degree (5 years); Higher Diploma (Master's of Engineering); Master's and Doctorate of Science (Najjar 2003). Figure 1 shows the number of engineering students enrolled in public and private universities (BSc students) as well as the community colleges (first and second years) for the academic year 2008/2009. Architecture, computer and software engineering are not included since they belong to different faculties, namely, the faculty of architecture and design and the faculty of computer and information technology, respectively. Access to engineering education is open to local and

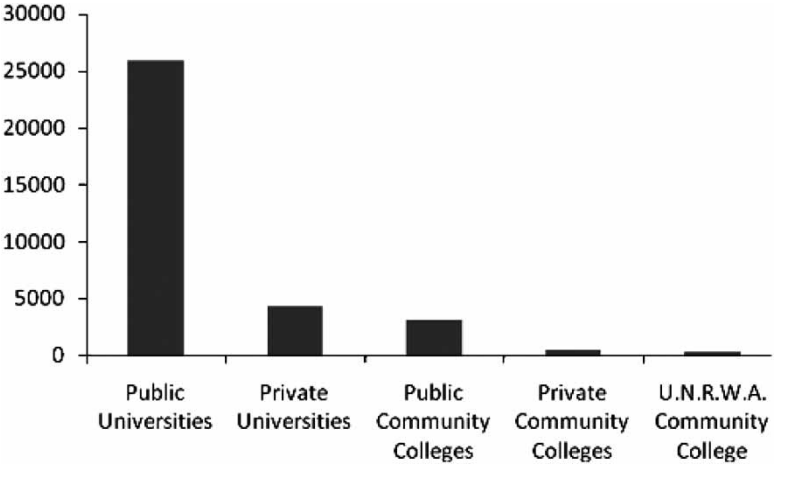

Figure 1. Number of engineering students enrolled for the year 2008/2009.

foreign holders of the General Secondary Education Certificate or equivalent certificates with high grade point average (GPA).

In the recent few years, the Jordan Ministry of Higher Education and Scientific Research put great emphases on programme evaluation, curricula monitoring, accreditation and quality assurance, to cope with the continuous increase in the number of universities and students (Ministry of Higher Education and Scientific Research 2009). The Jordanian Council of Higher Education, established in 1982, is responsible for setting regulations and planning higher education policies. It formed the core of the Ministry of Higher Education and Scientific Research, which was established in 1985. In 2001, the Accreditation Council was formed, to be responsible for defining the regulations for the accreditation of higher education institutions, amending and developing them in light of the general policy of higher education. It also supervised the performance of higher education institutions and their commitment to applying the rules of accreditation. The council aims to ensure that institutions of higher education reach their pre-defined goals through continuous evaluation of their programmes. The Accreditation Council was dissolved in June 2007 and was replaced by the Higher Education Accreditation Commission (HEAC). HEAC objectives are to enhance and guarantee quality in higher education, to encourage universities to be open to and interact with international scientific research institutions and accreditation commissions and to upgrade higher education in Jordan on the basis of internationally recognised criteria. HEAC is empowered to formulate relevant criteria, audit, evaluate and accredit institutions of higher education, making sure that they comply with all pertinent regulations, to collect data and do research related to higher education and to ratify reports by the President and committees and issue relevant research, studies and brochures. The Commission formulates accreditation criteria to govern new fields of study. It plans to form committees to formulate such criteria based on international, especially European, regulations, which will call for help from European experts in the field.

Accreditation may be general, for a whole institution, or special, for a certain programme within the institution. General accreditation values can be classified into two groups (Isaa 2000). The first group is the bylaws, which is a collection of bylaws and regulations that the university should abide by. The second group governs the structure of the institution, study plan, requirements for graduation and university capacity. It handles: 1) academic staff; 2) the area of the university; 3) the overall availability classrooms and their sizing; 4) the library; 5) admission and registration criteria; 6) general and specific facilities. Each of these criteria will reveal a number of students that the university can register. The average of the lowest three criteria determines the maximum number of students that the university will be licensed to accommodate. However, academic staff is the most important criteria and should not be exceeded. Special accreditation for a certain programme deliberates: 1) the study plan; 2) academic staff; 3) students; 4) the library; 5) laboratories and workshops; 6) administration; 7) equipment, tools and teaching aids. Accreditation, either general or special, implies that the minimum requirements for quality are met. This also includes other factors related to university structure, teaching methods, examination and self-assessment. For example, the library is one of the accreditation criteria and is not just a place that contains books and journals; the library should be involved in improving learning and teaching. Important things that should be handled include the number of students who use the library, the number of books and journals read by students and professors and so on.

The basic criteria used in the accreditation of engineering of engineering programmes require an understanding of the interrelationships between basic and engineering sciences. These include mathematics, science, engineering, economics, social science, synthesis and design (Valenti 1996). The engineering accreditation criteria set by the Ministry of Higher Education and Scientific Research are:

- The purpose of the programme and its outputs.

- The study plan should be reviewed every 5 years and includes a minimum of 132 credit hours, one credit hour is equivalent to almost two credits in the European Credit Transfer and Accumulation System), for a bachelor degree, six credit hours for engineering training and a graduation project.
- Academic and supporting staff: a minimum of four PhD holders, of whom at least one full or associate professor and a student-to-academic staff ratio of at most 20:1. The teaching load of the academic staff is as follows: the number of part-time professors should not exceed 20% of the faculty members; the number of instructors (not PhD holders) should not exceed 20% of the faculty members; the teaching load for a full professor is nine credit hours, 12 credit hours for associate and assistant professors and 15 credit hours for instructors; part-time instructors may teach up to six credit hours; faculty members, apart from instructors, may teach extra courses when necessity arises and they are willing to do so. Academic staff should hold degrees from recognised universities that teach in English. Furthermore, they should participate in research and publish in international journals and conferences. The faculty or university should have a unit for academic staff development. For supporting staff, the following should be achieved: 1) laboratory supervisors: an adequate number of laboratories' supervisors with a bachelor degree. The working hours per week for each supervisor are 18; 2) laboratory technicians: each laboratory should have at least one technician who has a bachelor degree or intermediate diploma.
- Books, journals, dictionaries and encyclopaedias: for books the following criteria should be met: 1) for each course in the study plan, at least five different titles should be provided and at least two copies of each subject; 2) at least 50 titles of advanced books for each specialisation; 3) at least 10% of the books should be new editions (last 2 years). For journals: at least 10 journals for each department and five for each specialisation, both electronic and hard copies. An adequate number of dictionaries and encyclopaedias should be provided.
- Laboratories and workshops: for laboratories: the minimum area for each laboratory should be at least 60 m^2 and the maximum number of students in each laboratory is 20 students. A computer laboratory with at least 20 modern computers should be provided in each department. The teaching load for a laboratory supervisor should not exceed 18 working hours weekly and he/she should have at least a bachelor degree. Workshops should be at least 60 m^2 of area with a maximum number of students of 15 in each workshop.
- Supporting facilities include restaurants, cafeterias, residences for student activities and clubs, sports playgrounds, indoor sport halls, a computer centre, prayer halls and offices for international institutes such as IEEE, IIE and so on. It is assumed that supporting the campus with such facilities upgrades the social and scientific life within the campus. They are appealing and attract the students to spend more time on campus.
- Equipment, tools and teaching aids include: 1) data shows, computers and other electronic teaching aids; 2) engineering programmes and software; 3) computers for teaching staff; 4) printers, TVs, maps, educational models, etc.
- Students: student assessment methods include examinations (essays, multiple choice questions, etc.), graduation projects, student training reports and student researches and reports.

Compared to the European accreditation systems, in Jordan, programmes are first established and defined later, if accreditation is required. The institutional autonomy allows for more rapid programme/curriculum changes. In UK, the Quality Assurance Agency (QAA) is responsible for assessing the performance against a range of criteria (Levy 2000). The QAA accreditation process for engineering degrees (also applies to all UK degrees) includes the following steps: (1) application by a university engineering department to a licensed engineering institution; (2) appraisal by a committee of academics and industrialists; (3) visit to the university; (4) joint accreditation by two or more institutions is possible. The teaching assessment procedure involves the following six

features of provision: (1) curriculum: design, content and organisation; (2) teaching, learning and assessment; (3) student progression and achievement; (4) student support and guidance; (5) learning resources; (6) quality assurance and enhancement. The separate research assessment exercise of QAA is a quite complex operation in which each department's publications and facilities are evaluated and scored (Levy 2000). The Engineering Council, which is a non-governmental organisation, acts as an 'umbrella' body for UK engineering education. Its central role is to set standards of engineering education and training. In Germany, programmes must be justified and defined before government approval is given (Bartels *et al*. 2002). Despite the autonomy of every single higher education institution in Germany, the governmental authorities take a significant influence on ensuring the quality of education and training and the general function of universities and other institutions (Heitmann 2000). This takes place by means such as: (1) legislation, framework regulation and directives; (2) funding and budgeting; (3) approval of study programmes and examination regulations; (4) appointment of professors based on proposal of the institutions. The Accreditation Council, which was established in 2004, certifies accreditation agencies and establishes guidelines and criteria for programme accreditation. There are currently seven certified agencies where ASIIN is the only German accreditation agency specialised in accrediting degree programmes from the fields of engineering, computer science, the natural sciences and mathematics.

3. Quality assurance and improvement activities at the faculty of engineering at JUST

JUST was established in 1986 and is located near Ramtha City, 70 km north of Amman, the capital of Jordan, and 20 km east of Irbid, the second largest city in Jordan. The main campus, which extends over 11 km^2, features the main buildings of a total area of 355,000 m^2 and was constructed according to modern architectural designs (JUST 2009). Today, JUST is recognised locally and regionally as one of the best institutions of engineering education in the area. JUST has 11 faculties in addition to the faculty of graduate studies and the deanship of research. The university provides 52 bachelor and 95 postgraduate programmes with more than 20,000 undergraduate students and 1600 graduate students. Each year the university grants over 3000 Bachelor and Master's degrees. JUST hosts more than 770 faculty members, of whom 137 are full professors.

The faculty of engineering is the oldest and largest faculty at the university. Currently, it has nine engineering departments with more than 4400 students and 163 faculty members. The faculty offers 12 undergraduate and 13 graduate programmes. The majority of faculty members have obtained their PhD degrees from American and European universities. The mission of the faculty is to:

> Provide students with a broad stimulating and rigorous engineering education, professional skills, basic and applied research, and knowledge that will enable them to succeed in future careers, adapt to the working environment, deal with the challenges of the local, regional, and global marketplace, and support the comprehensive sustainable national development plans.

The faculty adopted various measures for quality assurance and improvement of its engineering programmes. These initiatives are detailed below.

3.1. *The strategic plan and ABET accreditation*

The vision of the faculty is: 'Towards a leading college in quality engineering education and applied research'. The strategic plan for the next 5 years aims at assuring quality and sustainability in engineering education. One of the main emphases of the strategic plan is to achieve the ABET accreditation. As a result, three undergraduate engineering programmes are accredited by the

Engineering Accreditation Commission of ABET of the USA. These programmes are chemical engineering, biomedical engineering and industrial engineering. The programmes applied for accreditation in 2008 and received the accreditation in 2009. The remaining programmes will apply for accreditation once they complete the ABET requirements. The accreditation is an endorsement by an external professional body about the quality and standards of JUST engineering graduates as well as the process of quality assurance of JUST engineering education programmes.

Accreditation is intended to help improve good quality teaching and learning and this can be achieved only if the assessment process is continued with diligence and devotion (Zahed *et al*. 2007). Hence, the accredited programmes should apply for the next rounds of evaluation. ABET EC-2000 accreditation criteria include students, programme educational objectives, programme educational outcomes, continuous improvement, curriculum, faculty, facility, support and programme criteria. ABET accreditation has a great impact on the learning and teaching of the accredited engineering programmes at JUST. The engineering faculty at JUST has appointed a vice dean for the task of quality engineering education and accreditation. ABET committees have also been formed for this purpose at the levels of the college and the departments. The review process of the educational objectives and outcomes of each department included the Industrial Advisory Boards (representatives of local industries), Jordan Engineers Association and employers from the government and private sectors. Such involvement had a clear impact on the study plans of each department to meet the local and global market needs. Moreover, the college revised its vision, mission and objectives to meet the accreditation requirements.

The faculty organised alumni days to provide feedback on what skills the graduates should possess. To this end, specially designed questionnaires have been delivered to different companies that hire graduates or provide training to engineering students to assess the skills acquired by students and ensure that training is delivering its objectives. To enhance students' involvements at all stages, evaluation forms are designed for each course and students are asked to evaluate the outcomes of the courses and extra-curricular activities. Moreover, senior students evaluated their educational experience in their departments through specially designed questionnaires. The results of the questionnaires were analysed to provide better insights, explanations and recommendations.

3.2. *Development of curricula*

It is important to consider quality at the course level, programme level and institutional level. Curricula development provides the foundation for quality assurance among the three levels. The curricula development at JUST is a long process that is planned thoroughly at the department, faculty and university levels before its final approval and implementation. For engineering programmes, curricula have been revised several times, taking into consideration local requirements, international trends and professional needs. Currently, all the engineering programmes of the faculty consist of 160 credit hours for a Bachelor degree (BS) and 34 credit hours for a Master's degree. For BSc, the curriculum includes an 8-week internship (six credit hours) in an industrial organisation after the student completes a total of 117 credit hours successfully. Training is a compulsory part of the curricula and is prescribed as engineering practice or training course (XX 490 or XXX 490) in the curricula. The structure of the latest curricula is reconsidered to fit the accreditation requirements in order to meet domestic and global market needs.

3.3. *Supporting facilities and services and technological development*

A quality educational programme can best function in an environment that is conducive to learning and provides a safe and comfortable place for students and staff. Supporting facilities and technological developments are important for quality engineering programmes. Supporting

Table 1. Research and academic engineering laboratories (labs)

Department	Research labs	Academic labs
Chemical	7	6
Civil	1	8
Electrical	2	11
Mechanical	0	8
Biosystems	0	7
Biomedical	0	3
Industrial	0	5
Deanship	0	1
Total	10	49

facilities at the faculty of engineering include research and academic laboratories (see Table 1), computing services, administrative support and library facilities (a new library facility is currently being built). Supporting services include the IEEE and IIE branches. Student email and e-learning are available where workshops, seminars and online courses are conducted and encouraged. Technological developments include wireless network across campus and new laboratory equipment. However, more supporting facilities and services are needed because the number of enrolled students is increasing and new programmes are being offered. Furthermore, due to the rapid development of information and technology, more technological developments are also needed.

3.4. *Staff training and development*

The academic development centre at JUST provides the faculty staff with the required training through workshops, mini-courses, seminars and consulting. In addition, the centre conducts surveys and evaluation studies to help stakeholders adapt to new policies concerning staff development. The centre enhances education quality by focusing on staff development by offering a set of activities related to course planning and syllabus design, contemporary teaching methods and strategies, test construction, grading systems and research. This is achieved through the following:

- Workshops, seminars and training courses.
- Students' evaluation of staff.
- Teaching consultations.
- Class videotaping and consulting.
- Other services offered, such as a resource room, teleconference hall, etc.

3.5. *Community service*

The faculty of engineering offers many local and regional services through the Consultative Centre for Science and Technology. The centre has been functioning in the faculty since 1996 in order to serve the local community and strengthen faculty and community cooperation. The centre provides extra income to faculty members and employees and helps to develop local and regional participants by providing the ground for linking with industry, technological investment, workshops, consultations and studies, laboratory tests and technical services, industrial and research project evaluations, collaboration with industry projects, patent evaluation and lectures and seminars. Table 2 shows the services offered during the years of 2001–2007. Among the services offered is 'the faculty for factory', which is discussed below.

Table 2. Services offered by the Consultative Centre for Science and Technology (2001–2007)

Year	Collaboration with industry	Project evaluation	Laboratory tests	Consultations and studies	Patent evaluation
2001	21	7	66	21	–
2002	15	10	82	15	3
2003	11	6	81	11	3
2004	11	4	182	11	5
2005	13	–	89	13	8
2006	–	2	12	16	–
2007	1	–	–	18	–
Total	72	29	512	105	19

3.6. *Faculty for factory national programme*

This programme is intended to enhance university–business cooperation. The programme enhances the partnership between the industrial and the educational sectors. It helps the university to produce graduates better suited to employers' needs and to provide lifelong learning opportunities. Through this programme, faculty members apply their expertise to a specific factory need and propose solutions, as well as introduce the factory to useful local sources of ongoing technical expertise or services. The faculty may invite selected students to work on the project and share their practical experience as case studies with students in their classrooms to stimulate interest in the real world of business. This will provide opportunities to students and teachers to work on real-life local industry problems, thus enhancing their professional experience as well as developing a high degree of motivation and quality consciousness.

3.7. *Alumni relations*

The university strictly believes that one true measure of quality is found in the success of JUST graduates. As a result, the university aims to enhance its relationship with its graduate students and keep contacts with them by:

- keeping up to date contacts of graduates;
- providing information about important events at the university;
- alumni surveys prepared by the quality assurance office;
- JUST Career Fair, which is conducted every year at the university campus to help students find jobs.

Building and improving alumni relations is one of the objectives of the faculty of engineering. The faculty organises alumni days as an attempt to provide feedback on market needs and on what skills graduates should possess. Furthermore, specially designed questionnaires have been delivered to different companies that hire graduates or provide training to the faculty students to assess the skills acquired by students and ensure that training is delivering its objectives.

3.8. *Quality assurance office*

In 2008, JUST established a quality assurance office to track the accreditation requirements for the university to comply with HEAC. The quality assurance office functions based on several parallel dimensions that cover areas in:

- students;
- student learning and an effective teaching process;

- faculty members;
- university status and educational output;
- external feedback.

These areas cover the inputs, processes and the output of the JUST educational system. The mission of the quality assurance office is to ensure the highest quality assurance practices in education, research and administration. Functions of the office lie in the following three domains:

1. Accreditation domain: the office develops and updates policy manuals of accreditation for national body and institutional use, conducts training programmes about national commission, self-evaluation and external reviews, cooperates with regional and international quality assurance bodies and evaluates and reviews the accreditation process.
2. Quality assurance domain: the office formed a quality advisory board for the university and college planning, developed a quality assurance hand book, reviews programme monitoring and participation in training programmes, provides coordination and liaison services and conducts system-wide meetings related to quality in Jordanian education.
3. Research and assessment domain: the office collects and analyses data concerning students to better understand their attitudes, beliefs and behaviours. This information is primarily used to inform programmes and policy makers in the university.

The office also prepares the following surveys and forms:

- Staff self-assessment forms.
- Surveys for the companies that hire graduates to measure the company's satisfaction with graduate students.
- Student surveys.
- Alumni surveys.

4. Assessment of the current situation

The section presents survey results aimed at assessing efforts made to enhance quality at the faculty of engineering at JUST. To this end, random samples of engineering students and professors (about 60 students and 15 professors) are asked questions related to the current situation of engineering education and the different measures of quality improvement and assurance at the faculty of engineering. The students' survey focused on: 1) overall satisfaction; 2) course quality; 3) library services; 4) study plans; 5) academic staff; 6) supporting facilities and services; 7) classroom space and class sizes; 8) laboratories and equipment; 9) personal development; 10) rapport between staff and students; 11) academic advising; 12) campus climate. Survey questions about other areas, including the academic year, gender and specialisation, are also included. The professors' survey focused on: 1) overall satisfaction; 2) study plans; 3) students; 4) campus climate; 5) supporting facilities and services; 6) library services; 7) staff training and development; 8) course quality; 9) research; 10) organisation and management; 11) work load; 12) classroom space and class sizes. Other areas are also included, such as academic position, specialisation, as well as open-ended questions. Figures 2 and 3 illustrate the results of the students' survey and that of the instructors' survey, respectively.

Results obtained from both surveys illustrate the general satisfaction of the overall education process and the services provided at JUST. To stay competitive and leading in offering engineering education, JUST should provide more facilities, equipment and trained coordinators to cope with the increase in the number of its students. Moreover, JUST should work on reducing the number

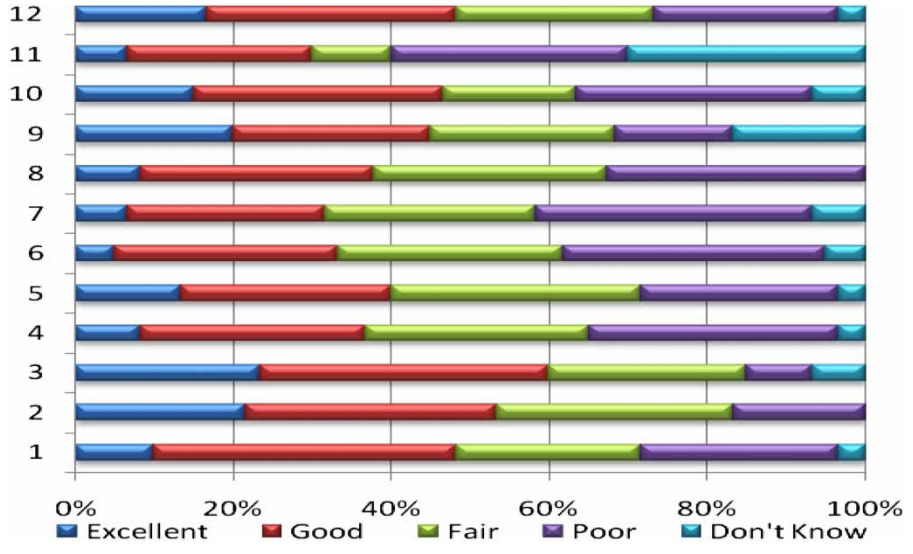

Figure 2. Student's questionnaire results.

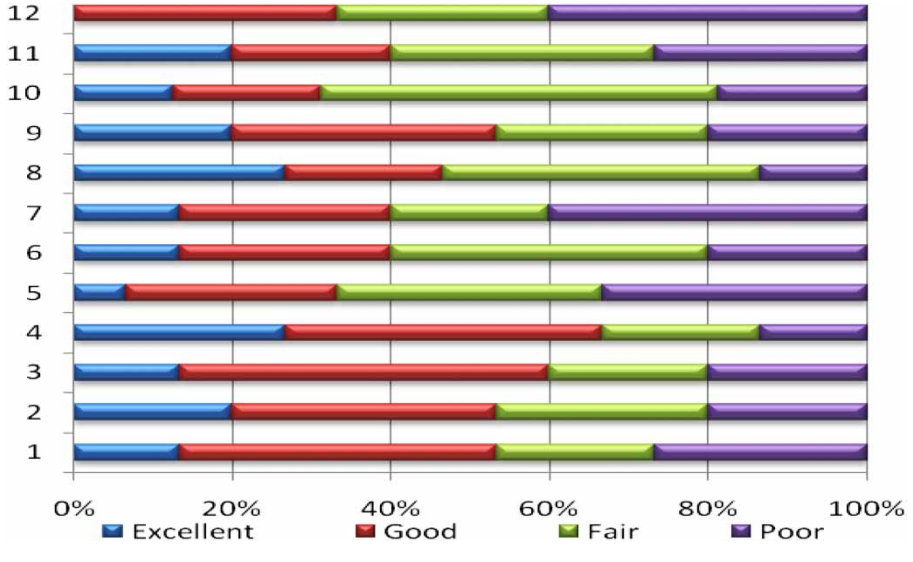

Figure 3. Instructors' questionnaire results.

of students per class to enhance quality. Currently, two classroom buildings are under construction at JUST to cope with the large increase in the number of students at the various departments.

5. Conclusions and recommendations

This paper investigates accreditation and quality assurance of engineering education in Jordan. Accreditation, currently curried out by HEAC, aims to enhance and guarantee quality in higher

education based on internationally recognised criteria. It facilitates interaction between the educational systems and society and enhances universities' responses to society's needs. Moreover, it promotes a 'culture of quality' and continuous improvement. Accreditation, either local or international, has a great influence towards achieving the quality assurance goals of the institution. Engineering education in Jordan is expected to include more inputs from practice, an emphasis on technology management, the promotion of continuous learning, and enhanced collaboration among universities, industry and government. Therefore, Jordan increased efforts to establish quality assurance in higher education and to promote effective quality management at both institutional and departmental levels.

Results of accreditation efforts had a large impact on the quality of education in the Jordan private and public educational institutions. To illustrate, the paper presents quality assurance policies implemented by JUST. Feedbacks from the ABET accreditation committees illustrate the high quality of education at JUST. To stay competitive and ahead in offering engineering education, JUST and other Jordan academic institutions have to continually improve the quality of their educational systems. Efforts should focus on the continuous improvement of the teaching–learning process, cooperation with industry, research, feedback and assessment, curricula content and accreditation. Moreover, engineering programmes should work hard to get international accreditation. Furthermore, accreditation enhanced the overall satisfaction of the students of the accredited programmes and the overall faculty reputation.

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About the authors

Faisal Aqlan is a graduate student at the Industrial Engineering Department at JUST. He received his BSc in Industrial Engineering from JUST in July 2007. Currently, he is pursuing his MSc in Industrial Engineering at JUST. He is expected to graduate in July 2010.

Omar Al-Araidah is an Assistant Professor in the Industrial Engineering Department at JUST. He received his PhD in Decision Sciences and Engineering Systems from Rensselaer Polytechnic Institute, USA, in May 2005. His teaching and research emphasises links between the multidisciplinary areas of industrial engineering.

Tarek Al-Hawari is an Assistant Professor in the Industrial Engineering Department at JUST. He received his PhD in Industrial Engineering from Lehigh University, USA, in May 2005. His research interests are in the areas of queuing theory, industrial simulation and multi-criteria decision making.