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A Sound Quality Assurance System for Achieving ABET Accreditation: Application to Qassim University Engineering Programs

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Abstract. Quality assurance for educational process is necessary to achieve continuous improvement. The present paper explains a quality assurance system (QAS) established in Qassim University (QU), and illustrates its implementation in the programs of College of Engineering. Quality assurance in education should consider the stakeholders' and accreditation organizations' requirements, and study all aspects and activities of that process. Therefore, to set up this system, the followings had to be realized; availability of clear and accurate internal and external information, setting clear mission, objectives and learning outcomes for academic program in consistence with the institutional missions, ensuring that all conditions are prepared for realizing academic programs objectives and outcomes, and continually maintaining them, ensuring commitment of all faculty members and students to the outcomes evaluation process. Implementation of the system has improved Qassim Engineering programs through considerable modifications and changes in the Programs' educational objectives, educational plans, curricula, human resources, facilities, education policies and student activities. As a result of the effectiveness of the quality assurance system all the programs of Qassim Engineering College have been accredited by ABET organization. The suggested system can be adopted by any engineering program and programs in other universities as it is comprehensive and flexible. The application of this quality assurance system will greatly facilitate academic accreditation of these programs.

Keywords: Academic Accreditation, Quality Assurance, ABET Accreditation

1. Introduction

Need of a rigorous quality assurance system (QAS) [1-3] has arisen for educational process to guarantee the quality of education, and to facilitate accrediting the educational programs by national and international organizations. Many Engineering, technology and computer sciences programs seeks academic accreditation by the most famous world organization ABET [4]. Authors have published their experiences during ABET accreditation procedure [5-9]. Shuman et al. [5] explained how to acquaint the students and assess the professional skills assigned by ABET. Quipmo [6] illustrated the procedure of curing the weaknesses observed in the curriculum of Water Resources Program of Civil Engineering at the University of Pittsburgh. Seber et al. [7] highlighted the disparities when initially prepare for the ABET review of soft-ware engineering and other engineering fields. Alyheya, et. al. [8] published a paper presenting the experience of QEC which gained during its first accreditation process. The education process was governed through a continuous improvement process. Ikbal, et .al. [9] presented procedures of preparing and qualifying an engineering program for ABET accreditation, and applied this to Civil Program in King Saud University. A comprehensive and rigorous QAS is required to be implemented in the educational programs to guarantee the quality, thus leads to getting academic accreditation.

Quality assurance is defined as a group of activities that must be performed in order to identify potential sources of problems and shortcomings in the educational process and dealing with them beforehand to avoid occurrence of problems and drawbacks in the educational process, and to achieve continuous improvement [1-3]. This technique contrasts with that of monitoring the educational process, checking the educational process outcomes in order to determine its shortcomings after the fact.

A quality assurance system for the academic programs at Qassim University (QU) has been established by a team headed by the Quality Assurance and Academic Accreditation Deanship [10]. The system has been constructed guided by National Commission for Academic Accreditation and Evaluation in Saudi Arabia (NCAAA) [11]. This system is based on observing and checking the programs learning outcomes, and keeps enhancing the process of learning through a continuous improving process.

In this paper, the system will be explained, and its implementation in the programs of the College of Engineering will be demonstrated with focusing on the Electrical Engineering Program as an example.

2. Quality Assurance System

Quality assurance of educational process requires studying all aspects and activities of that process. Therefore, to set up the QAS for academic programs at QU, the followings had to be realized [1-3, 12]:

i. Availability of clear and accurate information for internal and external stakeholders.
ii. Setting clear and accurate objectives and learning outcomes for the academic program offered which must be consistent with the program mission, which in turn must be consistent with the college and university missions.
iii. Ensuring compatibility of the academic program outcomes with
    a) Labour market demands,
    b) Community needs, and
    c) Requirements of National Commission of Academic Accreditation and Assessment (NCAAA) and/or other international accreditation agencies.
iv. Ensuring that all conditions are prepared for effectively realizing the academic programs objectives and continually maintaining them.
v. Upgrading professional services quality provided by the college to the community.
vi. Commitment of all faculty members to the outcome evaluation process and their active participation in all activities.
vii. Participation of the students in evaluation of the courses and program outcomes [13].

The developed system consists mainly of a main cycle, namely; Planning and Review cycle.

2.1 Planning and Review Cycle

Quality assurance process must be applied on course and program levels by academic departments and colleges. It must integrate in a continuous rotation of planning, observing, assessment, and revision (Fig. 1). While the observation must be incessant, there are usually two time periods for specific assessments to be carried out. The first is based on one-semester/academic year period where performance is evaluated, and appropriate adjustments are performed. The second, which is performed over a longer time period, includes major revisions. For activities and practices relating to quality assurance and academic accreditation, it is recommended to plan the periodic evaluations such that they comply with the periodical time of the revision carried out for accreditation or re-accreditation conducted by different accreditation organizations. This period is Five years in case of NCAAA [11] and six years in case of ABET [4].

The planning and review cycle consists usually of a set of linearly-consequent steps having set of timelines. Nevertheless, it is possible to flexibly repeat or exchange steps to comply with feedback and/or environmental variations.

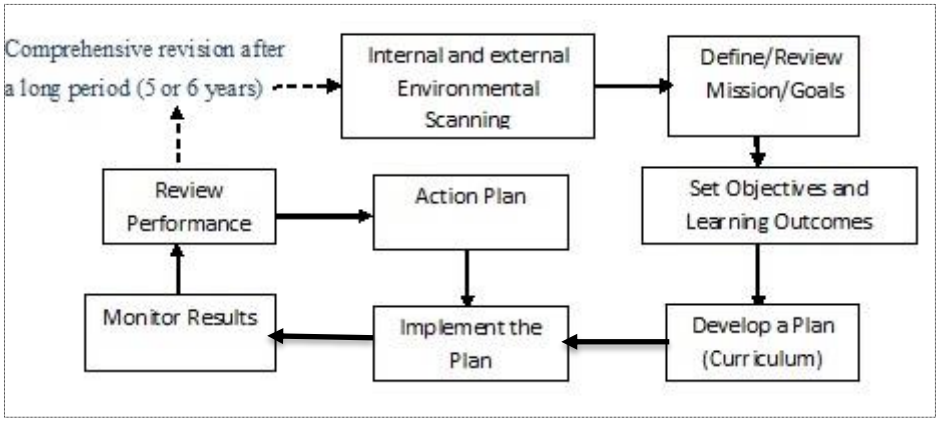

Fig. (1). Planning and Review Cycle

2.1.1 Planning

The internal and external situation primary study ought to include a comprehensive assessment of present performance quality, and an analysis of existing promising points, constraints, obstacles, threats and opportunities. SWOT (Strengths, Weaknesses, Opportunities and Threats) technique for analysis [14] is a suitable planning tool at this stage. The following hints and definitions may be applied to short term plans as well as long term plans:

i- **Implementation:** Notes on implementation should be steadily reported in order to ensure that planning steps are carried out according to schedule and to mark any disparities.

ii- **Monitoring Results:** Results must be monitored continuously when implementing plans, and adjustments are to be made in strategies when necessary, and when circumstances change or desired results are not attained.

iii- **Performance Evaluation:** Performance assessment is a major task in which the plan must be reviewed together with the events during the implementation period, and the progress made recorded. Adjustments to strategies and revision of goals should be made as needed.

iv- **Action Plan:** Based on performance evaluation, an action plan must be prepared for any necessary changes in the preliminary plans for the next period. The term "action" entails concentration on making specific recommendations and procedures for implementation which must be monitored and revised.

2.1.2 Periodical Revisions

It is important to go back periodically and make a comprehensive and thorough revision of appropriateness and effectiveness of the program processes. The periodical revision must be detailed and inclusive, and should include a reconsideration of the context of program operation and any anticipated alternations or improvements of the program processes. These revisions, along with any changes in university policies, may lead in turn to changes in medium term objectives or even in the college mission in extreme cases.

Reports must be prepared for all the above steps so that successful documentation of the processes is achieved. The reports must include all events, evaluations of the strengths and weaknesses which must be considered for future planning and changes done on the original plan. The basic aim of periodic revisions is to strengthen self-motivated effort of the program for improvement. Also, such reports are used as references when external revisions are performed.

2.1.3 Arrangements Required for Program Quality Planning and Revision

Various specifications and reports must be prepared providing details about the following elements for quality planning and revision applied to the academic programs:

- Detailed program specifications explaining the mission, vision, goals and objectives, the plans for development of the program, the plan courses, the main intended learning outcomes, the teaching techniques followed, methods of measuring and assessment of the learning outcomes [10, 11]. These program specifications are reviewed steadily, and may be adjusted due to stakeholder's feedback, the cumulative experience or changing conditions.
- Detailed course specifications are set-up for each course, thus the instructors going to give the course will be aware of what is to be taught, how the course contributes to the program, and how its outcomes will be measured and evaluated [10, 11]. Course specification are liable to modifications as experiences are gained. When programs have field practice courses, specifications of them should be established including planning, organizational management and tools for assessment.
- At the end of course delivery, informative report should be given by the instructors describing the status and conditions of the course, summarizing students' results, and suggesting improvement actions when needed. The reports are to be submitted to the program director.
- Based on the course reports, the program director, with the help of Program Quality Assurance Committee (PQAC), arranges for a comprehensive program report including

crucial information about state of the program in the regarded year and recording any needed modifications in the specifications.

- All the proposed adjustments of the program or its courses ought to be performed after their approval by the PQAC.

3. Implementing the Quality Assurance System in the Engineering Programs

In 2021, Qassim Engineering College (QEC) aimed to be re-accredited by the famous accreditation organization in USA; ABET [4]. To meet ABET criteria [15]; College of Engineering at QU adopted and adapted the University's quality assurance system for its educational processes in its civil, electrical and mechanical programs. Different committees, for each program, have been established to serve the quality assurance system.

i. Quality Assurance Committee: It is formed of qualified faculty members. The main task of this committee is to apply and monitor the quality assurance system in the Program.

ii. Assessment and Statistics Committee: It is formed of qualified faculty members. Its main task is to assess the comebacks of the constituencies' surveys.

iii. Subject Committees: Each is formed of some of staff members, and deals with a set of courses which serves a common area. The tasks of each subject committee are coordinated by a senior member. The tasks are to evaluate the results of assessment and analysis committee, and recommend suitable improvement actions if it is necessary.

iv. Professional Advisory Board: It is established of experienced engineers in addition to few senior staff members. Its task is to help in setting and revising the program objectives and outcomes. Also, the board evaluates the alumnae adequacy for the work market. It may suggest improvement actions.

v. Student Advisory Committee: It is formed of students at different study levels. Its job is to evaluate the educational process, the adequacy of the curriculum, the suitability of the learning resources, and to suggest improvements.

3.1 College and Department Missions

The College and Departments missions are those established in 2008, and have been kept reviewed since this time. These were finalized in coordination with the Program's constituencies, to be [16]:

Mission Statement of the College: "College of Engineering at Qassim University seeks to offer a developed and accredited engineering education to satisfy the needs of the job market, and to offer

society and research services which support the sustainable development in the Kingdom and contribute to the knowledge economy".

Mission Statement of the Department of Electrical Engineering as an example: "The electrical engineering department seeks to meet the needs of the Saudi society and the region with outstanding electrical engineering programs in education, research, and community service".

3.2 Program Educational Objectives

Program Educational Objectives are the features of the program graduates, which they can efficiently show in a short period (about four years after graduation). As an example, for EE Program four educational objectives were established in 2009 [17] and are kept reviewed since this time. The objectives were revised in 2012, 2016 and 2020 with the participation of the constituencies of the EE Program. Now, these are finalized as follows [18]:

1- Preparation of the graduates to have a successful career as Electrical Engineers in the governmental and private sectors.
2- Preparation of the graduates to pursue their professional development through self-learning and advanced degrees.
3- Preparation of the graduates to advance to positions of leadership in their profession.
4- Preparation of the graduates to effectively participate in the sustainable development of the Saudi Society.

3.3 Student Outcomes

Students' outcomes illustrate students' information, skills, abilities, and values when ending the program. EE Department Council has adopted the "a" to "k" ABET recommended outcomes for the engineering programs since 2009 till 2020. There after they have changed by the ABET to "1" to "7" [19-23]. These Program outcomes are available on the College site [18].

3.4 The Continuous Improvement Process

The Quality Assurance Committees adopted the quality assurance system established by QU which adopts the continuous improvement process explained in Fig. 2 [16]. The process exhibits two loops usually named as the "slow loop" for objectives, and is performed over a relatively long period, and the "fast loop" for outcomes, and performed over a rather short period. Many outcomes loops will be performed during the performing of one objectives loop.

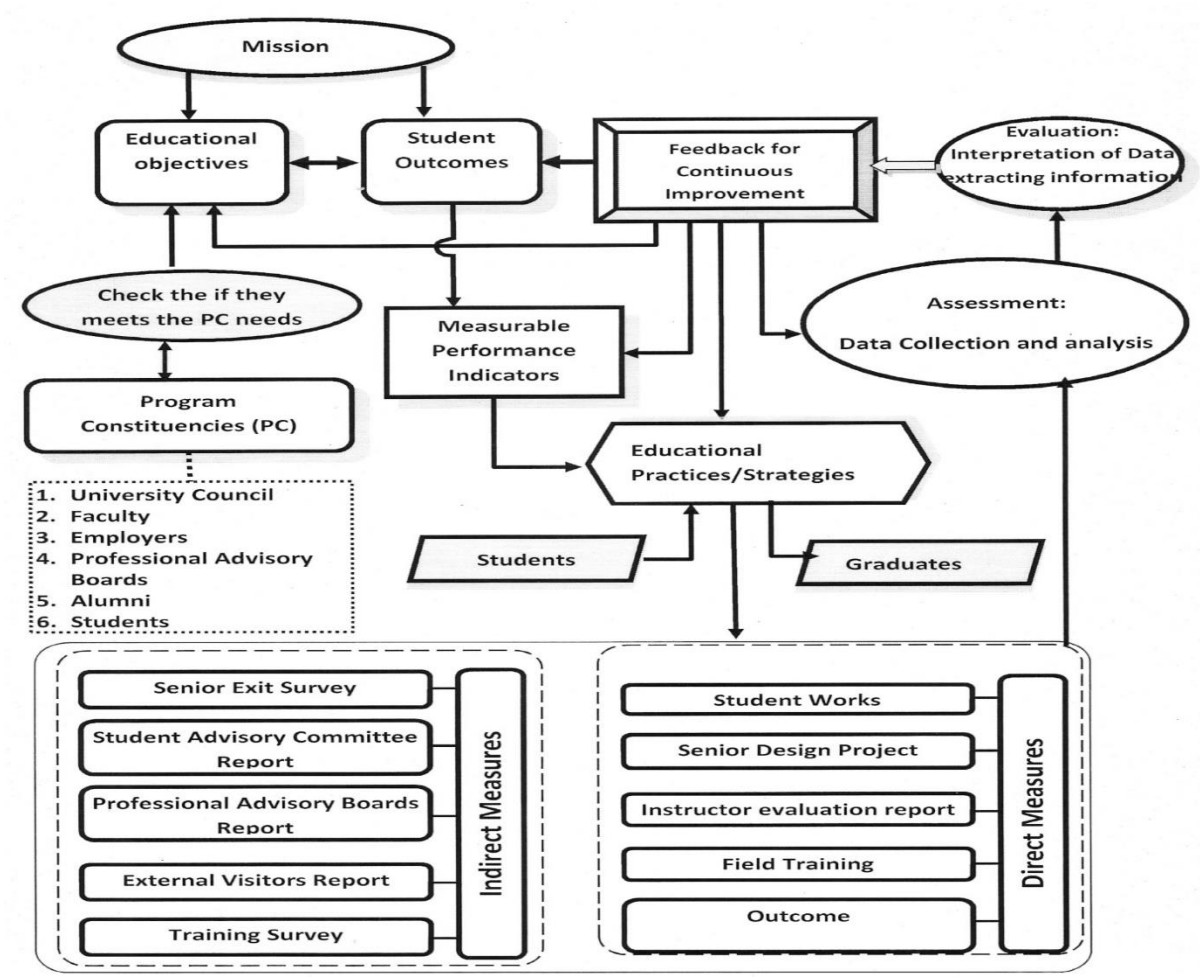

Fig. (2). Flow chart of the continuous improvement process

The fast loop of the process concerns with frequent revision of the courses and program student outcomes annually using direct and indirect tools [8, 16]. Data are collected every semester/year, and assessed during the outcomes round by the Assessment Committee. The resulting data are then submitted to the Subject Committees for evaluation. Consequently, actions are suggested for enhancement. Thereafter, the Quality Committee finalizes suggestions and submit them to the Department Council for approval. Coordinators of the Subject Committees arranges for applying the recommended courses' changes in cooperation with the lecturers. The extent of attaining the learning outcomes of the program is determined periodically. Accordingly suitable decisions will be proposed and executed to keep sustained improvement. This procedure involves [8, 16]:

i. Setting performance indicators,

ii. Gathering data and assessing the program student outcomes,

iii. Evaluating and suggesting improvement actions,

iv. Executing the improvement actions, and

v. Estimating influence of these actions.

The objectives cycle measures, assesses, evaluates and acts on the suitability of the objectives, and the fact of whether these objections meet the stakeholders' needs or not. The objectives are measured after graduation of the students by a reasonable time [4]. Measuring, assessing and evaluating the program objectives rely on indirect measures. The evaluation may end with proposing some actions to improve or modify the program objectives. It should be noted that it is not recommended to frequently alter or modify the program objectives. A relatively long time should be allowed since their establishment, to permit a sufficient time over which their validity could be checked. Nevertheless, updating may be made when the Program Committee thinks that it is necessary.

3.4.1 Assessment of Program Objectives

Assessing the program objectives rely on indirect measures such as, alumnae and employers surveys, reports submitted by the Professional Advisory Board (PAB).

3.4.2 Assessment of Achievement of Student Outcomes

The program outcomes are assessed utilizing for each outcome one method at least from each of the following direct and indirect measures [8, 16]:

i. Direct methods

a. Results of students' works (exams, assignments, quizzes, reports … etc.),
b. Outputs of the Senior Design Project (SDP),
c. Outputs of the field experience, and
d. Results of Outcomes Achievement Examination.

ii. Indirect methods

a. Surveys: students' surveys, senior students surveys, and trained students' surveys,
b. Reports submitted by the Professional Advisory Board,
c. Reports submitted by External Reviewer, and
d. Reports submitted by the Student Advisory Committee,

Assessment of the results is done using the conventional statistic techniques with the aid of rubric analysis [24].

3.4.3 Evaluation of Educational Environment

To evaluate the quality of facilities, resources and education policies, student surveys, instructor reports and surveys, Student Advisory Committee reports and external visitors' reports are

used. Feedback from the previous tools and other available data are used to determine Key Performance Indicators (KPI's) that assess the performance [11, 25]. A list of these indicators is given in Appendix A.

4. Results of the Evaluation Process

4.1Evaluation of the Objectives

The replies to employers' and alumnae surveys conducted in the academic year 2020-202 confirmed that they are satisfied with these objectives, and that the objectives are suitable for EE Program.

Professional Advisory Board reports state that the objectives meet the members' needs and that these objectives represent well the aims of the EE Program.

4.2 Evaluation of the Outcomes

Degree of attaining each outcome of the EE Program has been evaluated applying the following criteria on results of the different direct and indirect measures:

1. For group of selected senior courses, SDP, Cooperation Training and Outcomes Achievement Exam, the students' marks related to the investigated outcome should have an average of 66% at least, and the number of passed students should be 66% at least
2. The senior students' survey positive replies for each outcome should have at least an average of 3.7 out of 5.

The evaluation has been performed for several batches. Of these is the batch graduated in the second semester of the academic year 2011-2012 is presented as an example. The evaluation covered two tracks, namely; Electrical Power Engineering (EPE) and Electronics and Communications Engineering (ECE). The assessment results are depicted in Figs. 3-8 for EPE track. Detailed results for both tracks are documented in the Self-Study Report of the EE Program [16].

Based on the information gained from the analyses of the direct assessment, it can be stated that for EPE track batch graduated in the second semester of the academic year 2011-2012:

i- The results of the group of senior courses (Fig. 3), the SDP (Fig 4), the Co-operative Training (Fig. 5) indicate that all highly related outcomes have been achieved as they realized the 1st criteria above.

ii- The analyses of the results of Outcomes Achievement Exam (Fig. 6) indicate that for EPE track many outcomes (a, b, c, e f, h and k) have not been realized.

iii- Overall evaluation which is based on averaging the evaluation of the four tools

shows that the outcomes have been achieved to a good extent (Fig. 7).

The senior exit surveys and reports by instructors and Student Advisory Boards indirectly evaluates the outcomes as follows:

i. Based on the results of Senior Exit Surveys (Fig. 8) it can be stated that the mean rating of senior exit surveys' responses for each outcome confirm, with reference to the 2nd criteria, satisfaction of the students with the acquired knowledge and skills the program gave to them.

ii. Rather negative feedback on the program outcomes have been reported by the instructors and the presentation panels of SDPs as regarding the design skills (outcomes c and d) and the project execution facilities.

iii. Somewhat negative comebacks have been reported by EE Students Advisory Committee. They suggested introducing design practices into specific courses, and giving higher weight to the interaction and communication skills.

In general, the program student outcomes have been rather achieved. Actions have to be done to enhance some of the student outcomes. The feedback of SDP supervisors, instructors' reports and Student Advisory Committee closely resemble the comebacks of the Outcomes Achievement Exam.

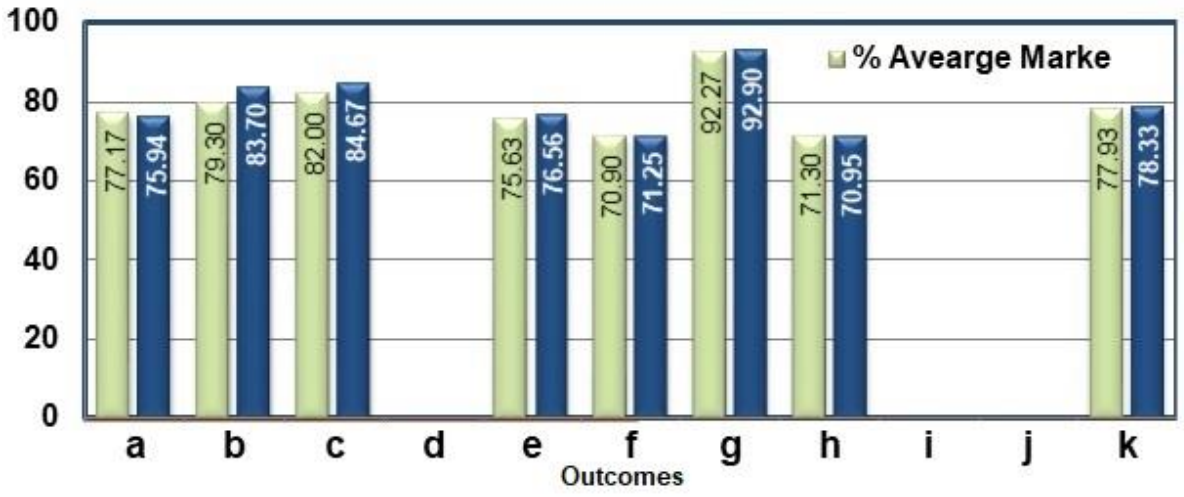

Fig. (3). Senior level courses based direct assessment of the EPE outcomes, first cycle

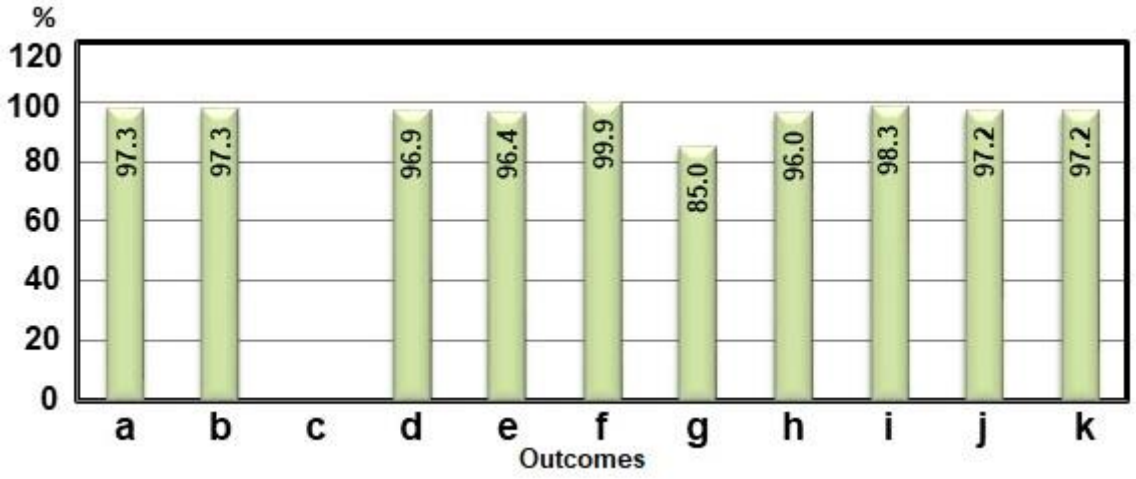

Fig. (4). Co-operative Training based direct assessment of the EPE outcomes, first cycle

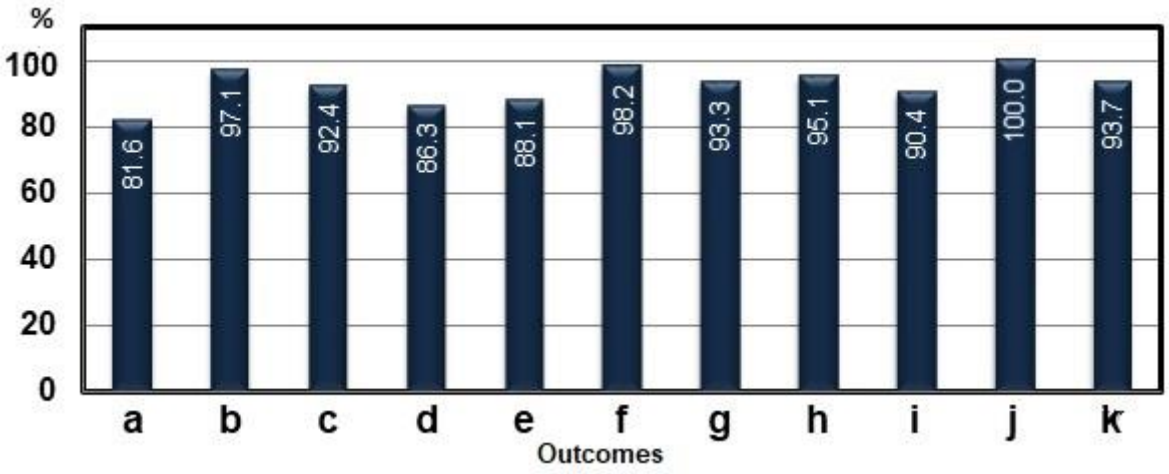

Fig. (5). SDP based direct assessment of EPE outcomes, first cycle

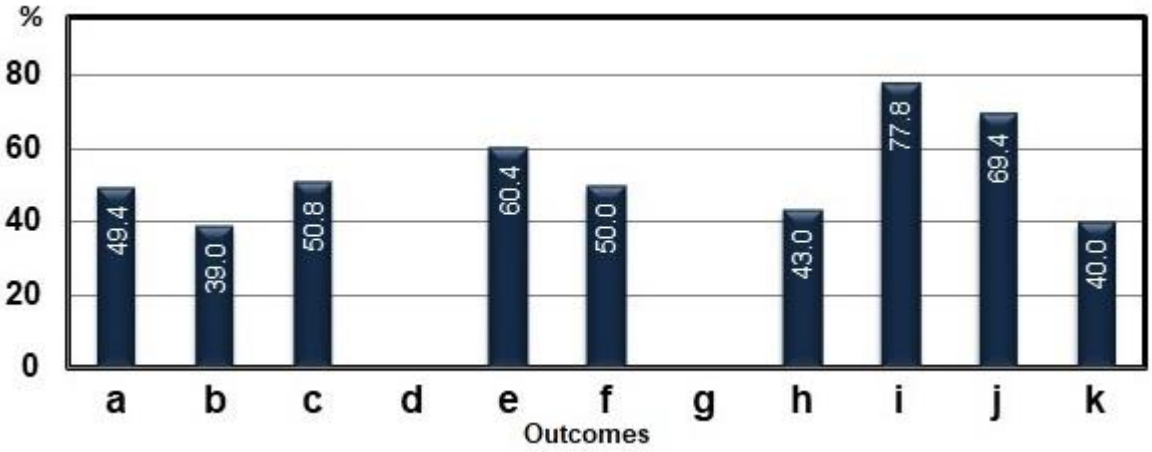

Fig. (6). Outcomes Achievement Exam based direct assessment of the EPE outcomes, first cycle

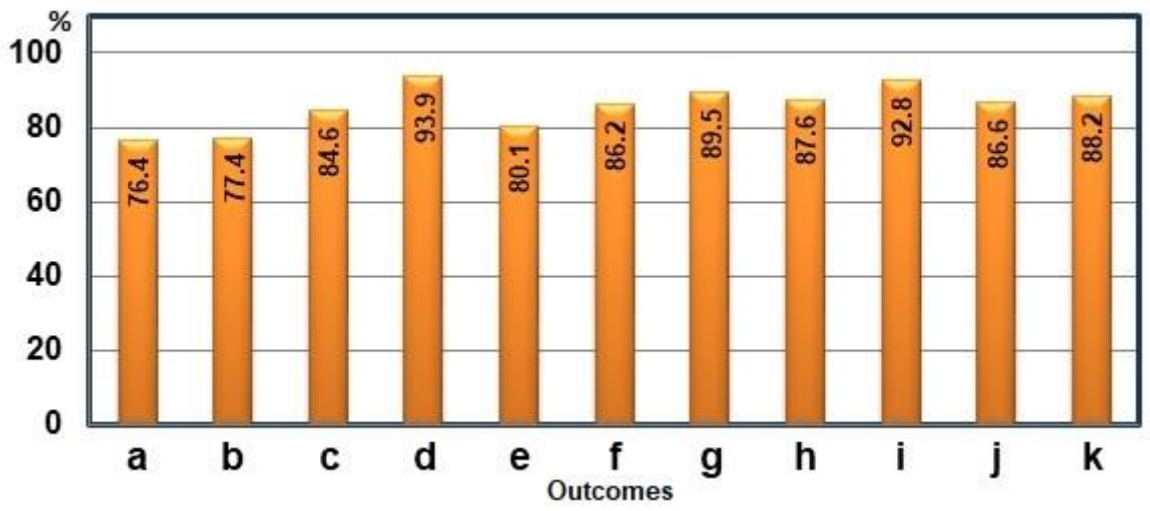

Fig. (7). Overall direct assessment of EPE outcomes, first cycle

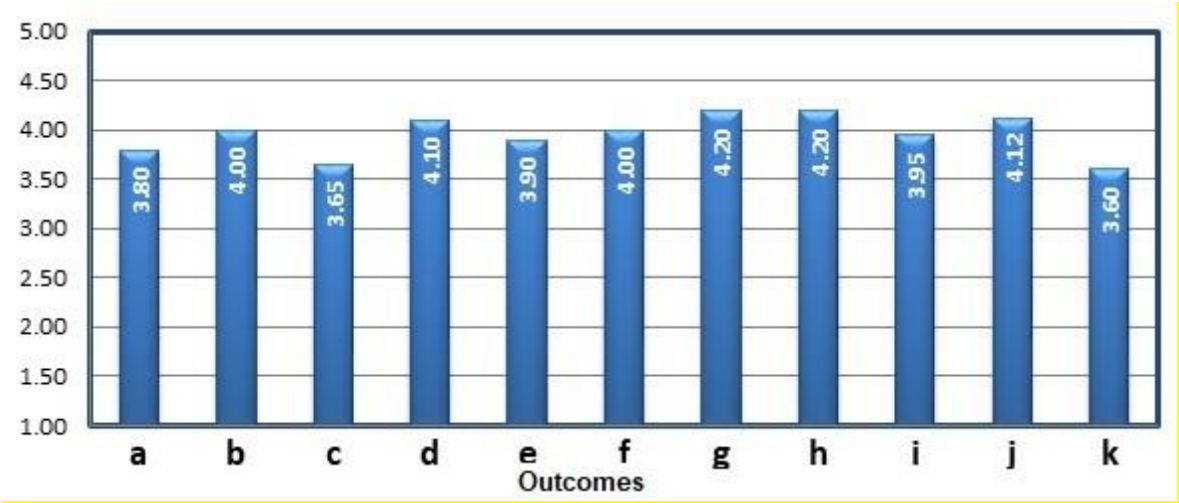

Fig. (8). Senior Exit Students' Survey based assessment of EPE outcomes, first cycle

4.3 Evaluation of Education Environment

Reference value for each KPI is set depending on benchmarking with similar and distinguished programs [25] to evaluate the current state. KPI's based evaluation gave the remarks shown in tables 1-3.

Table (1). The KPI's based evaluation of human resource

Serial	KPI	Bench-Marking	Current Ratings	
			2008-09	2009-10
1	Ratio of students to teaching staff.	14	17	18
2	Proportion of teaching staff with doctoral qualifications.	90	80	82
3	Ratio of students to administrative staff	40:1	56:1	58:1

4	Proportion of teaching staff who attended professional development activities during the past years.	20%	14%	15%
5	Number of attended academic conferences in the previous years per full time equivalent member of teaching staff	2	0.6	0.65
6	Number of refereed publications in international journals in the previous year per full time equivalent member of teaching staff.	1.5	0.8	1.0
7	Number of refereed publications in local journals in the previous year per full time equivalent member of teaching staff.	2	1.0	1.2

Table (2). KPI's based evaluation of Facilities and support

Serial	KPI	Bench-marking	Current Ratings	
			2008-09	2009-10
1	Student evaluation of academic and career counselling offered by the department	Very good	good	good
2	Average number of students per class	25	26.5	26.4
3	Number of laboratories serving the EE program	14	11	11
4	Number of accessible computer terminals per student or existence of wireless network	Exists	wireless network exists	wireless network exists
5	Availability of an interactive site for the college	Exists	Exists	Exists
6	Average overall rating of adequacy of facilities and equipment in a survey of teaching staff	4.0 / 5	3.4/5	3.45

Table (3). KPI's based evaluation of policies

Serial	KPI	Bench-marking	Current Ratings	
			2008-09	2009-10
1	The faculty satisfaction with the educational policies and regulation	good	Quite good	Quite good
2	The student satisfaction with the educational policies and regulation	Very good	good	good
3	Proportion of teaching staff leaving the institution in the past years for reasons other than age retirement	10%	12%	14%

5. Actions Performed to Enhance the EE Program

5.1 Improvement of the Academic Plan

Based on feedback from Program constituencies, and according to the outcomes evaluation of the batch graduated in the second semester of the academic year 2011-2012, the College Council decided the following improvement actions for the EE Program plan:

1) Change/Improvement Action: General change in the plan and curriculum. As Math, physics, and technical English courses are counted in the new Preparatory Year Program (PYP), Math 105 in the curriculum has been dropped and replaced by the one in the PYP. Accordingly, Math 106 has been moved to level 3 instead of level 4.

   Reason: Decision of dedicating a PYP for the scientific colleges.

   Aim: Ensuring ABET Curriculum criterion as regarding Math and basic science courses [19].

   Targeted Outcomes: a, e.

2) Change/Improvement Action: Probabilities and Statistics course changed to be a compulsory course instead of an elective one.

   Reason: Feedback from faculty, Professional Advisory Board and students.

   Aim: realizing ABET Curriculum criteria [19], and to enhance statistics and mathematics knowledge and skills.

   Targeted Outcomes: a, e

3) Change/Improvement Action: introducing option of having Summer Training followed by two semester SDP of 5 hrs total credits, or Co-operative Training of 7 credit hrs followed by one semester SDP of 3 credit hrs. This was intended to be applied on the batch entering the college in the first semester of the academic year 2016-2017.

   Reason: Feedback from the students and faculty concerning the short period given to SDP. To cure this, the SDP should be extended over 2 semester, which was difficult to be implemented as the Co-operative Training occupies the term before the last term. Feedback from the employers, alumni and Co-operative Training site supervisors about replacing the Co-operative Training with the summer training confirmed that about 52 % agree to replace Co-operative Training with Summer Training, 42 % were with to keep the Co-operative Training as it is, and the rest are neutral about this. The decision has been taken to have two options as explained previously. The students who desire to have summer training will do it seriously as it is counted as 2 credits, and the lesser engineering practice period will be replaced by additional SDP semester.

   Aim: Enhancing the student outcomes.

   Targeted Outcomes: a-k

4) Change/Improvement Action: Introducing an engineering project management course (MGMT402) Project Management of three credits in the last level.

   Reason: feedback from faculty and Professional Advisory Board.

Aim: Enhancing students leadership and team work abilities

Targeted Outcomes: d and f.

5) Change/Improvement Action: Adding 'Power Electronics Lab' course for EPE, track.

Reason: feedback from students' surveys and SAC. Also, the results of the Power Electronics Course (EE 432) has necessitated this action as outcomes 'a', 'b' and 'e' have not achieved for two successive semesters in this course [16].

Aim: Enhancing the student abilities and skills in the labs, and enhancing understanding of the theoretical concepts in the related course (EE 432).

Targeted Outcomes: a, b, e

6) Change/Improvement Action: Introducing new elective courses; EE 483 (Principles of Photovoltaic Energy Systems) for EPE, and EE 464 'Error Control Coding' for ECE

Reason: Feedback from the faculty and Professional Advisory Board.

Aim: Enhancing the contemporary issues knowledge of the students

Targeted Outcomes: J

5.2 Improvement Actions Regarding the Resources and Facilities

1) Change/Improvement Action: Recruiting more experienced staff.

Reason: Low values of the first and second KPI's of the human resources (Table 1).

Aim: quantitative and qualitative improvement of the staff members.

Targeted Outcomes: a-k

2) Change/Improvement Action: Giving more professional training courses to faculty members.

Reason: Low value of the 4^{th} KPI of the human resources (Table 1).

Aim: Improving the quality of staff members.

Targeted Outcomes: a-k.

3) Change/Improvement Action: Constructing student project laboratory.

Reason: Low value of the 6^{th} KPI of the facilities and support (Table2).

Aim: Enhancing the SDP outcomes.

Targeted Outcomes: b& c.

4) Change/Improvement Action: Increasing internet facilities for the teaching and administrative staff, as well as the students

Reason: Low value of the 4^{th} KPI of the facilities and support (Table 2).

Aim: Enhancing the sources of information.

Targeted Outcomes: i-k

5) Change/Improvement Action: Allocating more fund support to the student senior projects

through University Scientific Deanship.

Reason: Low value of the 6th KPI of the facilities and support (Table 2).

Aim: Enhancing the SDP outcomes.

Targeted Outcomes: b& c.

6) Change/Improvement Action: Activating extracurricular activities through the College Students' Club.

Reason: Feedback of the Student Advisory Committee.

Aim: Increasing the relations between the students and between them and the Community.

Targeted Outcomes: d

6. Effectiveness of the Improvement Actions

Effectiveness of these actions have been confirmed via the second cycle evaluation of student batch graduated in the second semester of the academic year 2014-2015, the assessment of the educational environment, and ABET independent evaluation.

6.1 Program Constituencies Opinions

The feedback of instructor reports, external evaluators and Professional Advisory Board, in addition to the surveys of alumni and employers confirmed that the objectives of the EE Program meet the society needs, and are very suitable. The surveys of field supervisors of field training confirm achieving the soft skills targeted by the program.

6.2 Evaluation of the Student Outcomes

Based on the information gained from analyses of the direct assessment, it can be stated that for the batch graduated in the second semester of the academic year 2014-2015:

i- The results of group of senior courses (Fig. 9), SDP (Fig. 10), Co-operative Training (Fig. 11) indicate that all the highly related outcomes have been achieved for EPE track as they realized the 1st criteria above. The same applies on the ECE track [16].

ii- Analyses of the results of Outcomes Achievement Exam (Fig. 12) indicate that for EPE track many outcomes have been realized. Outcomes e, f and h have been marginally achieved for EPE Program. Outcomes e, h and i have been marginally achieved for ECE Program [16]. Outcome k has been clearly improved for both Programs.

iii- Overall evaluation which is based on averaging the evaluation of the four tools shows that the student outcomes have been achieved and they are inferior to the

level of achievement of the first cycle (Fig. 13)

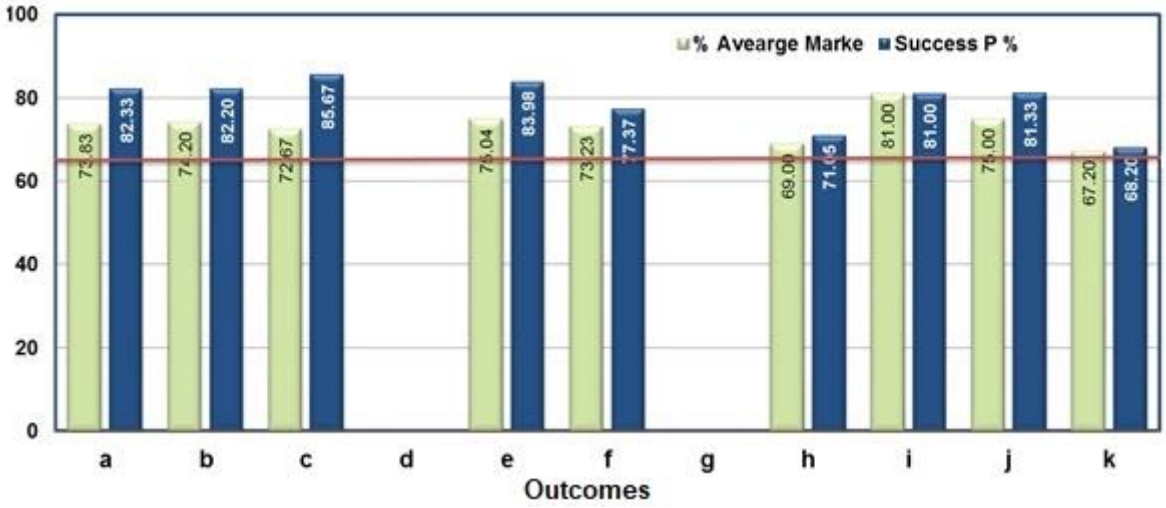

Fig. (9). Senior level courses based direct assessment of the EPE outcomes, second cycle

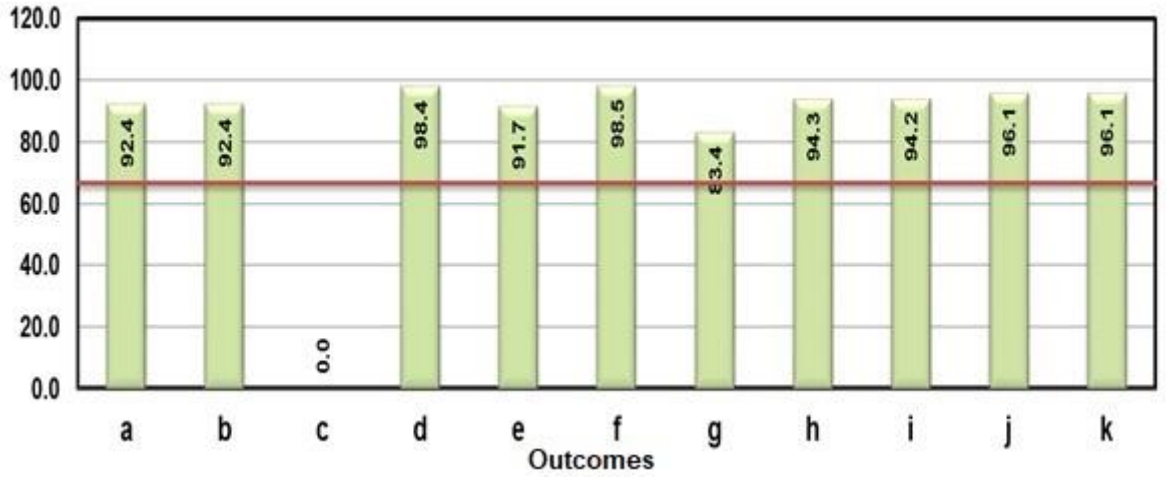

Fig. (10). Co-operative Training based direct assessment of the EPE outcomes, second cycle

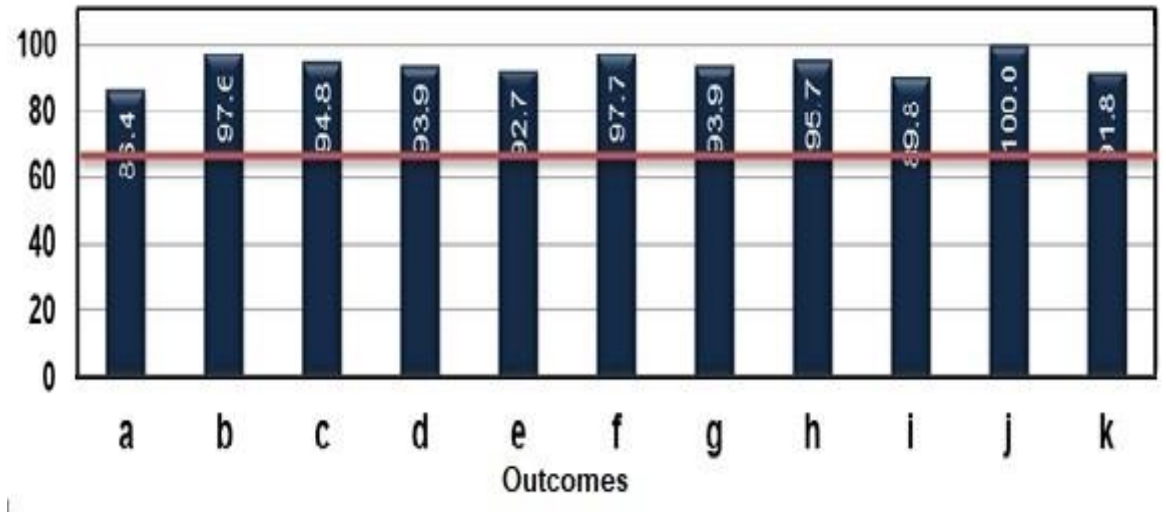

Fig. (11). SDP based direct assessment of the EPE outcomes, second cycle

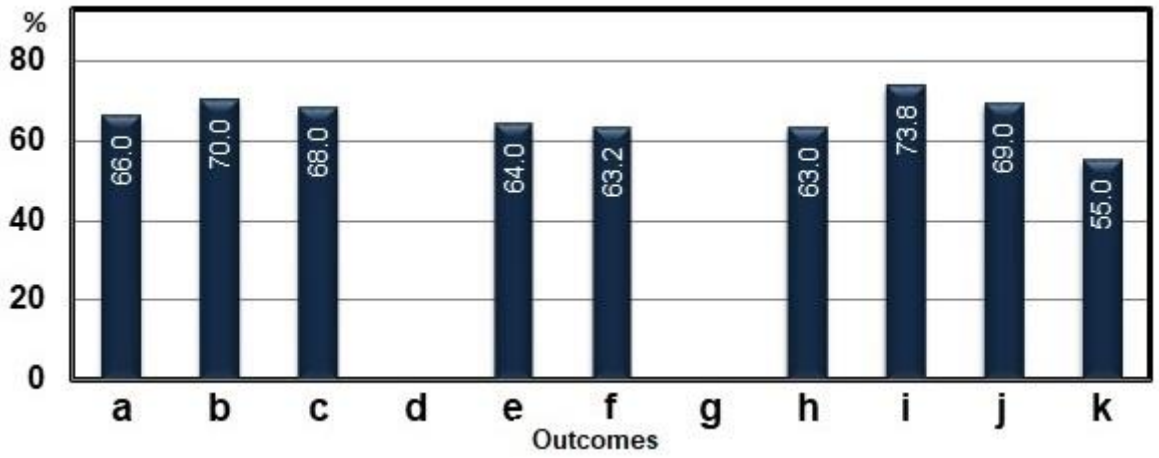

Fig. (12). Outcomes Achievement Exam based direct assessment of EPE outcomes, second cycle

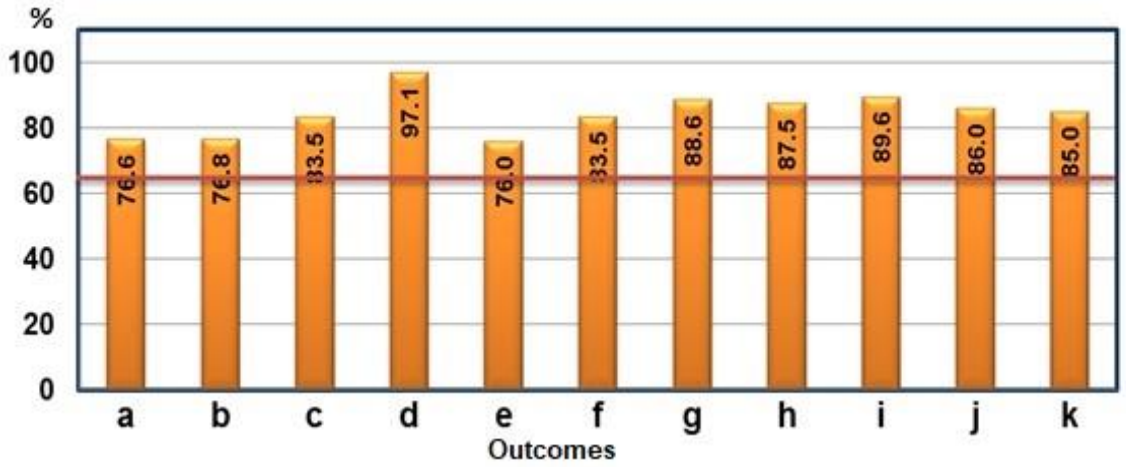

Fig. (13). Overall direct assessment of the EPE outcomes, second cycle

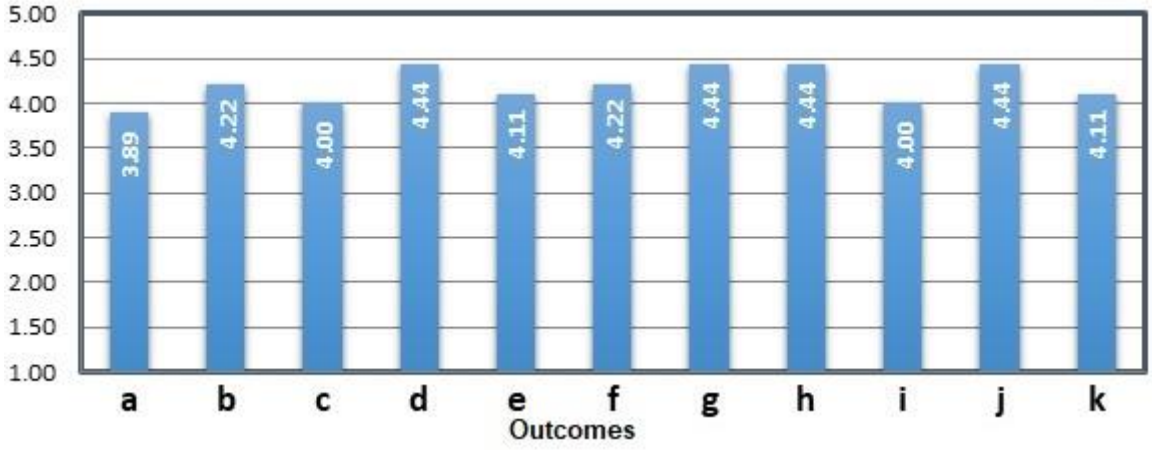

Fig. (14). Assessment results of Senior Exit Students' Survey of EPE, second cycle

The senior exit surveys and reports by instructors and Student Advisory Boards indirectly evaluate the outcomes as follows:

i. Based on the results of Senior Exit Surveys (Fig.14, [16]), the mean rating of the senior exit surveys responses for each outcome confirm- with reference to the 2nd criteria of Sec. 4.2- that the students are highly satisfied with the acquired knowledge and skills the program gave to them.

ii. No negative feedback regarding the student outcomes have been reported by the instructors and presentation panels of SDPs.

iii. Few suggestions have been reported by the Students Advisory Committee as regarding evaluation of the Summer Training.

6.3 Evaluation of Education Environment

The KPI's which evaluate the educational environment for this cycle gave the remarks shown in Tables 4-6. Values of the KPI's have been improved for the second cycle.

Table (4). KPI's based evaluation of human resource

Serial	KPI	Bench-Marking	Current Ratings	
			2013-14	2014-15
1	Ratio of students to teaching staff.	14	13.9	14
2	Proportion of teaching staff with verified doctoral qualifications.	90	91.5%	89%
3	Ratio of students to administrative staff	40:1	54.4	52
4	Proportion of teaching staff who attended professional development activities during the past years.	20%	22 %	20 %
5	Number of attended academic conferences in the previous years per full time equivalent member of teaching staff	2	0.6	0.8
6	Number of refereed publications in international journals in the previous year per full time equivalent member of teaching staff.	1.5	1.5	1.4
7	Number of refereed publications in local journals in the previous year per full time equivalent member of teaching staff.	2	1.4	1.6

Table (5). KPI's based evaluation of Facilities and support

Serial	KPI	Bench-marking	Current Ratings	
			2013-14	2014-15
1	Student evaluation of academic and career counselling offered by the department	Very good	good	good
2	Average number of students per class	25	22.5	22
3	Number of laboratories serving the EE program	12	10	11
4	Number of accessible computer terminals per student or existence of wireless network	Exists	wireless network exists	wireless network exists

5	Availability of an interactive site for the college	Exists	Exists	Exists
6	Average overall rating of adequacy of facilities and equipment in a survey of teaching staff	4.0 / 5	3.9 / 5	3.95 / 5

Table (6). KPI's based evaluation of policies

Serial	KPI	Bench-marking	Current Ratings	
			2013-14	2014-15
1	The faculty satisfaction with the educational policies and regulation	good	rather good	rather good
2	The student satisfaction with the educational policies and regulation	Very good	good	good
3	Proportion of teaching staff leaving the institution in the past years for reasons other than age retirement	10%	18.2%	12.2%

6.4 ABET Statements

Following ABET evaluation visit to Qassim College of Engineering during the accreditation cycle of 2015-2016, and 2021-2022 final statements have been received giving full accreditation to the EE Program of Qassim Engineering College.

7. Conclusion

Implementation of the quality assurance system established by QU employing the continuous improvement process has enhanced the attributes of the programs of Qassim College of Engineering, resulting in major changes in the educational plan, curriculum and teaching strategies. Also, changes have been carried out in the assessment practices, human resources, facilities, education policies and student activities. As a result of the effectiveness of the quality assurance system, all the programs of Qassim Engineering College have been accredited by ABET organization.

The direct tools for measuring the learning-outcomes realization such as Outcomes Achievement Exam, the SDPs and field training proved their significance for assessing and evaluating the learning outcomes. This conclusion was reached as the evaluation of the outcomes achievement utilizing these tools quite agrees with the comebacks opinion from the Program's constituencies through the indirect measures.

The quality assurance system can be adopted by other universities and tailored for programs of specializations other than engineering as the system is comprehensive and flexible.

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9. Appendices

Appendix A: Key Performance Indicators

a) Human resources:

Serial	KPI
1	Ratio of students to teaching staff. (Based on full time equivalents)
2	Proportion of teaching staff with verified doctoral qualifications.
3	Ratio of students to administrative staff
4	Proportion of teaching staff who attended professional development activities during the past years.
5	Number of attended academic conferences in the previous years per full time equivalent member of teaching staff

6	Number of refereed publications in international journals in the previous years per full time equivalent member of teaching staff.
7	Number of refereed publications in local journals in the previous years per full time equivalent member of teaching staff.

b) Facilities and support:

Serial	KPI
1	Student evaluation of academic and career counselling offered by the department
2	Average number of students per class
3	Number of laboratories serving the EE program
4	Number of accessible computer terminals per student or existence of wireless network
5	Availability of an interactive site for the college
6	Average overall rating of adequacy of facilities and equipment in a survey of teaching staff

c) Education Policies

Serial	KPI
1	The faculty satisfaction with the educational policies and regulation
2	The student satisfaction with the educational policies and regulation
3	Proportion of teaching staff leaving the institution in the past years for reasons other than age retirement.

نظام توكيد جودة مميز لتحقيق اعتماد ABET: تطبيق على برامج كلية هندسة القصيم

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ملخص البحث. توكيد الجودة للعملية التعليمية يهدف لتحقيق التحسين المستمر. يشرح المقال الحالي نظام توكيد جودة أسس في جامعة القصيم، ويبين كيفية تنفيذه في برامج كلية الهندسة في الجامعة. توكيد الجودة في التعليم يجب أن يعتبر حاجات الأطراف ذوي العلاقة ومتطلبات هيئات الاعتماد، وأن يدرس كل أنشطة التعليم، ولهذا لتأسيس ذلك النظام يجب تأمين الاتاحية والوضوح للمعلومات الداخلية والخارجية ووضع رسالة وأهداف ومخلرجات تعلم واضحة للبرامج التعليمية متسقة مع رسالة المؤسسة التعليمية والتأكد من توفير الظروف التي تضمن تحقق أهداف ومخرجات تعلم البرامج بكفاءة وضمان استمرارية هذا التحقق والتأكد من انخراط جميع منتسبي الكلية والطلبة في عملية تقويم الأهداف والمخرجات. لقد أدى تطبيق نظام توكيد الجودة لجامعة القصيم إلى تحسين برامج كلية الهندسة من خلال تحسينات وتعديلات معتبرة في أهداف وخطط ومناهج التعلم وكذلك مصادر ومرافق وسياسات التعلم بالإضافة لأنشطة الطلبة. ونتيجة لفاعلية نظام توكيد الجودة هذا حصلت جميع برامج كلية الهندسة على الاعتماد الدولي من هيئة ال ABET. إن النظام المقترح يمكن تبنيه في برامج الهندسة في الجامعات الأخرى نظرا لشموليته ومرونته، وسوف يؤدي تطبيق ذلك النظام لتسهيل تحقيق الاعتماد الأكاديمي لتلك البرامج.