

A newly established college of engineering led by a non-engineer

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ABSTRACT: The education and professional experience of the founding Dean of a newly established College of Engineering at King Faisal University (KFU), the Kingdom of Saudi Arabia, Dr Al-Arfaj, is in management and not an engineering discipline. The College of Engineering at KFU has five engineering programmes: biomedical, chemical, civil, electrical and mechanical. To ensure a successful start, highly qualified, dedicated faculty (academic staff) with academic experience were recruited from well-recognised universities to develop the curricula and laboratory facilities. One of the College's strengths is the commitment to assessment and evaluation of the educational processes to determine the effectiveness of, and improve, the quality of academic programmes. The College graduated the first batch of engineering students in June 2013, and in January 2014 the College will apply for an ABET (Accreditation Board for Engineering and Technology) evaluation visit. Briefly outlined in this article is the College's leadership philosophy and approach to the three major pillars of any respected engineering college: faculty, students and curriculum.

INTRODUCTION

King Faisal University (KFU) was established in 1975 in Al-Ahsa in the Kingdom of Saudi Arabia, with the goal of contributing to the dissemination of knowledge and regional development through quality education, research and specialised centres of excellence. Since its establishment, KFU has undergone substantial growth and expansion in terms of student enrolment, the teaching faculty (academic staff), academic programmes and degrees offered. King Faisal University paid special attention recently to academic quality and launched a comprehensive programme known as 11/11 to achieve institutional accreditation. The University has come a long way in this direction. As part of this effort, KFU has developed a strategic plan for the period 2011-2015, including vision and mission statements that focus on transforming KFU into a leading institution. The aim is to provide leadership in community partnerships and engagement, and service through quality education and research.

The College of Engineering is a newly established college that already has achieved much in the development of quality. Since the early beginnings, it was recognised that a qualified faculty is a basic ingredient and a major asset to achieving success. Thus, a systematic approach was adopted to attract and maintain a distinguished faculty and to provide a work environment where the faculty would be highly productive. The result has been the development of a culture of challenge, loyalty and team work while celebrating accomplishment.

The College graduated the first batch of engineering students in June 2013, and currently is in the process of applying for an ABET (Accreditation Board for Engineering and Technology) evaluation visit. This article outlines the College's leadership philosophy and approach to the three major pillars of any engineering college: faculty, students and curriculum.

FACULTY RECRUITMENT AND RETENTION

The success of any college depends mainly on the quality and dedication of its faculty members. To this end, the College of Engineering at KFU adopted and implemented the system shown in Figure 1. This figure depicts the general framework used by the College to attract and maintain qualified faculty members. Based on this system, identifying and selecting competent faculty involves three functions: human resource planning, recruitment and selection. The College has adopted several initiatives to implement these functions.

Human Resource Planning: The needs of the College for faculty members is based on annual/bi-annual human resource planning for the programmes, according to their specific requirements, taking into account specialisation, qualifications, and quantity. To determine the number of faculty members, the College attempts to maintain a faculty to student ratio of 1:16.

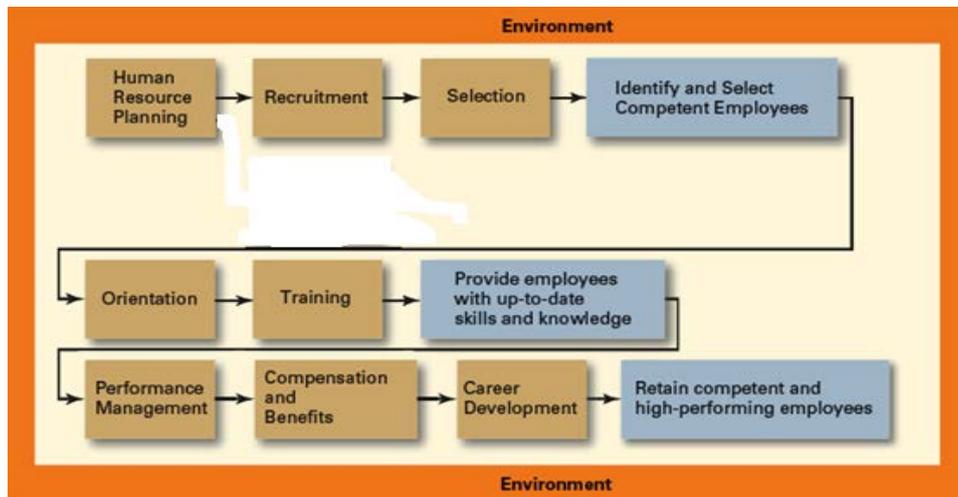


Figure 1: Faculty recruitment and retention scheme.

Recruitment: In addition to personal recommendations and nominations of potential candidates, job vacancy advertisements are placed in various ways and in numerous locations. The aim is to reach out to a large pool of candidates who are as diverse as possible.

Selection: The final selection of a faculty member goes through a vigorous, systematic, highly competitive and selective process that is conducted according to a set of high standards. It involves an initial screening of applicants, interviews (via Skype), and a personal interview when deemed necessary. The process starts with the programme Recruitment Committee goes to the Department Council, then, via the College Recruitment Committee to the KFU Administration. Based on this selection scheme, all PhD holders in the College hold degrees from institutions in developed countries such as the USA, Canada and Australia.

The objective of keeping faculty members up-to-date in skill and knowledge is achieved by the following two main activities:

Orientation: At the beginning of each academic year, KFU runs a prescheduled, rich orientation programme for all new faculty members joining KFU including, of course, those joining the College of Engineering. The programme lasts several days during which the new faculty members are provided with information to help them make a smooth transition while settling in at KFU. The programme includes information about KFU and its expectations of them, and some technical training on teaching-related strategies. In addition, a college-specific orientation programme is conducted for all new faculty members at the beginning of each year. In this, the salient points of College strategy, culture and general policies, among other things, are covered.

Training: In addition to the various professional development opportunities provided by the KFU system, the policies of the College are aimed at keeping the faculty abreast of the latest developments of knowledge and in relevant skills. To this end, ample opportunities are provided for the faculty members to attend related training events inside and outside the country. In the knowledge (technical specialisation) domain, affiliates are encouraged to attend and/or organise conferences, workshops, seminars, training sessions, etc. In the various skills domains, however, the focus is on teaching strategies that are meant to achieve specific learning outcomes and the best assessment methods. For instance, learning outcomes related to soft skills include communications, teamwork and leadership, lifelong learning and ethics, which make up a fundamental aspect of the training.

Much effort is made to recruit highly qualified faculty members and, then, to invest heavily in their development. They are regarded as the College's most precious asset. Even more effort is made to retain those who demonstrate excellence and dedication. In pursuit of this, the following initiatives have been implemented:

Career Development: This is one of the important measures to ensure operational continuity and a high standard of performance. It builds on a faculty member's potential to excel in a specific area and to focus their training efforts on that particular area. Ultimately, it prepares the faculty member not only to excel in a given field of work but also to develop a career in a given direction that serves the needs of the College. For instance, faculty strengths have been successfully developed in such areas as quality and accreditation, public relations, infrastructure and safety.

Quality Research: As far as research is concerned, the College of Engineering research is organised along two parallel lines: the internal approach and the external approach. The internal approach builds on the research expertise of the existing faculty, while the external approach identifies research priorities based on the needs of industry and the challenges that are of most significance for the national economy. Issues of national significance were categorised into two main classes: those with competitive advantages and those with competitive disadvantages. A competitive

advantage is an industry or sector where Saudi Arabia enjoys an apparent strength, such as oil, gas and petrochemicals. A competitive disadvantage refers to a problem or challenge to Saudi Arabia, such as water scarcity and corrosion.

STUDENTS

The College has stringent admission requirements in order to guarantee and maintain the quality of its outcomes. In order to maintain its high standards, the proactive recruitment policy attracts good quality students via a diverse spectrum of initiatives. For example, there is participation in the annual KFU exhibition, visits by top students from the community high schools to the College and, as well, there are other means of outreach to the Eastern Region (the Province where KFU is located) high school students.

At the College, there is a productive environment and supporting services for its students via a package of activities. Regular orientation days are held and numerous basic academic services to assist the student. Moreover, the College has space and hardware for a tutoring office and has an established system and documentation for academic advising and counselling. Further, as the complete and rewarding student-learning experience goes beyond lectures and is more than just getting high grades, diverse means exist by which to build a student's character. The most significant of these include extracurricular activities and initiatives, such as developing a set of soft skills and leadership, a design competition contest, hosting professional student branch chapters, including ASME (American Society of Mechanical Engineers), ASCE (American Society of Civil Engineers), IEEE (Institute of Electrical and Electronics Engineers) and AIChE (American Institute of Chemical Engineers), field trips, and inviting professionals to deliver lectures on campus. Furthermore, students are motivated by a number of initiatives that celebrate distinguished achievements; the most important includes a system of student awards and support.

The College's quality control system relies on a number of practices that make up the quality assurance system and which are designed to achieve the educational goals set for the College and to ensure continuous improvement. These activities are administered by a Quality Office (Committee) that is dedicated to overseeing all quality-related practices throughout the College.

Student Motivation: Students are motivated through a number of initiatives that celebrate and recognise distinguished achievements and encourage constructive competition among the students. The most important initiatives are the Outstanding Student Awards that include the Dean's List, which is awarded on a semester basis; the highest grade point average (GPA) senior student award that is given to the student with the highest GPA in the cohort; the best senior design award that is provided on a competitive basis; and a prize given to best achieving students by the Honeywell Company. Moreover, the costs are provided for senior design projects and there is a financial award to students who publish a paper in a specialised publication.

CURRICULUM, EDUCATIONAL OBJECTIVES AND STUDENT OUTCOMES

Since the establishment of the College, the aim has been to guarantee the quality of its services according to international standards and, thus, the College has been working using ABET guidelines. The innovative curricula coverage of broad basic engineering knowledge using a project-based learning model ensures that the graduates fit in today's multidisciplinary engineering profession. Moreover, the community has been engaged by establishing collaborative ventures and strategic alliances with leading industrial, as well as societal organisations.

The major aim of the College of Engineering at KFU is to ensure its graduates understand basic concepts of mathematics and sciences, have studied one engineering field in sufficient depth to appreciate its methodologies of analysis and design, and have acquired a solid basis for lifelong learning. These goals are accomplished through the establishment of courses in:

- mathematics and sciences;
- required technical topics in the major engineering areas;
- elective technical topics that combine breadth of subject matter with specific in-depth study;
- general education.

Laboratory and Design Experience are an Essential Part of the Curricula.

Curricula for the engineering programmes were developed in 2009 based on a survey of potential employers of graduates and in consultation with the College Industry Advisory Board. The curricula were revised in the first semester of 2011/2012. The changes in the curricula were made based on ABET accreditation requirements.

At the outset, the curriculum was to be designed to achieve the Program Educational Objectives (PEOs) as outlined in the following list:

1. Technically competent graduates for a successful and productive career in the engineering profession;
2. Graduates who are capable of pursuing graduate studies and research;

3. Graduates who can demonstrate their effective communication and teamwork skills in a diverse environment with an integrative perspective to solving engineering problems;
4. Graduates with the desire for lifelong learning for the purpose of continuous improvement.

These PEOs are assessed a few years after graduation and are consistent with the College's competitive advantages. Table 1 below shows the PEOs and their relation to the College's competitive advantages and core competencies.

The student outcomes of the engineering programmes at KFU are based on ABET Students Outcomes *a* to *k* [1]. These student outcomes lead to the achievement of the programme educational objectives.

Design Content/Capstone Senior Design

The success and continual growth of many industries is strongly dependent on the design of relevant components and systems. Therefore, one important and essential task confronted by engineers is that of design. Engineers not only must know and understand the scientific fundamentals of their discipline, but also must be able to analyse and design components and systems typically encountered in their field of specialty. For an engineering curriculum to be successful, it must provide students the opportunity to be exposed to engineering design.

ABET 2000 Criteria 3 requires that for an engineering programme to be accredited, it must demonstrate that appropriate educational programme outcomes are met. In 2000, ABET changed from a *bean counting* approach to an outcome-oriented approach - EC2000. Engineering programmes must now demonstrate that their graduates have 11 specific outcomes known as a) through k).

According to these criteria, all undergraduate engineering programmes need to provide for design experience. This fact is stated in outcome c): *an ability to design a system, component, or process to meet desired needs* [1]. To meet the requirements of the ABET accreditation criteria, the engineering faculty at KFU have integrated engineering design (see for example: Abu-Mulaweh and Al-Arfaj [2]) throughout the curriculum, spanning freshman, sophomore, junior and senior level courses.

The capstone senior design project is a degree requirement in any respected engineering programme. In the engineering programmes at KFU, the capstone senior design project is accomplished in two semesters. In the first semester, the problem statement is formulated and basic conceptual designs are generated and, then, evaluated. The best conceptual design is, then, selected and a complete and detailed design is generated by the end of the first semester. In the second semester, a prototype of the finished design is built, tested and evaluated. These projects can be single discipline or multidisciplinary that include students from at least two engineering programmes.

Assessment and Continuous Improvement

The ABET criteria are based on the principles of total quality management and continuous improvement. The criteria require that each programme's mission be consistent with the institutional mission. The mission must be translated into specific programme educational objectives and student outcomes that are expected as a result of the educational process. The students' outcomes should be measurable and must be assessed regularly. The results of outcomes assessment should be used as feedback to make programme improvements. Finally, a quality assurance and management process must be in place to achieve success.

The College has developed and implemented a comprehensive assessment plan to meet the ABET criteria of total management and continuous improvement. The educational objectives and student outcomes of all engineering programmes at KFU are assessed using direct and indirect measures, as summarised in Table 1.

Table 1: Direct and indirect measures.

	Measures	
	Direct	Indirect
Educational objectives	1) Employers (supervisors) survey and feedback 2) Student outcomes	1) Alumni survey 2) Admittance to graduate school 3) Industry advisory committee
Student outcomes	1) Interim assessment by faculty 2) Capstone assessment <ul style="list-style-type: none"> • Industrial sponsor • Faculty members 3) FE examination 4) Summer training supervisor report	1) Interim assessment by students <ul style="list-style-type: none"> • Courses outcomes • Laboratory evaluation • Engineering students' forums 2) Exit interview

For all assessment measures, the information collected is first reviewed by the Assessment Committee. In the case of any observed deficiency, it will be forwarded to the appropriate committee or faculty member with a charge to make recommendations or suggest corrective actions. These recommendations are presented to the faculty for discussion and a final action is fed back into possible changes in the curriculum content.

CONCLUSIONS

The newly established College of Engineering at KFU has come a long way under the leadership of a non-engineer. The founding Dean has a management background. Despite the lack of engineering background, the founding Dean has led the College utilising his management skills.

One of the College's strengths is the commitment to assessment and evaluation of the educational processes to determine their effectiveness and improve the quality of the academic programmes. The first cohort of the College students graduated in June 2013, and staff are currently in the process of applying for an ABET evaluation visit.

REFERENCES

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2. Abu-Mulaweh, H.I. and Al-Arfaj, A.A., Engineering design experience of an undergraduate thermodynamics course. *World Transactions on Engng. and Technol. Educ.*, 10, 1, 77-81 (2012).