



College of Engineering at King Saud University and its Partnership with Industry

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Abstract: Consistent with the mission of King Saud University, one objective of the strategic plan of the College of Engineering at King Saud University is to strengthen the partnership and cooperation with the different institutions of the society. In this regard, the College of Engineering has worked in several directions to activate such partnership. The first area is to provide engineering consultations by members of the teaching staff to the industry (mainly in the private sector). In addition, the College has established industrial advisory committees for the individual departments and the College at large to get continuous feedback from its stakeholders; the members of these committees are selected from both the governmental and the industrial sectors. The second area is to support the scientific research through the finance provided by industry in order to establish research chairs in the College, the first funded research chair was established in the College of Engineering among the colleges in King Saud University. So far, the College of Engineering has established thirteen research chairs, which are funded by different institutions of the society; most of them are from the industry. The third area contains the support provided by industry to the educational aspects in the College through the provision of scholarships to the outstanding students in different departments of the College. It also includes the provision of awards to the outstanding graduation projects in the departments. The fourth area involves the practical training of the College's students in different industrial companies. The training period is 10 weeks. The latter area focuses on providing specialized engineering training courses in different fields to the engineers. This paper presents the various aspects of the partnership of College of Engineering at King Saud University with the industry.

Introduction

Global competitiveness requires that engineering colleges contribute substantially to the diverse high technology of the different nations. This is to be done through participation in broad economic development projects, through the intellectual property development and collaboration and through strong partnerships with industry, which provide both research support and student education/training support. The general philosophy of engineering education is to produce graduates of high academic standard and of immediate value to the industry. Engineering Education is the process of training engineers for the purposes of initiating, facilitating and implementing the technological development in the society. The preparation of students who are deeply knowledgeable of the technical fundamentals as well as the professional skills of engineering is considered the main objective of engineering education is ^[1].

Engineering education in Saudi Arabia started in 1962 when the first College of Engineering was established within a collaborative project between the government of the Kingdom of Saudi Arabia represented by the Ministry of Education and the UNESCO Commission of the Organization of the United Nations. The College was under the auspices of UNESCO until 1969 when it became a college in King Saud University. Thereafter the establishment of colleges of engineering continued reaching 21 colleges in government universities and 8 engineering colleges in private sector universities in 2011 ^[2]. Each college within the university has its own

council charged with the responsibility to implement and carry out university policy and regulations, submit budget requests, and propose policy changes. Each department within the college has an organization paralleling that of the college and university. Engineering education in Saudi Arabia was expanded to include all the disciplines that provide the engineer with base to enable him to keep pace with scientific and technical development. The number of engineering students was seventeen students in 1962, studying at the College of Engineering at King Saud University, this number increased to about 33,000 students in 2011 studying in all colleges of engineering in Saudi Arabia ^[2]. The graduates of the first batch of Saudi engineers from College of Engineering at King Saud University was sixteen engineers in 1966; the number of graduates from engineering colleges increased to about 3900 graduates in 2011 ^[2].

There are currently several engineering programs offered by the universities in Saudi Arabia. There are 93 engineering programs offered by twenty-one colleges in government universities and 24 engineering programs offered by eight colleges in private sector universities in 2011 ^[2]. The traditional programs such as civil engineering, electrical engineering and mechanical engineering are offered by almost every university.

College of Engineering at King Saudi University

As stated above, the College of Engineering at King Saudi University was established as a joint project between the Ministry of Education of the Kingdom of Saudi Arabia and UNESCO in November 1962. This project lasted until 1969 when the College of Engineering became an official part of King Saud University. The College started with three departments, namely the Civil Engineering Department, Electrical Engineering Department, and Mechanical Engineering Department. In the year 1968, the Department of Architecture was established which later became a college in 1984 under the name of College of Architecture and Planning. In 1974, two new departments were established, namely the Chemical Engineering Department and Petroleum Engineering Department. In 1988, surveying engineering was established as a program in the Civil Engineering Department. In 1982, an industrial engineering program was established in the Mechanical Engineering Department. Later on, the program became the Industrial Engineering Department in 2002. Accordingly, there are currently six departments offering Bachelor of Science Degree in the following engineering fields: civil engineering, surveying engineering (offered by Civil Engineering Department), electrical engineering, mechanical engineering, industrial engineering, chemical engineering and petroleum and natural gas engineering ^[3].

The College of Engineering offers graduate programs in various fields in order to cope with scientific progress and to provide the Kingdom of Saudi Arabia with highly skilled specialists needed for the ambitious development plans. King Saud University Council endorsed the initiation of graduate programs in all departments of the College since 1981. Currently, there are six Master of Science programs (in every department) and four Ph. D. programs in civil, electrical, chemical, and industrial engineering.

The College of Engineering has been in the forefront of the remarkable transformation which KSU has witnessed over the past few years. Such transformation has impacted significantly on the research related programs and activities and has, consequently, resulted in major

improvements in both quality and volume of the College's products offered to the society. In this respect, the College is undergoing tremendous reforms towards international excellence and quality and works hard to satisfy stringent quality requirements and international recognition. As a testimony to its desire to become a world-class college, it obtained the Accreditation Board for Engineering and Technology (ABET) accreditation for all undergraduate programs as well as the ISO certificate for its administrative processes. The College of Engineering, with its long tradition of excellence in research and teaching, will remain committed to taking and maintaining a leading role as one of the top premier engineering schools in the region.

The College defines its vision and sets up its mission and objectives. The same is done by every department which links their vision, mission and objectives to those of the College. The road map of the College is developed through its strategic plan which was built by identifying strengths and weaknesses, opportunities and challenges. The vision of College of Engineering is [3].

To be a world class college and a pioneer in engineering education, innovative research and building knowledge community

On the other hand, the mission of College of Engineering is [3]:

*To provide high quality education programs that address the changing needs of future engineers, serve the profession and contribute to the advancement and well-being of the society by creating and disseminating knowledge and technology to future generations through teaching, research and **partnership with industry and government**.*

The College of Engineering has developed its strategic plan in 2008 as first among the University's colleges to define its strategic direction for the following foreseeable future. The strategic plan was revised in 2011. There are six strategic objectives of College of Engineering as follows [4]:

1. Provide excellent academic programs that best reflect the current needs and requirements of the profession.
2. Recruit, nurture and retain outstanding students
3. Recruit, nurture and retain outstanding faculty.
4. Empower the College's research
5. Establish a strong outreach and external business collaborations with industry, government and other entities in the society.
6. Establish and maintain effective and efficient support services, facilities, and infrastructure

College of Engineering Partnership with Industry

The College plays an important role in consultation and research activities as applied to local industries. In fact, the College considers industry as a major component of its external constituents. Saudi Arabia has many natural resources that include petroleum, natural gas, iron ore, gold and copper. It has major industries such as crude oil and natural gas production, petroleum refining, basic petrochemicals, cement, steel-rolling mills, construction, fertilizer, plastic, etc. Objective # 5 of the strategic objectives of College of Engineering (mentioned

above) illustrates College of Engineering partnership with industry. Five initiatives were set to achieve this objective. In each initiative, there are different actions as shown in Table 1. The key performance indicators of these initiatives are shown in Table 2.

Initiative	Actions
ENG 5-A: Secure long-term research funding through establishing partnerships with the industry.	<ol style="list-style-type: none"> 1. Continue to establish industry chairs in College of Engineering. 2. Continue to attract sponsors for the College's laboratories
ENG 5-B: Establish mechanisms for improving interactions with industry.	<ol style="list-style-type: none"> 1. Continue to work with the Industry Advisory Boards for the College and its programs. 2. Organize regular visits to leading companies to discuss new developments, accomplishments, and innovative ideas. 3. Organize campus visit and pre-interview programs for prospective employers 4. Establish a career placement center for the student. 5. Enhance the summer training program.
ENG 5-C: Facilitate College services directed at local industry.	<ol style="list-style-type: none"> 1. Encourage and facilitate faculty consultation. 2. Institute policies for faculty sabbatical/summer work at industry. 3. Carry out intensive training programs to serve the needs of the country. 4. Improve testing facilities and increase the quantity and quality of trained staff.
ENG 5-D: Launch a marketing campaign to improve the reputation of the College.	<ol style="list-style-type: none"> 1. Prepare different marketing materials for education, research and community services provided by the College and the various departments. 2. Build and update a good database for the different governmental and private sectors. 3. Maintain communication with various engineering sectors in Saudi Arabia. 4. Improve and update the webpage for the College of Engineering. 5. Establish a media office for the College of Engineering.
ENG 5-E: Create a strong sense of loyalty to the College among alumni.	<ol style="list-style-type: none"> 1. Establish an Alumni Association for departments across the College of Engineering. 2. Build and activate a database for College alumni. 3. Publish regular newsletters for alumni. 4. Provide alumni access to KSU facilities. 5. Invite the alumni to College events. 6. Organize an annual banquet to honor outstanding alumni.

Table 1: Initiatives of objective # 5 and their actions ^[4]

Initiative	KPI's
ENG 5-A: Secure long-term research funding through establishing partnerships with the industry.	1. Number of new sponsored laboratories in the College per year.
ENG 5-B: Establish mechanisms for improving interactions with industry.	1. Number of College's students joined training programs that contribute to society 2. The proportional of the value of donated gifts from the College's customers to total revenues of the College 3. Number of employers participating in mentorship programs.
ENG 5-C: Facilitate College services directed at local industry.	1. Percentage of faculty members involved in external consultations. 2. Proportion of faculty members formally associated with industry to the total number employed. 3. Proportion of the number of training activities offered to the society / year.
ENG 5-D: Launch a marketing campaign to improve the reputation of the College.	1. Number of reported news items about the College on the various media channels such as websites, reports, etc. per year. 2. Proportion of reported news items about the College on the university website to the total reported news. 3. Number of articles of engineering news in national media.
ENG 5-E: Create a strong sense of loyalty to the College among alumni..	1. Proportion of alumni who participate in establishing endowed and industry chairs as well as sponsored labs with respect to the total alumni. 2. Number of university graduates participating in engineering activities.

Table 2: Key performance indicators for initiatives of objective # 5^[4]

The College's relationship with industry has developed over the years to full-fledged partnerships. Forms of cooperation include but not limited to consultation, research, scholarship and training activities. Faculty members in the College provide engineering consultations to the industry. There are several faculty members who work as full-time consultants as well as part-time consultants in different industry companies. The College's well-thought and strong outreach programs with government, industry and society has resulted in financial sponsoring various research activities in the College including research centers and research chairs. Research centers and institutes in the College include: Prince Sultan institute for advanced technology, advanced manufacturing research institute, center of excellence in engineering materials, center of excellence in concrete technology, SABIC center for polymers, research center for sustainable energy.

There are thirteen endowed research chairs in the College funded by the industry as shown in Table 3 ^[5]. Research chairs cover different areas of engineering such as water and energy, traffic engineering, advanced manufacturing technology, electrical power and system, rehabilitation of structures, expansive soils, extraction of oil, earthquake engineering as well as communications. The research chairs improve the research in the College and support both the researchers and graduate students and many awards and patents were provided to them. The College has secured thirty four patents in the recent past representing more than half of the total patents (62) in King Saud University. Furthermore, the total ISI papers in the College in 2011 is 266 papers, most of them came from the research chairs ^[5]. These outputs showed the high level of achievement of the College faculty.

Chair	Department
Prince Khaled Ibn Sultan chair in water	Civil Engineering
Prince Mohammed bin Nayef chair in traffic engineering	Civil Engineering
Princess Fatma Bent Hashem chair for advanced manufacturing technology research	Industrial Engineering
Saudi Aramco chair in electrical power	Electrical Engineering
Saudi Electricity Company chair in the reliability and security of the electrical system	Electrical Engineering
Ben-Laden Group chair in research and studies in the rehabilitation of structures	Civil Engineering
Engineer Abdullah Bogshan chair in expansive soil	Civil Engineering
UNESCO chair for the desalination of water	Chemical Engineering
ACWA Power Company chair in water and energy	Civil Engineering
Alzamil Group chair for electricity and water conservation	Civil Engineering
Saudi Telecommunications Company chair in communications	Electrical Engineering
Mohammad Hussein Al-Amudi chair in extraction of oil	Petroleum and Natural Gas Engineering
Saudi Aramco chair for earthquake engineering	Civil Engineering

Table 3: Research chairs in College of Engineering ^[5]

Industry supports the educational aspects in the College through the provision of scholarships to the outstanding students in different departments of the College. It also includes the provision of awards to the outstanding graduation projects in the departments. Furthermore, College's students make their summer training program (10 weeks period) - which is required for graduation - in the industry companies. The total number of students who made their summer training during summer 2012 was 423 students in more than 20 government and industry

institutions ^[5]. Table 4 shows the scholarships provided by industry companies to the outstanding students in the College of Engineering. The scholarship includes monthly salary as well as training and possibility of employment depending on the company.

Company	Number of students	Disciplines
SABIC	60	Electrical Engineering Mechanical Engineering Chemical Engineering Industrial Engineering
BAE Systems	30	Electrical Engineering Mechanical Engineering Industrial Engineering
Contracting and Construction Enterprises (CCE)	30	Civil Engineering Electrical Engineering Mechanical Engineering Industrial Engineering

Table 4: Companies provided scholarships to the outstanding students ^[5]

The College of Engineering provides specialized engineering training courses in different fields in the College to the engineers working in industry. It also, provides testing and taking advantages of the facilities and laboratories of the College. These integrated relationships have culminated in the establishment of industrial advisory committees for the individual departments and the College at large. Members of these committees are selected from both the governmental and the industry sectors. The advisory committee is expected to:

- Provide feedback on curriculum, student evaluation, program objectives, and outcome definition
- Advice faculty and students of professional skills expected of graduates
- Provide the recognition of the faculty, students, and alumni
- Raise public awareness of the College
- Raise funds for endowed positions, scholarships and fellowships
- Provide resources to meet industry' needs
- Provide logistical support to collaborators
- Encourage talented engineers from local industry who is willing to work with students to become part-time adjunct faculty ^[6].
- Enhance partnerships between faculty members and selected people from industry through senior capstone projects and research projects in selected areas ^[6].

Summary and Conclusions

This paper presented the various aspects of the partnership of College of Engineering at King Saud University with the industry. The College of Engineering has been continuously working in several directions to activate such important partnership. The first area is to provide engineering consultations by members of the teaching staff to the industry. Furthermore, the College established industrial advisory committees for the individual departments and the College at large to get feedback from its stakeholders; the members of these committees are selected from both the governmental and the industry sectors. The second area is to support the scientific research through the finance provided by industry to establish research chairs in the College. Currently, the College of Engineering has thirteen research chairs in the present time funded by different institutions of the society; most of them are from the industry. The third area contains the support provided by industry to the educational aspects in the College through the provision of scholarships to the outstanding students in different departments of the College. It also includes the provision of awards to the outstanding graduation projects in the departments. Industry provides practical summer training of the College's students (10 weeks) in different industry companies. In addition, the College of Engineering provides specialized engineering training courses in different fields to the engineers as well as testing and taking advantages of the facilities and laboratories of the College.

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