Aspects of Collaborations Between College of Engineering at King Saud University and Industry

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***Abstract*—The mission of most colleges of engineering in many universities is to strengthen the partnership and cooperation with the different institutions of the society. This paper presents the various aspects of collaborations of college of engineering at King Saud University with industry. The first aspect is providing consultations by college faculty to industry companies. The second aspect is supporting scientific research through the finance provided by industry to establish research chairs in the college. The third aspect is providing scholarships to the outstanding students and awards to the outstanding graduation projects in all departments of the college. The fourth aspect involves the practical training of college's students in different industrial companies. The last aspect focuses on providing specialized engineering training courses in different fields to the engineers in industry.**

***Index Terms*—collaboration, college of engineering, engineering education, industry.**

I. INTRODUCTION

Engineering profession is one of the oldest professions that have served humanity through improving the environment, developing means of production and working to provide the comforts for people such as homes, roads, communications and equipment in various fields. As evidence of this are the pyramids in Egypt, the Great Wall of China and various towers in Europe. The major role of engineers is to design and implement solutions that have not previously existed, and that directly or indirectly serve 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 .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. Colleges of engineering contribute substantially to the diverse high technology 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 [1].

II. ENGINEERING EDUCATION IN SAUDI ARABIA

Engineering education in Saudi Arabia started in1962 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 2012 as shown in Table I and Table II, respectively [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.

TABLE I
COLLEGES OF ENGINEERING IN SAUDI PUBLIC UNIVERSITIES

College	University	City
College of Engineering	King Saud University	Riyadh
College of Engineering Sciences	King Fahd University of Petroleum and Minerals	Dhahran
College of Engineering	King AbdulAziz University	Jeddah
College of Engineering & Islamic Architecture	Umm Al-Qura University	Mecca
College of Engineering	King Kalid University	Abha
College of Engineering	Qassim University	Buraidah
College of Engineering	Taibah University	Madinah
College of Engineering	University of Hail	Ha'il
College of Engineering	Jazan University	Jazan
College of Engineering	Al Jouf University	Turaif
College of Engineering	Al Baha University	Al Baha
College of Engineering	Najran University	Najran
College of Engineering	Taif University	Taif
College of Engineering	Salman Bin AbdulAziz Univ.	Al Kharj
College of Engineering	Northern Borders University	Arar
College of Engineering	University of Tabuk	Tabuk
College of Engineering	Imam Mohammad bin Saud Un	Riyadh
College of Engineering	Majmaah University	Majmaah
College of Engineering	King Faisal University	Al Hasa
College of Engineering	University of Dammam	Dammam
College of Engineering	Shaqra University	Dawadimi

TABLE II

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COLLEGES OF ENGINEERING IN SAUDI PRIVATE UNIVERSITIES

College	University	City
College of Engineering	Prince Sultan University	Riyadh
College of Engineering	Prince Mohammad bin Fahd University	Alkhobar
College of Engineering	Alfaisal University	Riyadh
College of Engineering	Effat Private University	Jeddah
College of Architectural Engineering	Dar Al Uloom University	Riyadh
College of Engineering	Prince Fahad bin Sultan Un.	Tabuk
College of Engineering & Information Technology	Colleges of Business Administration	Jeddah
College of Engineering	Buraidah Colleges	Buraidah

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 38,000 students in 2012 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 2012 [2].

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. There are currently 93 engineering programs offered by twenty-one colleges in government universities and 24 engineering programs offered by eight colleges in private sector universities in 2012 [2]. The traditional programs such as civil engineering, electrical engineering and mechanical engineering are offered by almost every university.

III. COLLEGE OF ENGINEERING AT KING SAUD UNIVERSITY

As stated above, the college of engineering at King Saudi University was established in 1962. The college started with three departments, namely the civil engineering department, electrical engineering department, and mechanical engineering department. The department of architecture engineering was established in 1968 which became a college in 1984 under the name of college of architecture and planning. In 1974, both the chemical engineering department and petroleum engineering department were established. In 1988, surveying engineering was established as a program within the civil engineering department. An industrial engineering program was established in 1982 in the mechanical engineering department and became the department of industrial engineering in 2002. Accordingly, there are currently six departments offering seven Bachelor of Science Degrees. College of engineering started offering graduate programs in 1981. Currently, there are eight Master of Science programs and five Ph. D. programs in civil, electrical, mechanical, chemical, and industrial engineering. In addition to four Master of Science joint programs. Table III shows all programs provided by college of Engineering [3].

TABLE III

ACADEMIC PROGRAMS IN COLLEGE OF ENGINEERING

Department	Program
Civil Engineering	B.Sc. in Civil Engineering B.Sc. in Surveying Engineering M.Sc. in Civil Engineering Ph.D. in Civil Engineering
Electrical Engineering	B.Sc. in Electrical Engineering M.Sc. in Electrical Engineering Ph.D. in Electrical Engineering
Mechanical Engineering	B.Sc. in Mechanical Engineering M.Sc. in Mechanical Engineering M.Sc. in material Engineering Ph.D. in Mechanical Engineering
Chemical Engineering	B.Sc. in Chemical Engineering M.Sc. in Chemical Engineering M.Sc. in polymers Engineering Ph.D. in Chemical Engineering
Industrial Engineering	B.Sc. in Industrial Engineering M.Sc. in Industrial Engineering Dipl.. in Occupational Safety Ph.D. in Industrial Engineering
Petroleum and Natural Gas Engineering	B.Sc. in Petroleum and Natural Gas Engineering M.Sc. in Petroleum and Natural Gas Engineering
Joint Programs	M.Sc. in Renewable Energy M.Sc. in Environmental Sciences M.Sc. in Desalination of water M.Sc. in Nuclear Engineering

The college of engineering is undergoing tremendous reforms towards international excellence and quality and works hard to satisfy 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 collaboration with industry in stated in the mission of college of engineering [4]:

"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****"*

One of the six strategic objectives of college of engineering stated in its strategic plan which is related to the collaboration with industry is [5]:

"5. Establish a strong outreach and external business collaborations with industry, government and other entities in the society."

IV. COLLABORATION WITH INDUSTRY

Saudi Arabia has many natural resources which 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. The college of engineering is a major player in consultation and research activities as applied to local industries. In fact, the college considers industry as a major component of its external constituents. Objective # 5 of the strategic objectives of college of engineering (mentioned above) illustrates college of engineering partnership with industry.

The college's relationship with industry has developed over the years to full-fledged partnerships. Forms of cooperation include but not limited to:

A. Consultation
B. Research
C. Scholarships and rewards
D. Training
E. Formation of industrial advisory committees

A. Consultation

Faculty members in the college of engineering 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.

B. Research

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 twelve endowed research chairs in the college of engineering funded by the industry as shown in Table IV [6]. 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. College of engineering 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 college of engineering in 2011 is 266 papers, most of them came from the research chairs [6]. These outputs showed the high level of achievement of college of engineering faculty.

TABLE IV
RESEARCH CHAIRS IN COLLEGE OF ENGINEERING

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

A. Scholarships and Rewards

Industry supports the educational aspects in the college through the provision of scholarships to the outstanding students in different departments of the college of engineering. It also includes the provision of awards to the outstanding graduation projects in the departments. Table V 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 [6].

D. Training

Training is done by two ways. The students of college of engineering 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 406 students in more than 100 government and industry institutions [3].

TABLE V
COMPANIES PROVIDED SCHOLARSHIPS TO THE OUTSTANDING STUDENTS IN 2012

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

Also, college of engineering provides specialized engineering training courses in different fields to the engineers working in industry. It also, provides testing and taking advantages of the facilities and laboratories of the college for industry companies.

E. Formation of Industrial Advisory Committees

The integrated relationships between college of engineering and industry have culminated in the formation 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 [6]:

- 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 college of engineering
- 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 [7]
- Enhance partnerships between faculty members and selected people from industry through senior capstone projects and research projects in selected areas [7]

V. SUMMARY AND CONCLUSIONS

The relationship of college of engineering at King Saud University with industry has developed over the years to full-fledged partnerships. This paper presented the various aspects of collaborations which include but not limited to: consultation, research, scholarships and rewards, training and the formation of industrial advisory committees.

The collaboration improved research activities and the funds from industry lead to the establishment of many research chairs in the college and helped to get thirty four patents in the college and to publish more than 266 papers ISI papers.

The collaboration helped outstanding students to get scholarship from industry companies. The scholarship included monthly salary as well as training and possibility of employment. Although there are only three companies at present time, the college is planning to get more companies in future.

College of engineering provides specialized engineering training courses in different fields to the engineers as well as providing testing and taking advantages of the facilities and laboratories of the college. The integrated relationships between college of engineering and industry have culminated in the formation of industrial advisory committees for the individual departments and at the college level.

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