



## TECHNICAL AND ENGINEERING EDUCATION

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### ABSTRACT

*Education in Engineering and Technology in the Kingdom of Saudi Arabia has gone through many major developments. It is part of the general educational system that was built up in the 1950s. Many Engineering and Technology Colleges and Institutes have been established in this country in recent years. In this paper , a history review of engineering and technical education will be presented along with the current status. Globalization and advances in technology as a tool to help deliver and innovates engineering and technical education was also discussed. Finally, challenges and future outlook for engineering and technical education is presented.*

**Keywords:** *Engineering, Technology, Technical Education, Vocational Training, Colleges.*

### 1. INTRODUCTION

Late King Abdul-Aziz united the Kingdom of Saudi Arabia in 1932. At that time, trades and jobs of the residents of the new state were pasturage, farming and commerce. Shepherds of the Bedouins at the little transient green areas amid the endless deserts conducted pasturage. Farmers practiced traditional agriculture in the rural towns and oases of the north, center, east and south. There was some trade activity mainly in the ports of the Red Sea and the Arabian

Gulf. There were not the diversification and specialization of the modern economic activities. No training was required because anybody with the help of unskilled labor and some devices could easily do such activities.

With the discovery of oil in Saudi Arabia in the forties of the last century, the government thought of utilizing oil revenues in building the infrastructure of the country i.e. water, health and power facilities, roads, schools and essential industries. The development in industrial, agricultural and commercial sectors necessitated required dependence of expatriate specialized manpower. The strategic perspective was to qualify and train local manpower to gradually take over from the foreign manpower. First trials of inservice training started in Aramco [Alqahtany, S., et al., 2000]. Several government agencies also delegated picked out citizens to train and study in the neighboring countries. The budget surplus during the economic boom period of the seventies in the last century drove further the tendency of scholarships to the USA and Europe.

Several local studies foresaw technical education as the first priority in this strategy. Technical education began under the Ministry of Education but vocational training was a department under the Ministry of Labor. The first industrial school was inaugurated in Jeddah in 1949 [Alqahtany, S., et al. , 2000]. The next two decades saw the opening of at least 10 industrial, commercial, and agricultural schools. After the oil crisis in the seventies, things had changed with the soaring of oil prices. Saudi Arabia and other Gulf States moved faster from the Bedouin roaming life to the agricultural settled society, and further to modern industrial and commercial communities as a feature of the economic boom era. It has become necessary to restructure and develop a new technical education and vocational training system to provide the qualified technical workforce needed in the different industrial, agricultural and commercial new facilities. In the light of the above, the General Organization of Technical Education and Vocational Training (GOTEVT) was founded in 1980 [Aldhalaan,S., et al., 1999].

Engineering education, on the other hand, was affiliated with the Ministry of Education until the Ministry of Higher Education was established in 1975. Although there are eight universities, only four of them provide engineering programs through more than ten colleges of engineering and computer science

## **2. TECHNICAL EDUCATION**

The major functions of GOTEVT include; providing training for the Saudi citizens in various sectors of economy; soliciting the support and involvement of the advanced industrial countries; continuous training and improvement of teachers and instructors; updating the curricula and syllabi; and conducting research work. The GOTEVT provides three main categories of vocational and training education [Tang, Q., 1998]; Vocational Training Centers,

Secondary Technical Institutes, and Higher Technical Education (Colleges of Technology). In this section, each of the three categories will be discussed in some detail.

### 2.1. Vocational Training Centers

It is a current priority for Saudi Arabia to establish vocational training centers in all the provinces to satisfy the fast growing economic development needs of laborers and technicians. These centers provide training for Saudi youth with at least elementary education (Grade 6 and above) in morning and evening sessions. The duration of study ranges between 6 months courses and two-year diploma. At the end of each course the trainee acquires a certificate of attendance and diploma certificate for those who complete the full course. There are 30 vocational training centers kingdom-wide [Tang, Q., 1999].

Duration of the Diploma morning courses is two years (4 semesters) providing courses in general electricity, radio and TV, car mechanics, refrigeration and air-conditioning, carpentry, plumbing, printing, welding and metal sheet. Evening courses are presented for a period of six months to provide short courses comprising some of the above mentioned trades.

These vocational training centers act for conveying ordinary workers into highly skilled technical workers (with academic certificates) and supply them with the necessary skill, expertise and work chance if possible. The vocational training centers prepare workers to be knowledgeable of modern industrial technology and production techniques in different disciplines.

### 2.2. Secondary Technical Education

There are three categories of secondary technical institutes: **Technical Industrial Institutes, Technical Commercial Institutes, and Technical Agricultural Institutes**. These institutes accept intermediate school graduates (Grade 9) for a period of three years, offering graduates with the secondary diploma at the end of the period. This level is the core of technical education and training.

The industrial technical institutes offer the course of mechanics, which include general mechanics, metal works and agriculture machinery. Electricity course includes electrical installation and electro-mechanics of electrical appliances and instruments. Car mechanics course includes vehicle mechanics (gasoline) of auto-electrical branch, diesel mechanics, and electro-mechanical repair. Electronics course includes industrial electronics and audio-visual instruments.

The commercial technical institutes teach the programs of business administration and secretariat; accounting and financial affairs; economy and commercial correspondence. The agricultural industrial institutes offer the programs for agricultural production and animal production.

Graduates with excellent grade from the secondary technical institutes may have the opportunity to pursue their higher education at one of the colleges of technology. Nowadays, a pilot project is trying to raise the level of some of these institutes to develop these institutes into the college level where the demand is very high from the technical institutes graduates to enter this kind of education. Now Saudi Arabia has 35 technical institutes [Alqahtany, S., et al., 2000].

### **2.3. Higher Technical Education (Colleges of Technology)**

The Higher Education Committee stressed the importance of technical education at the college level to provide the country with high-level technicians to work for the modern and sophisticated industries as assistant engineers. The first college was established in Riyadh in 1983 [Alqahtany, S., et al., 2000]. The colleges of technology have an education system with specific characteristics. Period of study is three years. Each year is divided into two semesters. 90 credit hours are required in the three years. Admission is limited to the general secondary school graduates and the technical secondary school graduates. This level of technical education has gone through a number of successive developments. The last major change was applied in 1999.

The College of Technology in Riyadh provides a 5 years bachelor degree program to provide the graduated with the engineering technology degree in the different fields of technology. Currently, there are seventeen colleges distributed over the different regions. Seven more colleges are yet to be opened in the next five years [Aldhalaan, S., et al., 1999].

The medium of instruction in the recent program is English and the first year includes an intensive English language program as preparation for the coming years. More basic science courses are provided during the first year as well. One semester of cooperative training is offered in collaboration with the private and public sectors. There is more emphasis on communications, computer technology, petrochemical technology and Electro-mechanical technology. The location of the college and its proximity to specific industries both have deep effects on the programs offered.

### 3. ENGINEERING EDUCATION

The higher education of engineering in Saudi Arabia has two paths; The first path is the university path with four to five years of academic study to obtain the Bachelor of Engineering through four to five years of study at one of the colleges of engineering. The requirement for admission at the university engineering program is the General High School Certificate. The second path is the technical education represented by the colleges of technology (as described in the previous section). The students of this path may continue their study to obtain the Bachelor of Engineering Technology from the college of technology in Riyadh for a period of 3 years following the associate diploma.

Engineering education is one of the most important fields required for the development plans in developing countries. Colleges of engineering provide the national market with a growing number of engineers year after year. Four universities provide the engineering specialties in Saudi Arabia. The engineering programs have a specific function, namely the student's development of knowledge and skills with respect to engineering, technology, analysis and preparation of work. Thus, universities act on preparing their graduates to satisfy the market needs and to keep pace with the world scientific and technological development.

When we think of the march of technical and engineering education in Saudi Arabia, we see a foreign expertise participation in the development of programs, teachers qualification and equipping its laboratories through intergovernmental technical cooperation agreements with some industrial countries such as Germany, Japan as well as the USA which has wide choices in technical and engineering education. This assistance mostly focuses on [Ezo, M., et al., 1998]:

- Special training for the teachers and technicians and qualifying them to adapt to the requirements of the local market technology;
- Transfer of the experience of these countries in educational and administrative organization, and setting specified criteria for efficiency, performance evaluation, discipline and directing the cadres vocationally and academically;
- Providing the educational institutions with the highly efficient and experienced personnel and benefiting from the high caliber education which characterizes these industrialized countries.
- Equipping laboratories and workshops with facilities that are inline with the advancement of modern technology
- Participation in establishing occupational training centers on a large scale all over the country by coordination with the private national companies to cater for market needs in accordance with the economic and social conditions.

#### **4. TECHNOLOGY ADVANCEMENT AND GLOBAL MARKET**

The region in general and Saudi Arabia in particular pass through the turn of the new century with various economic and social challenges and aspirations that have international and regional dimensions [Jalal, Z., et al., 1998]. In view of the contemporary technological development, many economic and cultural barriers disappear with the advancement of science and communications technology and easiness of transport and under the international tendency towards liberating international trade and lifting boundaries between countries. All these factors lead to more intense competitiveness between major industrialized countries, and more monopoly on the international market. The result will be narrower economic and scientific competition on the part of the developing countries with an impact on their different development programs.

Therefore, a need arises for new skills and expertise, and new methods of production and manufacturing that are able to compete in the international markets. This imposes a responsibility on the science, training and educational institutions to permanently upgrade the abilities of their graduates to grasp the sophisticated technologies and create their own contributions.

Hence, we stress the necessity of developing and modernizing the educational capabilities and the efficiency of the graduates (engineers and technicians) to meet the new challenges by preparing a "Global Engineer". We also need to benefit from the cultural, commercial and scientific openness offered by the new world trade tendency seen in the World Trade Organization agreements.

The major benefits that may be gained from this New Global aproch are:

- The easiness of dealing with the scientific and research institutions inside and outside the Kingdom primarily King Abdul-Aziz City for Science and Technology and universities in the USA and Japan through technology transfer, resident short term and long term experts, information exchange and technical cooperation in general;
- Benefiting from the scientific advice and finding the practical solutions to the problems facing the students and researchers in preparing their technical projects;
- The presence of research centers and laboratories and advances in communications media and the availability of libraries and modern periodicals for the service of research work;
- The easiness of getting the means of learning a foreign language by students and researchers, most importantly English which has a major role in developing the technical and engineering education and opening new horizons of knowledge in world literature; and
- The easiness of knowing the mechanisms of the new global market from the fundamentals of economy and accounting and the new innovations in science and technology.

## 5. CHALLENGES AND FUTURE OUTLOOK

No doubt that the tremendous progress in technology and in engineering sciences in general, the intermingling of the product markets and the emergence of new world trade imposed a new reality on the policies of education. The biggest challenge faces the engineering education, as it is more absorbent of the ever-emerging new technologies. This shoulders on the educational institutions the responsibility of upgrading the abilities of their graduates with respect to assimilating the new technologies, being creative, knowledgeable of the market mechanisms, manpower availability, and mastering English. These form a hindrance before recruiting the graduate in the marketplace especially in the industrial sector, which depends on expatriate manpower.

There are other difficulties such as the inability to meet market requirements i.e. the delicate specialties, which multiply fast with the discovery of new technologies in the industrial sector. The educational institutions have to always change their curricula and courses to adapt with the technological and industrial development in the world. This change has a big financial cost and it is difficult to do in a short time. These delicate specialties are not taken into account upon drafting the development plans because the quick emergence of new technologies with the passage of time not known before.

The development of Saudi Arabian economic growth depends mainly on the education and training of its workforce to attain the skill and knowledge needed for new industrial and technical sectors. The ever-increasing world market competitiveness and technological sophistication bear on the national economy and workforce needs. As a response to this competition, a new approach for workforce development and success is fundamental. Such approach may include:

**(i) Flexible training courses;** the engineering and technical institutes should develop a flexible and various training programs including intensive short courses and in-service together with training for specific functions or technology. There may be need for morning and evening sessions. The variance in specialties, timing and approach will meet the diverse needs of local workforce.

**(ii) The use of modern technological means and the new engineering training methods;** it is a requirement. This takes the form of workshops, seminars, brainstorming sessions, presentations using audio-visual aids, computers, simulators and the Internet. These new methods of teaching and training can be robust means for addressing many of the Saudi manpower training needs.

**(iii) Advisory committees, with the private sector in the adjacent locations;** recommended to be formed to review the curriculum programs based on their requirements. In view of the introduction of new technologies and innovations, the needs of the workforce for continuous

development are growing. Many engineers and technicians, and professionals think of changing carriers. Engineering and technical institutes and the private sector must allow for this dynamism in the work market.

Although there has been cooperation between educational institutes and both the public and private sector enterprises, a more intensive direct contact with these enterprises is strongly recommended. Not only would this cooperation lead to the absorption of a high percentage of the graduates, but also would provide high-tech equipment (workshops and laboratories) and work place training for the students.

More emphasis should be placed on encouraging self-employment among the students. This could be achieved by introducing some enterprenial courses in the curriculum of the centers, institutes and colleges. Due to the saturation of many public enterprises and some private sector enterprises, self-employment in small businesses becomes necessary for the graduates.

Here we need highly qualified teaching staff to maintain a quality teaching and training with many of the teaching and management staff being trained in some developed industrial countries like U.S.A., U.K., Germany, Japan, etc. These technical trainers normally have at least several years of industrial experience before being employed in the teaching profession. They all have a deep understanding of the needs of the technical advancements and well informed of the current trends.

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