Session 0560

Engineering and Engineering Education in Egypt

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I Introduction

The long history of Egypt is marked by a number of engineering achievements which gave it a well deserved reputation of a nation of great builders.

Foremost among these achievements is the construction of the first stone building in the history of mankind, the stepped pyramid of Sakkara which is associated with the name of its architect Imhoteb, the eminent figure of engineering and medicine deified by the ancient Egyptians and revered by the Greeks for centuries.

Another example of engineering achievements is the construction of the Giza pyramids which required not only a mastery of many sciences and technologies such as geometry, cosmology, architecture … etc but also the management of a work force consisting of tens of thousands of workers that had to be housed fed and medically treated on the construction site.

The list of engineering achievements is large and encompasses all the civilizations that flourished in the Nile Valley. It includes the temples of Karnak and Abu Simbel, the Pharos of Alexandria and the mosque and madrassa of Sultan Hassan among others.

This history is also associated with the creation of the first forms of "universities" as centers for the generation, conservation and transmission of knowledge. Oun (3000BC) best, known as Heliopolis, was the first center of its kind and was the mecca of Greek philosophers, scientists and historians. The Bibliotheca Alexandrina and its Museum (300BC) brought together the scientists and philosophers from all parts of the Mediterranean and preserved the knowledge of all the major civilizations along its shores. The University of Al Azhar (10^{th} century AD) was and remains the major that flourished theological center of the Moslem world.

II Origins of Modern Engineering Education in Egypt

Modern engineering education in Egypt started in the aftermath of the cultural shock provoked by the French Expedition lead by Napoleon Bonaparte which occupied Egypt from 1798 to 1801. It was a fundamental component of the policy of Mohamed Aly, the founder of Egypt's Royal Dynasty, to modernize Egypt and integrate it in the international economy. Engineers were needed to take in charge the large infrastructure projects (specially in the field of irrigation) and the new industries required by the new modern state.

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The first school of Engineering dates back to 1816 and was located in Saladin's Citadel. It was followed by a regular school in Bulak (Cairo). In 1858, two new engineering schools were created. The first, dedicated to irrigation was located at the Delta "Barrage" north of Cairo. The second, specializing in architecture was housed in the Citadel. They were replaced again in 1866 by a single school for both disciplines and moved to Abbasia, then a new suburb east of Cairo. In 1886, the Ministry of Education and the "Ministry of Public Works" established new by-laws for the school and imposed a 5 year curriculum.

The Royal School of Engineering was created in 1902. It moved in 1905 to its new location in the buildings occupied presently by the Faculty of Engineering, Cairo University. In 1916 five departments were created : Irrigation, Architecture, Public Works, Mechanical and Electrical Engineering. In the following two decades, the Royal School of Engineering witnessed a large development in its facilities, staff and students.

In 1935, it joined Cairo University, (Fouad 1st University at the time) to become the Faculty of Engineering. It remained the sole Faculty of Engineering until the creation of the Faculty of Engineering of Alexandria University in 1942, followed by that of Ain Shams University in 1950 and that of Assiout University in 1957. Presently there are 19 engineering faculties belonging to state universities and 9 faculties belonging to private universities in addition to a large number of high technical institutes.

III Curricular Models and Influences

Engineering education, from the beginnings all through the 19th century, was basically influenced by the French model as the process of modernization, started by Mohamed Aly and pursued later by Khedive Ismaïl, was carried mainly in cooperation with France. This influence was materialized by sending the first mission of Egyptian students to Europe in 1826 to study in the "Ecole Polytechnique" in Paris. On their return they formed the nucleus of the new Egyptian engineering community.

Moreover, the installation of the disciples of St Simon between 1833 and 1851 in Egypt with their strong engineering background, emphasized the French presence in engineering education and practice. One of them, Lambert Bey, was the Director of the School of Engineering from 1838 to 1851. Moreover they designed and supervised the construction of the Delta dam (Barrages) and contributed the first plans of the Suez Canal.

In the beginning following the French model of the "Ecole Polytechnique" and "Ecole des Mines", the school curricula privileged theoretical studies specially mathematics. Soon it was realized that the model of the "Ecole Nationale des Arts et Manufactures" was more adequate as its curricula were more technology oriented.

The fall of Egypt under British Occupation in 1882, brought the dominance of the British influence and model. It was established from 1902 to 1924 through the first three directors of the Royal School of Engineering, who were British. However the presence of Dr. Charle Andrea, a former professor and dean of the Zurich School of Engineering (ETH), at the head of the Royal School from 1928 to 1937, together with the major improvements, he introduced in the curricula and the large number of labs and workshops he created, introduced a noticeable central European influence.

The advent of the 1952 revolution signaled the end of the predominance of the single model. The new modernization process based on "intensive" industrialization required the increase of the n° of faculties of engineering. The new staff members earned their PhD's in the USA, Canada, France, the UK, Germany and, for a limited period, from USSR, East Germany and Tchequo slovakia.

Nowadays, the curricular models vary widely from one discipline to the other, with the anglo saxon model remaining the predominant one. The North American model however prevails in specific disciplines such as electronics, telecommunications, computer engineering, petroleum engineering, biomedical engineering and aeronautical engineering.

IV Student and Staff Demographics

The number of engineering graduates from Egyptian state universities grew from 140 in four disciplines in 1941 to 12213 in 2001 in 14 different disciplines (Fig.1). In the same period, the number of students graduating from the Faculty of Engineering, Cairo University grew from 140 to 1613 and the number of staff members from 209 in 1970 to 717 in 2001.

The number of undergraduate students registered in state universities in the academic year 2001/2002 was 104315 whereas the number of postgraduate students was 10034 for an academic staff amounting to 3572 resulting in an overall student to staff ratio of 32. The corresponding figures in the Faculty of Engineering, Cairo University give 11895 undergraduate and 3539 postgraduate students for an academic staff amounting to 717 resulting in a student to staff ratio of 21.5. This is compared to 34.3, 33.3 and 28.5 ratios for Alexandria, Assiout and Ain-Shams universities.

The distribution of the graduating students over the different disciplines varied over the years according to job market variation. In 2002 32% of the graduating students from the Faculty of Engineering, Cairo University specialized in Electrical Engineering, 21% in Civil Engineering, 13% in Mechanical and Aeronautical Engineering, 13% Architecture, 13% Petroleum, Mining and Material Engineering 8%, Chemical Engineering 5% (Fig.2). The staff distribution among the different disciplines reflects globally the same trend.

One of the most striking features of engineering education in Egypt has been always the relatively large percentage of female students compared with their percentage in western schools of engineering.

In 1999/2000 this percentage varied between 25% for Assiout University which belongs to the South of Egypt and 35% for Alexandria University, the national average being 30.5%. This is to be compared to 50.16% ratio for the total university population. It should also be noted that this feature is not new although the figures grew steadily in the last five years (Fig.3). In the early 1960's this ratio was almost 10%.

The female graduates represent more than 50% of Architecture and Chemical Engineering graduates, around 30% of those of Electrical Engineering, 25% of Civil Engineering and around 15% of the Mechanical Engineering ones (Fig.4).

On the staff side, the percentages are less pronounced by are still much larger than the corresponding in western engineering educational institutions.

V Brain Drain and Migration Trends

The Egyptian engineering community has been very seriously affected by intensive brain drain toward the West for the last four decades. A good percentage of would be university staff studying for their PhD. in European and specially North American countries stay there or return there after a short stay in Egypt. This phenomenon is specially pronounced in the fields of information and communication technology.

The brain drain is not limited to Western countries. Arab and specially Gulf countries attract almost 25% of the staff of engineering faculties in Egypt to teach in their engineering schools the Egyptian law allowing university staff to be detached for periods that total 10 years in Arab universities.

The attraction exerted by the Gulf countries is not limited to university staff. Tens of thousands of practicing engineers in all disciplines are currently working in egyptian, local and international engineering firms operating in the Arab World.

VI Challenges for Engineering Education

The rapid developments in science and technology, the stronger incorporation of Egypt in the world market, the rapid fluctuations of the job market and the growing student population represent some of the challenges facing the engineering community in Egypt.

In general the large number of students is the major challenge. It limits student-professor interactivity whether in the class room or in graduation projects, and provide less opportunities for experimental work. This adversely affect the quality of education and requires major investments to create new campuses, modernize teaching and research facilities (labs, workshop … etc), and increase and motivate staff members.

The growing presence of international companies in Egypt, and the growing number of Egyptian companies operating the international level requires a "standardization" of the engineering education and of its "products" along "internationally accepted criteria", this requires a TQM approach which covers not just the curricula but all the components of the educational system.

The rapid fluctuations of the job more and the constant emergence of new multidisciplinary specializations necessitate an educational system that provides the student with a strong basis in fundamental sciences and which is flexible enough to adapt to the students desires and job market requirements. In general, an appropriate credit hour system with efficient tutoring is the answer but student demographics limit its applicability for the time being.

Another major problem facing the academic engineering community is the increase of the average age of the staff on account of the brain drain resulting from low remuneration and inadequate research facilities.

Presently there exists several initiatives sponsored by the Government and several international organizations to address these crucial problems.

Conclusion

Engineering education in Egypt is almost two centuries old. Over this period it was exposed to a variety of influences and adopted different models. Egyptian engineering educational institutions not only were the first in the region but also contributed to the creation of engineering schools all over the Arab World and contribute almost 25% of its staff to teach in them. The engineering community in Egypt is by far the largest in the region and participated over several decades in the implementation all types of engineering projects in it.

The engineering community is challenged to modernize and expand its educational and research institutions in order to respond with a quality education to rising student demographics, to a more demanding job market and to an ever increasing international competition. I am sure that the Egyptian engineering community will live up to this challenge.

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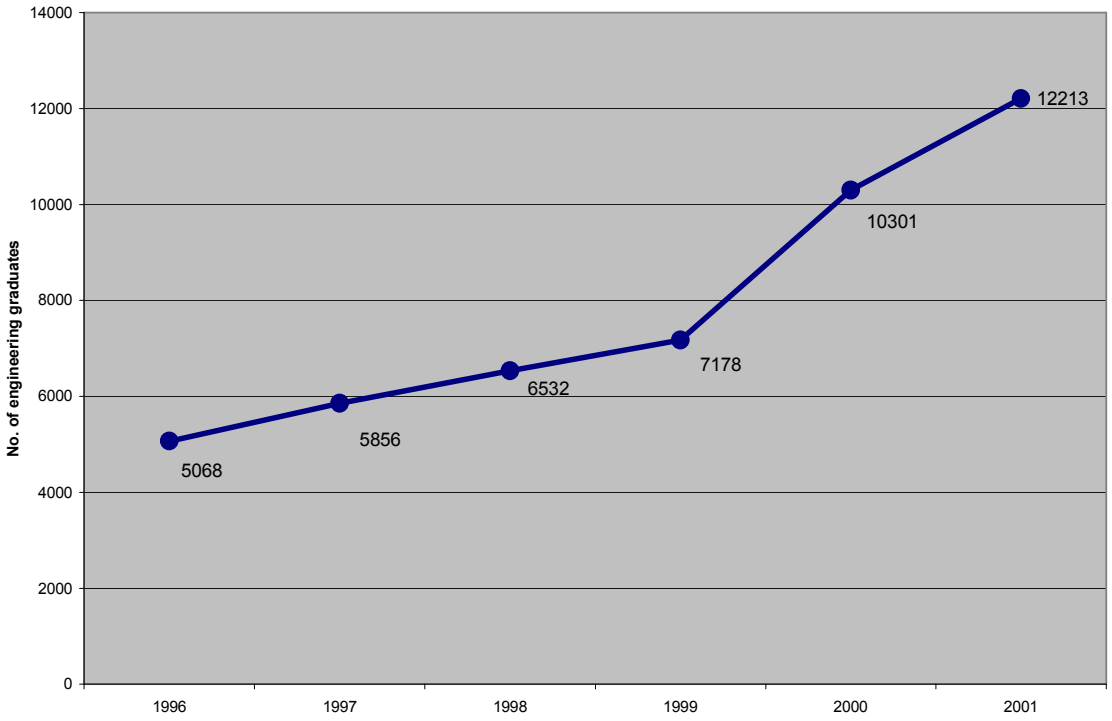

Fig.1
Total no. of engineering graduates (1996 - 2001)

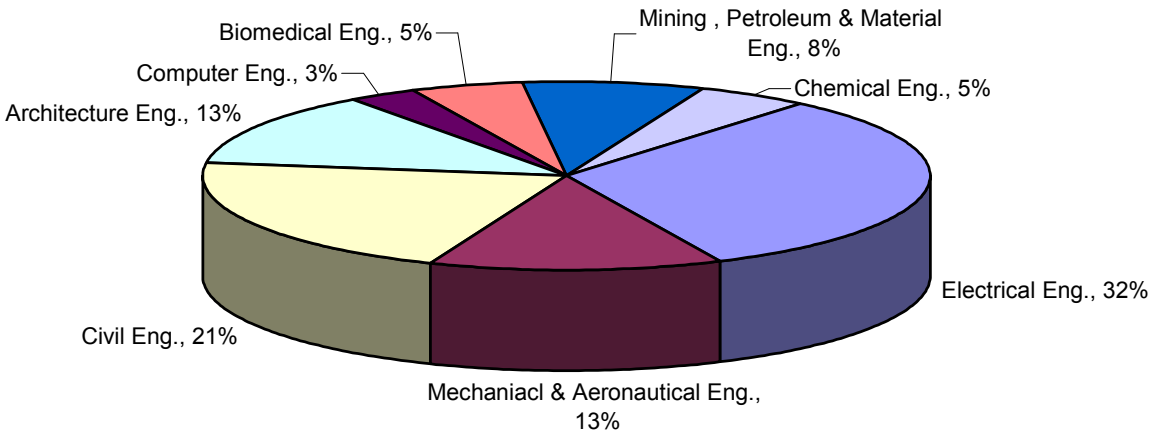

Fig.2
Distribution of engineers graduating from Cairo university in 2002 among different specializations

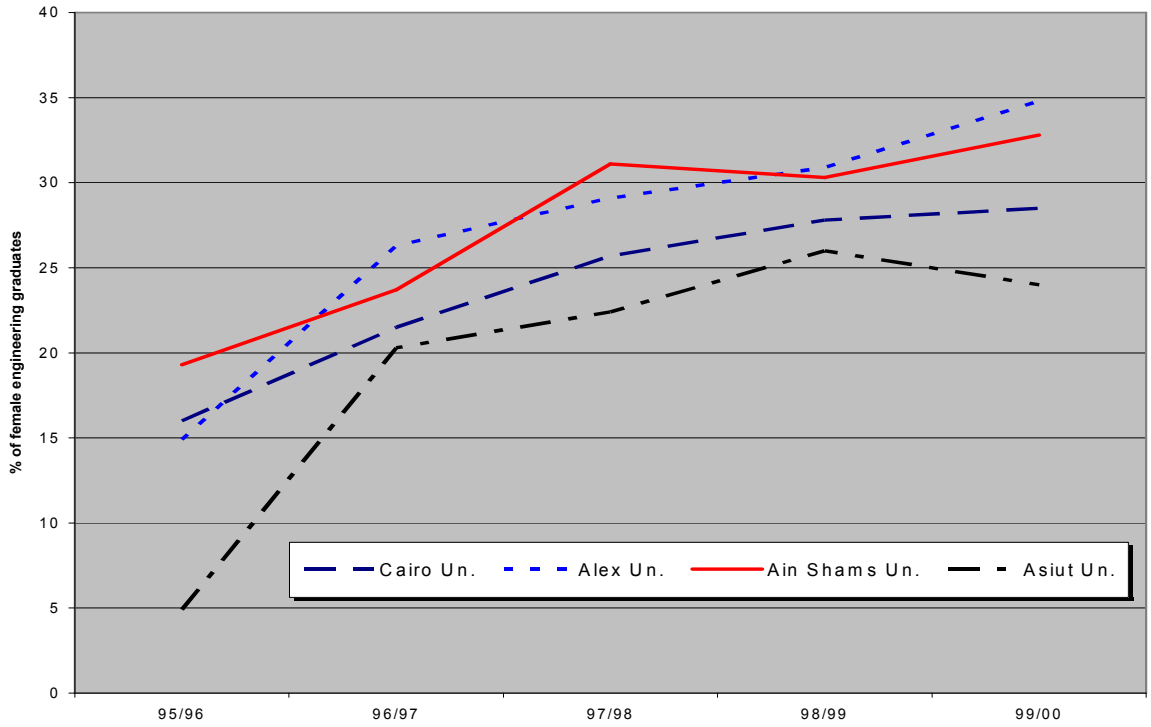

Fig.3
Evolution of percentage of female engineering graduates in the main state universities

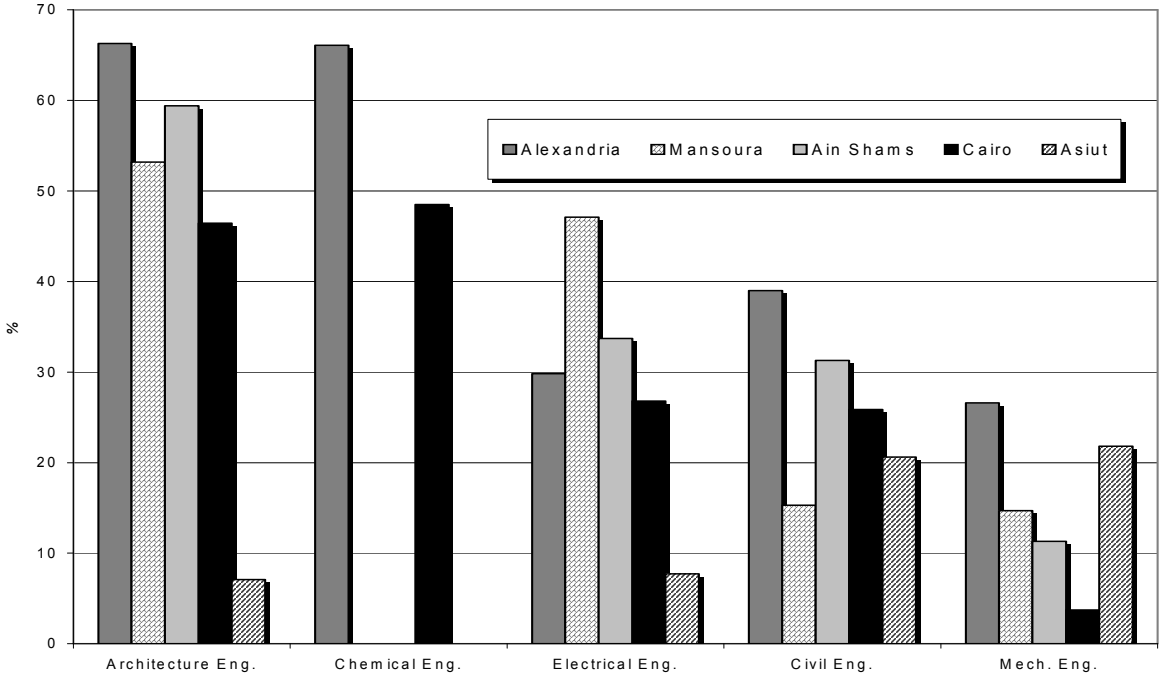

Fig.4
Percentage of female engineering graduates in the main engineering disciplines in the main state universities