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Engineering Education and Training

by

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Introduction

The educational system in the Philippines in the tertiary level is different from higher educational systems found in other countries. Ours is probably the only country where the responsibilities of engineering education fall primarily on the shoulders of private engineering schools. These responsibilities are to the individual, to society and to the profession. Engineering schools have the responsibility to develop in the person his potentials to enable him to pursue a personally satisfying career in engineering after graduation. To society, the schools are responsible for graduating competent engineers who are expected to serve society wisely. To the engineering profession in general, the schools have the responsibility to graduate engineers who are expected to push the frontiers of knowledge and be called to further the cause of their profession.

While in other countries tertiary level education is heavily supported through government funds, in the Philippines, funding to support higher education comes primarily from resource generation of private schools. This situation highlights both strength and weakness. The strength lies in the fact that the Philippine government spends a smaller amount for higher education as compared to other countries. This constitutes "savings" for the government. The weakness lies generally on the motivation of private schools and their lack of funds which have invited concerns and serious questions on matters such as standards, facilities, faculty, quality of graduates and, in general, their capability to meet the responsibilities of engineering education.

During the past decade, the educational system of the country has been undergoing some reforms as a result of a national policy to make the system more responsive to the needs of society. In general, the government is fully committed to achieve a better quality of life for every citizen. Engineering education therefore must fully respond to this concise commitment of the government.

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Current Situation

As of December 1982, there were 172 schools offering engineering courses or programs (including both complete and incomplete five-year programs) in approximately 15 separate disciplines. Approximately 85 percent constitute private schools and 15 percent were state supported institutions, including the University of the Philippines. These figures reflect a period of rapid growth in the interest of students in engineering and technology, considering that in 1969 there were only about 79 schools that offered courses in engineering.

A recent survey * on engineering and technological manpower in the Philippines has yielded some findings. The following are some of the more important findings of the survey:

* based on 30% sampling proportion, the computed number of engineers employed in Metro Manila would be approximately 64,000 and 19,000 in the other 12 regions of the Philippines, or a total of 83,000;
* a total of 12,068 was computed to have graduated in 1980;
* the total demand for engineers in 1980 was calculated to be 10,110;
* there was an excess of approximately 2,000 engineers in 1980 (which added to the 1979 unemployment figure);
* it was estimated that 30% of the engineering graduates currently employed are doing the work of technicians;
* the estimated cummulated excess of supply over demand would increase from 4,991 in 1980 to 12,800 in 1984 should the trend in annual enrolment growth rate (7.8%) be maintained;
* there was a general consensus of those surveyed that the curricula were inadequate which necessitates an on-the-job training for new graduates;
* limited, poor or obsolete laboratory facilities made it difficult for many engineering schools to extend adequate training to students;
* more than 50% of officer-respondents surveyed commented on the poor communication skills of engineering graduates in their respective companies; and
* there were 125 engineering schools offering five-year engineering courses in 16 separate engineering disciplines.

It was however observed that although the supply of engineering graduates exceeded the demand for professionally qualified engineers, the demand for well-trained professional engineers exceeded the available supply. It was also observed that although there were more than adequate numbers of engineers, the quality, however, appeared to be weak in both theoretical and practical aspects of the profession.

Transfer of faculty members to industry has made the maintenance of quality instructions in engineering schools a serious problem. Retention of highly qualified faculty members as well as the design and the conduct of programs for faculty development have become major concerns considering that the staff of many engineering schools are composed almost entirely of engineers whose academic preparation did not go beyond the bachelor's degree level.

*Engineering and Technological Manpower Survey in the Philippines – 1980, EMGI.

Aside from some inadequacies that were observed regarding the various engineering curricula, one major criticism made is the inflexibility of curricula which render them unresponsive to the ever-changing needs and dynamic state of technological development.

Improvement of Engineering Education

Given the problems facing a large number of engineering schools in the country, which include the lack of well-trained teachers, the lack of laboratory facilities, inadequate space, outdated curricula and lack of financial support, programs for the improvement and upgrading of engineering education should be formulated. In general terms, the following measures, among others, should be taken:

* Engineering teachers should be given the necessary training and background in order that they could design curricula, formulate experiments, introduce innovative methods in teaching, design teaching materials, inspire their students to strive for quality performance and when and where possible, make available their expertise to government agencies and industry through research and consultancy;
* Considering the generally prohibitive costs of laboratory facilities and other equipment, schools should be encouraged to build and fabricate laboratory equipment and experimental set-ups using locally available materials whenever possible, with the minimum of basic measuring instruments and recording equipment imported from other places;
* To prepare students, undergraduate curricula should be designed to offer the prospective engineer the science courses in mathematics, physics, chemistry and a sound foundation of engineering courses. To round out their education in order to *humanize* them, their curricula should include general education courses as well as other courses which would make them aware of the need to safeguard the quality of life and its environment;
* Additional funding should be sought through loans, grants, increased industry support, increased fees and revenue generation through consultancies, research projects, and use of laboratory and testing facilities;
* Development of other cooperative programs with industry and other government agencies to increase the practical experience of students and to expose students to the more modern industrial equipment not ordinarily found in engineering schools;
* Encourage the participation of industry people and practicing engineers in classroom lectures as well as school seminars and workshops;
* Encourage interlibrary loan and exchange of instructional materials; and
* Encourage formation of consortia among schools for purposes of facilities/faculty sharing.

Agents of Change

The Philippine government has been continually exerting efforts toward the development of projects aimed at improving the quality of education at all levels. Within the overall development plan, high priority is given to the improvement of

engineering education in the country.

A project (EDPITAF-managed Engineering Education Project) was initiated by the Philippine government, through an Asian Development Bank loan and was intended to undertake four major activities during its implementation, namely:

* Improvement of the Government's management and regulatory systems;
* Development of a national standard system for engineering education;
* Provision of improved facilities, teaching equipment and materials to selected institutions; and
* Development of staff and faculty training programs.

Agencies (agents of change) that perform pivotal roles are the College of Engineering of the University of the Philippines (UPCE), the National Engineering Center in UP (NEC) and the Technical Panel for Engineering Education (TPEE) of the Ministry of Education, Culture and Sports (MECS), which is also housed in the NEC.

The UPCE offers masteral programs in the various engineering disciplines, including engineering education which are open to both engineering teachers and practicing engineers. The Masters in Engineering Education (MEE) provides graduate students advanced training in both the professional courses and in the field of education.

Among the functions of the NEC are the tasks assigned to it by the Project. These include the administration of seminars and short-term courses for engineering teachers, the preparation of teaching materials, design of laboratory experiments and equipment (including their selection), assistance to the TPEE in such matters as curricular revisions and the administration of some programmed activities.

Technical Panel for Engineering Education

The TPEE, in general, operates and serves as a staff consultative and advisory body to the MECS to study and recommend strategies to rationalize and make more effective the existing and proposed engineering institutions with regard to their operation, course offerings, facilities, personnel, organization, funding and output standards. The TPEE was created on August 3, 1977 by the then Department of Education and Culture. There are seven members of the Panel, namely:

* The Director of the Bureau of Higher Education (as Chairman)
* The NEC Executive Director (as Vice-Chairman)
* A representative each from NEDA and PRC
* One representative from industry
* Two representatives drawn from the faculties of engineering schools

A secretariat, headed by an executive secretary and composed of staff engineers and clerical staff, provides support services to the TPEE. Consultants, some working on full-time basis while others on part-time status also provide technical assistance to the TPEE.

Some of the specific duties of the TPEE include the following:

* To study the current and prospective supply of, and demand for, engineers in both national and regional level;
* To recommend development plans which will provide the framework for determining the appropriate scope, type and number of engineering programs to be offered;
* To recommend qualitative standards on admission, enrolment, faculty, curricula, courses, facilities, instructional equipment, student services, library resources, and other related criteria applicable to all engineering education programs in both public and private schools;
* To evaluate all engineering programs, courses and curricula in both public and private schools for purposes of standards determination; and
* To provide technical assistance in the supervision, inspection and regulation of all existing institutions offering engineering courses for purposes of the maintenance of government authority to operate such courses (also with respect to new schools and/or courses).

The TPEE has developed and formulated a manual of national basic standards for engineering schools and programs. The general objective of such formulation is to ascertain that students are provided with the necessary knowledge and skills consistent with the planned development and growth of the individual needs of society, and requirements of the profession. Items covered in the manual include the criteria for:

* Hiring personnel including administrators, faculty and staff;
* Physical plant and facilities planning/construction/installation including classrooms, laboratories, offices, library and audio-visual system;
* Maintaining effective and efficient services for students;
* Maintaining pertinent, proper, effective and efficient information and records system; and
* Maintaining effective and satisfactory admissions and graduation requirements consistent with pertinent rules and regulations of the MECS.

The development process and the rationale behind each standard were based on a thorough study of conditions obtaining in the country, prevailing circumstances and existing constraints. Every effort was exerted to ensure that the basic standards developed were realistic, minimum, implementable and financially attainable.

The TPEE also reviewed the 1973 MECS-designed curricula for various engineering undergraduate programs (ChE, CE, EE and ME) and proposed revisions to these curricula. Recently also, the TPEE formulated a curricular guideline for industrial engineering with the view of unifying and rationalizing various industrial engineering-related programs.

It was the general desire to design engineering curricula which were properly balanced so as to provide not only the immediate employment needs of the graduates but also their long-term professional needs. In fine, the criteria followed in the curricular revisions were the following:

* Formulate guidelines for the design of engineering curricula appropriate to produce trainable graduates who would suit particular needs of their employment;
* Make the various curricula flexible which would allow innovations in teaching, regional differences in resources, and the offering of options within a given degree-granting program;
* Consider requirements of graduate programs;
* Set a maximum load per semester with not more than 30 hours of actual contact time per week for the students;
* Make the first two years as common as possible for all curricula;
* Provide for the strengthening of technical communication skills development in the curricula;
* Reduction (whenever allowed) in the number of government required courses; and
* Make the curricula valid and relevant for the next five to eight years.

The major components of the revised curricula include the following:

* Specification of minimum requirements for five-year courses (ex: BSChE 171 credit units);
* Specification of allowable maximum credit units common to all courses (210 credit units inclusive of PE, CMT and Theology, or equivalent subjects);
* Description of courses which includes specification of prerequisites and corequisites; and
* Suggested curricular structure for each discipline based on minimum requirements.

The manual for basic standard as well as that for curricular revisions are pending at the MECS for approval.

Continuing Education

Continuing education programs (short- to medium-range courses, seminars and workshops) are important because they provide practicing engineers and engineering teachers some opportunity to keep in pace with the rapidly growing complexities in scientific and technological fields. Accumulation of knowledge has accelerated new technologies which are rapidly being developed while making others obsolete. Engineers and engineering teachers might find themselves unfamiliar with new developments if they could not avail of continuing engineering education programs. For example, twenty five years ago, high speed computers were considered highly sophisticated machines which found general use almost exclusively in industry. Today, because of the rapid development in the electronics industry, cheaper and more powerful high-speed computers are being made available to more users. In this instance, engineers who do not keep pace with this development will find themselves deprived of a powerful computational tool which is almost a must in many professions.

Engineering schools, generally, have some responsibilities to design and conduct continuing education programs. In the University of the Philippines, the conduct of continuing education programs in engineering and allied fields is handled by the NEC.

Research and Extension Services

Research and extension services are generally part of the overall function of institutions of higher learning. Particularly, schools of engineering in their total educational program should provide opportunities for their faculty members to undertake research. Schools should encourage teachers and researchers to do researches which are supportive not only of their academic teaching functions but also to needs of the community, the region and even the nation.

It is said that fundamental or basic research is likely to open up still unexplored fields of investigation thus "advancing the frontiers of knowledge" to extend man's understanding of his surroundings. One who is engaged in fundamental research may not necessarily enter into an area where the sole concern is the utilitarian application of new knowledge. Fundamental research however leads not only to great discoveries of theoretical nature but also to some practical application. Applied research is the research which provides information on the practical application of new discoveries. Applied research however is deliberately aimed at actual and existing problems and needs of society. Rather than conducting researches beforehand and identifying practical applications later, applied researchers determine needs of society and then plan their programs toward these needs.

As a general rule most of the researches in a developing country such as ours, because of some limitations in finances, infrastructure, organization, manpower and other resources, should be applied in nature, and should be addressed directly toward the achievement of a much improved social status and economic level of the country. Research and development programs relevant to these include areas in industrialization, natural resources, energy, food, health, shelter and environmental quality.