TECHNOLOGICAL EDUCATION APPROPRIATE TO A DEVELOPING COUNTRY

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Abstract:

The Philippines offer a singularly interesting case of a developing country in transition to a more industrialized state. The Philippine Government, recognizing the needs created by these often painful social changes has instituted with the help of the Asian Development Bank the Engineering Education Project, a complete re-evaluation and redesign of its technological education system. The goal is to develop a system of technological education of internationally acceptable standards while being specifically suited and appropriate to Philippine national needs and the Philippine cultural environment. The paper describes the main changes suggested in terms of staff upgrading, curriculum modifications, upgrading of physical and administrative facilities by highlighting the specificity of the newly-introduced "Philippine-oriented" accreditation system for Philippine engineering universities. This upgrading problem is very serious and complex due to the fact that tertiary education is overwhelmingly in the control of profit-oriented private establishments that resist any governmental attempts to investigate or control their operations.

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The Republic of the Philippines is presently in the process of transition from a purely backward agrarian economy to a more developed industrial environment. This has resulted in major upheavals in the Philippine social and cultural environment. It has greatly affected the aspirations of its people. The Governement of the Philippines has recognized that one of the major components affecting future growth and development possibilities of the country is the appropriateness and quality of its educational system. Hawaleshka (2) gives an overview of the entire system of Philippine higher education and of its problems.

The Philippine system of higher education is extremely large and diverse for a country of 45 million population and its present state of development. There are over one thousand institutions of higher learning with about 1.2 million students. At last count there were over 180 universities offering B.Sc. degrees in engineering. The striking fact is that, contrary to the experiences in other developing countries the higher education system in the Philippines is practically completely controlled by private interests: only 18 establishments are public. Private establishments are either sectarian, supported by various Church groups or private commercial organizations, some of non-profit nature but most operating with a profit motive. Herein lies the very crux of the problem. These private schools

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have proliferated in response to an incredible desire for education, - any education - by the people. Spanish colonial heritage has degraded the status of non-administrative or non-office occupations and thus the average family sees as the salvation of its children the pursuit of higher studies in the "professions" particularly in commerce and business administration. With the increase in technological sophistication of the country, the Philippinos have increasingly been turning to engineering as a means of obtaining that pinnacle of achievement: the B.Sc. - without regard to the eventual utilization of the knowledge obtained. The private entrepreneur, always eager to provide what the customer wants, created more engineering schools.

Since the government's beleaguered and grossly understaffed Department of Education and Culture cannot possibly thoroughly investigate and review applications for new engineering programs and institutions, most of the recent establishments are not even remotely capable of producing an acceptable engineering graduate. There is no trained staff, no laboratories or equipment, extremely backward working conditions and very non-competitive salaries. As long as they are able to bring in the completely uncritical and passive students and collect the fees, then these schools will continue existing and wasting an important natural resource - the highly intelligent and ambitious youth.

Having recognized the difficulties of its position, the Government has taken a series of steps designed to improve it. It has streamlined the operations of the Ministry of Education. All aspects of higher education are now administerd by the Department of Higher Education which now has several university/government/industry panels to assist it. For example, the Technical Panel for Engineering Education has the task of advising the DHE regarding all aspects of higher engineering education. In particular it is entrusted with the development of a new accrediation process that will be spevifically adapted to Philippine conditions and reflect the need expressed by enunciated long-term national goals and aspirations. A similar advisory panel has been formed with responsibility for technical/vocational education.

The 1981 Engineering and Technical Manpower Survey of the Philippines identified significant overproduction of engineering graduates while at the same time noting a scarcity of high quality graduates and for well-trained technicians and craftsmen. It is a reflection on the cultural environment and of the quality of graduates presently produced by the schools when the Survey noted that at least 30% of engineering graduates employed were employed in jobs of low technician or craftsmen levels although the official job descriptions and titles always included the word "engineer". And so we see "Senior Instrument Engineers" with 18 years experience after graduating from one of the best recognized engineering schools in the country and working for the largest electrical utility actually repairing Bourdon pressure gauges or electric wall plugs.

In actual fact there is no doubt at all that the major requirement of the country is a steady supply of a large number of well-trained craftsmen and technicians. The difficulty is making the population accept that

type of non-professional employment.

The Engineering Education Project.

The Government of the Philippines has secured a major loan from the Asian Development Bank for the purpose of improving the engineering education system with its Engineering Education Project administered by the Educational Developments Implementing Task Force of the Department of Education and Culture of the Ministry of Higher Education. The objectives are

1. To upgrade the quality of education in the four major basic disciplines of civil, chemical, electrical and mechanical engineering.

2. To improve the system of governemntal planning and regulation of the number of engineering schools and students, and the quality of engineering programs and courses.

3. To initiate and formalize a continuous process of faculty training, curricular development and the production, distribution and use of improved instructional materials and equipment.

4. To plan and establish a sound foundation for the later development of specialized and advanced engineering courses.

Common to all these aims is to make the engineering graduate of a quality acceptable by international standards and particularly adapted to the needs of the Philippines.

The Project with the assistance of an international team of consultants has after very careful evaluation of the Philippine situation developed many proposed changes and improvements, some of which have already been implemented.

Actions proposed by the Engineering Education Project.

Since one of the most glaring deficiencies of the Philippine engineering schools is a near-total absence of acceptable laboratories with equipment in operating order, the Project has allocated considerable sums as loans to a selected group of 20 universities for the express purpose of upgrading their buildings and equipment. These universities (as listed in Table 3 of ref.2) are nearly all of the better developed establishments in the engineering field. The expenditures are very closely monitored and should greatly enhance the opportunities for the Philippino student to actually "lay his hands" on some real experimental apparatus. In most situations it was common practice to simply talk about an experiment and never perform it since the equipment was never there or hasn't been in working order for many years (regardless of the sincere assurance of the Dean that every student in his faculty uses the laboratory equipment regularly).

There were essentially no opportunities for engineering faculty to improve

their technical expertise through advanced courses or degrees. The only university offering Master's degrees in engineering was the official governmental flagship of education, the University of Philippines. The Engineering Project has caused the creation of a new program of Master of Engineering Education designed to help upgrade the teaching abilities of university staff by education-type courses as well as specialized courses in their discipline. It is hoped that this and similar new programs will help increase the proportion of engineering faculty with higher degrees. (At present there are essentially no faculty members with PhD's and extremely few with M.Sc's. In many of the newer and outlying universities many staff members have no degree at all).

Very complete and detailed revisions of the curricula in the four major disciplines have been proposed and introduced. It will take many years however before the new system will really be accepted. Without listing individual courses, the new programs propose a common two-year core with discipline separation occurring in the third year. The new curricula also propose major reductions in the onerous (46 credit hours) load of compulsory legislated courses that have no relevance at all to an engineering program. Courses have been streamlined, modernized with specific emphasis on modern technology that can be easily adapted to Philippine conditions. There is increased stress on manufacturing and production engineering, telecommunications and the applications and utilization of microprocessor devices. These are major changes when one considers that the typical Philippine engineering student had never been exposed to any sort of computer or computer programming.

The new Philippine Accreditation Standards for Engineering Education.

It was obvious to the Government that it simply was not able to allocate sufficient funds to adequately maintain and improve all engineering schools and programs in the country to an internationally accepted level. The majority of newer and commercially oriented schools are essentially not salvageable. Only the more serious established institutions offered any hope for significant improvement. Hence the government is faced with the problem of how to reduce the number of engineering schools so that the remaining ones become viable in terms of quality and quantity of output and resources. The problem is very complex as most of these private schools are owned by a powerful and entrenched elite that the government can ill afford to alienate.

The basic question is relatively simple: Which programs and schools should be licenced and supported? Obviously: those that are best for the objective intended, the production of a satisfactory engineering graduate. On what basis is one to judge which schools meet requirements? A set of standards had to be developed to reflect the goals and needs of the country's future engineers.

The Philippine environment is not conducive to a straightforward application of the familiar "peer evaluation" method common to Western countries.

Such an accreditation method can easily lead to abuse. The Project consulting team after a very thorough investigation of conditions, evaluation of alternatives and comparison of many other accrediting systems decided to develop criteria that would be practical, applicable and acceptable to the Philippine milieu. The accreditation standards and procedures used by the Engineering Council for Professional Development (ECPD) in the United States were found to be totally inappropriate to the Philippine setting. Even the previous voluntary accrediation systems that had been developed by some associations of private schools were found to be too vague and open to misuse.

The decision was made to develop the new standards in two steps: the first "basic" standards that the participating schools were to accept and meet within two years of acceptance, followed by permanent "higher" standards to be met within the following five years. It is most important to note that these accreditation standards differ from other known ones by being very specific and quantitative. They are very comprehensive yet very simple and designed to minimize the opportunity for personal subjective judgments and possible influences. It was very difficult for the schools to agree to these standards (even though that from our perspective they are extremely lax) and it is to their credit that they did accept them. It remains to be seen how their application will work out in practice. Their basoc simplicity and appropriateness to the Philippine condition augurs well for their eventual successful utilization.

The following table (Table 1) lists a selected sample of suggested standards that would be included in the first, or "basic" set. The recommended standards are listed according to area of application in the left column, followed by a rationale or explanation as to why this particular standard has been developed. The rationale often offers very pointed comments that succinctly describe the present condition of the Philippine engineering education system. The third column provides a checklist that would be used in the evaluation and reporting process. It provides a series of very clearly stated questions directly based on the appropriate suggested standards in the first column. These questions normally will require only a simple yes/no answer or an easily obtained numerical bit of information. The aim is obviously to facilitate the understanding, acceptance and application of the standards and to minimize possible manipulations. The listed standards are quoted directly from (1).

In the maintenance and development of an adequate product (in this case the engineering education system) the most important tool available is a set of specifications, rules or standards that the product must adhere to if it is to perform satisfcatorily. It is for this reason that this paper goes out of its way to specifically present some of the proposed new standards. It seems to the author that such a set of standards has a much better chance of actually accomplishing its objective than the haphazard imposition of Western standards that have no real application in the still-developing countries.

Table . Selected Representative Sample of Standards: "Suggested Basic National Accreditation Standards for Engineering Education", Republic of the Philippines. Quoted from Ref.1.

SUGGESTED STANDARDS	RATIONALE	CHECKLIST
Personnel The College of Engineering shall have at least: 1. a full-time dean for academic affairs in engineering. 2. full-time department heads in each engrg. discipline, on reduced teaching load (no more than 80% of a full-time teacher's load)	Ensures sufficient top-level administrators conversant with the technical nature fo the engineering school program who are able to devote their full-time efforts to the betterment of the program in engineering.	1. Is the engineering program run by a full time dean? _____ 2. Are there full-time department heads in each curricular area on reduced teaching loads?___ 3. Is the reduced teaching load no more than 80% of the teaching load of a full-time teacher?_
The Dean of engineering shall have authority and responsibility for all expenditures incurred by the College of Enggineering.	Ensures that the person most knowledgeable about the engineering program will have the authority and responsibility for funds spent on engineering programs.	1. Does the Dean of Engineering have the authority and responsibility for all expenditures incurred by the College of Engineering?____
Full-time engineering faculty members shall have at least a Bachelor's degree in either mathematics, chemistry, physics, engineering or a related science.	Persons without mathematical, engineering or scientific training should not be asked to train others in these disciplines.	1. Do all full-time engineering faculty members have at least a Bachelor's degree in an area called for by the standard?___
The institution shall have at least 10% holders of Master's degrees or equivalent in its full-time engineering faculty in each area in which it	Will encourage advanced degree programs while facing realistic limitations on school hiring possibilities in provincial areas.	1. Do at least 10% of the full-time engineering faculty in each discipline in which it offers a degree hold a Master's degree or have 30 graduate hours in an

(continued)

Table cont'd.

SUGGESTED STANDARDS	RATIONALE	CHECKLIST
Full-time faculty members shall have earned by the end of their 10th year of teaching a Master's degree either in engineering education or innanfield of engineering, physics, chemistry, mathematics or computer science or have accumulated 5 years of professional engineering experience outside of teaching or have accumulated 30 graduate credit hours in the field of the faculty member's majority teaching experience.	Encourages all full-time teachers to pursue advanced degrees or relevant work experience while noting the difficulties of obtaining advanced degrees in the Philippines. A faculty member could fulfil the standard by taking one 3-credit hour graduate course each year for ten years.	1. Do all full-time teachers of 10 years experience meet this standard?_____ 2. Is there evidence that all full-time teachers of less than 10 years experience are working to meet this standard?_____
Full-time teachers shall have a maximum of 50 paid clock hours in a work weeks as follows: 1. at least 5 scheduled paid clock hours for preparation time on campus per week. 2. at least 3 scheduled paid clock hours for student conference time per week. 3. no more than 42 paid clock hours of scheduled teaching or class duties per week.	Ensures that faculty will not be overloaded and lose teaching effectiveness. Ensures adequate preparation for classes and labs. Implements Regulation 78 of the Manual of Regulations for Private Schools, 1970, 7th edition, p.59.	1. Do all full-time teachers work no more than 50 clock hours per week? _____ 2. Does each have at least 5 scheduled clock hours of preparation time on campus/week? _____ 3. At least 3 scheduled clock hours of student conference time per week? _____ 4. No more than 42 clock hours of scheduled teaching or other duties per week? _____ 5. Are they paid for all hours spent? _____

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Table cont'd.

SUGGESTED STANDARDS	RATIONALE	CHECKLIST
Engineering faculty members shall be paid by the number of clock hours worked at rates appropriate to their ranks and tenure.	The present system of payment by credit hours in some schools leads to differentiated pay rates which downgrade the importance of lab programs (where credit hours and clock time are unequal). In effect, the schools are telling teachers that running a lab is not "teaching". The sad state of Philippine engineering laboratories is in part directly attributable to the lower per clock hour salary associated with it. This rule may help to make the labs stronger.	1. Are engineering faculty members paid by the number of clock hours worked? _____ 2. Are they paid at rates appropriate to their ranks and tenure? _____
Facilities:		
The site should be located in a wholesome environment.	Modified from MEC Order 36, Included by request.	1. Is the site in a wholesome environment? _____
There shall be no more than one student per 1 sq. meter of classrooms floor space.	The standard here recommended may be the lowest in the world. It is based on MEC standards.	1. Do all classrooms spaces meet the area requirement?
There shall be no more than one student per 2 sq. meters of laboratory floor space.	Unesco documents suggest a classroom standard of 2 sq. meters/student in classrooms and 5sq. meters/student in laboratories.	2. Do all laboratory spaces meet the area requirement?
All spaces used for group instruction shall be provided with at least a) one square foot of writing area per student.	Classroom environments in the Philippines badly need upgrading. This standard is designed ensure that minimum environ-	1. Is each student provided with at least a) one square foot of writing area per student? _____

(continued)

Table cont'd.

SUGGESTED STANDARDS	RATIONALE	CHECKLIST
b) One functioning dual electric outlet.	Allows use of audiovisual equipment.	2. Is each instructional space provided with one functioning dual electric outlet? _____
Curriculum		
All teachers in the field of engineering shall follow the curricula specified by the Ministry of Education and Culture	Implements current curriculum guides and assures consistency.	1. Are the syllabi in civil, electrical, chamical and meachanical engineering followed? _____
All laboratory courses shall consist of activities each of which shall involve a) hands-on manipulation of apparatus and equipment by each and every student. b) Experimental procedures carried out by students that require collection, reduction and analysis of data. c) Individual report writing emphasizing the development of skill in technical communication.	Too often lab experiences are qualitative demonstrations without the taking of measurements or hand-on experience by each student. There is a great deal of standing around but little doing. Fill-in-blank reports should be discouraged.	1. For each lab activity a) is there hands-on manipulation of apparatus by each student?__ b) are experimental procedures carried out by students?_____ c) do the procedures require the 1. collection of data?_____ 2. Reduction of data?_____ 3. Analysis of data?_____
The school of engineering shall have an ongoing program of curriculum revision and developmentin each field of engineering offered, realistic in scope and coordinated with available lab space, equipment and local needs.	Unless the school of engineering maintains a continuous curriculum updating program it will fail in its mission to prepare practical engineers adapted to the requirements of the country and of a changing profession.	1. Is there an ongoing program of curriculum revision and development?_____ 2. Is the program in each discipline?

Other possible justifications for the new Accreditation System.

If one reflects on the situation facing the Philippine government with regards to the proliferation of sub-standard private and commercial higher education establishments one comes to the conclusion that this new set of standards that the governement so readily accepts may, in fact, serve another, different purpose as well.

Due to the political power of the private school owners and the well documented desire of the Philippino for higher education it is politically unwise for the government to arbitrarily reduce the number of engineering schools and programs in line with expected demend for quality and quantity. It is wiser to select those schools that at present show the most promise (eg. the 20 schools participating in the Project), have them voluntarily to the development of these new accreditation standards, offering them at the same time the carrot of significant financial assistance towards upgrading their facilities, equipment and staff as well as curricula. Once these standards are accepted they will de facto become the standards for every school wishing to rpovide a program in engineering. The twenty schools in the program will be able to meet these standards as will a few others not part of the Project. The great majority of the other establishments will not be able to meet them and thus will have to fall by the wayside. This will accomplish several governmental objectives in one step:

1. It will reduce significantly the abnormally large number of engineering schools that have diluted resources and lowered standards.

2. It will reduce the number of students enrolled in engineering and reduce the output while improving quality.

3. By saving the schools that are presently among the best and that are capable of meeting the new standards there is an assurance of the delivery of a graduate much better trained and suited to local conditions.

4. By reducing the number of educational establishments in engineering the government will thus create the possibility of eventually developing a manageable financing system for this type of education.

5. The resuction in the number of schools and programs will facilitate the government's future stricter control and deeper involvement in higher education.

Another, ususally undiscussed objective that the government would like to achieve is by the application of these standards gently direct those schools unable to meet them, away from engineering towards technician and craftsmen education for which the need is much greater than for engineers. This "forced alternative" may appeal to the school owners once they see the writing on the wall. This will however create other problems as technician

education systems are even more capital intensive than those for engineering. Adequate staffing however should be much more feasible and quite acceptable to the Philippine goal for a job in a clean office environment.

Final Comments.

Although it is realized that these basic standards really are very "basic" (they for example do not at all address the possible development of research activities by engineering faculty members - simply because present teaching loads make such research impossible), their very simplicity and specificity should make them a very useful tool in the development and maintenance of an appropriate engineering education system in the Philippines.

References:

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