# ENGINEERING AND TECHNOLOGICAL MANPOWER SURVEY

By

ISIDRO D. CARINO, PH.D. AND E.P. FORMILLEZA*

## Introduction

### *Rationale*

The Engineering and Technological Manpower Study constitutes a very important tool for educational planners particularly those involved in the development of technological education for four reasons, namely:

a) It is the first study of national scope that attempted to identify manpower requirements in a specific major discipline. As such it should constitute an important contribution to Philippine education.

b) It could serve as a tool for educational planners to develop an effective educational program and strategy that will match technological output of schools with technological manpower requirements.

c) It has achieved considerable success in collecting, classifying and analyzing significant data that has remained unsurveyed due to the difficulty of obtaining this type of information in the Philippines.

d) It provides educational planners a rich source of readily available benchmark information not existing elsewhere.

The study becomes even more significant in the light of expected changes in the economy envisioned in the 20-Year Development Plan of the Philippines, which will require a greater need for engineering and technological manpower. The Plan calls for an acceleration in the growth of three sectors, namely: manufacturing, mining and construction as well as an acceleration in the application of new technology adapted to local conditions.

---

*Isidro D. Cariño is the project director of the study and E.F. Formilleza, the assistant project director.

*Project Background*

The Engineering and Manpower Study was contracted by the Educational Development Projects Implementing Task Force (EDPITAF) of the Ministry of Education and Culture, to the Executive Management Group, Inc. (EMGI), to determine the supply and demand situation of engineering and technical manpower study was later expanded to include the study of the demand but not the supply of technicians.

*Objectives*

The study has the following objectives:

a) To determine the current supply and demand for engineering and technological manpower engaged in four basic disciplines: civil, chemical, electrical and mechanical engineering;

b) To determine the capability of established engineering schools in the country to produce the required supply of professional engineers;

c) To determine the adequacy of existing curricula in engineering;

d) To prepare supply and demand projections for engineers and technicians over the next five years.

*Limitations*

The study has the following limitations:

a) Establishments with less than 50 employees are assumed to have generally no engineers, hence, these establishments are excluded from the survey.

b) Engineering and Technician graduates who are self-employed and/or occupations are not significantly represented in the survey.

c) Engineering and Technician graduates in other professions and occupations are not significantly represented in the survey.

d) The demand projections for engineers and technicians given by establishments do not include upper and lower demand limits.

e) Only demand projections given by firms that responded could be considered for analysis.

## Methodology and Survey Execution

### *Respondent Population*

The population considered consists of all private establishments and government offices employing 50 or more workers. The list of establishments from the 1975 Economic Census of Establishments of the National Census and Statistics Office (NCSO) was used as the sampling frame for the private sector. The sampling frame for the government offices was derived from the list of existing government offices at the national and regional levels as listed in the National Budget of the Philippines.

The total number of establishments thus identified was 525,610.

For schools, the sampling frame consists of the 79 engineering schools offering a five-year course in at least one of the four basic fields of specialization under consideration.

### *Sampling Design*

A stratified systematic sampling technique with a random start was adopted. A ten percent sample of all engineers and technicians employed in each establishment surveyed was taken. Respondent engineers and technicians representing different fields of specialization were chosen for omtervoew;

The stratification scheme constructed for the private sector utilized the following as substrata:

a) region : 13 regions of the Philippines

b) employment size : 50-99; 100-199; 200-499; 500-999; 1000 & above

c) industry type* : 9 industries, namely:

Agriculture, Hunting, Fishing and Forestry
Mining and Quarrying
Electricity, Gas and Water
Manufacturing
Construction
Wholesale, Retail Trade, Restaurants and Hotels
Transfort Storage and Communication
Financing, Insurance and Real Estate and Business

Financing, Insurance and Real Estate and Business Services
Community, Social, Recreational and Personal Services

From the above classification, the following were excluded in the study:

1. Wholesale, Retail Trade, Restaurants and Hotels
2. Financing, Insurance and Real State
3. Community, Social, Recreational and Personal Services

The exclusion of establishments classified under these three industries as well as those employing fewer than 50 employees was made on the premise that these establishments commonly employ few or no engineers. This belief was confirmed by a pre-test of a cross section of establishments in Region IV which indicated a negligible number of engineers employed by establishments classified under each of these categories.

*The Questionnaires*

The Manpower Survey Questionnaire consists of three components:

a) Schedule A (for the establishments surveyed, private and government to be answered by the person in charge of personnel);

b) Schedule B (for the respondent engineer and technician;

c) Schedule C (for the schools offering engineering courses to be answered by the Dean).

Respondents in Schedule B were grouped according to the following:

a) graduates of engineering in the four basic fields of specialization, namely: civil, chemical, electrical and mechanical;

b) graduates of engineering in other fields of specialization;

c) holders of a PRC license in electrical and mechanical engineering who have not completed courses in engineering but who are allowed by law to practice their profession in view of their wide experience in the field as provided in Republic Act 184;

d) high-level technicians, defined as graduates of a 3-year vocational-technical course or an equivalent experience of 2-years (in the field of speciaization for every year of formal schooling);

e) ordinary technicians, defined as graduates of a 2-year vocational-technical course or an equivalent experience of 2-years (in the field of specialization) for every year of formal schooling.

*Data Collection*

Data gathering was done through personal interviews by seven (7) teams, with four to five members to a team. Five teams were assigned to handle the 12 regions and 2 teams in Metro Manila.

Fieldwork was under the general supervision of regional coordinators who foresaw the operations under their jurisdictions. Sport checkers were fielded to dtermine problem areas and to ensure the reliability of responses from the protocols (completed questionnaires).

As much as possible, questionnaires were accomplished in initial interviews. However, instances that warranted two to three visits due to non-availability of respondents were not uncommon.

In schedules A and C, data gathering was done in two stages: firstly, by personal interviews of the personnel officer and the dean of the school concerned respectively and secondly, by leaving the questionnaires with the respondents to give them sufficient time to prepare the statistical data asked for.

Guidelines used in data gathering are the following:

a) All attempts are made to interview respondents who are not found in establishments located in cities but who are assigned in plant sites outside the city limits;

b) Respondents not available for interview in the sample establishments are deleted from the list to be interviewed;

c) Sample establishments that are currently found to have less than 50 employees but are included in the list of sampled establishments are excluded from the survey;

d) In the 12 regions, government offices at the regional level rather than the local level are surveyed. In Metro Manila, however, government offices at the national level are surveyed.

*Validity and Reliability of Findings*

The sample size of 722 establishments initially proposed by EMGI was later revised to a thousand (1,000) establishments in anticipation of the possible non-cooperation of some establishments, establishments that have ceased operations and establishments that would have fewer than 50 employees.

The sampling frame used in the survey was based on the 1975 listing of establishments by NCSO. Considering that the data is not up-dated, EMGI anticipated the large number of establishments that would be affected as a result of using the NCSO listing.

Out of the sample of 1,000, of which 222 establishments are government agencies and 778 are private establishments, 93 establishments surveyed were deleted from the list because of the following reasons:

a) closure of business;
b) address unknown due to transfer of business location. . . . . or change of business activity;
c) establishments that were listed under NCSO listing as those with more than 50 employees but which have presently less than 50 employees.

Response rates for the two schedules (A and B) based on the 1000 establishments and for schedule C varied as follows:

| | | |
|---|---|---|
| a) | Schedule A | 80.7 |
| b) | Schedule B | 90.5 |
| | Engineers | 96.7 |
| | Technicians | 86.1 |
| c) | Schedule C | 82.1 |

From the 907 establishments that were given questionnaires, only 807 establishments responded. Fifty-five (55) establishments in the 12 regions and thirty (30) in the national capital region had no engineers and no technicians. Thus, only a total of 722 establishments out of the original 807 that responded was considered for the "schedule B" interviews.

The rather large sample size taken in anticipation of non-responses, closure of business and possible change in employment size of establishments to be surveyed, as well as the care taken to ensure that respondents being interviewed indeed represent the four basic fields of specialization in engineering and technology were all taken to ensure reliability of results.

Consistency in answers was carefully checked. Doubtful answers to some questions were not used as bases for analysis and interpretation. Only items answered by most respondents were given due credit in the analysis. "No replies" were not included in the computations.

*Survey Problems and Difficulties*

There were several problems and difficulties during the implementation of the survey. These are the following:

1. *The existence of plant sites that are located at a distance of 15 to 30 kilometers from the location of the sampled establishments.* Many of the establishments surveyed apparently perform the role of public relations offices or administrative offices only. The engineers and technicians employed in these establishments are located in plant sites normally outside the city limits.

This situation necessitated conducting of interviews in two different places for each establishment surveyed.

2. *The standard practice of establishments, both government and private to classify their data on personnel either by position designation or by occupation, rather than by field of specialization.*

Not one of the sampled establishments has a compilation of personnel data by field of specialization. Even the personnel data classified by position designation, are not readily available.

The absence of readily available data as well as the necessity of reclassifying available data according to the requirements of the project meant that EMGI staff has to go through volumes of raw data to get the information in the forms desired.

The extreme cases of primary data handling in government offices deserve special mention and these are in the following government offices: (1) Professional Regulation Commission; (2) Office of Emigrant Affairs; and 93) Overseas Employment Development Board.

In the professional Regulation Commission, a list of examinees in the four basic fields of engineering during the period 1974-1979 numbering more than 30,000 had to be classified by field of specialization, by region, by school and by status of examination taken whether passed, failed or condition. The Professional Regulation Commission merely compile their data by type of examination taken.

On the other hand, in the Office of Emigrant Affairs and the Overseas Employment Board, offices that are entrusted with the task of processing papers of employees who will work abroad as emigrant workers and contract workers respectively, data are classified by occupation.

Hence, one has to go through volumes of data numbering 190,000 in all, reviewing them one by one merely to determine the field of specialization of each of the engineers and technicians.

3. *Insufficiency of baseline information from colleges and universities.*

Most colleges and universities do not have adequate records on their enrolment, graduates and faculty, particularly an up-to-date compilation of data on the above for at least a period of five years. This naturally complicate survey procedures. Estimation procedures are also affected, because reliable estimates require good and adequate bechmark data. The absence of a complete information system in school limits the estimate of future demand for engineering graduates in the four basic fields.

4. *The validity of responses given by some establishments surveyed.*

Some sampled establishments lack forthrightness in giving their answers in schedule A forms (questionnaire for establishments to be answered by the person in charge of personnel). This is gleaned from the discrepancy found in the total number of engineers reported versus the actual number found in sampled establishments and in plant sites.

It has been observed that a number of sampled establishments have not been able to meet the requirements set by Bureau of Labor Standards regarding the employment of a specified number of licensed engineers (in specific fields) for certain types of operation. Apparently, these establishments have managed to circumvent the provision of law by doing one of the following options:

a) pay a licensed engineer for the use of his name without requiring the engineer to be physically present in the establishment;

b) hire a non-licensed engineer on a temporary status (pending his passing the board examination for engineers in his field) to occupy a position that calls for a licensed engineer;

c) include in their personnel list, a number of engineers presumably employed for the purpose of complying with certain requirements, but who are in fact "employees in absentia".

5. *The bureaucracy involved in getting the approval of officials in sampled establishments and engineering schools for EMGI to conduct the manpower survey.*

The rather rigid rules set by some sampled establishments and engineering schools that necessitate the approval of no less than the Minister of the government agency concerned or the President of either a university or private agency, before accommodating a survey seems too bureaucratic.

The heads of the agencies concerned are normally very busy executives such that simple requests such as the EMGI request to conduct the Manpower Survey do not merit their attention.

The rigid implementation of such a policy naturally result in delays in the implementation of the survey.

6. *The behavioral traits of respondents.*

Respondents normally do not appreciate the value of surveys. Quite a number of them are very complacent in filling up questionnaires. Sometimes they either totally ignore the questionnaires and forget all about them or answer the questionnaires carelessly just to comply with your request.

This is gleaned from the inconsistencies found in the following:

a) The total number of licensed engineers reported versus the total yielded (as computed) in the segregation of engineers by field of specialization;

b) The total number of engineers doing high level technicians work versus the number computed by EMGI based on "schedule B" responses.

In cases like these, answers given would most probably reflect estimates rather than factual data on information asked for.

Hence, information contained therein had to be validated. Considering that the schedule B forms are handled by the interviews themselves, the data gathered from B would probably reflect a more factual data than those gathered from A.

7. *Availability of respondents.*

In most establishments surveyed, engineers are readily available for interview. Technicians are generally difficult to interview in view of the very nature of their work.

Owners and managers of establishments surveyed allow only a small percentage of their technicians to be interviewed because of the disruption in the work of technicians brought about by these interviews. Interviews are normally limited only to a maximum of five technicians a day. In some establishments, interviews of technicians are limited only to one day a week.

All the above results had to be faced by the EMGI Team and every effort was instituted to validate results and minimize the impact of some inaccuracies resulting from situations beyond their control.

| | 1980 | 1981 | 1982 | 1983 | 1984 |
|---|---|---|---|---|---|
| Supply (no. of graduates | 12100 | 13000 | 14000 | 15200 | 16300 |
| Demand for Engineering Graduates from Establishments (including 2.5% allowance for attrition)* | 10300 | 11000 | 11500 | 12100 | 12900 |
| Excess of Supply over Demand | 1800 | 2000 | 2500 | 3100 | 3400 |
| Cumulative Excess | 1800 | 3800 | 6300 | 9400 | 12800 |

The supply demand ratio is found to be understated in view of the following:

1) Survey results show that 31% of engineers are underutilized as high level and ordinary technicians.

2) A large number of engineers performing high-level technicians' jobs are not very honest in indicating their true tasks.

Aside from the above observations, other adjustments are made on the real demand for engineers in view of the following:

1) 7.6% of technicians are found to be performing engineering work;

2) The demand of schools for engineering faculty has to be added to the demand given by establishments surveyed.

By field of specialization, the results indicate a large demand for civil, mechanical and chemical engineers by 1984. The largest excess of supply over demand will also be in these groups.

## Analysis of Significant Findings

### *Supply and Demand for Engineers*

A summary of significant findings on the Engineering survey indicate that there are 92,000 employed engineers in the entire Philippines. This figure may probably be underestimated since only establishments in certain economic categories and which had 50 or more employees were sampled. It is the opinion of the authors, however, that (given the time and financial constraints in the implementation of the survey) the underestimation while conceded, is not significant to warrant the inclusion of the establishments deleted in the sample.

The records of 79 engineering schools offering at least one of the four basic disciplines under consideration in this study (other engineering schools do not offer any of the four disciplines), indicate engineering graduates total 10,100 in 1979.

An ADB Mission Appraisal Report on Engineering Education in the Philippines states that the 79 engineering schools account for 90% of total engineering graduates in 125 engineering schools in the Philippines offering five-year engineering courses in 16 separate engineering disciplines. The other 46 schools account for only 10% of total engineering graduates.

Extrapolating the total graduates of engineering from 125 engineering schools on the basis of the ADB findings, we find the number to be approximately 12,1000 for 1980 and 16,300 by 1984.

Projections given in the next page, indicate an increasing excess of engineers every year from 1980 to 1984.

| Field of Spezialization | Excess of Supply Over Demand | | | | |
|---|---|---|---|---|---|
| | 1980 | 1981 | 1982 | 1983 | 1984 |
| CE | 1400 | 1800 | 2300 | 2500 | 2700 |
| CHE | 700 | 500 | 500 | 1000 | 1000 |
| EE | none | 100 | 100 | 100 | 200 |
| ME | 800 | 800 | 700 | 800 | 800 |
| Others | 500 | 400 | 500 | 500 | 700 |
| Total | 3400 | 3600 | 4100 | 4900 | 5400 |

*Taken from unpublished doctoral's dissertation of Gaston Z. Ortigas entitled "UTILIZATION AND DEVELOPMENT OF ENGINEERING GRADUATES IN THE PHILIPPINE INDUSTRY," Harvard University, 1974.

The excess of supply over demand for engineering graduates presented in the previous page brings out three significant points:

1. The need to reduce the number of engineering graduates as well as improve their quality.

2. The critical need for an educational strategy that will utilize effectively engineering graduates.

3. The need to develop the vocational-technical education program in the Philippines.

*Demand for Technicians*

EMGI reports a total of 145,500 technicians employed by establishments in the entire Philippines. Survey results of establishments surveyed indicate the demand for technicians to grow by an average rate of 7.9% annually from 1980 to 1984.

Survey findings reveal that approximately 31% of engineers perform technicians' jobs while 7.6% of technicians perform engineering work. Incorporating these percentages to the estimated demand for technicians of 15,100 in 1980, by adding the former percentage and deducting the latter from this total we get approximately 17,100 in 1980.

Comparing the demand estimates for engineers and technicians, results indicate a higher demand for the latter, with a ratio of two technicians to 1 engineer. Considering that the demand for technicians of a large number of establishments employing less than 50 workers is not considered in this survey (technician study was unfortunately decided

only after the engineering study had already been designed), the figures are definitely conservative.

The projected real demand for engineering and technology graduates for the year 1980 — 1984 is presented in the succeeding pages.

PROJECTED REAL DEMAND FOR ENGINEERING GRADUATES BY FIELD OF SPECIALIZATION, PHILIPPINES
1980-1984*

| Field of Specialization | 1980 No. | 1981 No. | 1982 No. | 1983 No. | 1984 No. | Average Annual Growth Rate (Geometric Mean) |
|---|---|---|---|---|---|---|
| Civil | 2700 | 2900 | 3100 | 3400 | 3700 | 8.2 |
| Chemical | 800 | 1100 | 1100 | 800 | 900 | 3.0 |
| Electrical | 1100 | 1100 | 1200 | 1300 | 1300 | 4.3 |
| Mechanical | 2900 | 3100 | 3200 | 3400 | 3600 | 5.6 |
| Others | 1200 | 1200 | 1300 | 1400 | 1400 | 3.9 |
| TOTAL | 8700 | 9400 | 9900 | 10300 | 10900 | 5.8 |

*rounded figures.

PROJECTED REAL DEMAND FOR TECHNICIANS
BY FIELD OF SPECIALIZATION
PHILIPPINES, 1980-1984*

| Field of Specialization | 1980 No. | 1981 No. | 1982 No. | 1983 No. | 1984 No. | Average Annual Growth Rate** |
|---|---|---|---|---|---|---|
| Civil | 2800 | 3000 | 3300 | 3600 | 4100 | 10.0 |
| Chemical | 700 | 900 | 900 | 900 | 900 | 6.5 |
| Electrical | 4400 | 4500 | 5300 | 5600 | 6300 | 9.4 |
| Mechanical | 5900 | 6799 | 7100 | 7700 | 8200 | 8.6 |
| Others | 3300 | 3300 | 3400 | 3600 | 3400 | 0.8 |
| OTHERS | 17100 | 18400 | 20000 | 21400 | 22900 | 7.6 |

*rounded figures

*Underutilization of Engineering Graduates*

Survey results indicate that 31% of engineers are underutilized as high level and ordinary technicians. The distribution of engineers in the four basic fields of specialization performing both high-level and ordinary technicians' work is shown below:

| | Number of Engineers in Survey Performing High-Level and Ordinary Technicians' Work | Percentage to Total |
|---|---|---|
| Electrical | 160 | 33.4 |
| Chemical | 77 | 29.8 |
| Mechanical | 259 | 29.0 |
| Civil | 192 | 27.8 |
| Others | 144 | 38.5 |

The very high percentage of electrical engineers performing high-level and ordinary technicians' work stems from the following:

Electrical engineers are generally the least flexible among the basic fields of engineering. The very nature of their work limits them to activities which normally would be done by technicians;

b) There are less opportunities for electrical engineers in the Philippines compared to engineers in other fields of specialization, hence, they end up performing jobs of electricians;

c) The incapability of EE's to adopt themselves to electronics industries.

Mechanical engineers record the highest percentage performing high-level technicians' work. The percentage of engineers by basic field of specialization performing high-level technicians' work is ranked as follows:

| | Total Engineers Surveyed | Total Number Performing High-Level Technicians' Work | Percentage to Total |
|---|---|---|---|
| ME | 893 | 220 | 29.0 |
| CE | 691 | 176 | 24.0 |
| EE | 479 | 155 | 21.0 |
| ChE | 258 | 72 | 10.0 |
| Others | 374 | 121 | 16.0 |
| Total | 2695 | 744 | 100.1 |

The shift of electrical engineers from first position in the previous table to 3rd position in this table indicates that many electrical engineers are used as ordinary technicians (electricians).

The above findings have the following implications:

1) That position titles do not necessarily reflect the work done;

2) That administrators generally do not recognize the differences between engineering and technicians' work;

3) That people generally prefer to be classified as highly as possible but they do not seem to demand work commensurate with their qualifications;

4) That the demand for true engineering graduates is often overestimated in view of the number of graduates presumably holding engineering positions but who are in fact performing technicians' work.

*Distribution of Engineers by Field of Main Activity*

The importance of management in the work activities of engineering graduates is obvious from the percentage of engineering graduates in management, administration and supervisory work. The largest percentage of engineering graduates interviewed was in these categories.

By the very nature of conditions in the Philippines, engineers do not normally receive high salaries unless they are elevated to high positions in the management hierarchy. Their appointment in technical positions alone will not ensure them of high salaries. Hence, for most of the engineering graduates, a management position is the ultimate goal since managerial posts are normally associated with high salaries.

In developed countries on the other hand, engineers need not reach a manaterial position before they can receive high salaries. Their technical positions would be sufficient to ensure them of high pay.

Out of 2,695 engineers interviewed, 38% were performing Management, Administration and Supervisory Work (Code 1); 38% were performing Engineering, Technical and Scientific Work (Code 2); 28% High-level Technicians (Code 3); and 3% Ordinary Technicians' Work (Code 4).

These graduates have not been formally given undergraduate academic qualifications that may be necessary for a managerial position since present Philippine engineering programs provide very little or no units at all in management except in the specialties of Industrial Engineering and Engineering Management. As a result, 95% of engineering graduates interviewed had to attend training and seminars in management after joining the work force.

The value attached to an engineering degree even without undergraduate managerial training is clear from the proportion of engineers who very rapidly progress into managerial positions.

We have the following percentages of engineers by field of main activity:

| | Metro Manila | | 12 Regions | |
|---|---|---|---|---|
| | Total | % | Total | % |
| Management and Administration Work | 694 | 34.0 | 324 | 51.0 |
| Engineering, Technical and Scientific Work | 677 | 32.0 | 168 | 26.0 |
| High-Level Technicians or Technologists' Work | 612 | 30.0 | 132 | 21.0 |
| Ordinary Technicians' Work | 73 | 4.0 | 15 | 2.0 |
| Total | 2056 | 100.0 | 639 | 100.0 |

It is apparent that Code 1 always gets the biggest percentage among the different fields of main activity. This implies that we have a very high proportion of engineering graduates are involved in management and administration.

*Distribution of Engineers by Field of Specialization*

The ranking of engineers by basic field of specialization is as follows:

| | Total Engineers | Percent to Total Engineers |
|---|---|---|
| ME | 8,425 | 30% |
| CE | 7,495 | 27% |
| EE | 4,601 | 17% |
| ChE | 2,461 | 9% |
| Others | 4,665 | 17% |
| Total | 27,647 | 100% |

Most engineers in management are mechanical engineering graduates (34% of the 1018 engineers surveyed are in managerial positions). Other specialties represented in management positions are as follows:

| | |
|---|---|
| Civil | 29% |
| Electrical | 14% |
| Chemical | 12% |
| Others | 11% |

The ranking of engineers by specialty working at different levels of activity, follows a consistent pattern.

Mechanical engineers ranked first followed by civil, electrical and chemical engineers.

Some of the reasons behind the predominance of mechanical engineers in all fields of main activity are:

1) There are more graduates of mechanical engineers compared to other basic fields of specialization in engineering;

2) Mechanical engineers are the most broadly trained engineering graduates and hence suitable for a great variety of work;

3) Except for consturction where civil engineers predominate, mechanical engineers by the very nature of their training, predominate in varied fields of industrial activity especially in the manufacturing and mining industries;

4) Out of a total sampling frame of 3,361 establishments, manufacturing constituted 57% of total establishments.

*Adequacy of Existing Curricula in Engineering*

Field survey results indicate that while the number of institutions offering engineering is large and enrolment high, the quality of most programs is unsatisfactory. Respondents decry the existence of too many unnecessary subjects in the engineering curriculum such as Rizal, Land Reform and others.

Forty-eight percent of engineer respondents state the absence of actual training or on-the-job training in the curriculum. The findings indicate the highly theoretical training given to engineering students.

Another survey finding worthy to note, is the need for management subjects. Majority of respondents engineers in the 13 regions, totalling

2332 availed of training and seminars in one or more management subjects conducted by companies and their organizations. A significant percentage attendance in industrial psychology and safety courses was recorded among the seminars and training given by companies.

The importance of safety courses particularly to electrical engineers because of the very nature of their jobs, has not been recognized. It is surprising to note that safety engineering if offered at all in the curriculum for electrical engineers constitute only an elective rather than a required subject.

While a very insignificant percentage of engineer respondents did not express either positive or negative comments about the competence of their faculty members as well as the teaching methodology of these faculty members, a significant percentage made strong and assertive comments about the inadequacy of laboratory facilities as well as the engineering curricula when viewed from the standards of these respondents.

## Conclusions and Recommendations

The 1980 EMGI survey on Engineering and Technological Manpower constitutes an important instrument for engineering and technological education planners as it indicates that the following conditions exist in the Philippines:

a) An excess of supply over demand for engineering graduates now will increase significantly by 1984;

b) There is a shortage of technician manpower;

c) A large proportion of engineers are presently underutilized as high-level and ordinary technicians;

d) The present engineering and technology curricula need improvement in practical training on-the-job and in management subjects essential to the performance of their jobs;

e) A number of engineering schools are producing graduates which were observed to have the following limitations;

f) Some engineering colleges and universities do not keep an up dated record of their educational statistics;

g) There is a dearth of reliable educational statistics on enrolment, graduates and faculty, hence, equally reliable projections are difficult to prepare;

i) Establishments and schools do not normally prepare long-run projections of their manpower needs.

As a result of the above findings, the following recommendations are given:

A. Short-term Recommendations

1. Reduce the number of engineering schools to a more appropriate and manageable number that can really produce quality graduates;

2. Improve the qualification standards of students and of institutions by:

a) Stressing proficiency in Science and Mathematics for NCEE (National College Entrance Examination) candidates going into Engineering;

b) Setting much higher requirements for candidates entering engineering;

c) Developing and enforcing strict accreditation standards for all engineering programs and universities;

d) Improving the facilities of the engineering universities;

e) Significantly upgrading the qualifications of academic teaching staff;

3. Revise engineering programs to ensure a thorough foundation in mathematics and the basic sciences and to include specifically management, communication, and safety courses;

4. Reduce the number of courses and provide more integration of subject matter;

5. Provide a different direction for engineering programs such that they should not be directed towards merely the passing of the Board Exams;

6. Initiate surveys to follow-up activities of engineering and technology graduates in Philippine industry so that the appropriateness of their education can be monitored;

7. Engineering faculty members should be required to improve their qualifications by completing higher graduate degrees;

8. Encourage more faculty members to teach full-time in their universities. Part-time faculty members drawn from consultants or industry should be limited to those who are academically dedicated and aware of the responsibilities that go with university involvement;

9. In order to make academic work more attractive, salaries of engineering professors should be increased substantially. This will discourage "sidelines" that dilute their commitment to the university;

10. Encourage university academics in the pursuit of research or development activities. This will greatly improve the effectiveness and appropriateness of the engineering programs;

11. Produce operationally-oriented technical people as well as engineers who are analytically oriented;

12. Provide for a regular dialogue between industry and engineering schools; industry should offer assistance such as:

a) Incentives in the form of scholarships, apprenticeship training to students, etc.

b) Official arrangement between Industry and MEC to assign their qualified engineers to schools for part-time teaching on official company time.

13. Provide for a built-in mechanism to ensure a continuing up-dating of data on supply and demand for engineers.

a) Avail of the services of the proposed Industry-Engineering Council to ensure a regular up-dating of data presented in this study particularly projections on supply and demand.

b) MEC should adopt measures for stricter control of engineering schools to ensure the collection of more accurate and reliable information on their graduates and faculty.

It is recommended that EDPITAF and the team of consultants from RMI* consider the above recommendations in the design of the new engineering curricula.

It is also hoped that the above recommendations would be considered in the formulation of new technological programs as foreseen in the upcoming Vocational and Technical Education Project.

B. Long-term Recommendations

1. Establish training schools in strategic places such as in Metro Manila, Baguio, Cebu, Davao. These schools would constitute the core in specific regions and be entrusted with the responsibility of handling the training of the teaching staff of technical institutes.

2. The Government of the Philippines should recognize the importance of engineering education to the economy of the country and help the selected engineering universities by direct financial support or through suitable forms of tax incentives, soft loans, BOI incentives, and similar devices.

3. EDPITAF should institute the setting up of polytechnic schools in all regions in cooperation with the Technological University of the Philippines for the training of faculty members who will eventually teach in the Polytechnic schools.

The availability of competent faculty members has always been a very serious problems in the development of technological education in the Philippines.

Majority of the present faculty members generally possess the academic background but lack the industry and practical experience. To be able to overcome this difficulty, it is recommended that:

a) A Foreign Assistance Program with the ADB or IBRD be arranged for the training of our faculty members in Polytechnic Schools in Southeast Asia such as Singapore and Hongkong;

b) Because of their familiarity with educational problems similar to those in the Philippines, faculty members of Southeast Asian polytechnic institutes such as those in Singapore and

*Resources Management International, Inc.

Hongkong should be invited to help with the upgrading and training of faculty members of Philippine Technological Institutes;

A Foreign Assistance Program be arranged for these faculty members of Polytechnic Schools in Singapore and Hongkong to enable them to teach and train faculty members in the Philippines.

4. The polytechnic schools set up should strive for the production of higher quality graduates similar to graduates of Don Bosco.

The 1980 Engineering and Technological Manpower Survey is very useful in identifying many problems regarding the supply and demand for engineering and technological manpower in the Philippines, and some aspects of the present engineering and technician education. While the survey does have some limitations arising from inherent conditions in the Philippines which made the survey implementation difficult, it does serve as the only current study that gives a supply and demand picture of the engineering manpower. It is hoped that the study would serve as a catalyst for the needed changes called for in engineering education in the Philippines.