Philippine Engineering Journal (1993) XIV (2): 85-94

ENGINEERING MANPOWER AND TRAINING NEEDS OF THE VARIOUS INDUSTRIES VIS-A-VIS CURRICULAR/TRAINING PROGRAMS IN SELECTED ENGINEERING SCHOOLS

Francisco L. Viray, Ph.D.
President, National Power Corporation
and Professor of Electrical Engineering
Department of Electrical & Electronics Engineering
University of the Philippines

Donato S. de la Cruz
Ma. Rosario L. Chan
Assistant Professors
Department of Chemical Engineering
College of Engineering
University of the Philippines

Bonifacio T. Doma, Jr.,
Ma. Concepcion L. Chan
Lourdes O. Ojeda
Research Associates
College of Engineering
University of the Philippines

ABSTRACT

The study is based on the result of a suvey conducted among establishments in mining and quarrying, manufacturing, electricity, gas and water; construction; transport, storage and communications and banking located in Regions 4,7,10, 11 and NCR. The study shows that: (a) engineering graduates are mostly employed either in management/administrative or are doing low level technologies' work and only a small fraction of them are employed in work that requires engineering skills such as design and research and development; (b) engineering education is perceived to be either adequate or inadequate depending on whether the operation of the company is specialized or not; (c) most companies provide for the training needs of their newly-hired engineering graduate especially in management or in specilaized technical skills, through on-the-job or in-house trainings; and, (d) companies still deem that the following must be effected to uplift engineering education: more time for on-the-job trainings, improve facilities, improve curriculum and improve teaching faculty.

INTRODUCTION

The primary role of engineering schools is to provide competent technical manpower to industry. It is not surprising, therefore, that whenever there are renewed efforts for industrialization, a call to assess this role is also being expressed. The present government's

thrust for the country to achieve the status of a Newly Industrializing Country by the year 2000 has spurred efforts not only in strengthening engineering education but also in appraising its capability to produce engineers with the necessary technical qualifications. This capability, however, should always be seen from the point of view of the needs of industry which have very strong influence in casting the orientation of engineering education in the country.

Questions on the competence of engineering graduates has from time to time been raised. A number of major studies in this area, discussing the problems afflicting engineering education in the country, has already been done in the past, the latest of which was finished in 1985. There is the need to update these studies together with the regular evaluation of the orientation and thrust of engineering education in the Philippines.

This study is an attempt to look into the engineering manpower needs of the industry and the adequacy of the present curricula to provide such needs. Generally, this study aims to identify the manpower and training needs of the manufacturing and service industries and the capability of selected engineering schools to supply these needs.

SCOPE OF THE STUDY

This study involves a survey of establishments in the manufacturing and service sectors and of the engineers employed thereat. It covers the five regions of the country with the highest concentration of manufacturing firms, namely, National Capital Region (Metro Manila), Region 4 (Southern Tagalog), Region 7 (Central Visayas), Region 10 (Northern Mindanao) and Region 11 (Southern Mindanao). Together, these regions have about 80 percent of the country's total establishments.

By industry type, the establishment surveyed were those belonging to the following industry classifications: mining and quarrying; manufacturing; electricity, gas and water; construction; transport, storage and communications; and banking. These industries are the ones employing significant number of engineering graduates.

Only establishments employing 50 or more people were included in the survey. Establishments with less than 50 employees were excluded as they have very few or no engineers. [Executive Management Group, Inc.]

The methodology used in the study is shown in Appendix A.

RESULTS AND FINDINGS

Profile of Respondents

Establishments. One hundred seventeen (117) companies responded to the survey. Of these, 38 or 29.9 percent claim that they do not employ any engineer while 9 firms or 7.1 percent were not willing to participate. Of the 70 companies which sent completed questionnaires 60 percent are from Metro Manila and 15.7 percent each from regions 4 and 7. By industry type, 71.4 percent of the companies are engaged in manufacturing. On the other extreme, a very small percentage (1.4 percent) are in mining and quarrying. Majority of the

companies surveyed are small to medium in terms of employment size. Twenty percent (20%) employs between 50 to 99 people, 24.3 percent between 100 to 199, 25.7 between 200 to 499 and the rest have 500 or more employees.

Engineers. Among the 500 respondent engineers, 81.2 percent are male and the majority of whom (68.6%) ages 21 to 30. In terms of region of origin 71.8 percent are from NCR, 14.6 percent from Central Visayas, 8.6 percent from Southern Tagalog, 4.6 percent from Southern Mindanao and 0.8 percent from Northern Mindanao. By industry type, 59.2 percent are in manufacturing, 18.4 percent in transportation, storage and communications, and 10.8 percent in construction. Majority of the engineers are employed by large companies: 59.2 percent of the respondents are from companies with at least 1000 employees. Fifty-eight and two-tenths percent (58.2%) obtained their engineering degree in 1986 and onward, with the majority in the field of mechanical engineering (23.6%), followed by electronics and communications engineering (21.4%), and civil engineering(15.8%). Only 1.8% of the respondents have graduate degrees. Majority of the respondents came from big schools in Metro Manila and other cities.

Employment Patterns

Most of the 3,959 engineers employed by the 70 respondent establishments either hold administrative and managerial positions (29.75%) or handle technologist work (30.64%). Only 11.95% are in engineering design while an even smaller percentage (9.12%) are involved in research and development. This trend is observed irrespective of the type of industry where the establishment belongs or the region where it is located.

The survey results also showed that 50 percent of the respondent companies do not require their new engineering employees to have a PRC license. This trend is true for all regions, regard less of employment-size and industry-type. Among the different sectors, it is only in the construction industry where almost all the companies require a PRC license. This may due to the fact that most of the operations in the construction industry require approval and signature of a licensed civil engineer.

Among the respondent engineers, 49% worked as technologists and 21.1% as management trainees/supervisors in their first jobs. Only 7.2% work in engineering design and 5.6% in research and development. While more than half (56.4%) have PRC licenses this figure is still small considering that all fields of engineering (except Industrial Engineering) require a board examination/license. Other respondents had either failed or had not taken the required board examination (29.8%).

Majority of the new engineers in the companies surveyed are employed as technologists or management trainees. This fact, which had been established by earlier studies, indicates that what industry needs are more technologists and lesser engineers. The available engineering jobs cannot absorb the engineers being produced by the different schools and, therefore, many engineers end up working as technologists. This situation solves the need of the industry for skilled manpower at the expense of underutilizing valuable human resources. Thus, the competency or adequacy of the undergraduate training of these engineers is not the issue but rather the demand of the industry for engineers who will do engineering jobs, i.e., design and research and development work.

The low percentage of engineers doing design work in the manufacturing sector can be attributed to the prevalent "turn- key" practice of many companies in the country. Instead of designing and fabricating their equipments, many companies are importing technology from foreign companies.

The small number of engineers working in research and development indicates that the level of activity in this area is very low. Small and medium size companies can only spare so much of their money for research and development. On the other hand, big multinational companies prefer to conduct their research and development activities in other countries.

Since it is industry that shapes the demand for engineers, the steps necessary to produce engineers that fit their needs have to be taken by them. This is of course with the support or some intervention from the government.

Adequacy of Undergraduate Engineering Education

Fifty percent (50%) of the respondent establishments said that the undergraduate engineering education of newly hired employees suffice to meet the competency requirement of their entry-level job positions. On the other hand, 42.9% expressed the opposite. Almost the same percentage of engineers (47.8%) as the company respondents consider their undergraduate education sufficient in their present jobs. On the other hand, 42.6% of the respondent engineers believe that their undergraduate education is insufficient.

Both the respondent companies and engineers viewed the adequacy of engineering education as dependent on whether the operation of the company is specialized or not. The question of adequacy of the undergraduate engineering education and the competence of new engineering graduates was answered with a yes or a no, depending, not on the educational training/preparation of new engineers but rather, on the level of specialization of operation of a particular company. If the job involves very specific technology or specialized operation, then the undergraduate training of the engineer is not enough. On the other hand, if the job requires simple processes then the undergraduate education of the new engineer will suffice.

This shows both the strength and the weakness of the type of engineering education we have - strong on the basic concepts and lacking in on-the-job training. Engineering students are confined to theory which limits their opportunity to learn specific technology and actual operations of a company.

Training Needs

Training Provided by the Establishments/Companies. Sixty percent (60%) of the companies surveyed provide on-the-job training for their newly hired employees and 48.6% provide in-house and/or outside trainings on specific topics. From the point of view of the companies surveyed, the bulk of the training needs of its engineering employees is on technical and management aspects. Of the technical topics identified, about one-third are specific training on the technical area or technologies being employed by the company. Skills improvement is also one of the major areas of training needed by the companies. This includes leadership/supervisory training, communication and computer literacy.

The respondent companies are offering in-house seminars to their newly hired engineers mainly to bridge the gap created by the perceived weakness of the engineering curriculum. Many of these seminars, which are technical in nature, introduce and familiarize newly hired employees on the specific operation and technology the company uses.

The training needs expressed by the respondent companies also jibe well with the inadequacy of the engineering education as perceived by the company and are focused on technology and management, the areas where most of the engineers are involved.

Need for Advanced Studies. Almost two-thirds (61.5%) of the respondent companies indicated that an advanced degree is not necessary to assume higher positions in their organization. Except for some which indicated that it is company policy to require advanced degrees for some positions, most agree that the things that matter most in promotion are performance, experience, and work attitude.

Only 37 or 7.4% of the respondent engineers are taking up advanced studies, about half of them (17 respondents) in Business Management. They do so primarily to improve their competence and for purposes of job promotion. On the other hand, time (61.4%) and financial (23.4%) constraints are the main reasons why majority of the respondent engineers were not pursuing advanced studies.

Of the 500 engineer respondents, 382 or 76.4% are planning to take up advanced studies mainly in the field of management (29.6%) and computer science/engineering (12.6%). About half of them plan to start studying in the next three years. Those who plan to take advanced studies saw the need to improve oneself and consider that an advanced degree is necessary for promotion or career advancement. Those who do not have plans to pursue advanced studies either do not have the time or see no need for them.

Suggestions to improve the current state of undergraduate engineering education

The respondent establishments are looking at four major areas that need to be addressed to uplift the current state of engineering education in the Philippines. These are: increasing the number of hours for the on-the-job training of students; improving the school's facilities, curriculum, and teaching faculty.

Increasing the number of hours for on-the-job training. Some engineering schools in the country have already made arrangements with different private and government establishments to accommodate their students for practicum or on-the-job training. However, inspite of these linkages, many problems still have to be addressed in order for these programs to be meaningful. One of these problems is the small number of participating companies. Thus, only the best students of a particular school are able to participate in these programs. Moreover, some of the participating establishments do not have concrete training programs, thereby, not maximizing the benefits that can be accrued from such programs.

Improving the curricula. The establishments' suggestions on how to improve the engineering undergraduate curricula are nothing new. It seems that the need is not to add more technical courses but rather to improve or add non-engineering courses such as attitude/value

formation, communication skills, management skills and more time for laboratory and practical trainings. The need to introduce the students to state of the art technology would not require a change in curriculum but on the particular subject syllabus.

The 1980 study of Carino, et. al., also pointed out the need to include management subjects and the improvement of language and communication skills for engineers. A decade had passed and the same points have again been raised by the industry sector. In general this can be seen as a complaint of industry that had not been heeded.

Among the courses that the respondent engineers deemed should be included in the undergraduate education are computer and management courses. Computer courses are now part of the engineering curriculum. However, there were some respondents who still said that they should be included. Obviously, they are those who belong to the generation when computer courses were still unknown in Philippine engineering education. Business Management courses are still taken as elective in the engineering curricula.

CONCLUSIONS AND RECOMMENDATION

The observation that many engineers are either working as managers, administrative staff or technologists have been cited several times in past manpower studies. This present study would establish that such a trend still continues at present. Some authors have already stated that the trend may be due to the companies' preference for engineering graduates for management positions, hence they recruit and train engineering graduates as management-trainees.

While the recruitment of engineering graduates to work as technologists answer the need of industry for qualified middle-level manpower, it is also reflective of the underutilization of these graduates.

The low demand for design engineers and researchers is a consequence of the prevalence of the turn-key mode of development of industry and that private companies still conduct few R & D. This could explain why only a small fraction of engineering graduates are employed in work that requires engineering skills such as engineering design and research and development.

Engineering education is perceived to be either adequate or inadequate depending on whether the operation of the company is specialized or not. If specialized, the present quality of engineering education may not be adequate. Otherwise, it is.

The findings of the study tend to strengthen the need for practical training for undergraduate engineering students. While most companies provide for their training needs in the technical aspects, they express the need for practical training or internship programs, either in-house or on-the-job, both in the areas of management and specialized technical skills.

While companies indicated that an advanced degree is not necessary for promotion, most engineers expressed the desire to take up higher studies to improve their chances for promotion and for self development.

Companies still deem that the following must be effected to uplift engineering education: more time for on-the-job training, improved facilities, improved curriculum and improved

teaching faculty. However, a lot of catching up has to be done in terms of implementing the resolutions to solve problems related to faculty development, facility improvement and curriculum development.

While the possession of advanced degrees is perceived to be an advantage, experience is still considered more important for either promotion or employment. Most of the companies, as well as the engineers themselves, point to management studies as being more relevant to promotion.

Although it is very tempting to make several recommendations based on the above conclusions, many of these would just be motherhood statements. Changing the demand pattern of engineers in the industry would require crucial changes and would depend on a lot of factors. On the other hand, improvements in facilities and teaching faculty of engineering schools are already being done, though much is still to be desired.

Only one recommendation will therefore be made - the inclusion of more on-the-job training in the undergraduate engineering curriculum. This would require a close linkage between industry and engineering schools and, a good example of which is the University of the Philippines - Manufacturing Linkage Program. This should be duplicated in other schools and must cover not only on-the-job training but more importantly, should work toward a closer interaction between industry and the academe. This is just a small step and is not very hard to implement.

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Appendix A

Methodology

Sampling Design

A list of 3,699 establishments in the five regions obtained from the National Statistics Office was used as the sampling frame. Using a tolerable error of 0.10 and a confidence level of 0.95, the required sample was determined to be 344 companies. The sampling size was estimated using the following formula:

$$n = \frac{(za/2)2pq}{e^2}$$

where:

za/2 = the z value leaving an area of a/2 to the right
(1-a)100 = confidence level
p = proportion of success in a random sample
q = 1 - p
e = tolerable error

Stratified by region, sample companies were determined using a purposive, systematic sampling with a random start. In addition, more than 4,000 questionnaires, distinct from those sent to the companies, were sent to engineers of these same companies. Employment size was a major consideration in determining the number of questionnaires to be given per respondent-company.

Survey Instruments

Two sets of questionnaires, one for engineers and one for companies, were developed. Both questionnaires focused on perceived weaknesses/strengths of engineering education and the training needs of the industrial sector. The questionnaires for companies were addressed to the company president and were usually answered by the technical manager or the personnel manager. On the other hand engineer- respondents were selected by the companies themselves.

Pre-testing of Questionnaires

Both questionnaires were pre-tested in a petroleum company, with about 300 engineers participating. To supplement findings during the pre-test, the Questionnaire for the Company was presented and discussed in one of the meetings of the University of the Philippines-Manufacturing Linkage Program (UP-MLP). Comments and suggestions gathered during both activities were incorporated in the final research design and questionnaires.

Data Gathering

For companies in Metro Manila, questionnaires were delivered to ensure that they are not lost and that they reached the proper persons who should answer them. Follow-up by telephone and by mail were made. Completed questionnaires were picked-up, verified and validated as necessary.

For companies in other regions, the questionnaires were mailed to the respective companies. Follow-ups were made by mail, except for companies in Cagayan de Oro and Iligan which were personally visited. Companies from these regions were requested to send their response by mail.