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How Indian Industry Perceives Engineering Curricula in Relation to Job Requirements

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This study is aimed at producing the profile of an Indian engineering graduate as perceived by Indian industry, in relation to job requirements. It is based on a questionnaire-based survey of the perceptions of a wide spectrum of industries, classified into manufacturing and service sectors. The rating scales on which the expectations and availability of competencies have been ranked provide the quantitative information, which has been averaged over all the engineers employed in the two different types of industries. The analysis has resulted in the identification of areas of good match and mis-match, areas considered absolutely essential by industry, the areas with the largest mis-match, and areas of minimum competency. It is found that the specific requirements of individual industries are quite varied, and are quite different from the average requirements. that it is not in the larger interests of industry to expect tailor-made products to be provided by the universities.

INTRODUCTION

QUITE frequently, the captains of Indian industry have criticized the country's engineering education system, particularly with reference to the mismatch between industry's expectations of engineering graduates on the one hand, and the knowledge, skills, abilities and attitudes imparted to them in engineering institutions on the other. Industry and other employers appear to be of the opinion that, by and large, the engineering graduates turned out by the several engineering colleges in the country are provided only with theoretical knowledge, largely unrelated to industrial practice, with very little practical knowledge and skills relevant to design, development, construction, production, etc., as applicable in real-life situations. The charge has been made that universities produce 'engineering graduates' rather than 'engineers'. The typical response from faculty members of engineering institutions is that their primary objective is to provide their students with a broad-based education, plus specialized knowledge in their chosen branch, and not to produce 'finished products', who can just fit into industrial occupations, without additional training or orientations.

While these arguments and discussions have been going on for quite some time, there are no specific studies or attempts to reconcile the differences in perceptions and expectations, and to initiate strategies to bridge the gap.

SCOPE OF PRESENT STUDY

It is the purpose of this study to come up with a profile of an Indian engineering graduate, as perceived by industry, and also to assemble industry's expectations in specific functional areas, in order to match them, both qualitatively and quantitatively. This will enable the identification of inadequacies or shortcomings in the existing engineering education system, and also the areas in which industry is responsible for organizing pre-service training programmes for the fresh graduates.

Methodology

The study is based on responses to a questionnaire, which covered the following six major functional areas in which engineering graduates are usually employed: (i) design; (ii) development; (iii) production/construction; (iv) operation/maintenance; (v) services; and (vi) testing and certification. Under each of these areas, several main tasks that the engineers are expected to perform, have been included. For each task, the degree of essentiality of competencies (knowl-

edge, abilities, skills and attitudes) which the engineering graduates are required to possess at the point of entry to the job, and the extent to which the engineering graduates possess these competencies at the time of recruitment, are obtained on a five-point scale.

The questionnaires were sent to a large number of industries, both in the manufacturing sector and the service sector, and to R&D institutions. Responses were received from 52 manufacturing industries, 22 service organizations and two R&D institutions. This covered a total of 10,544 engineers in the manufacturing industries, 6743 engineers in the service sector, and 94 engineers in the R&D institutions.

Correlation of data

The data have been correlated separately for all the manufacturing industries and for all the service industries, in view of the differing activities and requirements. For each of the tasks listed under each of the major functional areas identified, the data provided by each industry on a 0–4 scale have been utilized to calculate the overall expectation and the overall availability:

$$E_o = \Sigma E \times N/N \quad (1)$$

$$A_o = \Sigma A \times N/N \quad (2)$$

where

N = number of engineers
E = expectation
A = availability of competence
E_o = overall expectation
A_o = overall availability

From E_o and A_o, the value of the gap for each task ($E_o - A_o$) is calculated, and also as a percentage of the overall expectation.

For a better appreciation of the results, these have been plotted as bar graphs, with E_o plotted above the centre line and A_o plotted below; the gap is indicated as a hatched area. (Figures are not included here, to save space.)

These results are also calculated separately for two large manufacturing industries, for comparison purposes.

DISCUSSION OF RESULTS

Comparison of manufacturing and service industries

1. There appears to be no commonality, in general, between these two groups of industries.
2. In both sectors, except for a few characteristics, expectation is much more than competence availability.
3. In both sectors, the maximum gap is identified to be in the following characteristics.
   - Statement of objectives, policies, targets, turn-over, etc.
   - Use of negotiating skills with employers and clients.
   - Adoption of appropriate channels and forms of communication.
   - Understanding of the psycho-social system in industry/business
   - Knowledge of relevant factory acts, procedures, statutory requirements.

One of the important decisions to be taken after identification of the expectation – competence availability is who is responsible for removing it—industry or university? In this context, the characteristics (or tasks) in the 10 functional areas are classified below, according to whether industry or university, or both, are better placed for achieving the desired objective. The guiding principle has been that university is the place for providing basic knowledge, problem-solving abilities and broad perspectives, while industry is where specific applications, commercial and economic aspects, codes, specifications and costs, operation and maintenance procedures, etc., are learned better.

CONCLUSIONS

The analysis of the results of the questionnaire-based survey yields the following inferences:

Manufacturing industries

1. The expectation far exceeds the competence availability in almost all the tasks in all the functional areas.
2. There is good match only in three tasks: design of machines, structures, buildings (for which university is responsible); civil engineering construction practice (for which both university and industry are responsible); and value analysis (for which industry is responsible).
3. Industry places a high premium on the following competencies: metrology, quality measurement, ferrous metals, and material treatment (for which both university and industry are responsible); and production/construction/process planning and control (for which industry is mainly responsible).
4. The largest gap between expectation and competence availability is identified to occur in the following characteristics: metrology, quality measurement, and production processes such as welding, machining, material treatment (for which both university and industry are responsible); and production/construction/process planning and control, scheduling, company procedures, maintenance management, installation and commissioning of machinery, and general information and knowledge about industry (for all of which industry is responsible).
5. According to industry's perception, engineering graduates have no competence in the following characteristics: company procedures, mainten-

ance management, and installation and commissioning of machines.

Service industries

1. Expectation far exceeds competence availability in almost all the tasks in all the functional areas.
2. There is a good match only in five characteristics: casting, metal forming, plastic moulding and NC machines (for which both university and industry are responsible).
3. Industry places a high premium on the following competencies: preparation of quotations, tenders, estimates and specifications, appreciation of materials and costs, use of instruction manuals, condition monitoring and maintenance management, and purchasing procedures (for all of which industry is responsible); electrical measurements (for which university is responsible): and personal drive and initiative.
4. The largest gap between expectation and competence availability exists in the following characteristics, for all of which industry is responsible: use of quotations, tenders, estimates and specifications, condition monitoring and maintenance management, purchasing procedures, and general knowledge and skills relating to industrial practices.
5. Competence availability is slightly greater than expectation in the areas of design of jigs, tools and fixtures, and of machine elements and assembles, and circuits (for which both university and industry are responsible).
6. For this class of service industries, both expectations and competence availability are very small in the following characteristics: production processes such as casting, metal forming and plastic moulding, and material treatment.

Comparison of manufacturing and service industries

1. There appears to be no commonality, in general, between these two groups of industries.
2. In both sectors, except for a few characteristics, expectation far exceeds competence availability.
3. In both sectors, the maximum gap is identified to be in the area of general information and knowledge about the industrial ambience.

Specific industries

The analysis of data obtained from two typical industries reveals that specific industries have special perceptions, orientation, expectations and requirements, which are quite different from the mean perceptions.

CONCLUDING REMARKS

The present work is an attempt to obtain the perceptions of a wide spectrum of industries about the competencies expected of engineering graduates in relation to their job requirements. The data have been averaged over all manufacturing industries and all service industries separately. The analysis has resulted in the identification of areas of good match and mis-match, areas considered absolutely essential by industry, the areas with the largest mis-match and areas of minimum competency. This can serve as a starting point for a meaningful dialogue between university and industry for mutual understanding and benefit.

It is also seen that specific industries have requirements that are quite different from the requirements averaged over all industries, separately classified into manufacturing and service industries. This clearly shows that industry's expectation that universities must provide them with 'finished products' is unrealistic and not really in the larger interests of the overall sector. This is not to imply that universities have no scope for improvement. Specific areas have been identified here for providing additional inputs; in addition, the universities have to anticipate future developments and prepare their graduates for coping with the challenges of the future.

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