Employability Skills: Pre-Requisites for an Engineering Graduates

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Abstract

Indian economy is striving for continuing its growth but on the other hand it is facing the problem of skill shortage. Very few researchers have done work to identify the demand of Indian employers in terms of skills. This study has tried to answer some questions i.e. (i) Indian employers are demanding for which skills, while they are recruiting fresh engineering graduates? (ii) What is the satisfaction level of Indian employers with the skills of fresh engineering graduates? Which skills need to be imparted in engineering graduates by engineering institutes during their study? (iii) After carried out the study, result shows that, Indian employers are not satisfied with the skills of engineering graduates. Study also reveals that employers in India are putting more emphasize on technical skills and human skills than conceptual skills. Findings of this study also suggest that engineering institutes of India needs to (i) work hard for enhancing employability skills of engineering graduates, (ii) put more emphasize on soft skills development in engineering graduates, and (iii) rethink about the teaching-learning and assessment process as well as syllabus reforms as per the requirement of industries.

Keywords: Engineering graduates, employability skills, technical skills, human skills, conceptual skills.

Introduction

Supply of engineering graduates with required employability skills to Indian industries is a prerequisite for continuous growth of Indian economy. The growth rate of Indian economy is 6.9% on average over the past ten years. If academia can make able to provide quality-engineering graduates, growth rate of Indian economy can have a good status.

As, sectors like information technology, power and infrastructure are heavily dependent on engineering graduates, are facing very difficult situation due to low supply of engineering graduates with good employability skills. Due to low supply of engineering graduates with good employability skills, these industrial sectors are facing problem of salaries hike 20% annually. Particularly, power sector is focusing on quality engineering graduates to develop new infrastructure with the help of solar energy in place of various conventional sources of energy for the betterment of environment. As per report published by the National Association of Software and Services Companies

(NASSCOM) and Mckensey in 2012, only 25% of the engineering graduates are employable in India.

To fulfill the demand of higher number of engineering graduates, more number of engineering institutes have been started to cater the need of society in India. Increased of more than 500% in the enrollment of engineering students has been reported for 1998 to 2008 (AICTE, 2009). But actually it has been observed that with the increment in the enrollment of engineering students, it has been perceived that expansion in enrollment has led to degradation in the quality of engineering education.

With this situation, research in this field is necessary and through this study, researcher has tried to identified the skills demanded by employers in India and through this researcher has tried to serve society by providing such crucial information to teachers of engineering institutes, administrators and policy makers.

The study was intended to answer following questions:

(i)Indian employers are demanding for which skills, while they are recruiting fresh engineering graduates?

(ii)What is the satisfaction level of Indian employers with the skills of fresh engineering graduates?

(iii)Which skills need to be imparted in engineering graduates by engineering institutes during their study?

Literature Review

Paranto and Kelkar (1999) did a survey of total 136 employers to know their satisfaction level with the skills of business graduates hired by them from a regional university in the United States.

Noel-Levitz and Utah State University did a survey in 2004 to know the employer satisfaction with the skills of engineering graduates in which total 112 employers had responded. The survey instrument focused on graduates' major, general and specialized skills.

Lattuca, Terenzini and Volkwein (2006) had analyzed the impact of accreditation through outcomes of student learning as suggested by the Accreditation Board for Engineering and Technology (ABET). The National Board of Accreditation has also suggested same outcomes of students learning.

In 2008, Academy for Education Development (AED) has done a survey of 92 employers in Egypt to provide suggestion to the Education Ministry for the enhancement of employability skills of their engineering students.

Hill and Petty (1995) did an analysis focusing on occupational work ethics. Through this analysis they identified three factors namely interpersonal skills, initiative and being dependable and recommend engineering institute to focus on these three factors while educating engineering students.1

Research Methodology

Researcher has conducted an online employer survey during January and February 2020. Total 157 employers across the India have submitted the completed survey questionnaire.2

The questionnaire includes the skill set that makes an engineer employable have been identified through a literature review.

Employer has to rate on a scale from 1 (not at all) to 5 (extremely) for each skill, which makes engineering students an employable engineering graduate. The questionnaire also includes questions on satisfaction level with skills of engineering graduates listed in table.

Sample Size and Sampling Strategy

A stratified random sampling was considered for the employer survey. An 80% confidence interval with margin of error 0.05 was applied, z is the abscissa of the normal curve that cuts off at a given significance level i.e., 1.28, p (in this case 0.6) is the estimated proportion of an attribute that is present in the population, q is 1-p, and e is the desired level of precision, i.e. 0.05.

Using following formula, the sample size was taken 157.

$$n = (z^2 * p * q) / e^2$$

Analysis

Skill Weightage

Initially factor analysis has been carried out for 25 skills provided in questionnaire. As a result of factor analysis individual skills have been grouped in to small number of skill groups[3] as given below with the indication of skills having factor loading:[4]

Table 1: Factor Pattern Matrix for Skills

Skills	Technical Skills (Factor 1)	Human Skills (Factor 2)	Conceptual Skill (Factor 3)
Trouble shooting (0.83)	0.83		
Application of technical knowledge (0.78)	0.78		
Technical competence for problem solving (0.76)	0.76		
Process design (0.74)	0.74		
Research skill (0.65)	0.65		
Sourcing of technical knowledge (0.63)	0.63		
Project management (0.59)	0.59		
Maintenance (0.58)	0.58		
System analysis (0.49)	0.49		
Testing (0.33)	0.33		
Effective communication (0.74)		0.74	
Leadership (0.73)		0.73	
Teamwork (0.72)		0.72	
Conflict resolution (0.59)		0.59	
Relationship management (0.50)		0.50	
Goal alignment (0.42)		0.42	
Global mindset (0.42)		0.42	
Networking (0.41)		0.41	
Creativity and innovation (0.80)			0.80
Strategic thinking (0.77)			0.77
Professional and ethical responsibilities (0.73)			0.73
Critical thinking (0.67)			0.67
Social cultural global and environmental responsibilities (0.51)			0.51
Information management for decision making (0.45)			0.45
Visualization (0.42)			0.42

The first factor comprises of engineering specific skills. Some skills are having factor loading greater than 0.55 i.e. Trouble shooting, Application of technical knowledge, Technical competence for problem solving, Process design, Research skill, Sourcing of technical knowledge, Project management, Maintenance. This factor is defined as Technical Skills.

The second factor comprises of interpersonal skills. In this Effective communication, Leadership, Teamwork and Conflict resolution are having factor loading greater than 0.55 and this factor is defined as Human Skills.

The third factor comprises of higher order thinking skills and Creativity and innovation, Strategic thinking, Professional and ethical responsibilities, Critical thinking are having factor loading greater than 0.55.

Table 2: Skills Grouped Into Three Factors

Factor 1 (Technical Skills)	Factor 2 (Human Skills)	Factor 3 (Conceptual Skills)
Trouble shooting	Effective communication	Creativity and innovation
Application of technical knowledge	Leadership	Strategic thinking
Technical competence for problem solving	Teamwork	Professional and ethical responsibilities
Process design	Conflict resolution	Critical thinking
Research skill	Relationship management	Social cultural global and environmental responsibilities
Sourcing of technical knowledge	Goal alignment	Information management for decision making
Project management	Global mindset	Visualization
Maintenance	Networking	
System analysis		
Testing		

Research question on satisfaction and skill gaps has been responded in following paragraphs with the help of these three identified factors.

Satisfaction of Employers

Average satisfaction rating on overall skills was 3.15 and the mean of the average satisfaction rating of each skill was 3.19, which reveals that all employers have responded consistently on the dissatisfaction level for the specific skills and overall level. 5

No skill in the questionnaire has been rated above 4.0 i.e. "Very satisfied", it reveals that, employers are not happy with any skills listed in the questionnaire.6

This dissatisfaction indicates that engineering graduates does not meet the expectations of employers.

Table 3: Satisfaction Level

Skills	N	Mean	Std. Dev.
Conflict resolution	150	3.95	0.68
Trouble shooting	153	3.50	0.88
Sourcing of technical knowledge	153	3.46	0.81
Research skill	151	3.44	0.72
Application of technical knowledge	153	3.37	0.86
Maintenance	153	3.37	0.91
Global mindset	150	3.34	0.95
System analysis	153	3.29	0.77
Critical thinking	150	3.23	0.84
Effective communication	150	3.22	0.89
Technical competence for problem solving	153	3.20	0.93
Goal alignment	150	3.17	0.83
Testing	153	3.15	0.81
Professional and ethical responsibilities	150	3.15	0.85
Relationship management	150	3.13	0.82
Process design	153	3.12	0.79
Project management	153	3.12	0.95
Teamwork	150	3.08	0.92
Visualization	153	3.08	0.92
Networking	150	3.03	0.93
Leadership	150	3.02	0.90
Strategic thinking	150	2.95	0.96
Information management for decision making	153	2.95	0.86
Creativity and innovation	150	2.87	0.96
Social cultural global and environmental responsibilities	150	2.65	0.93

Technical skills of engineering graduates are more satisfying than Human skills and Conceptual skills. Employers are satisfied with higher level with Conflict resolution skills of engineering graduates as compare to other skills. Critical thinking skills have achieved highest level of satisfaction in Conceptual Skills.

On the other hand Creativity and innovation, Strategic thinking and Leadership skills are rated at the lowest level of satisfaction by employers and it is very urgent matter to be think upon for the betterment of Indian economy.

Table 4: Satisfaction Level by Three Factors

Technical Skills	Mean	Human Skills	Mean	Conceptual Skills	Mean
Trouble shooting	3.50	Effective communication	3.95	Creativity and innovation	3.23
Application of technical knowledge	3.46	Leadership	3.34	Strategic thinking	3.15
Technical competence for problem solving	3.44	Teamwork	3.22	Professional and ethical responsibilities	3.08
Process design	3.37	Conflict resolution	3.17	Critical thinking	2.95
Research skill	3.37	Relationship management	3.13	Social cultural global and environmental responsibilities	2.95
Sourcing of technical knowledge	3.29	Goal alignment	3.08	Information management for decision making	2.87
Project management	3.20	Global mindset	3.03	Visualization	2.65
Maintenance	3.15	Networking	3.02		
System analysis	3.12				
Testing	3.12				
Average	3.30	Average	3.24	Average	2.98

Skill Gaps

Skill gaps7 can be identified with the help of above two sections i.e. employers' rating of skills and employers' satisfaction level for that particular skill, deviation between these two has given skill gap and it should be addressed on urgent basis.

A high skill gap indicates that the skills is marked "Important" by employer and engineering graduates are unable to meet the expectations of the employers.

Technical Skills faces high level of skill gap compared to Conceptual Skills and Human Skills.

Table 5: Skills Gaps by Three Factors Skills

Technical Skills	Mean	Human Skills	Mean	Conceptual Skills	Mean
Application of technical knowledge	1.22	Relationship management	0.99	Critical thinking	1.06
Project management	1.10	Teamwork	0.96	Professional and ethical responsibilities	0.99
Process design	1.03	Conflict resolution	0.89	Creativity and innovation	0.93
Maintenance	1.03	Leadership	0.85	Social cultural global and environmental responsibilities	0.89
Trouble shooting	0.98	Goal alignment	0.83	Information management for decision making	0.88
Technical competence for problem solving	0.95	Networking	0.68	Strategic thinking	0.85
Research skill	0.91	Global mindset	0.61	Visualization	0.85
Sourcing of technical knowledge	0.90	Effective communication	0.31		
System analysis	0.86				
Testing	0.77				
Average	0.98	Average	0.77	Average	0.92

Findings

- All skills given in the questionnaire has been grouped in to three main skills i.e. (i) Technical Skills, (ii) Human Skills, (iii) Conceptual Skills.
- As per employers' survey, all skills are important for them but they are concentrating on Technical Skills and Human Skills than Conceptual Skills.
- Only 64% employers are satisfied with the skills of engineering graduates and with the quality of knowledge, engineering studentsare having.
- Engineering graduates are having good English communication skills and employers are also demanding for it.
- Engineering graduates are not having analytical, self-assessment and innovative skills and employers are having requirement of these skills more than skills like application of theoretical knowledge on field.

Suggestions

Based on the above results, following suggestion should be taken in to consideration by policy makers and administrators of engineering institutes:

As per the requirement of employers, policy makers and administrators of engineering institutes should concentrate on technical skills, human skills and conceptual skills while preparing curriculum of engineering.

Policy makers and administrators of engineering institutes should thoroughly concentrate on soft skills.

Policy makers and administrators of engineering institutes must remain in close contact with employers on continuous basis.

Policy makers and administrators of engineering institutes should redesign assessment process as well as pedagogy with immediate effect.

Policy makers and administrators of engineering institutes should customize the courses to match the demand of employers.

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Endnotes

In this paper, author has used the term “skills” in extensive context. So attributes, competence, ability to perform etc. are included in the term “skills”.

The survey questionnaire for employers has been given in tabular form in Appendix A.

Table 2 is showing the grouping of skills in three different factors i.e. Technical Skills, Human Skills and Conceptual Skills.

Factor loading are the correlation coefficient between each variable and the factor. Skills with high factor load are more relevant to the respective factor. Table 1 shows the skills with its factor loadings.

Table 4 summarizes the importance level of each skill under the three factors.

Table 3 represents the standard deviations.

Table 5 represents the skills gaps by three factor skills.

APPENDIX A

Questionnaires for Employers Satisfaction Survey

Rate IMPORTANCE for successful performance of the job					Skills	Rate SATISFACTION with this employees' qualities				
Extremely	Very	Somewhat	Not Very	Not at all		Extremely	Very	Somewhat	Not Very	Not at all
					Conflict resolution					
					Trouble shooting					
					Sourcing of technical knowledge					
					Research skill					
					Application of technical knowledge					
					Maintenance					
					Global mindset					
					System analysis					
					Critical thinking					
					Effective communication					
					Technical competence for problem solving					
					Goal alignment					
					Testing					
					Professional and ethical responsibilities					
					Relationship management					
					Process design					
					Project management					
					Teamwork					
					Visualization					

					Networking					
					Leadership					
					Strategic thinking					
					Information management for decision making					
					Creativity and innovation					
					Social cultural global and environmental responsibilities					
Comment:										