CHAPTER III
METHODOLOGY

3.0 Overview

This chapter presents the methodology of the study undertaken. It explains the relevance for the study, the sample and the procedures adopted in administering the instruments and the collection of data, the components of the tools adopted – all involved in the measurement of the employability skills of the engineering graduates in the light of the industry needs.

3.1 Relevance of the Study

During the past two decades, there have been continuous changes in the specific skills requirement of the industry from the entry level engineers. There is ample evidence to the fact that graduate engineers lack the required communication skills, particularly when considering the needs of industry internationally\(^1\),\(^2\) and compared to various other related disciplines offered at universities. The issue of lack of employability skills of the graduates in general and engineering graduates in specific, is a matter of great concern warranting for immediate and serious concern. Studies, whether at the micro or macro level should be of values to apex bodies for education and employment.

“India’s young demographic profile, to its vast network of academic infrastructure that churns out 3.1 million graduates annually, to its English speaking workforce, the country offers a matched mix of human-power benefits to organizations.” Of the total engineering workforce coming out of the academic portals, 25 to 35 percent only get their jobs. While more studies are available in various countries, Indian studies are very much less. Many Indian states need an assessment study, though Andhra Pradesh alone has done it in 2009. The situation in Kerala needs to be studied. In the absence of any such
study, the results of a study of this nature may help inputs to the process of policy decisions for bridging the skills gap. The present study undertakes to investigate the competence of Engineering graduates, related factors and their level.

3.2 Statement of the Problem

Forces, including demographics, globalization, and rapidly evolving technologies are driving profound changes in the role of engineering functions in the present day society. The changing workforce and technology needs of a global knowledge economy are dramatically transforming the nature of engineering practice, demanding far broader skills than simply the mastery of scientific and technological disciplines. A lot of research is going on all over the world – both in developed and developing countries, in identifying the gap between the industry needs and engineering graduates’ employability skills. A gap is felt to be persistent between the two factors. Falling in line with the concern of the global trend, the topic of present investigation is the “Industry Requirements for and Competence of Engineering Graduates- A study”.

The main objective of the present study is to identify the status of the art regarding the skills level of engineering graduates of the present day with a sample drawn from three universities in Kerala State.

3.3 Objectives of the Study

The general objective of this study is to develop recommendations, based upon the findings and conclusions of a skills-gap analysis, that can be implemented by key stakeholders to increase the rate of employable engineering graduates. The study aims to identify and measure the competency of the engineering graduates in terms of the industry needs and expectations. The specific objectives of the study include the following:
1. To understand and measure the competency of the engineering graduates through Differential Aptitude Test Battery;

2. To study and measure the level of emotional intelligence of the engineering graduates;

3. To measure the attitude of the engineering graduates towards the least preferred coworker;

4. To measure the level of their achievement in the non-technical skills as assessed in practice by the industry;

5. To compare the Differential aptitude, Emotional intelligence and achievement of the engineering graduate students and professionals/non students;

6. To find out the association between the selected socio demographic conditions, competency, emotional intelligence and achievement and

7. To find out whether or not the engineering graduates’ competency matches the requirements of the industry.

In accordance with the general and specific objectives, the study formulated a set of hypotheses so as to fulfill the objectives.

3.4 Hypotheses of the Study

The set of hypotheses formulated for the present study includes the following:
1. Engineering graduates belonging to different categories do not differ in their competence and emotional intelligence;

2. Engineering graduates from different branches of study do not differ with regard to their competence and emotional intelligence;

3. Male and female engineering graduates do not differ with regard to their competence and emotional intelligence;

4. Engineering graduates from different semesters do not differ with regard to their competence and emotional intelligence;

5. Engineering graduates do not differ with regard to their competence and emotional intelligence in the context of Least Preferred Co-worker;

6. Engineering graduates who have secured placement orders do not differ in their competence and emotional intelligence with regard to their achievement level;

7. Engineering graduates who are already employed do not differ in their competence and emotional intelligence with regard to their achievement level;

8. Engineering graduates who are already employed with different salary do not differ with regard to their competence and emotional intelligence;

9. Engineering graduates who are already employed do not differ with regard to their competence and emotional intelligence in the context of Least Preferred Co-worker.
3.5 Research Design

The present study adopts multistage cluster sampling which belongs to the category -- cluster sampling. According to Sarndal, Swenson, and Wreman, “One of the sampling techniques is the Cluster sampling in which the entire population of interest is divided into groups, or clusters, and a random sample of these clusters is selected. Care should be taken to ensure that each cluster must be mutually exclusive and together the clusters must include the entire population. After clusters are selected, then all units within the clusters are selected. No units from non-selected clusters are included in the sample. Cluster sampling is different from stratified sampling, in which some units are selected from each group. When all the units within a cluster are selected, the technique is referred to as one-stage cluster sampling. If a subset of units is selected randomly from each selected cluster, it is called two-stage cluster sampling. Cluster sampling can also be made in three or more stages which is then referred to as multistage cluster sampling.”

Selection of samples for this study are based on the steps and procedures prescribed under multistage cluster sampling.

3.5.1 Sample

The present study identified engineering graduate students from the 5th, 6th, 7th and 8th semesters from eight Engineering Colleges, affiliated to anyone of the three universities namely, Mahatma Gandhi University, Kottayam, Calicut University and Cochin University of Science and Technology (CUSAT), all geographically located in the Kerala State and they all follow the same syllabus structure. The study is confined to the clusters of engineering graduates from three branches of specialization namely, Electronics and Communications Engineering; Computer Science and Engineering; and Information Technology, besides selective students with placement orders identified during campus interviews and selective engineering graduates already employed in the IT
industries in Kerala. The study identified the division of the population into similar groups on the basis of known properties of the population and fixed each of the subgroups satisfying the procedures of sampling.

In the state of Kerala, around 30,000 students are annually inducted into various engineering institutions approved by the All India Council of Technical Education. In the eight colleges covered under the present study, there are about 3,000 students taken together in various branches of Engineering discipline. The sample for this study identified a total of 571, out of which 434 belonged to the students category, 81 students under the provisionally selected under campus interviews category and 56 belonged to the employed engineering graduates category. The facets of distribution of the samples are provided in the following tables.

Table 3.1 College-Wise Distribution of Respondents (General)

<table>
<thead>
<tr>
<th>S.No</th>
<th>Name of the College</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Royal College of Engineering</td>
<td>38</td>
<td>8.8</td>
</tr>
<tr>
<td>2</td>
<td>Sree Narayana Gurukulam College of Engineering</td>
<td>19</td>
<td>4.4</td>
</tr>
<tr>
<td>3</td>
<td>Rajagiri School of Engineering and Technology</td>
<td>22</td>
<td>5.1</td>
</tr>
<tr>
<td>4</td>
<td>Amaljyothi College of Engineering</td>
<td>109</td>
<td>25.1</td>
</tr>
<tr>
<td>5</td>
<td>Viswajyothi College of Engineering</td>
<td>15</td>
<td>3.5</td>
</tr>
<tr>
<td>6</td>
<td>College of Engineering, Poonjar</td>
<td>100</td>
<td>23.0</td>
</tr>
<tr>
<td>7</td>
<td>College of Engineering, Kalloopara</td>
<td>71</td>
<td>16.4</td>
</tr>
<tr>
<td>8</td>
<td>Ilahia College of Engineering</td>
<td>60</td>
<td>13.8</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>434</strong></td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>
From table 3.1, it is found that 25.1 percent of the respondents belong to the Amaljyothi college of Engineering followed by 23.0 per cent from College of Engineering Poonjar.

**Table 3.2 Distribution of Respondents Provisionally Selected in Campus (Selected Group)**

<table>
<thead>
<tr>
<th>S.No</th>
<th>Branch of study</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Information technology (IT)</td>
<td>15</td>
<td>18.52</td>
</tr>
<tr>
<td>2.</td>
<td>Electronic &amp; Communication Engg (ECE)</td>
<td>48</td>
<td>59.26</td>
</tr>
<tr>
<td>3.</td>
<td>Computer Science Engineering (CSE)</td>
<td>18</td>
<td>22.22</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>81</strong></td>
<td><strong>100.00</strong></td>
</tr>
</tbody>
</table>

The respondents were from different branches of study in Engineering having obtained ‘provisionally selected’ orders from different concerns under the campus interview program. From table 3.2, it is found that 59.26 per cent belonged to ECE branch, 22.22 per cent to CSE branch and 18.52 percent to IT branch.

**Table 3.3 Distribution of Respondents who Are Already Employed**

<table>
<thead>
<tr>
<th>S.No</th>
<th>Designation</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Lecturer</td>
<td>41</td>
<td>73.2</td>
</tr>
<tr>
<td>2.</td>
<td>Non Lecturer</td>
<td>15</td>
<td>26.8</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>56</strong></td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>

The third set of respondents was drawn from the already employed with Engineering degree as lecturers and others. From table 3.3, it is found that 73.2 per cent is with a designation as lecturer and 26.8 per cent is with different designations.
3.5.2 Data Collection Method: Questionnaire Supplemented by Interviews

Initial steps commenced with an informal survey as personal interviews by the investigator with Human Resource (HR) heads of selective companies whose presence is well established in Kerala. The survey focused on the skills requirement they expect from the engineering graduates who are their potential candidates for recruitment. The companies included were Tata Consultancy Services (TCS), INFOSYS, US Technologies, Cognizant Technology Solutions, IBS in Technopark Thiruvananthapuram. Literature study also is pointing to the very same parameters suggested by the heads of HR consulted. Aspects of the tools were adopted from the well established set of Differential Aptitude Test Battery (DAT), Fiedler’s Least Preferred Coworker (LPC) scale and the others (Overall Emotional Intelligence) were the ones already found consolidated by Dr. Immanuel Thomas and Sushama S. R. of Kerala University. Suggestions and comments offered by the Guide along with the panel of experts were incorporated into the final version of the instrument. The Graduate Engineers were tested and measured for their employability skills and competence.

3.5.3 Parameters Analyzed

Competence of engineering graduates well suited to their employability gives rise to large number of parameters, but this study confines to a selected few of them. Looking into the findings of the informal survey as personal interview conducted among a few Human Resource (HR) heads of select companies whose presence is well established in Kerala and the suggestions and results revealed in published literature suitable parameters were finalized for the study. The main parameters included are verbal reasoning, numerical ability, space relations, speed and accuracy, emotional intelligence, leadership and team work.
3.5.4 Tools Design for Different Parameters

The tools to assess the identified parameters were finalized with elaborate discussions with the Guide and also the various experts in the field. Various experts include senior professors and research guides in the Department of Psychology in the Calicut University, Department of Behavioral Sciences, Mahatma Gandhi University, Department of Psychology, Kerala University, Department of Psychology, K.E College Mannanam and many retired professors and experts in the field. Some of the tools were taken from the well established set of Differential Aptitude Tests (DAT) and the others were already developed by Dr. Immanuel Thomas and Sushama S. R. of Kerala University. Thus, the Graduate Engineers were tested and measured for their

i) Numerical Ability
ii) Space Relations
iii) Verbal Reasoning
iv) Speed and Accuracy
v) Emotional Intelligence Inventory, and
vi) Least Preferred Coworker

The first four are in accordance with the parameters included in the Differential Aptitude Tests (DAT) battery. Numerical Ability and Space Relations could give a measure of logical thinking, Verbal Reasoning, that of the verbal communication and Clerical Speed and Accuracy, that of speed. Emotional Intelligence Inventory is a measure of the emotional intelligence and finally the Least Preferred Coworker, that of the team work as propounded in Fiedler’s theory. The structure of instruments used for the present study is given in the following passages.
3. 5.4.1 Numerical Ability

This is a test to find out the computational and numerical capability of a person. There are 40 questions, for each of which correct answer is to be selected from a group of 5 values given as A, B, C, D and E. Every correct answer carries 1 mark and every wrong answer carries $\frac{1}{4}$ marks as negative. Questions are from general arithmetic operations of addition, subtraction, multiplication, division, square root, cube root, percentage etc. The time to administer test is 30 minutes.

3. 5.4.2 Verbal Reasoning

This test gives an indication of the verbal capability of a person in English language. There are 50 sentences in each of which the first word is omitted, and also the last word and a blank space is provided in their respective places. The person under test has to pick out words which will fill the blanks from a list of words given with every question. The first word is to be selected from four words given in the first row subtitled as 1, 2, 3 and 4, where as the last word is to be selected from the second row A, B, C and D. The answer will be an alpha numeric, a combination of a digit from 1 to 4 and an alphabet from A to D as, for example, 2C, 1D etc. Every correct answer is given one mark and there is no negative mark. The time allotted for their test is 30 minutes.

3.5.4.3 Space Relations

This test gives the clear picture of engineering imagination of a person as to which physical body can fit into another exactly. There are 40 questions, each of which contains a ‘developed surface’ pattern. It can be folded into some figures. The person under test must be able to identify blocks whose development is the given pattern. The exact conformity between the developed surface and the object is what is sought. In each question 5 objects are given
and there can be one or more correct answers which will conform to the
developed surface. Correct answers are given one mark each and wrong
answers, negative one. Totally it has 100 correct answers to mean the maximum
mark to be 100. The time to administer test is 30 minutes.

3.5.4.4 Speed and Accuracy

This is a test to assess the capability of a person to compare combinations
of a letter and number in one order in a specific combination and in another place
in a different order, but in the same combination. The item to be compared will be
underlined in the given format and the same is to be underlined by the candidate
in the answer sheet. There are 100 questions each in part I and II. Originally time
allotted to complete each part was 3 minutes as presented in the test material.
While the initial survey was conducted every candidate could do this almost
100%. Hence, in consultation with experts, in this study time was reduced from 3
minutes to 2 minutes so as to make the comparative study more meaningful.

3. 5.4.5 Emotional Intelligence Inventory (EII)

The aim of this test is to know how the respondents evaluate their own
habitual behaviour styles. The tool selected was the one developed by Prof.
Immanuel Thomas and Sushama S.R., Department of Psychology, University of
Kerala, Thiruvananthapuram, namely Emotional Intelligence Inventory (EII). This
contains 50 statements with 5 possible assertions out of which the candidate is
directed to tick any one. The marks are 5,4,3,2 and 1 respectively as for
completely agree, agree, undecided, disagree and completely disagree
respectively. This is the way mark is given when the statement is in positive
order. If the statement is in negative order, the order of marks will be just the
reverse. In this set, there are 29 positive order statements and 21 negative order
statements.
3.5.4.6 Personal Efficacy (PE)

Out of the 50 statements, 26 items together will give an indication of the Personal Efficacy (PE). It is a measure of one’s ability to act with highest efficiency, in accordance with the different social situations. Some of the characteristics of those who score high on this scale are: ability to think and act independently; self-reliance; self-esteem; sense of responsibility; earnestness; sense of commitment and ability to control one’s own behaviour.

3.5.4.7 Interpersonal Efficacy (IPE)

Out of 50 statements 11 items give out one person’s the Interpersonal Efficacy (IPE). IPE is a measure of the ability to develop and maintain social relations and personal relations. This is the second component of Overall Emotional Efficacy (OEE). Some of the characteristics of those who score high in this are: ability and interest to bring and keep people together; key role in group activities and opinion formation of groups, ability to influence one’s social milieu, more than getting influenced by it and to keep it always favorable to oneself.

3.5.4.8 Intrapersonal Efficacy (InPE)

The remaining 13 items will give the Intrapersonal Efficacy (IPE). It is a measure of the extent to which one is free from the mental conflicts and tensions, which negatively influence the development of personality. It is the third component of OEE. People with low InPE succumb very easily to emotions and experience a lot of mental conflicts. Frustration, self-derogation, anxiety, etc. are other characteristics.
3. 5.4.9 Least Preferred Coworker

There may be a person with whom one can work least well. He may be someone, one can work with now; or he may be someone known in the past. He does not have to be the person one may like least well, but should be the person with whom one had the most difficulty in getting a job done. Fiedler’s scale is used to describer this person as he appears to one. On the scale given are pairs of words which are opposite in meaning. Respondents are asked to select one of the eight boxes on the line between the two words and put a mark in it to indicate respondents’ assessment of the person.

LPC scale designed by Fiedler is used to identify a person’s dominant leadership style. Fiedler believes that this style is a relatively fixed part of one’s personality and is therefore difficult to change. Though the statements are about the coworker one has maximum difficulty in getting a job done, it speaks for himself about the task orientation and relationship orientation. This has 16 statements for which the candidate has to make the affirmation on a scale of 8 to 1 in the positive direction and a scale of 1 to 8 in the negative direction. The maximum score can be 16 \times 8 = 128. Lower the score, higher in the task orientation and higher the score, higher is the relationship orientation.

3.6 Achievement Level

An algorithm for Composite Achievement Score (CAS) was developed. CAS is based on three criteria. A CAS scale was developed by analyzing the placement data of respondents who have been provisionally selected for employment and already employed engineering graduates. The procedure for CAS computation is explained below:
1. Criteria for CAS computation

Criterion A: Number of attempts for initial placement

<table>
<thead>
<tr>
<th>Number of attempts</th>
<th>Grade</th>
<th>Point X</th>
</tr>
</thead>
<tbody>
<tr>
<td>First attempt</td>
<td>A</td>
<td>4</td>
</tr>
<tr>
<td>Second attempt</td>
<td>B</td>
<td>3</td>
</tr>
<tr>
<td>Third attempt</td>
<td>C</td>
<td>2</td>
</tr>
<tr>
<td>More than 3 attempts</td>
<td>D</td>
<td>1</td>
</tr>
</tbody>
</table>

Criterion B: Company tier at first employment

<table>
<thead>
<tr>
<th>Company tier</th>
<th>Grade</th>
<th>Point Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tier 1</td>
<td>A</td>
<td>4</td>
</tr>
<tr>
<td>Tier 2</td>
<td>B</td>
<td>3</td>
</tr>
<tr>
<td>Tier 3</td>
<td>C</td>
<td>2</td>
</tr>
<tr>
<td>Not placed</td>
<td>D</td>
<td>1</td>
</tr>
</tbody>
</table>

Criterion C: Salary level entry

<table>
<thead>
<tr>
<th>Salary level</th>
<th>Grade</th>
<th>Point Z</th>
</tr>
</thead>
<tbody>
<tr>
<td>High (above Rs.25, 000)</td>
<td>A</td>
<td>4</td>
</tr>
<tr>
<td>Medium (22,000- 24000)</td>
<td>B</td>
<td>3</td>
</tr>
<tr>
<td>Low (13,000 – 21,000)</td>
<td>C</td>
<td>2</td>
</tr>
<tr>
<td>Below 13,000</td>
<td>D</td>
<td>1</td>
</tr>
</tbody>
</table>

2. Formula for CAS

\[
\text{CAS} = \frac{100}{12} \sum (X + Y + Z)
\]

Where,

\(X\) = Points based on number of attempts for securing a job

\(Y\) = Points based on company tier at first placement

\(Z\) = Points based on salary level at entry
3. CAS Scale

<table>
<thead>
<tr>
<th>CAS</th>
<th>Achievement Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>75 &lt; CAS ≤100</td>
<td>HA</td>
</tr>
<tr>
<td>50 &lt; CAS ≤ 50</td>
<td>MA</td>
</tr>
<tr>
<td>0 &lt; CAS ≤ 50</td>
<td>LA</td>
</tr>
</tbody>
</table>

HA : High achievement      Top 33 %
MA    Medium achievement   Between 33 % and 50%
LA     Low achievement      Bottom 50 %

3.7 Administration of Tools

In order to find out the competency of the Engineering graduates, the appropriate, standardized tests have been conducted and scores have been given to the answer sheets collected from respondents who appeared for the test. The tool used is a standard one used in the industry to identify the competency of respondents and as such, it did not require any pilot study. The questionnaire has been administered to the selected sample. They were also provided with answer sheets while they were instructed to make their choice of answers to all the questions. The investigator maintained a good rapport with the respondents as it is required in such contexts to make the study effective. The investigator outlined the main objectives of the study to the respondents.

In view of a good number of samples, the assistance of a soft skill training group by name TURNING POINT under the leadership of Mr. Thomas K. George was commissioned for the smooth conduct of the survey. Turning point is a team having program running for six days giving training to engineering students in developing the soft skills at a stretch. The team could build a good rapport with the participants which was very much essential. From experience it was found that all the participants were mentally transformed to a positive attitude being
ready to do cooperate. Such a conducive atmosphere was very much essential for securing the cooperation of the students during the survey. The cooperation of the students was highly appreciable.

Each unit of the questionnaire set was served one after another and students sat for more than 2 hours at a stretch and answered fully as and when the questionnaires were served.

3.7.1 Administering the Tests

The timing for administering of the tests in each college was finalized in consultation with the students for their convenience without affecting their regular class work and with the permission of the college authorities. Students were assembled in the classrooms. The purpose of the survey and its method of answering were explained to them in detail. The time specifications of the DAT test were well informed in advance and specific instructions regarding each test were given. The possibility of multiple answers in the case of Space Relations was clearly explained. Starting time and ending time for each test were announced and filled in answer papers were collected in time with the assistance of some of the faculty members of the colleges. Answer papers were collected in the correct order and were finally all the answer sheets were sorted out candidate wise and tagged accordingly, well packed and kept in safety for evaluation.

All the files were taken home and each of them was individually evaluated manually. This ‘time consuming’ and laborious work was completed meticulously and conscientiously. Scores were entered in records and later tabulated in the computer in the Microsoft Excel spreadsheets – a format easier for commissioning the services of SPSS.
3.8 Statistical Tools Used in This Study

Data are gathered using readily available tools which are modified and adopted by the researcher. There are many types of tools and each type has its unique characteristics and each should be considered for its appropriateness for collecting certain kinds of data on a selected research problem.

The present study encompasses various modes of analysis such as percentage analysis, diagrammatic analysis and differential analysis. The following are the statistical tools used in the present study.

1. Mean percentage score
2. Chi-square test
3. t-test
4. ANOVA – F ratio

The collected data were fed into the computer and analyzed using SPSS version 14.0 and the output were converted into tables for further analysis. Moreover, charts and diagrams were generated suitably and presented.

3.9 Limitations of the Study

The study was carried out with samples from select Engineering institutions in Kerala state. This does not claim to be an exhaustive survey. This study avoids a comparative analysis which may reveal individual or institutional characters, though a general gender analysis is included.

It should be noted that the project focused exclusively on Bachelor degree level programs and does not include any sample from the Post Graduate level. The investigator is aware that whilst some of the findings of this project may have application to higher level qualifications and there may well be other issues in relation to employability skills for Master level students. In terms of employers
and businesses, the consultants and representatives of selective Indian-based firms only were interviewed. The engineering graduates from institutions may seek employment within or outside India and such a factor was not considered within the purview of this study.

3.10 Supplementing Features

The data collection of the study has been supplemented by the opinion from Educationists including a Vice Chancellor, an IAS Officer turned Educationist and MLA, Senior Professors from Engineering and Psychology disciplines, Personnel from the IT industry and teachers. A schedule comprising of 14 items were used to elicit answers from the interviewed. Electronic gadgets were used to record the interview and for the conversion of the voice to text, besides human technical assistance. The summary of the interviews is added as the last section of the fourth chapter namely Analysis and Interpretation.

3.11 Organization of the Chapters

Following is the plan of organizing the chapters included in the report of this study:

1. Introduction
2. Review of Literature
3. Methodology
4. Data Analysis and Interpretation
5. Findings and Discussion
6. Recommendations, Suggestions and Conclusion
7. Documentation
8. Appendix
3.12 Rendering of the Bibliography

The rendering of the bibliography is in accordance with the Chicago Manual of Style with modifications in rendering Indic and Muslim names and the year of publication. Instead of placing the year after the name of the publisher, it is enclosed within circular brackets and placed immediately after the name(s) of authors. Notes and references are provided at the end of each chapter and in addition as a consolidated bibliography in an alphabetical order is appended at the end of the report.
3.13 Notes and References

