Some Studies on Quality, Employability, Skill Development and Knowledge Creation in Technical Education

Submitted in fulfillment of the requirements for the award of the Doctor of Philosophy

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CANDIDATE'S DECLARATION

I hereby certify that the thesis titled "**Some Studies on Quality, Employability, Skill Development and Knowledge Creation in Technical Education**" and submitted in fulfillment of the requirements for the award of the degree of Doctor of Philosophy is an authentic record of my research work carried out under the guidance of Prof (Dr) S.K. Garg. Any material borrowed or referred to is duly acknowledged.

The matter presented in this thesis has not been submitted elsewhere in part or fully to any other university or Institute for the award of any degree.

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SUPERVISOR'S CERTIFICATE

This is to certify that the thesis titled "Some Studies on Quality, Employability, Skill Development and Knowledge Creation in Technical Education", submitted in fulfillment of the requirements for the award of the degree of Doctor of Philosophy is an original research work carried out by Mr Om Prakash Shukla, under my supervision. The matter presented in this thesis has not been submitted elsewhere in part or fully to any other university or Institute for the award of any degree, to the best of my knowledge.

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EXECUTIVE SUMMARY

In India, the employability of engineering graduates was not the major concern before 1990, when the seats were limited and brilliant students were getting admission directly in engineering education. The huge expansion in number of technical education institution with enhancement in intake capacity took place amid the 1990s, and on other side the requisite academic infrastructure and faculty as per requirement were not made available. This has caused deterioration in providing of quality technical education. The students passing out also not meeting the expectations of employers as far as technical knowledge and skill are concerned.

The expression "quality" is profoundly subjective in nature and hard to characterize quantitatively. It is broadly acknowledged that the countries with poor quality education may not ready to contend in the worldwide information economy. The mushrooming of technical education institutions not only caused deterioration in quality but also made students unemployable. The NASSCOM report says that out of passed out graduate engineers only 25% have employable skill. This indicates that there is mismatch between expectation of skill and knowledge by employer and student posses after attaining their bachelor degree in engineering education. Therefore there is need to study the expectation of students, Industry and perception of faculty about the quality, skill development, knowledge creation and employability. The present research reported in this thesis is an attempt to find the characteristics responsible for quality of technical education as expected from the stake holders in engineering education system like students and employers. The perception of faculty on various attributes also analyzed in the present study.

A comprehensive review of the literature identifies the issues related to Quality, Employability, skill development and knowledge creation. Quantitative and qualitative techniques are the two primary methodologies utilized as a part of research. Quantitative strategy evaluated the collected data through analysis of various statistical techniques. It involves a deductive approach like hypothesis and regression etc. Both primary and secondary data sources have been utilized to answer research questions. Primary data obtained through the directing of questionnaires from stake holders while secondary sources through past reviews and information collected from different databases so as to have a real examination in the study.

The study, developed on the basis of a comprehensive study in the Indian context, is aimed to understand the expectations of students by way of ranking of the parameters of an institution and also to analyze their perceptions about the various elements in their institutions. The analysis shows that good faculty has got the highest rank and further the faculty has a strong positive relation with placements and skill development. Factor analysis of perception resulted in seven factors based on the students' perception.

The review reveals that one of the important reasons for non employable engineering graduates is the lack of necessary skills imparted in the curriculum. Though the purposes of education is the holistic development of the graduates and make them strong in fundamentals, but it cannot be denied that in the present economic environment, developing necessary skills is also important. The survey of industry executives visiting campuses for placement was carried out to find out the skills required by the industry so that the curriculum can be revised and delivery mechanism augmented to prepare students with desired skills. Relationship also attempted between different institute attributes to understand the role of faculty, infrastructure and other inputs on skill development, employability and improvement of quality of technical education.

After the conduct of the study of three stakeholders, based on their inputs and review of literature, Interpretive Structure Modeling(ISM) is carried out to develop the structural relationship among the enablers to make the education system student centric and employment focus. ISM is characterized as a process to provide a framework about an education system where various activities are interlinked. ISM is observed to be a well-demonstrated and generally acknowledged framework displaying approach for indicating the interrelationships between the factors affecting the system (Warfield, 2005). It helps in critical thinking to find relationship and brings into thought of arrangement of related components, which portrays the complex hierarchical issues (Warfield, 1976).In the absence of the knowledge of the structural relationship, it may happen that the institutions are focusing at a wrong place and at the end not getting the desired results. The exercise shows that the commitment of the promoters and top leadership is the most important and significant driver in building competency and making the graduates employable. This ISM study

also aims to identify the factors called enablers, which need to be present in the eco system.

The findings of the study are presented chapter wise along with policy recommendations, scope for further research.

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ABBREVIATIONS USED

α	Cronbach Alpha
AHP	Analytic hierarchy process
ANOVA	Analysis of variance
AHP	Analytic Hierarchy Process
AICTE	All India Council of Technical Education
CSR	Corporate Social Responsibility
DSCI	Data Security Council of India
DTU	Delhi Technological University
e-mail	Electronic mail
EQ	Emotional quotient
ESD	Education for sustainable development
FSIT	Foundation Skills in Information Technology
GATE	Graduate Aptitude Test in Engineering
GBFS	Global Business Foundation Skills
GER	Gross Enrolment Ratio
HCD	Human Central Design
HOLSKED	Holistic Skills Education
IBM	International Business Machines
ICT for D	Information and communication technologies for development
IHL	Institutes of Higher Learning
IIEST	Indian Institute of Engineering Sciences and Technology
IIT	Indian Institutes of Technology
IQ	Intelligent quotient
ISM	Interpretative Structural Modelling
IT	Information technology
IUR	Ideal Ultimate Result
KM	Knowledge Management
KMO	Kaiser-Meyer-Olkin
KRA	Key Result Areas
MHRD	Ministry of Human Resource Development
MICMAC	Matrix of cross impact multiplication applied to Classification
MTUN	Malaysia Technical University Network

NAC	NASSCOM Assessment of Competence
NASSCOM	National Association of Software and Services Companies
NDML	NSDL Database Management Ltd.
NF	NASSCOM Foundation
NIRF	National Institution ranking framework
NISG	National Institute for Smart Governance
NOS	National Occupational Standards
NPE	National Policy on Education
NPTEL	National Programme on Technology Enhanced Learning
NSDL	National Securities Depository Ltd.
NSR	National Skills Registry
QIP	Quality Improvement Program
S&T	Science and Technology
SD	Sustainable development
SEM	Structural Equation Modeling
SPSS	Statistical Package for the Social Sciences
TQM	Total Quality Management
UGC	University Grants Commission
UIC	University Industry Collaboration
WBL	Work-Based Learning
WENR	World Education News & Reviews

CHAPTER 1

INTRODUCTION

1.0 INTRODUCTION

Growth of any country depends upon the growth of quality education, particularly, the technical education. It significantly impacts the economy of any country. Accordingly, the focus areas of present government are – 'Digital India', 'Skill India', 'Startup India', & 'Make in India'. It will have direct impact on economy of the country as digitalization will enhance accuracy and transparency whereas skill will make the youth more employable. To create jobs, the startups and product development need to be encouraged. The targets are to make manufacturing contribution in GDP as 25% from the present level of about 18%.

On the wings of economic growth due to liberalization and globalization, India has witnessed growth in engineering education institutions and the intake capacity. The 38-degree level institutes with intake of around 2500 in 1947 expanded to 1668 institutions with intake of 6,53,290 in 2007 & 3364 degree level institutes with intake of around 16,000,00 in 2015. This steep growth is also due to the fact that India has been lagging behind in technical human resource as compared to many countries. Due to non-linkages with employment, the interest of admission seekers are reduced and as reported around 50% seats in B. Tech courses are lying vacant across India, although the international survey indicates that India has shortage of human technical resources. Comparing to other countries, India has only 3.5 per thousand S&T personnel against China 8.1, South Korea 45.9, USA 55, Germany 76 and Japan 110. These countries are optimally utilizing their resources that they have become much ahead of India in innovation, and productive development. The flip side of the growth in technical education sector in India has caused deterioration in quality of education and thus causing low employability. The NASSCOM a Body to monitor quality of technical education especially in Information Technology (IT) field indicated that out of passed degree holder engineers only 25% are meeting direct employable conditions.

1.2 Growth of Technical Education in India

The specialized schools in India started in the seventeenth century. The first technical school was opened in May 1794 in Madras (now Chennai). It was continuously extended and in the eighteenth Century more specialized universities and schools were opened. The Civil Engineering College, Madras; College of Science, Pune; Government Engineering College, Howrah and Thomson College of Engineering, Roorkee were opened amid 1884-85. In mid nineteenth century the specialized Institutions established are IISc, Banglore (1911) and Banaras Hindu University (1916).Thus the five Technical Institutions establishments in 1919 rose to 21 in 1939. In 1945 Sarkar Committee was constituted, which recommended setting up of specialized Institutions in each zone of the country, i.e, East, West, South and North, and thus Indian Institutes of Technology at Kharagpur (1950), Bombay (1958), Kanpur (1959), Madras (1960), and Delhi (1961) came into existence.

An Apex Body - All India Council of Technical Education (AICTE) was constituted in 1945 to screen the specialized instruction organizations. Under the umbrella of AICTE, further expansion started. The fast growth witnessed in last six decades that 38 degree level Institutions with intake of 2500 in 1947 expanded to 1668 Institutions with intake of 6,53,290 in 2007 and 3364 degree level institutions with intake of 16,000,00 in 2015.One of the explanations behind gigantic expansion was a huge populace of youth in the age of 18-23 years seeking higher education that is accounted as 1408 lacs in 2013 (MHRD, GOI Reports) against which just 296.29 lacs enlisted for advanced education out of which around 20% in technical education. There is a significant increment in Gross Enrolment Ratio (GER) seen in higher education, i.e., 8.1 in the year 2002 to 21.1 in 2012.Even with this development; India is a long way behind in GER of other nations. China has GER of 26.7, while Germany 61.7, UK 61.9, Russia 76.1 and USA 94.30. The universal overview demonstrates that India has a lack of specialized HR as available with developed nations. It has just 3.5 for every thousand Science and Technology (S&T) work force against China 8.1, South Korea 45.9, USA 55, Germany 76 and Japan 110. These nations are ideally using their assets and this is the

reason that they are much ahead of India in innovations and gainful improvement.

The specialized training in India developed at a quick and fast pace and resulted into mushrooming development since 1990. The Government permitted the investment of private sector to cope up with the immediate need of technical manpower and around 85% of technical education is being catered by the private sector (World Bank, 2010).

A typical growth in engineering institutions increased to 2,894 in the year 2009 from 46 in 1947 as shown in figure 1.1. There is a huge partcipation of private sector in providing technical education of our country after the initiation of economic reforms which can be studied from the following table:

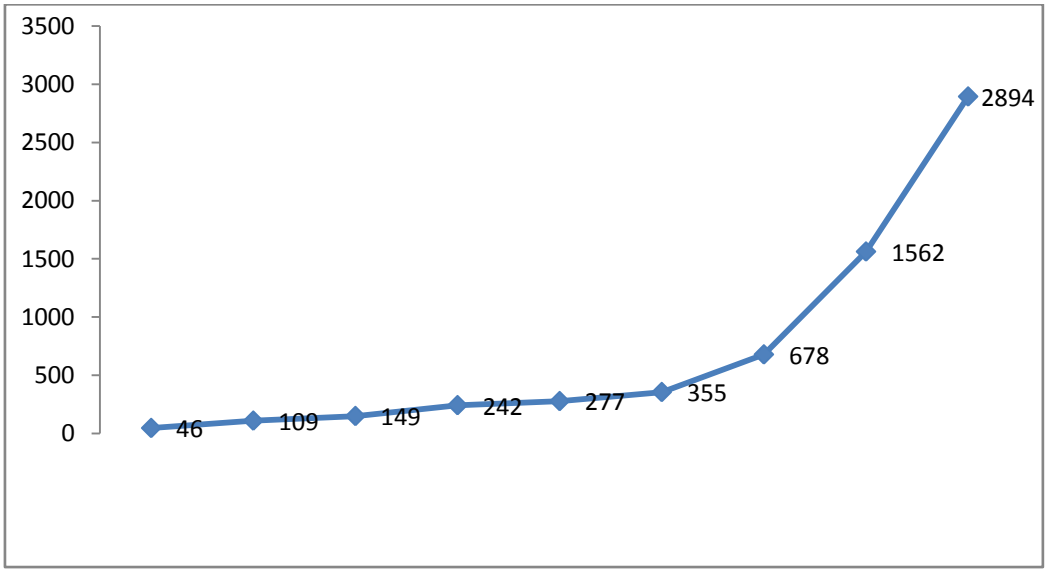


Fig. 1.1: Number of Engineering Institutions (1947-2009)

Source: Selected Educational Statistics (Various Years), MHRD, New Delhi.

Table-1.1: Engineering and Technical Institutions in major states of India (1986-87 to 2009-10)

States and UTs	1986-87	1996-97	1997-98	1998-99	1999-2000	2000-01	2001-02	2002-03	2003-04	2004-05	2009-10
AP	27	31	42	38	101	105	164	222	238	261	698
Assam	3	3	3	2	2	3	3	3	3	3	9
Bihar	6	11	11	9	9	9	9	9	7	7	10
Delhi	2	9	9	9	9	9	18	16	16	16	15
Goa	2	2	2	3	3	3	3	4	4	4	2
Gujarat	11	14	23	15	25	29	29	31	32	44	29
Haryana	2	9	16	22	22	20	28	41	41	69	154
Karnataka	44	49	49	66	66	66	112	116	120	120	174
Kerala	6	20	11	25	25	23	43	66	66	66	98
Madhya	11	30	30	30	30	56	60	19	25	30	208
Maharashtra	74	111	124	129	142	167	167	167	177	177	312
Odisha	5	10	10	13	19	19	19	19	19	37	82
Punjab	3	16	15	15	16	16	27	11	11	15	82
Rajasthan	3	7	7	7	7	39	39	7	9	7	96
Tamil Nadu	40	74	74	96	96	96	96	96	96	222	440
Uttar Pradesh	3	18	18	34	34	34	34	69	69	69	212
Uttarakhand	-	-	-	-	-	-	-	2	2	2	14
West Bengal	10	12	12	15	15	31	43	43	43	54	73
INDIA	**258**	**418**	**458**	**540**	**635**	**680**	**838**	**978**	**1068**	**1302**	**2894**

Source: Selected Educational Statistics (Various Years), MHRD, New Delhi.

Table 1.2: Region and Management Wise Number of Degree Level Engineering Institution in India (2006-07)

Regions	Government Institutions	Private Institutions	Total Institutions	% of Government Institutions	% of Private Institutions	Region wise Government Institutions as a % of Total Government Institutions in India	Region wise private Institutions as a % of Total Private Institutions in India
Sout	10	875	885	1.13	98.87	6.06	41.69
Nort	25	216	241	10.37	89.63	15.15	10.29
Easte	22	122	144	15.28	84.72	13.33	5.81
West	13	216	229	5.68	94.32	7.88	10.29
Centr	32	216	248	12.90	87.10	19.39	10.29
Nort	23	255	278	8.27	91.73	13.94	12.15
Sout	40	199	239	16.74	83.26	24.24	9.48
India	165	2099	2264	7.29	92.71	100	100

Source: Author's Calculation from the available information from AICTE website.

Table 1.2 also demonstrates uneven development of technical and specialized institutions in various states and UTs of India. The information confirms that, more number of institutions have been set up in the South Indian states like Andhra Pradesh, Karnataka, Tamil Nadu than Northern states.

The locations of institutions both by the private and government sector in different areas evident that the southern India figures at the top whereas eastern region lies at the bottom. From the above table it is also evident that only 6 percent of government establishments are available in the southern area which is the most minimal among all the regions, while around 42 percent of the private institutions exist in the region. Also the south west region is having the most elevated rate of government institutions and the eastern area is having the least rate of private institutions in India.

Undoubtedly there is a big development of advanced education over the last five decades as indicated in above table. In any case, the student enrolment is just 11 percent of the qualified age of 18-23 populaces which is far below to 54.6 percent enrolments in the developed nations, 36.5 percent in the nations experiencing significant change and rest of world, 23.2 percent.

The table 1.3 demonstrates the share of technical trainees out of graduates per one lac populace. As mentioned, over the years the percentage of technical education graduates against total graduates, significantly increased after development of technical education in private sector.

Table 1.3: Share of Engineering Education to Total Higher Education in India (1970-71 to 2011-12)

Year	Enrolment in Higher Education	Enrolment in Engineering Education	% of Engineering Enrolment to Total Higher Education	Engineering graduates per lakh Population
1970-71	1953700	87257	4.46	16.12
1975-76	2426109	96067	3.95	15.82
1980-81	2752437	128937	4.68	18.98
1985-86	3605029	176540	4.89	23.38

1990-91	4924868	216837	4.40	25.84
1995-96	6574005	315720	4.80	34.02
2000-01	8399443	529469	6.30	51.95
2001-02	8964680	605597	6.75	58.34
2002-03	9516773	692087	7.27	65.60
2003-04	9953506	716652	7.19	66.78
2004-05	10481042	754635	7.19	69.23
2005-06	11028020	795120	7.20	71.82
2009-10	13872870	2005563	14.44	171.26
2010-11	18670050	2862439	15.33	185.32
2011-12	20327478	3261590	16.00	269.53

Source: UGC, Annual reports (Various Years).

On one side we are showing our inefficiency in engineering education by estimating its share to higher education and the students per lakh population (Table 1.2 and 1.3 respectively) but on other side there is a massive unemployment among engineers due to poor quality and non-skill education provided by Institutions, this needs to be addressed.

1.3 Quality of Higher and Technical Education in India: Issues and Challenges

Issues and difficulties identified with the nature of Indian higher and specialized instruction are examined in this segment. Many studies have archived lacking in higher and specialized training in India. This includes: unregulated and unequal development of organizations, particularly in the private sector in the specialized instruction; absence of satisfactory and qualified workforce; powerless industry-the scholarly community communication; obsolete educational program; feeble quality-affirmation structure, particularly accreditation methodology; lastly absence of open financing for specialized training.

1.3.1 Unregulated and unbalanced growth of institutions:

Over the latest two decades, there has been mushrooming in establishment of private technical institutions across India. In the decades of 1990 and 2010, the engineering colleges alone rose from 282 to more than 2800 (of which ideal around 2500 are in the private territory). This free improvement has incited to various issues, like staff inadequacies, rising rate of unemployment, and a general reduction in insightful measures (WENR, 2007). The four southern states (Andhra Pradesh, Karnataka, Kerala and Tamil Nadu) and Maharashtra combined caters technical education of 60% through Institutions belonging to private sector. Against this, eastern and northern states have only 16% of total. It has been investigated that the quantitative advancement of specialized training that non attendance of organizing lab-workplaces or required staff quality who can take the load of extended number of students is a big issue.

1.3.2 Lack of adequate and qualified faculty:

Non availability of acceptable and qualified number of work force in outlining instruction in India is a main component for low quality (Varshney, 2006). The doctorates allowed each year is one percent of the total graduates conceded every year; however the worldwide it exhibits that countries like China, USA, and the total PhD degrees conceded yearly range between 5-9 percent of outlining graduates. The AICTE report indicate that the number of professionals with Ph.D. were 6829 against an essential of 36,963 in 2006. The shortfall of Ph. D holders was more than 30,000 in 2006 and was anticipated to 70,000 in the year 2010-2011. AICTE Report (2006) has highlighted condition that private Institutions did not annex satisfactory impetus to the need of having capable instructors and are inclined to satisfy the numbers and not the abilities to adequately meet the testing requirements of the employers. The purpose behind this condition is the non-availability of instructors with the prescribed capacities. The talented potential of top level Indian specialized institutions (IITs, NITs) are being pulled in either by lucrative private institutions or by research openings at better financed

establishments abroad. From 1985 to 2000, Indians earned more than 13,000 science and technology doctoral degrees at US universities and majority of them did not return to India in the wake of better career prospects abroad (WENR, 2007).

1.3.3 *Weak industry-academia interaction*:

Another vital part of higher and technical education in India is the poor linkage between the Higher and Technical Education Institutes and the business organizations. This is one of the significant factors responsible for unemployment of specialized graduates. A report uncovered that 53 percent of specialized graduates are not meeting the guidelines of the business and just, 13 percent were observed to be industry prepared while, 17 percent were discovered worth trainable (The Pioneer, third January, 2013). In many developed nations, the industry and specialized organizations work closely. In India, apart from a couple of built up specialized Institutions like IITs, the industry-scholarly community association is practically missing. In fact, in India 85 percent of technical education is catered by private technical education institutions and there is less government to implement more association with industries. National Policy on Education (1986) had emphasised on the system administration for improvement in specialized instruction, industry, R and D associations, which had encouraged improvement and presently many policies and schemes introduced by government accelerated improvement in academic standard of Institutions.

1.3.4 *Outdated Curricula:*

There is need of a solid relationship amongst educational program and occupation showcase in the event of specialized training in India. What subjects ought to be instructed to the graduates and of what quantum? These inquiries have turned out to be vital for raising on account of the multi-faceted and expanded obligations of contemporary graduates. In the present setting, engineers need to settle on choices utilizing their specialized abilities. To

release their obligations legitimately, they need to have an adjusted sort of training so that their ability and aptitude might be ideally utilized. It is contended that there is a gigantic mismatch between the instructive yield and the employment opportunities in the nation. From one viewpoint, there are an extensive number of graduates being delivered in certain branches not having much requirement in the Indian work showcase, while some branches have fewer graduates to take care of the demand of the occupation requirements. The crisscross between the supply and interest of technical graduates resulted to gigantic unemployment among these graduates. The present educational program needs to be with correct vision by the strategy creators. In nations like USA and Korea, the undergraduates are given a comprehensive preparing which includes administration, sociology, and open strategy other than technical education. Thus, their degree becomes more useful in suiting to employment.

1.3.5 *Weak quality-assurance structure*:

Quality-affirmation structure, especially accreditation techniques is a basic gadget used extensively in the worldwide setting to gage the way of higher and specialized instruction. Some of these at international levels are Accreditation Board for Engineering and Technology, USA; Engineering Council, UK; Institution of Professional Engineers, New Zealand; Accreditation Board for Engineering Education, Korea; Board of Engineers, Malaysia, etc. Similarly, for quality assurance in technical education in India, National Board of Accreditation (NBA) has been set up by the AICTE. NBA screens whether the Institution has shown its ability to support and improve assessment criteria and has earned trustworthiness by the end customers. In spite of the fact that accreditation is required; only10 percent of the Institutions in the specialized training sector have been accredited. As on May 2003, only 1985 courses from 202 Institutions under AICTE had been accredited and now it has been increased to around 7000 courses. The NBA is not prepared to play out its obligation suitably, as there is huge number of specialized courses, especially in the private sector in the country. Considering

this aspect, it has been emphasized that specialized training institutions in the country may go for accreditation from University Grants Commission (UGC) like NAAC. This is being done to provide accreditation to institution as a whole considering all courses and overall norms and standards maintained by the Institution.

1.3.6 *Lack of public funding*:

The surveys in the area of technical education indicates that the level of open financing to technical education institutions are insufficient to cater the requirement of ultramodern infrastructure and other facilities. Inadequate sponsoring really impacts the quality and quantum of higher and specialized training, which will have encouraged proposals for improvement and esteem (CABE Committee Report, 2005). Higher quality specialized training comes at a higher cost for each understudy (Duraisamy, 2000). Financing to this region from open source was the genuine in mid 1960s as less resource was from private sources. An important part (41 percent) of the union government's utilization on specialized instruction is accounted by the stipends to the Indian Institute of Technology in the year 2006-07 while AICTE and NITs together constitute 27 percent and rest are allotted to IIMs, IISc and all other specialized establishments under central government. The impact of inadequate open financing on quality has been reflected through non-openness of physical establishment, nonattendance of attractive workforce etc. even in a segment of the government specialized establishments.

1.4 REVIEWS OF COMMITTEE REPORTS ON QUALITY OF TECHNICAL EDUCATION IN INDIA

1.4.1 Committee appointed to consider the Development of Higher Technical Institutions in India--- Sarkar Committee Report

This committee was set up to recommend for the improvement of technical education in India It was felt that the current offices for higher technical education in India are deficient, both in quantity and quality, to fulfill India's

post-war requirements for high review technologists. The advisory group felt for the start of a program of higher technical education and research with most extreme speed and assurances. The main objectives of committee were:

(a) A focal organization perhaps on the lines of the Massachusetts Institute of Technology, with various subordinate establishments subsidiary to it, or

(b) Several technical organizations on a territorial premise, or

(c) Any other association.

The major recommendations made in the report include:

(i) Four higher technical institutions, one in each of the four regions (East, west, north and south) are required to satisfy the post-war requirements;

(ii) The institution for eastern region should be established in Calcutta and for western region in Bombay;

1.4.2 National Policy on Education - 1986

The National Policy on Education (NPE) 1986 aimed to review the whole gamut of educational situation and was formulated on the basis of a national consensus; it enunciated a comprehensive framework to guide the development of education in its entirety. Some of the major objectives and recommendations for the development of technical and management education are:

(i) In order to improve the situation regarding manpower information, the technical manpower information system needs to be strengthened further;

(ii) In order to increase the relevance of management education, particularly in the non-corporate and under-managed sectors, the management education system will study and document the Indian experience and create a body of knowledge and specific educational programmes suited to these sectors;

(iii) Appropriate formal and non-formal programmes of technical education will be devised for the benefit of women, the economically and socially weaker sections, and the physically handicapped;

(iv) Research as a means of renovation and renewal of educational processes will be undertaken by all higher technical institutions which will primarily aim at producing quality manpower capable of taking up R & D functions;

(v) Institutions will be encouraged to generate resources using their capacities to provide services to the community and industry;

(vi) The curricula of technical and management programmes will be targeted on current as well as the projected needs of industry or user systems. Active interaction between technical or management institutions and industry will be promoted in programme, planning and implementation, exchange of personnel, training facilities and resources, research and consultancy and other areas of mutual interest;

(vii) In the interests of maintaining standards and for several other valid reasons, the commercialization of technical and professional education will be curbed. An alternative system will be devised to involve private and voluntary effort in this sector of education, in conformity with accepted norms and goals.

1.4.3 Committee to Review the Working of IITs (P. Rama Rao Committee Report)

The aim of this committee was to review the performance of the Indian Institutes of Technology (IITs) in relation to their vision, mission and goals, both in quantitative and qualitative terms. The objectives linked with the quality of technical education include:

(i) To review the extent and intensity of linkages and interaction with industry for technology development and consultancy;

(ii) To review the management structure and governance mechanisms as also financial management and make recommendations on potential improvement;

(iii) To review and make recommendations on faculty recruitment, retention, and development process in order to induct high quality

faculty retain it and motivate it to perform consistently at high levels of excellence;

(iv) To review the state of physical infrastructure of the IITs in order to make recommendations relating to their modernization, removal of obsolescence and future development consistent with their anticipated role at national and international levels.

Some of the important recommendations for the improvement of academic environment in IITs are:

(i) In view of the prevailing high demand for higher qualified technical personnel, the service conditions of the IIT faculty, including their pay scales and allowances need to reviewed urgently and the committee recommended for a system akin to that prevalent in IISc;

(ii) For creating a vibrant research environment the committee recommended for funding towards engaging visiting professors and scientists in large numbers and for longer durations, for collaborative work with well-established research institutions abroad, offering more number of research fellowships for bright candidates to complete Ph.D.;

(iii) Government should institute new mechanism for assuring careers to highly talented IIT post-graduates, also to offer tax incentives to industry if they hire Ph. Ds and research trained post graduates;

(iv) To see a prosperous linkage with the industry, and a thriving entrepreneurial spirit, experienced industry technical personnel should take full-fledged positions, physical facilities should be established on IIT campuses for cooperative R & D, a clear understanding of sharing IPRs between industry and IITs should be developed;

(v) The use of information and communication technology (ICT) for the development of knowledge system and recommended that a group consisting of experts drawn from IITs, IISc and the Department of Space should review key aspects related to technology infrastructure,

training of mentors, content generation and delivery and research collaboration.

1.4.4 CABE Committee Report on Financing of Higher and Technical Education

The committee on the subject of 'Financing of higher and Technical Education' was constituted to examine the critical issues relating to financing higher and technical education in India which has a significant impact on maintaining the quality of this sector. Two major objectives of the committee were:

(i) To examine the adequacy of investments in higher/technical education and to find ways of augmenting the resource flow in higher education;

(ii) To suggest the ways of encouraging and regulating private participation and investments in higher a/technical education.

Some of the major recommendations made in the report, which have a broad linkage with the quality of higher and technical education, include:

(i) The public expenditure towards higher and technical education is very less (the total expenditure on technical education forms merely 0.4 per cent of the total government expenditure) and thus, it should be increased significantly for quantitative expansion, for improvement in quality and excellence, and for preserving and promoting equity in higher education. Further, the government (both union and states) must make a firm commitment to fund higher and technical education in such a way that basic teaching, research and extension activities are not affected in their quality and quantum due to paucity of financial resources.

(ii) Allocations for research need to be increased, as it contributes towards quality improvement and excellence in the higher and technical education sector. It may be worthwhile for the government and the universities to earmark special funds for promotion of research.

(iii) Institutions of higher and technical education may be encouraged to establish a close link with industry, mainly to improve academic

relevance of the programmes and caution needs to be taken to see that institutions do not extensively rely upon corporate sector for funds, as that might affect academic autonomy of those institutions.

(iv) The growth of private higher and technical education need to be regulated. A detailed regulatory framework has to be developed that would allow only genuinely interested private sector that has philanthropy and education, and not profit as the main consideration, to enter higher and technical education sector.

(v) Though there is a need for expansion of higher and technical education in the country, it is important to see that proliferation of poor quality and unviable institutions does not take place as it will degrade the quality. The growth of such institutions has to be based on some sound criteria.

(vi) There exists a huge vacuum on data on various aspects of higher and technical education in India. Thus the Ministry of Human Resource Development (MHRD) and University Grants Commission (UGC) should launch a programme for building up a strong database on higher and technical education.

1.4.5 High Power Committee for Faculty Development in Technical Institutions (P. Rama Rao Committee Report)

Keeping in mind the end goal to address the deficiency of qualified workforce in building and specialized training a board of trustees was selected under the chairmanship of Prof. P. Rama Rao in 2005 which presented the report in July 2006. The board of trustees plans to ponder proposals concerning the staff lack and quality. Especially it has tended to the issues, for example, arrangement of less qualified educators in the specialized foundations, absence of research culture in the current organizations and the huge territorial dissimilarity in the quantity of specialized establishments in the nation.

To address these issues the present board of trustees suggested various plans which are to be preceded with altogether improved arrangements for the staff advancement. These incorporates Quality Improvement Program (QIP) for

personnel, Visiting Professorship, AICTE-INAE Distinguished Visiting Professorship, Emeritus Fellowship, workshop concede, vocation grant for youthful educators, money related aide to proficient bodies, national doctoral cooperation and PG grants for GATE qualified M. Tech. Understudies for seeking after Ph.D. program. Other than these, the advisory group has likewise recommended a few novel institutional activities and plans like distinguishing proof of one hundred coach organizations for workforce improvement, setting up a Virtual Technical University, educational modules based personnel preparing, Technology Enhanced Distance Education Program, successive summer program, a significant number of going by and subordinate staff from industry, national research facilities and other propelled scholarly establishments. The advisory group has likewise recommended the upgrade of the period of enlistment upto 65 years; re-work of resigned workforce upto 70 years old and offering alluring compensation bundles/motivations/recompenses for extraordinary entertainers. To actualize these proposals the advisory group has at long last and in particular recommended for setting up of a different board committed to the critical assignment of personnel advancement.

1.4.6 Report of the Expert Committee on Transformation of Selected Technical Institutions into a New System of Institutes of National Importance (Anandakrishnan Committee Report)

Three major tasks of the committee were:

(i) To examine the vision documents and give necessary suggestions to meet the goals;

(ii) To identify the gaps in resources and suggest measures to raise the additional fund requirement;

(iii) To suggest a plan of action for upgrading the identified institutions to the level of IITs.

The committee has prescribed a couple of recommendations in the territories of administration, scholastic framework, and foundation. It was proposed the foundation of an arrangement of Indian Institute of Engineering Sciences and Technology (IIEST) as establishments of National Importance through an Act of Parliament. The advisory group prescribed five unique establishments for

the change into IIEST. These foundations might be predominately post graduate establishments offering five year incorporated double degree. They ought to likewise endeavor cognizant and think endeavors to pull in outside understudies for various educating and research programs. Each IIEST should have a current focal library office utilizing best in class advances and learning assets with great spatial arranging and format to give proficient library administrations to the clients. Each foundation ought to have an Education Technology Center related with the focal PC office basically for improvement of courseware and educational programming devices and overhauling virtual labs, virtual classrooms and video chatting.

1.4.7 National Knowledge Commission

The National Knowledge Commission was constituted with the following broader objectives:

(i) To build the excellence in the educational system to meet the knowledge challenges of the 21st century and increase India's competitive advantage in the fields of knowledge;

(ii) To promote the creation of knowledge in science and technology laboratories;

(iii) To improve the management of institutions engaged in Intellectual Property Rights;

(iv) To promote knowledge applications in Agriculture and Industry.

In the area of engineering education, the NKC has proposed some recommendations like:

(i) The new initiatives for the reforming of regulatory framework will enable the All India Council for Technical Education (AICTE) to focus on important issues such as curriculum development, pedagogy, faculty development etc.;

(ii) In order to encourage greater flexibility and autonomy, there is a need to progressively do away with the system of affiliation of engineering institutions to universities and where feasible they should be given full autonomy;

(iii) Measure should be undertaken to attract good faculty and retaining them. These include the measures like better incentives, autonomy to the faculty etc.

(iv) The curriculum should be modified to provide greater flexibility, inter-disciplinary perspective and choice of electives;

(v) Incentives are necessary to promote research in the engineering discipline;

(vi) In order to attain greater alignment of engineering education with employment opportunities, frequent dialogue between industry and institutions is needed;

(vii) To increase the access of engineering education, a framework for public private partnership should be developed

1.4.8 Committee to Advise on Renovation and Rejuvenation of Higher Education (Yash Pal Committee Report*)*

In 2008 the committee to Advised on Renovation and Rejuvenation of Higher Education was constituted under the chairmanship of Professor Yash Pal to

(i) Review the function of the UGC/AICTE and to critically assess the role of these bodies and their preparedness to provide institutional leadership to the emerging demands of access, equity, relevance and quality of higher and technical education;

(ii) The role of the UGC/AICTE in determining and enforcing standards of higher and technical education in State Universities and the possibility of introducing a system of incentives and disincentives so that national standards of higher and technical education are not compromised or diluted;

(iii) To give suggestions for the transparency and efficiency in the functioning of the UGC and AICTE; (iv) to assess the role of the UGC in coordinating standards of higher education vis-a-vis the functional role of other statutory bodies such as AICTE, MCI, DCI, NCI, NCTE, DEC etc.

The specific recommendations made by the committee on technical education include:

(i) Institutions of excellence like the IITs and IIMs to be encouraged to diversify and expand their scope to work as full-fledged universities, while keeping intact their unique features, which shall act as pace-setting and model governance systems for all universities;

(ii) The IITs and IIMs must strive to be models of all-round excellence, like the famous Massachusetts Institute of technology or CALTECH in the US.

1.4.9 Committee on Taking IITs to Excellence and Greater Relevance (Anil Kakodkar Committee Report)

The advisory group was set up to propose a guide for reinforcing money related, regulatory and scholastic independence of the Indian Institutes of Technology (IITs). The particular destinations are:

(i) To propose ways and intends to hold/pull in top B. Tech understudies inside the IIT System and outside to Postgraduate and PhD Programs;

(ii) To consider the issue of personnel enlistment and Development i.e., to recommend measures to enhance the quality of IIT staff might be proposed for appropriation and usage;

(iii) To propose a self prepared framework inside the IITs to accomplish the ideal level of admission of understudies every year (UG and PG) and the council could investigate the likelihood of discharging assets to the organization on per understudy premise to boost development;

(iv) To recommend intends to raise the assets/corpus of the IITs through research extend from the Government, Industry, Consultancy, Donations from graduated class, and so on., and to investigate the likelihood of coordinating awards from the Ministry;

(v) To take load of the present development program and furthermore propose the future game-plan as far as consideration, extension and greatness in future;

(vi) Looking into conceivable cooperative energies that could be created from not just connection and joint effort among the IITs;

(vii) To investigate the part that IITs have been playing and could play later on to build its part as a human asset and innovation supplier in support of comprehensive national improvement in a quickly creating/developing economy;

(viii) To survey a couple of comparable activities that have occurred somewhere else on the planet to comprehend the procedure required to land at dependable proposals.

The board of trustees made proposals on six essential regions of IITs like advancing exploration, money related independence and administration, personnel advancement, part of staff and development and enterprise, and Scaling Engineering Education with Quality in India. A portion of the particular proposals made in the board of trustees are:

(i) To make IITs the essential research foundations, with an attention on astounding outskirts research and innovation advancement inside the Indian setting;

(ii) To bolster an essentially extended and superb Ph.D. program, the examination foundation at the IITs;

(iii) Enable Ministries to set up R&D labs in IITs to drive innovation advancement significant to national projects;

(iv) Government to monetarily bolster investigate at the IITs in the arrangement mode to understand their maximum capacity for national needs regarding exploration, innovation and human asset in science, innovation and business enterprise;

(v) The Board of each IIT will choose the parts, duties and examination of their workforce and their parts incorporate educating, look into, innovation improvement and modern consultancy, and in addition approach/gauges advancement;

(vi) The IITs should likewise perceive that Innovation flourishes when staff, experienced industry people and understudies connect in formal and casual situations.

1.5 RESEARCH ASPECTS IN TECHNICAL EDUCATION

Technical education has many areas of research related to the inputs, outputs and the performance and then these issues can be studied from the perspective of different stakeholders. In this research, the following aspects of the technical education are studies:

a) Quality
b) Employability
c) Skill Development
d) Knowledge Creation

1.5.1 Quality Aspects in Technical Education

As communicated in past fragment, the quality in specialized instruction is a key stress of the training providers, controllers, supervisors and industry. A quality specialized work can go about as a power house to bolster the economy of a country. As a result of this reason, sweeping number of studies has been driven in different countries to perceive the key elements of significant worth, their closeness in a particular setup, impact of significant worth, enabling specialists of significant worth, troubles in improving quality etc. Petruzzellis and Romanazzi (2010) investigated the factors responsible for students' choice for a university and suggested that Universities to be more aggressive in their marketing activities and need to be clear about their positioning and the image they want to convey to the public. The identification of student needs and the ability of the institution to meet these needs to be publicized as prime activities of Institutions as students have, the university choice on two different categories of elements: the university related factors and the student related ones.

Senthilkumar and Arulraj (2011) in their model of organization quality estimation perceives with parameters of teaching: critical instructive projects, instructing and learning backing, speculative and sensible data of educational staff, course material, degree to which exams are illustrative of courses trained, degree to which academic staff are up to date in their subject. Sakthivel et al (2005) in their paper of TQM utilization in educational

association and understudy satisfaction perceived the five TQM variables: obligation of top organization, course movement, grounds workplaces, thoughtfulness, and customer feedback and change. These together foresee the understudies' satisfaction of academic execution in the outlining associations.

1.5.2 Employability Aspects in Technical Education

The highly skillful and competent human capitals are critically needed to accelerate and contribute efficiently towards the development of technology in spearheading Malaysia's transformation agendas. Among the Key Result Areas(KRA) viz-a-viz graduates of Institutes of Higher Learnings (IHL), the employability considered as prime factor which depends on the curriculum design and mode of its execution. The study in Malaysia was to determine the crucial ingredients required in engineering education curriculum to produce engineering graduates who can truly be termed 'productive workforce' of high caliber and originality Besides that, employability skill is also crucial in all professions as well as in education (Overtoom, 2000). Lankard (1997) stated that the current working environment differs from the previous one. This is because of global competitiveness, cultural & gender diversity, latest technologies etc. made the need for critical thinking and better communication skills among management and workers, which have taken new dimensions. Curriculum that could fulfill the criteria as required in the job market can help students to face challenges and to secure a place for themselves in employment market.

A few studies had been carried out to determine the 'employability' of the students. De Leon and Borchers (1998) studied on the skills required by Texas School graduates to serve in production industry. On the basis of employers being research respondents, this research emphasized on a few skills such as reading, writing, calculating, communicating, critical thinking, interaction in groups, self development, computer skills, technical system awareness, leadership and employability. This study found that the three most

important skills required by employers are group interactions, employability and self development.

1.5.3 Skill Development

Today, India is one of the youngest nations in the world with more than 62% of the population in the working age group (15-59 years) more than 54% of the total population below 25 years of age. Naturally, the 15-59 years bracket is going to swell as time elapses. It is further estimated that the average age of Indians shall hover around 29 years by 2020 against 40, 46 and 47 years in USA, Europe and Japan respectively.

In the next 2 decades the labour force in the industrialized world will decrease by 4% against an increase of 32% in India. This presents a challenge as well as an opportunity. To reap this demographic dividend which is expected to last for more than 2 decades, India now needs to instill and develop 'employability skills' among its young workforce and reap the benefits of resultant productivity which would transform India into a developed country.

India recognizes that planned Skill Development is imperative for the speedy and sustainable development which would be characterized by all-around growth and meaningful employment to our youth. The demographic opportunity available to India, if availed, may make India the skill capital of the world. It may not be far-fetched to envisage a situation whereby India would become self-sufficient in terms of Technical Manpower resources and also contribute to the ageing advanced economics. This has been supported by the Boston Consultancy Group (2007) which states that, by 2020 India will have surplus of 56 million working people but the rest of the world will face a scarcity of 47 million working people. However, imparting the requisite skills to this massive young population is quite challenging and daunting.

1.5.4 Knowledge Creation in Technical Education

Knowledge has been defined as a collection of relevant information about a particular field, which is used according to the needs of the user. Up-

gradation of this available knowledge in terms of facts, new uses and application is termed as creation of knowledge. Krogh et al., (2012) have termed Knowledge creation as a continuous process in which the knowledge created by individuals becomes available and amplified within the organization's knowledge system. Institutes of Higher Learning/ Technical Education are established with the objective to expand the available knowledge and to produce new knowledge. For this purpose, they set up teaching learning processes for sharing of available knowledge and establish research and community services for exploring and expanding new knowledge. Research activities in these institutes contribute to formation of new knowledge that ultimately becomes the cause of development for humanity. The concept of University is further broader where knowledge of various disciplines is created, promoted, shared and developed through inter dependent activities of teaching and research. Through inter disciplinary initiatives knowledge originates even in new dimensions.

The success of companies in the today's competitive markets is highly dependent to the degree to which they create new knowledge. Integrating different types of knowledge and experiences is vital to foster innovation and learning (Passila *et al*., 2013). These facts highlight the importance of Knowledge Creation Process (KCP) in any company.

The theory of knowledge creation was first introduced by Nonaka (Sundaresanand Zhang, 2012) which consisted of four distinctive interactions between tacit and explicit knowledge. The model was then reinforced and expanded in 1995 by Nonaka and Takeuchi (1995). According to the proposed definition, the KCP model concerns the conversions between tacit and explicit knowledge and is made up of four intertwined activities; Socialization, Externalization, Combination, and Internalization (also referred to as SECI model). Socialization implies people that share knowledge through more traditional methods like direct person-to-person contacts and foster new tacit knowledge such as shared mental models and technical skills. Externalization codifies tacit knowledge to intelligible and explicit concepts. Combination converts explicit knowledge into more systematic sets by integrating key parts.

Finally, internalization embodies explicit knowledge into tacit knowledge, while explicit knowledge institutionalizes to tacit knowledge in people.

1.6 PROPOSED Q-SK-E MODEL OF TECHNICAL EDUCATION

From the input perspectives quality in the system needs the presence of good faculty, good infrastructure and good processes which also enhances the employability as directly/indirectly makes the students to achieve the skill required for the job. The presence of these will lead to the creation of right type of education leading to proper development of technical and allied skills. The presence of proper system will create an environment where the faculty and students can indulge in innovation, creativity, research, development and technology development. These aspects have been named as knowledge creation. Industry has certain specific expectations from the graduates which they look for at the time of their first placement. The presence of these expectations in the graduates can make them employable. These days, employability of graduates have become a very sensitive issue in the technical education in India due to (a) global recession in the economy and (b) lack of focus of the institutions on quality of education and capability development of graduates. Thus for technical institutions the focus should be on quality, skill development, knowledge creation and employability. Keeping stakeholders and the focus in view, for this research a model as given in Figure 1 has been used.

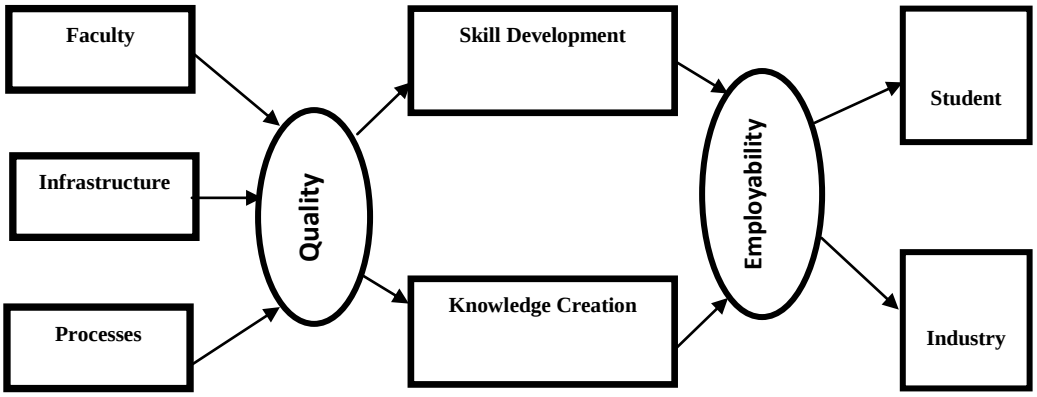


Figure 1.2: Q-SK-E model of the Technical Education

Like in any service or manufacturing systems, quality of education is an important aspect in technical education. Different authors have considered different aspects which produce the quality in technical institutions. Infrastructure **(**Gourishankar and Lokachari, 2012; Sohail and Shaikh, 2004; John and Senith, 2012); Faculty (Abili et al., 2012; Ibrahim et al., 2012); processes like admission and examination system (Angell et al., 2008) along with other aspects have been considered as important for the quality of education.

1.7 NEED, BROAD OBJECTIVES AND SCOPE OF THE STUDY

1.7.1 Need of the Study

The major stakeholders in the technical education system are students, employers, faculty and other staff, administration and the promoters of the institutions along with the government. In this research, the employability perception with quality technical education has been captured to understand the various parameters involved in delivery of education.

1.7.2 Broad objectives of the study are as follows:

- To understand the key factors effecting Quality of Technical Education.
- To identify the various factors affecting the quality of technical education.
- To determine the impact of quality of technical education on employability of the students.
- To determine the important skills being imparted by the institutions, relevance of these skills and their impact on employability.
- To determine the importance given to knowledge creation by the institutions and its impact on teaching quality.

1.7.3 Scope of the Study

- The study will cover only engineering education.
- Only five branches namely Computer science, Electronics, Electrical, Information Technology, Mechanical and Civil engineering will be included in the study.
- Only few states namely Delhi, Rajasthan, Uttar Pradesh, Madhya Pradesh, Bihar & Andhra Pradesh will be included in the study

1.8 ORGANISATION OF THE STUDY

The study is organized into seven chapters each dealing with a specific spectrum of the total research:

- **The First Chapter *Introduction*** will provide a brief about technical education including growth of technical education in India pre-independence and post independence. The theoretical setting for the study which includes Basic concepts of Quality, Employability, Skill Development, Introduces the topic of the Research, Need and Motivation for Research in this area, Broad Objectives and Scope of the Research also briefed.
- **The Second Chapter *Review of Literature*** devoted to the literature review to understand the basic issues related to the quality and employability of technical education. It also contains the review of knowledge management, quality models and empirical studies in technical education. The studies by authors of different countries on quality technical education, employability, skill development also briefed.
- **The Third Chapter *Research Methodology*** provides methodology of the research. This research uses exploratory study by developing three instruments to capture the expectation/ perception of students, faculty and industry. Interpretative Structural modeling is also used to develop the relationship of the enablers.
- **The Four Chapter Student Expectations and Perception** presents the analysis, results and discussion of the expectations of the students of technical education. The data as collected through responses from students of various engineering institutions are analyzed by using t-test and factor analysis.
- **The Fifth Chapter Analysis of Faculty Perception of Technical Education** presents the analysis, results and discussions of the perception about the Quality attributes by Faculty members. The regression and hypothesis analysis used to find relation between various attributes of technical education in respect of faculty perception.

- **The Sixth Chapter Expectations of Employers: Analysis and Interpretation** presents the analysis, results and discussion of the expectations of employer from the technical education institutions. The various attributes like Engineering knowledge, Problem analysis, Design/ Development of solutions, Ability to conduct investigation of complex problems, Modern tool usage, Synergy between engineering and society, Environment and sustainability, Ethics are studied and tested for t-test and co-relation. The co-relation has been found between different attributes expected from student by Industries.
- **The Seventh Chapter ISM of Enablers of Quality and Employability** presents the identification and brief description of enablers of quality and employability and the structure them using interpretative structural modeling(ISM) technique. The technique helps to deal with complex issues like competency building and helps in decision making. It generates a dia-graph, a visual mapping of the system enablers to obtain new insights helpful for the decision maker. ISM incorporates pair wise comparison, transitive logic and concept synthesis to develop a visual map. ISM can be defined as a process that performs unclear and poorly articulated mental models into system and then into visible, well defined model useful for many purpose.

- **The Eighth Chapter Summary and Conclusions** the chapter of conclusions and include key findings, Implications for Institutions and Regulators, limitations and future scope of the study.

CHAPTER 2

REVIEW OF LITERATURE

2.1 INTRODUCTION:

To understand the state of the art in the area of management of technical education, literature review is carried out and classified under the following sections:

- Quality in Technical Education
- Employability in Technical Education
- Skill Development in Technical Education
- Knowledge Creation in Technical Education
- Empirical Studies in Technical Education
- Contemporary studies in different countries
- Methodology and statistical tools used by researcher

2.2 QUALITY IN TECHNICAL EDUCATION

The significance of technical education has become important for augmentation of economy in more noteworthy measure in the start of the 21st century. This acknowledgment has been strengthened by the status of globalization that has breathed new life into the Indian economy. The Government of India energized the spread of technical education. In the previous decade, there has been a sharp increase in the number of private engineering colleges and in addition colleges in India with the status of colleges or state colleges ignored the quality aspect which resulted to unemployment. The NASSCOM report showed that a quarter percentages of graduated students are having employable quality. The Quality in educational services is an incorporation of standards, techniques and best practices that will give a system to educational institutions to make progress toward academic excellence.. The upheaval through information and communication technologies (ICT) or information technology (IT) has made teaching learning process more precise, effective and quality conscious. The challenge for engineering education is not only to provide knowledge but also to make them competent for the job market. Several factors and conditions are required to

develop the students to prepare them for employment at the first level and aim to attain good career. Keeping this in view, the affiliation and accreditation parameters have also changed in India over a period of last two decades. Earlier the basic parameters like land, building, classroom, equipment, etc.; were used which now shifted to process based like teaching process, pedagogy, examination system, admission process, etc. The recent parameters, called outcome based, include passed percentage of graduates, campus placements, higher education admissions, career after 3-4 years after passing out. Not only this, the focus is on improvements on quality on year to year basis.

Several research papers are available which covers these aspects under service quality as it is linked to students' satisfaction and their employability. The empirical study done by Ham and Hayduk (2003) tested student satisfaction on twenty one elements of quality aspects of education and six items on scale of satisfaction and found faculty member communication most important. The study also shows that students expect that faculty to provide adequate feedback about student performance and be consistent in their grading practices.

Sultan and Wong (2013) reported the understanding of graduating pupils regarding service quality in the field of education with the focus of developing a model in view of university in Australia. The study by Cardoso et al (2013) reveals that the Portuguese academics provide a support system for the major objectives and aims of assessment of quality which might include the newly designed quality assessment and system of accreditation. They tend to support more mechanisms of assessment of quality that provide control improvement.

The term good teaching defined in a study by Lee et al, (2015) and linked to five commonly evaluated categories of teaching i.e. preparation and organization, knowledge, learning and thinking, enthusiasm and delivery. A good teacher has to adhere with these key parameters. This is supported by the study on student perception on value about teaching. The open ended

questions from 3500 students asked and on the basis their responses and themes derived from NVIVO analysis, the key factors identified for a teacher were student engagement, rapport with students and vocation (Bradley et al, 2015).

The Vidalakis et al (2013) have explored the relationship between the quality and value of higher education facilities by comparing the views of different user groups and professionals involved in the procurement and the design of such facilities. The student group was found least critical among the other groups i.e. academic staff, professionals, that enjoys the infrastructure of the institutes/universities.

The student perception on the quality of education analyzed by Senthillkumar and Arulraj (2011) through questionnaire on teaching methods, environment change in study, disciplinary measures, placements, service quality and satisfaction level. The study indicated that quality of education is based on the best faculty and excellent physical resources to improve employability. Good placement is found as a key factor in higher education Institution.

Gourishankar and Lokachari (2012) identified major challenges in educational development in India as Access, Reach, Medium of Instruction, Teaching standards, Teacher-student ratio, Student-classroom ratio, Infrastructure implementation, Resource requirements, and Quality of Education and Educational measurement. The study by Ardi et al, (2012) explored to identify the connections among quality measurements in higher education (HE) and to decide the impact of every quality measurement on students' overall satisfaction of an engineering teacher in an Indonesian state university. CFA was utilized to test the extent of being valid of the conceptual model and structural equation modeling (SEM) was conducted to measure the relationships that lie within the model. The study reveals the links among the dimensions of quality in higher education in engineering faculty in an Indonesian state university. The outcomes depict that the satisfaction of students was impacted in a positive manner by rigorous work of faculty,

manner of course conduct and feedback provisions for improvement of quality.

According to Sahney (2012) the education system is customer centric where internal customers are faculty and administrative staff and external customers are students and industry. The various design characteristics identified for the mentioned customer group i.e. management system Technical system and social system. The study indicated highest mean for the technical system as students more believe on good academic infrastructure arrangement.

The Young et al (2013) studied student perception on academic advice. The study shows that student having skills which are strong in terms of study; responsibility sense and higher level of self motivation are more probable to achieve success. Thus, it indicates advisors role in the success of students. The study also indicated the design to assess the suggestive advising in academic field regarding what students need and aspire rather than just going by the general student satisfaction measuring benchmarks already established. Espinoza and Gonzalez (2013) analyzed and discussed outcomes of the system of accreditation put into process in Chile and observed that accreditation in higher education institutions, graduate and undergraduate courses has brought several quality initiatives and good outcomes.

The empirical research conducted by Debnath and Shankar (2014) investigated customer satisfaction on support services of the academic process and concluded that academic process is not only confined to classroom activities and evaluation but also includes disciplines like sports and facilities for students satisfaction. The students' perception about service quality dimensions was investigated by Sumaedi et al (2012) and found curriculum, contact personnel, social activities, education counsellors, assessment and instruction medium are the major service quality dimension. The dimensions of service quality are perceived on gender based and on junior and senior students based. It is resulted that there is a gap in student quality perception

based on gender. Similarly, senior and junior students perceived service quality with a significant difference of facility and social activity dimensions.
A study by Wilkins and Balkrishnan (2013) shows that levels of student satisfaction at UAE branch grounds were by and large high. The variables that were most compelling in deciding were that a student at UAE branch was satisfied in general with the parameters i.e. the quality of the speakers, quality and accessibility of assets, and viable utilization of innovation. As per Sumaedi et al (2012), the students' apparent quality is imperative for a university these days. This can be clarified by rivalry among colleges, internationalization, higher desire of advanced education institutions etc. Quality influences consumer loyalty, trust, and client reliability were found to be the important parameters. The study demonstrated that there are seven service quality measurements imperative to university students, i.e. educational programs, offices, contact staff, social exercises, education guides, appraisal, and direction medium.

The potential factors perceived by the students leading to quality in higher education in Cambodia, investigated by Chen et al (2007) are academic curricula, quality of faculty, good infrastructure and interactive network. Through web based approach, quality assurance and assessment in technical education system is tested by Hill et al (2003) by using web based information of institutes to develop TEQ-AA system. Through the system comparative rating of each institute can be found to have the choice of students for quality education.

According to Maclennan (2008), there are main six areas where the potential students do the research to select the technical institution. These are the selection for course, differentiation factors that make the classes interesting and knowledgeable, the teaching methodologies, course subjects and provision ofbooks in libraries.

Student perception on University choice depends on the offer and services attributes of the University (Petruzzellis and Romanazzi 2010). The three hypotheses found positive are:

i) The university choice depends on student related attributes more than university-related ones. This increases students' acceptance of their choice fostering their commitment to the university system.

ii) Student related attributes positively influence the value dimensions, the higher the satisfaction, the stronger the commitment, thus reducing risk perception & uncertainty in choosing the university.

iii) The student choice depends on the value students expect, which is a function of the trade-offs between benefits & sacrifices deriving from the university experience.

Further various researches indicating the quality dimensions are summarized and listed below.

2.2.1 **Contemporary studies: Review of Quality Aspects in Technical Education**

S N	Author	Purpose	Findings
1.	Abili et al. (2012) Iran	To determine university service quality in the International branch of Amirkabir University (Iran) which is based upon the gaps between the expectations and perceptions of the students.	Five dimensions of service quality were identified namely: assurance, responsiveness, empathy, reliability and tangibles. The results demonstrated that in all of the five SERVQUAL dimensions there was a negative quality gap which means students' expectations are greater than their perception.
2.	Douglas et al. (2008) UK	To propose a model between the higher education experience and student satisfaction level.	This study shows that responsiveness, access and communication are the major aspects that Educationists need to focus at. Also, the methodology of CIT data collection may be used by Higher Education sector.

3.	Angell et al. (2008) UK	To recognize the service elements utilized by postgraduates in their quality assessments and to examine the fittingness of IPA (importance performance analysis) in the estimation of service quality being provided.	From the study, four factors of service are identified; existence, provision of comforts, corporate relations and financials involved. Utilizing importance-performance analysis (importance performance analysis) technique, the outcomes show the "academic" & "industry links" are very crucial for postgraduates.
4.	Yeo (2008) Saudi Arabia	To identify the factors that influence service quality in higher education and their contribution to the overall performance of a higher learning institution.	From the study, the main three aspects of quality of service were identified: course design/delivery, customer orientation, and support services. These aspects are considered important for enhancing the learning experience and total fulfilment of the diverse aspects leading to overall student satisfaction.
5.	Galdo´s et al. (2012) Spain	To determine the variables of education quality at universities of Spain.	Ten quality factors were identified from the study out of which; "The expertise and motivation of lecturers" were high rate at 94%, while "communication skills of lecturer" was rated 93%.
6.	Sultan and Wong (2013) Australia	To determine the critical aspects and consequences of quality of service base on student perception and to develop a theoretical model.	Three aspects of perceived quality of service were identified: academia, administration and infrastructure. Satisfaction and trust of students have positive correlation with service quality.

7.	Cardoso et al. (2013) Portugal	To explore Portuguese academics' expectations on advanced education quality assessing goals and purposes, when all is said in done, and on the latest framework for advanced education quality evaluation and accreditation.	The study concluded the existence of statistically significant different perceptions between different groups of academics belonging to different types of institutions, with different disciplinary affiliation, gender and, although to a lesser extent, experience in quality assurance activities.
8.	Ali and Musah (2012) Malaysia	To determine the linkages in the quality culture & workforce functioning in Malaysian higher education sector.	The analysis yielded a nine-factor-indexed quality culture construct, while the workforce construct constituted two factors. The findings of the study postulate statistically significant correlation between quality culture and workforce performance.
9.	Johan (2015) Malaysia	This paper plans to concentrate on the view of the students to the instructors of education with technical background towards their learning knowledge.	The outcomes demonstrated that students have a good observation on the teachers with corporate industry interface. Over 80% responses found that the students feel that the teachers can enhance their knowledge and provide value addition in their skill enhancement.
10.	John and Senith (2012) India	To portray the perceptual measurements of the student evaluations of the nature of their technical education and to bridge those measurements with students fulfilment with their experience.	Five factor of service quality were identified: Administration, Student Safety, Faculty Communication, Facilities and Interpersonal Behaviour of Faculty. Among these Faculty members' communication was most important factor perceived by the students.

11.	MacLennan, A. (2008) UK	The study is about to list and show aspects, actions required, to raise the quality of technical education.	Six fundamental aspects found to improve technical education are: choice for courses; differentiation aspects inside classes; linking with industry; teaching techniques; libraries; and technical education as a subject.
12.	Khan et al. (2008) India	To focus on finding out bench marking institutions, and using Data Envelopment Analysis (DEA) technique for ranking of technical institutions based on their efficiency scores, and discuss improvement areas for inefficient institutions using.	The result indicated significant difference between the conventional system of evaluation and DEA methods. Factors such as quality of inputs (students), investment pattern in the institution, funds generation by the institution, research and development activities, etc. were identified for improving the overall ranking of the technical institutions effectively.
13.	Mahapatra and Khan (2007) India	To determine the minimum number of common items of service quality capable of addressing the concerns of key stakeholders in order to achieve overall customer satisfaction and improve service quality.	Areas of improvement identified in the study are: Training on state-of-the-art technology, Comprehensive learning resources, Opportunities for campus training and placement, Close supervision of students' work, Expertise in subjects and well-organized lectures and Good communication skill of academic staff.
14.	Ibrahim et al. (2012) Malaysia	The study investigated how students perceive the service quality offered at public and private technical education and vocational training institute (TEVT).	Ten service quality dimensions identified. Most important aspects were instructor; curriculum; and training delivery while physical facilities; reliability of services; and training equipment were least important.

2.3 SKILL DEVELOPMENT IN TECHNICAL EDUCATION

Today, India is one of the youngest nations in the world with more than 62% of the population in the working age group (15-59 years) more than 54% of the total population below 25 years of age.. It is further estimated that the average age of Indians shall be around 29 years by 2020 against 40, 46 and 47 years in USA, Europe and Japan respectively.

In the next 2 decades the labor force in the industrialized world will decrease by 4% against an increase of 32% in India. This presents a challenge as well as an opportunity. To reap this demographic dividend which is expected to last for more than 2 decades, India now needs to instill and develop 'employability skills' among its young workforce and reap the benefits of resultant productivity which would transform India into a developed country.

The various studies carried out to know the role of different skills responsible for making the youth more employable. Few researches are listed below

2.3.1 Contemporary studies: Review of Skill Development in Technical Education

SN	Author	Purpose	Findings
1.	Greenan et al. (1997) Ireland	The points of the exploration study are to: • decide the advantages and learning results of gathering based assignments; • decide if there is an advancement of transferable individual aptitudes using this particular evaluation prepare; • survey whether bunch introductions are a	The outcome infers that: • Programs ought to concentrate on students needs and be more intuitive in outline; • They ought to offer members the chance to apply hypothetical ideas in pragmatic circumstances; • Curriculum advancement must concentrate on using proper educational methods which upgrade learning and create authority and

		compelling method for creating relational and presentational abilities; • judge whether the act of utilizing self-and associate evaluation upgrades students' capabilities concerning self intelligent learning.	relational aptitudes.
2.	Varela et al. (2013) USA	To propose a re-evaluation of learning objectives and appraisal methodology for management ability improvement in MBA education.	The outcome revealed that highlighting on having a command on complex administrative aptitudes as a normal learning result may be an excessively demanding objective that can result in disregarding early accomplishments in expertise obtaining and make untrue impressions of MBA program failing.
3.	Jackson and Chapman (2012) Australia	To inform stakeholders in undergraduate education the areas that require review of the findings on gaps of skills in other developed, culturally-similar economies and to understand the generality of identified problems.	It was found that graduates are lacking in important aspects of the managerial abilities. There were differences in the feedback provided by the prospective employers regarding the skill set which could not be found in the academic record of the students.
4.	Raybould and Sheedy (2005) UK	To identify skills required for employability and requirements for students from a point of view of the recruiter.	It was concluded that graduates need to focus on developing their personal and professional skills relevant for the world of work in order to improve their chances of employment success.
5.	Munastiwi (2015)	To formulate an education quality assurance management	HOLSKED model can change the mind-stream of the majority of students and

	Indonesia	model, with the focus on vocational schools.	help them in enhancing their creativity, problem solving skills and productivity.
6.	Amirkhanova et al. (2015) Kazakhstan	The study about the problem of formation of self-education skills in the process of education in a system of higher educational institutions and to determine the degree of readiness for professional self-education. The purpose of research was to study a model of self-education skills.	Skills identified for self-education are (independence, information awareness, decision making, planning, emotional attitudes). Among which Independence, decision making and planning are considered most important for the formation of readiness for professional self-education.
7.	Murali and Rajaram (2015) India	In this study, the discussion is about the corporate expectations from young engineering graduates focusing on the skills that required by them to being employable	Skill identified based on student perceptions: Communication Skills: 38.99% Positive attitude: 26% Team work: 17.99% Leadership: 5% Decision making: 11.01% Others: 1.01%
8.	Baser and Buntat (2010) Malaysia	The purpose of the research was to investigate teachers' readiness in informal learning and to develop to help the teachers to understand the state of their readiness in teaching the Engineering Technology subject based on knowledge and management skills.	The results of the model has been developed, there are fourteen items that must be followed in the process of informal learning in which all items can develop skills and generate new skills to improve job satisfaction among workers in the work environment.
9.	Ab.Hadi et al. (2015) Malaysia	To find out utilization of thinking skills competencies in work process by conducting	There are at least six thinking skills initiate by worker in work process to accomplish job task in semi-

		survey in Technical and Vocational Education Training (TVET) institutions.	professional job duties of TVET qualification; care observation judging, inquiring, imagining, remembering, wondering and evaluating.
10.	McMurray et al. (2016) UK	To report on research carried out with employers to determine the demand for business and management skills in the Scottish workforce.	The most important transferable skills to employers when recruiting graduates were; trustworthiness, reliability, motivation, communication skills and a willingness to learn.

2.4 EMPLOYABILITY IN TECHNICAL EDUCATION

In Indian context the NASSCOM has studied about employability of engineering graduates and found that only 25% graduate engineers' suit to the industries & suggested improvement in employability skills during study. Skill of getting employed is a non-technical in nature.. 'Technical ability' is important skill also required by the prospective employers. Robinson (2000) says that, skill of getting employed is dissimilar to any technical skill. This skill is naturally inbuilt type of quality according to the prerequisites of the job specifications. Bektaş and Tayauova (2014), mentioned Higher education institutes (universities) make important contribution to the economy and social life. So universities effectiveness is important for industry. Cooperation between university and industry can facilitate the transfer of knowledge and stimulate the production of new knowledge and technology. University knowledge is applied in industry to support innovation and creation for new technology. University-industry cooperation both fosters new university capabilities and effectiveness of higher education.

Johan (2015) studied the competency of the students particularly the graduating ones with employability aptitudes. With regards to Malaysia Technical University Network (MTUN), the graduating technical students were relied upon both in scholastics and the soft skills specifically to become a

successful engineer. In accordance with the National Graduate Employability Blueprint 2012-2017 distributed by the Ministry of Higher Education Malaysia, one of the method selected that getting the information of being a specialist in technical field is to take in and encounter it from the engineers themselves thus proposed the teacher to be a engineer himself ideally with a long connection in the business. Such experiential learning is possible if the college teachers have introduction to industry experience and the students have certain level of key information to boost the learning procedure. The review demonstrated the view of the students to the speakers with such technical knowledge towards their learning background.

The studies emphasized on the technique of specialized colleges which are exceptionally required to contract teachers with experience of industrial interface. The review specified about the advantages with regard to the experience of working in the business into the lecture halls. Regarding employability abilities, designing of engineering courses as per demand of industries and access of students to industries is one important factor. This high impression of the students which is shown as over 80% in combined rate recommends that the students see the instructors, who can increase the value of them in terms of confidence, thinking process, and creativity.

McMurray et al. (2016) studied about important factors considered while recruiting Graduates by Industries. The result indicate that "Personal Attitude" was most important followed by Employability skill and Relevant work experience .The research also found the important transferable skills and Trustworthiness was found most important followed by reliability, motivation and communication. Wickramasinghe and Perera (2010) studied about Employers perception towards Employability skill. The author observed higher employability skill in female graduates with highest mean of 4.33 in Basic Arithmetic where 4.18 for male graduates. The Punctuality also found higher in female graduates with mean of 4.33 against mean of 3.93 in male graduates. However the other skill like Problem solving skill was found higher in male graduates with mean of 3.89 against 3.56 in female graduates.

Murali and Rajaram (2015) studied the corporate expectations from engineering graduates and observed that earlier corporate industries used to hire fresh graduate engineers based on their academic qualification shown through their marks and technical skills, but now there is need for the graduate engineer to have other skills like soft-skills. This may be due to the rapid growth in technology, the dynamic world economy, the increased influence of information technology, the ever rising competition and globalization. It was also identified communication skills as the critical requirement for them under the category of soft skills followed by positive attitude. It was also evident that the engineering institutes have now started focusing on the soft skills, with interviews leading followed by Personality Development. Approximately 98% of the graduates are aware that positive mind-set plays a major role in attaining and maintaining a job. Zaharim et al. (2010) identified the perception and the expectation of employers on skills of engineering graduates at their work place. The finding indicated that majority of those companies employing engineering graduates have been satisfied with the knowledge and skills of the graduates they recruit. The expected skills from graduates were:

a. Capacity to work viably as an individual and in a team with the ability to be a pioneer or administrator and also a viable colleague.
b. Capacity to convey adequately, with experts as well as with the team.
c. Ability to identify problems and to find their solution.
d. Ability to identify detailing and arrangement of any occurring problem.
e. Ability to procure and apply information of building basics.
f. Having competency in technical application and introduction.
g. Ability to use a frameworks ideology to deal with plan and assess operational execution.
h. Recognizing the need to embrace deep rooted learning, and having/getting the ability to do as such.
i. Ability to plan and conduct tests, and in addition to examine and translate information
j. Having the competency in hypothetical and research building.
k. Having inside and out specialized ability in a particular specialized discipline.

l. Having social awareness, social, worldwide and ecological duties and morals of an expert designer and the requirement for supportable advancement.

m. Having the information of contemporary issues.

n. Having essential entrepreneurial aptitudes.

With mean value above 3.5 all categorically of skills as listed were found important except basic entrepreneurship skill.

Shamshina (2014) investigated the requirements of technical university graduates (communicative readiness, creativity, positive relation to the profession, methods of the technical and economic analysis, etc.), the notion of professional competence, based on the federal educational standards and data from the interviewing industrial employees, is highlighted as one of the professional skills required of a bachelor-degree-holding engineer working in the engineering industries Baharom et al (2014) observed that in addition to technical competence and soft skills, graduates' business acumen has also been identified as crucial to their well roundedness to suit the Industries. In realizing this initiative, Malaysian institutions of higher learning are now working towards incorporating elements of business acumen in their curriculums. The higher learning institution, in which this research had been undertaken, is one such educational institution that inculcates business acumen skills in its graduates. The study aimed to gauge the level of business acumen skills the students demonstrated during their seven month internship period. Descriptive statistics were computed to find out the interns' level of business acumen (behaviour, attributes, skills and ethics) as rated by their supervisors. The results indicate means scores ranging from 3.24 to 3.71, the interns were rated as possessing considerably high business acumen levels by their internship supervisors. Notably, the interns were rated very highly on entrepreneurial ethics (mean 3.71), signifying the possession of good ethical values among the interns. The interns were however, rated the least (mean 3.24) on entrepreneurial skills.

Moreno et al. (2012) studied to help both academia and the software industry from a relationship point of view between the competences of recent graduates of undergraduate and graduate software engineering programmes and the tasks that these professionals are supposed to perform as part of their jobs in industry. The biggest gap concerns tasks associated with the IT Business Consultancy profile. Knowledge required for such tasks is beyond the basic technical knowledge that one is accustomed to acquire in most undergraduate and graduate software engineering programmes. The results were consistent with other studies that claim there is a need to move from technical to the business issues (Gartner, 2005; Davey and Tatnall, 2008). Kazilan et al. (2009) investigated the level of employability skills among the students of technical and vocational training institutions and found Certificate of Skills was being pursued by them in one of the five areas that included art and building, electric, electronics, automotive and mechanical. A major gap was identified between the required skills and their specializations.

The employability skill found most important are Personal Quality Skills- 4.13 followed by Interpersonal Skills -3.95, Basic Skills- 3.84, Thinking Skills- 3.81, Resource/ Capability Skills- 3.79, System and Technology Skills- 3.78, Information Skills- 3.74.

Adeyemo et al (2010) learned about employment and work scenario in Nigeria. It was contemplated whether the education they get not in consonance with today's expertise necessities in the work showcase or is the educational modules utilized as a part of the higher education institutions excessively obsolete? Numerous businesses of work for the most part griped that graduates are inadequately arranged for work. They trust that scholarly models have fallen extensively over the previous decade and that a university degree is no longer an assurance of employable abilities or technical fitness. It looks to answer these and different inquiries with respect to the levels of graduate readiness for employment. The study demonstrated that numerous science graduates were lacking in technical and professional abilities, poor in business enterprise aptitudes and also inadequate in data innovation aptitudes. It was

proposed that university should change their educational program over the interval of years with worldwide market demand. The, businesses are having requirements for new educational module that incorporate expertise measures and maybe even seller which should be incorporated into conventional university educational program. Remaud et al. (2010) studied about Internships as a broadly settled practice in French engineering schools, empowered for enhancing employability additionally regulated by CTI(an accreditation office in France). The study was drawn with respect to the fundamental difficulties influencing industry temporary positions like interns and the effect of this practice into training quality.

The French accreditation body for engineering (CTI - Commission des Titres d'Ingénieur-) builds up, for all French five-year expert projects of engineering, a base temporary job time during internship of 28 weeks (14 of them must be mandatorily done in industry, while the rest should be possible in an exploration research centre). It is perceived to have various constructive outcomes, for example, expanding the employability and the universal versatility of technical graduates. Incorporated temporary jobs inside the French educational programs have a long history and right now constitute an essential segment of the French building educational programs. The distinctive global accreditation demonstrated that the French temporary job model could be effectively extended to other countries. Collet et al. (2015) explored about graduate abilities and employability, the non appearance of a mutual dialect between student, scholarly and industry partner bunches implies that characterizing industry aptitudes necessities is both basic and troublesome. The study is to survey graduate abilities prerequisites in a learning concentrated industry.

2.4.1 **Contemporary studies: Review of Employability issues in Technical Education**

S N	Author/Context	Objectives	Findings
1.	Kazilan et al. (2009) Malaysia	To study the employability skills of the students of institutions that are providing technical and vocational training.	The level was moderate and individual skill at higher level. There was considerable gap found between the field of study of students and the required employability skills in the industry.
2.	Adeyemo et al. (2010) Nigeria	To recognize variables deciding the employability of science and innovation alumni of polytechnics and colleges.	Important factors for being employed: 1. Field of study 2. Subject specialization 3. Reputation of university attended 4. Class of degree 5. Age of applicant 6. Previous work experience 7. Theme of thesis/project work
3.	Rao (2014) India	To overcome any issues amongst campus and industry among the administration and engineering students to improve their employability.	The exploration discoveries recognize that the students must audit and reassess the prerequisites of the enrollment specialists. It uncovers that the individuals who are better furnished with hard and soft abilities are probably going to more employable.
4.	Rasul et al. (2013) Malaysia	To investigate the importance of employability skills as perceived by employers from manufacturing industries.	The findings of the study showed that employers place great importance to communication skills, problem solving skills, team work skills, leadership skill, entrepreneur skill, technology skill, informational skills and personal qualities.

5.	Wickramasinghe and Perera (2010) Sri Lanka	To investigate employability aptitudes that businesses, university teachers and graduates emphasize on to get to the work environment.	The outcomes suggest that there are contrasts in the needs given for employability aptitudes by taking after gatherings – Gender of graduates, Employers, and University instructors. Self-confidence, problem solving, and team work are considered as the essential elements of skills required for employability.
6.	Andrews and Russell (2012) U.K.	To analyse the strategies to improve the skills required for employment &to identify the areas of future study.	Key emerging themes include issues i.e. lack in the differentiation of graduate destinations; the hurdle of identifying the employer needs; & difference between actual and expected.
7.	Pitan (2016) Nigeria	To propose a model of graduate employability enhancement.	The findings suggest the relationship between different components of employability, which are arranged in the form of model named as: University Graduates Employability Model
8.	Jackson and Chapman (2012) Australia	To determine the skills required for employability from industry perspective based on literature available in the area of employability skills and historical research on managerial competencies.	Core business skills and problem solving were deemed most important by employers, closely followed by the ability to effectively work with others. Within core business skills, 72% of respondents ranked numeracy as more important than technology skills. Rankings for problem solving were more equally spread with 60% classing diagnosing, rather than reasoning, skills as more important.
9.	Dubey et al. (2009) India	To explore gap between industry expectations and quality of recent college graduates.	Twelve determinants of employability were identified: namely-soft skills, leadership qualities, suitability, analytical power, ethical component, dressing sense, language,

			appearance, manageability, training needs, industry's view and professional commitment. The results indicated the importance of soft skills and other criteria along with the basic theoretical knowledge.
10.	Murali and Rajaram (2015) India	To determine the expectations of Graduates students on skills required by Corporate Industries in order to improve their employability.	Top five employability skills identified are: 1. Soft skills, Interview and ethics, 2. Personality development programs, 3. technical skills, 4. communication skills, 5. placement training
11.	Zaharim et al. (2010) Malaysia	To identify the perception and the expectation of employers on skills owned by engineering graduates in their work place.	The result shows some significant gap exists between the skills actually possessed by employee and the skills are thought to be important by employer. The most important skills but most lacking skills are teamwork, communication, and problem-solving.
12.	Afonso et al. (2012) Spain	To analyse the compliance of university education with labour market demands and the potential that university industry cooperation has as a means to foster employment.	It was found participation of industry professionals in postgraduate courses and students internships in companies are the mechanisms with greatest impact on employability.

2.5 KNOWLEDGE CREATION IN TECHNICAL EDUCATION

The main activity for any technical institution is to produce knowledge and capabilities in a quality learning environment. Two major dimensions of this activity are teaching and research. Teaching promotes learning through knowledge formation amongst students which is new to them. Research contributes to learning for humanity through creation of new knowledge.

Service and consultancy contribute to local learning for communities (geographical, industrial and other types) through knowledge formation for particular purposes.

Creation of knowledge is characterized as a continuous procedure through which the knowledge becomes accessible in the institution's learning framework (Krogh et al., 2012). The achievement of organizations in today's highly competitive environment is exceedingly goal oriented on the basis of how much new learning is made by them. The results indicated five attributes, namely, knowledge acquisition, knowledge dissemination, leadership, culture and technology are important dimensions of knowledge management orientation in engineering institutions. Sohail and Shaikh (2004) discussed about KM initiatives required for educational institutes, creating teaching learning environment, research activities, technology based knowledge and knowledge based networking. Daud et al (2011) investigated the attributes that a business graduate requires for actual performance in employment – the dimensions of attributes found in four major areas of communication, abilities, development of personality and acquisition of knowledge. The curriculum development to be as per needs of market & industry. Bhusry and Ranjan (2012) study indicates the requirement for knowledge management in the learning and development cycle in technical aspect of education institution and use of IT in KM intervention. The exploration proposed a KM system for up gradation of learning combination in the institutional educating leaving process by the utilization of shared IPs. With support of IT, framework becomes a significant knowledge enabler. Lee et al (2015) investigated about characteristic for good teaching like preparation and organization, knowledge, learning and thinking enthusiasm and delivery. The knowledge beyond curriculum is one of the characteristic for a good teacher. Voss and Gruber (2006) study indicate desired quality of lecturers. The result of study found that student want lecturers to be knowledgeable. The survey conducted through laddering questionnaires and observed that students indicated highest impact on a knowledge that a teacher have. Gera (2012) investigated the gap in transfer of managerial knowledge between academic and practioners. The study reasoned the exchange of administrative information of the KT cycle.

Bektas and Tayauova (2014) investigated the transfer of knowledge, production of new knowledge and between University and industry. University knowledge is applied in industry to support innovation and creation for new technology. The research created the four factor model. These factors are University, industry, govt. and civil society organization.

Baumann et al (2014) studied the role of knowledge workers in new economy. The research indicates that every business is a part of new economy and every worker needs to be more educated and have better skills work.

Glomann (2015) investigated that professional knowledge is gathered through learning-by-doing across disciplines. The Human Central Design (HCD) has an important role and students and professionals from the field of psychology, IT, Business and design to work together. Guerrero et al (2014) study indicates the competitive exercise of engineering. The group of student belonging to engineering project management indicated strong evidence for improvement of basic competencies; underlying science knowledge, knowledge of fundamental and advance engineering, engineering reasoning and problem solving, systematic thinking etc.

Ankrah et al (2013) investigated the learning exchange amongst University and Industry. The exploration experimentally showed that at state there is a good level of shared characteristic amongst thought processes and advantages for University and Industry performing artists, in any case, at a point by point level the intentions and advantage vary between the two groups.

Kafouros et al (2015) indicate the positive role of academic collaborations in enhancing firms' innovation performance. It may be fruitful for firms to have few valuable academic collaborations which will help managers to have time for establishing shared processes, address initial ambiguities and remove communication gaps and thus create a better fit with academic institutions.

Maietta (2015) investigated how university-firm R&D, collaborations impacts from product and process innovations and how the "knowledge context" in which the firm operates affects this relationship. The research showed that

collaborations of firm with local university can be important than the distant located firm (within 150kms).

Somers et al (2014) investigated how business school student and faculty organize and apply general business knowledge by using mind maps. The mind maps indicated that advanced under graduate and MBA students partitioned knowledge into distinct silos and their knowledge bases were thin, where as in contrast business school faculty developed rich mind maps characterized by dense connections among concept.

Table shown below provides the summary of the review related to the knowledge creation in technical education.

2.5.1 Contemporary studies: Review of Knowledge creation in Technical Education

S.N	Author	Purpose	Findings
1.	Nejatian et al. (2013) Malaysia	To identify the concepts of (KCP) and (KMEs) and showing the effect of KME factors on KCP through literature review.	As KM turns out to be increasingly critical in making competitive edge for companies worldwide, analysing the past reviews to reveal insight upon future ways appears to be fundamental. This review has inspected the impact of KMEs on KCP by a surveying literature of the related studies.
2.	Cheng (2012) Hong Kong	To find the strategies and activities applied in schools in Hong Kong and to identify the relationship between knowledge requirements and the capacity of learning of students.	The findings reveal that they use personal knowledge sharing as their major strategy.
3.	Gera (2012) India	To measure the differences in knowledge& dissemination to education industry and corporate & to lay a foundation which bridges the gaps with the help of IT, KM and HRP practices.	The findings included that by orienting the educationists towards creating skill sets for students for increasing employability, experiments can be made

			for applying theoretical knowledge in practice leading to improved performances and competitive skill set.
4.	Ankrah et al. (2013) UK	To Ask both university and industry performing artists about their engagement in learning exchange:	This exploration has yielded various conclusions, which ought to demonstrate helpful for hypothesis, practice and strategy making including the outline of open strategies gone for encouraging and cultivating university–industry information exchange. In this review, it is looked to inspect the intentions of university and industry people required in information exchange connections, and the results of the connections as far as benefits and disadvantages.
5.	Somers et al. (2014) USA	To examine the manner in which business students and faculty frame and analyse complex problems using mind maps.	Results indicate that mind maps are a promising technique that can provide insights into how students integrate and apply knowledge. These insights can be very helpful in shaping the future of business school pedagogy and curricula.
6.	Adhikari (2010) Nepal	To display an idea of learning among the college heads and other university pioneers to make them aware of how critical management of knowledge is to accomplish quality education criteria.	Results showed that initiatives ie. teaching-learning environment, research activities, technology-based knowledge and knowledge-based networking are essential for ensuring success of KM activities in higher education institutions.
7.	Sharma (2012) India	To investigate the view of teachers about KM	Factor analysis created five variables of KM

		introduction in Indian engineering establishments in the National Capital Region and to propose a reasonable model to evaluate KM introduction in private engineering foundations in India.	introduction in the wake of erasing those things with an element stacking of under 0.50. The outcomes demonstrate that five factors – i.e. information securing, learning spread, authority, culture and innovation – are essential measurements of learning introduction in engineering establishments.
8.	Bhusry and Ranjan (2012) India	To stress upon the requirement of KM in the education process in the higher education institutions that provide technical education in India and to assess the impact of applying KM in the whole process that is mentioned above.	The literature supports the value addition provided by KM in increasing the overall quality of the education process in India. Also, to identify the requirement of research & development in the information technology based knowledge management interventions that have an impact on the overall education process in the higher technical education institutions in India. According to the past researches, a model was proposed that enhances the overall teaching learning processes, increasing the productivity, improving communication process in education industry, improving the understanding level of students and providing a pool and a corpus of knowledge base for all.

2.5.2 Contemporary study: Review of the role of University-Industry collaboration in technical education

S.N	Author	Purpose	Findings
1.	Gupta et al. (1994) USA	The purpose of this study was to investigate the perceptions of leading IS employers in Taiwan regarding three issues: importance of various skills for an entry-level IS position, needed expertise level of these skills, and actual expertise level possessed by the graduates.	Results indicated that both general and technical skills are important. Students need to improve their communication skills and understanding of business needs. Deficient technical areas are project management, systems analysis and design, telecommunications and database management. University-industry collaboration has to be enhanced in the areas of conference participation, training programmes and consulting contracts.
2.	Jackson and Chapman (2012) Australia	The research objectives were to (i) produce a set of valid business graduate competency profiles which accurately reflect the current needs of Australian employers and (ii) to analyse exactly how, if at all, these profiles vary across different demographic characteristics and business activity/work area variables.	Three distinct clusters (or 'types') of graduates were identified: the 'Manager', 'People Person' and 'Business Analyst'. They provide an overview of the required balance of cognitive and affective competencies important in the modern Australian business graduate. The preferred 'types' align with recent literature in the area of employability skills and historical research on managerial competencies. Findings suggest that the demand for individual competencies, and the way in which they manifest themselves in the form of workplace behaviours, differs in some ways. The three distinct business graduate profiles are, however, generic across employers from a broad spectrum of business activities,

			work areas and backgrounds.
3.	Kleibert, J.M. (2015) Netherlands	This study investigated, what degree organizations take part in linkages and joint efforts with colleges and how the education segment reacts to the new requests of the learning economy. This researches the sort of linkages made, which characters participate in them and their inspirations, to comprehend the subsequent ramifications for monetary advancement. Interviews with remote investors and advanced education establishments uncover that most coordinated effort is started by organizations and concentrates on level aptitudes improvement for their operations.	The outcome of study demonstrated that organizations have built up linkages with colleges and schools to encourage access to qualified specialists. Small institutionalized specialist co-ops have been most dynamic in creating connections and changing educational module in the domain of English-dialect abilities, while higher-end specialist organizations have been hesitant to take part in joint efforts to propel technical and administration aptitudes.
4.	Ictenbas and Eryilmaz (2011) Turkey	The purpose of the study is to evaluate different teaching methods in perspective of employers' expectations using the QFD approach.	Effective teaching methods: Lecture, case study, class discussion, project work, presentation, field training, internship, live demonstration and Customer importance ratings were identified. Based on the study, the most effective methods in terms of meeting the employer's requirements found as lecture, case study and project work.
5.	Jamaluddin et al. (2013) Malaysia	A main objective of the study is to expose students to the practices in engineering specific to their chosen field of study and industry.	In this paper the industrial training program has been described, and the benefits gained by the students, faculty and industry have also been highlighted. The implementation of the industrial training program in (Faculty of Engineering and Built Environment) FKAB proved to

			be beneficial for students, faculty and industry.
6.	Nordin et al. (2012) Malaysia	To Study the Impact of Industrial Talks and Visits towards the Outcome Based Education of Engineering Students	Preliminary results showed that 96% of students agreed that the proposed industrial talk give a positive impact, based on the analysis from the program outcomes.
7.	Kosogova and Araslanova (2015) Russia	To decide the critical ranges of exercises of the Soviet Government and the Communist Party to fortify collaboration between advanced education and industry, and uncovers the cooperation wastefulness reasons routinely partitioned into three gatherings: those identified with elements of the authoritative and arranged economy, to the communist model of economy and to connect between state specialists and a man.	To choose the basic scopes of activities of the Soviet Government and the Communist Party to sustain coordinated effort between cutting edge education and industry, and reveals the participation inefficiency reasons routinely divided into three social affairs: those related to components of the definitive and organized economy, to the model of economy and to interface between state authorities and a man.
8.	Bektaş and Tayauova (2014) Turkey	The study aims to examine the university-industry collaborations for effectiveness of education as a result of the four factor model.	The study stated that University–industry cooperation is thought to increase both industrial productivity and educational efficiency in university. Combining theory with practice accelerates the learning process, and facilitates the transfer of knowledge to the field of production.
9.	Kartashova et al. (2015) Russia	To analyse practical experience of performing series of actions by higher education establishments aimed at integration of scientific, educational and industrial structures and defining future prospects and opportunities for the development of higher education.	It is found that integration of science, education and industry based on higher education establishments is a multilevel process, which includes the development of international cooperation of global information medium, uniform educational space and use of different innovative techniques and methods of teaching.

10.	Baharom et al. (2014) Malaysia	The objectives of this study are to: 1. Investigate the level of business acumen among interns as observed by internship supervisors, 2. Compare the level of business acumen between interns from different programs, 3. Compare the level of business acumen between interns of engineering and technology stream.	This research has highlighted the importance of understanding graduate attributes and how it relates to employability. The value of cooperative education and the synergy derived from this engagement via internship has profound implications on curriculum development and its quest to produce graduates with high employability attributes.

2.6 RESEARCH GAPS

- The review of the literature reveals that not much work has been done in comparing the technical education in rural and urban based institutions and also not compared self financing and state funded institutions.
- No framework has been reported to improve the quality and employability of graduates of technical institutions.

Limited reported research was found which has studied simultaneous the expectations of students, faculty and industry

CHAPTER 3

RESEARCH METHODOLOGY

3.1 INTRODUCTION

This section includes exhibiting and spurring the decision of technique for gathering and investigating information, from both a hypothetical and reasonable perspective, contrasted with the relative focal points and weaknesses of other strategies.

In this chapter, the philosophical footing of the investigation is researched which will enlighten the clarifications behind the choice of methodology used as a piece of this investigation. The essential inspiration driving this part of study is to display the methodology embraced for the review and systems used as a piece of this survey remembering the true objective to answer the examination addresses and to reach to the investigation objectives.

As mentioned in Chapter-1, one of the major objectives of the research is to determine the impact of quality of technical education on the employability of the graduates. Further it was also identified that skill development and knowledge of creation are other two significant outcomes of a good technical education system. Three stakeholders namely students, faculty and employers are studied through a structured questionnaire to seek their perception and expectations from the technical education in India. To develop the questionnaire, different variables and attributes which affect the quality of technical education are identified through literature review and in interaction with student, faculty and employers. For studying these issues, input data were collected from all three stakeholders by questionnaire based survey. Detailed methodology adopted for analyzing industry data is explained in present chapter. In this chapter, first research methodology and its justification will be described. After this, development of questionnaire and its administration will be discussed. In following sections, description of statistical tools being used for analysis of data and finally framework for measuring overall performance and competitiveness is also discussed.

3.2 RESEARCH PHILOSOPHY

It has been chosen to utilize subjective techniques that depend on the assumptions which concern the way of learning and reality, how one assimilated and is able to understand the real situation, and the way toward obtaining learning and learning about reality. The analyst to make certain presumptions concerning learning and the real scenario, that enables him to choose a specific research orientation and these reservations give a shape to the research procedure. Considering the topic, the researcher needs to emphasize upon what epistemological and ontological presumptions, so that researcher can settle on the correct technique to approach the study.

3.2.1 Ontological Assumptions

Ontology mention about the method for social reality that is, paying little mind to whether in all actuality target and outside to the individual, or whether it is subjective and mentally created on an individual start. It incorporates what exists on the planet and what is real is the concept of ontology. These positions are regularly insinuated independently as objectivism and constructivism. The concept of objectivism indicates that there is a single objective truth whereas Constructivism believes that there is no reality other than that relation is constructed by individuals.

3.2.2 Epistemological Assumptions

Epistemology can be portrayed as the way of learning. In addition, learning can be viewed as target and theoretically accessible to all, or subjective and dependent on individual experience. The conflicting issue with epistemology is paying little heed to whether the social world should be focused by comparable measures, frameworks, and ethos as the standard science. In simple words epistemology is concerned with how we gain knowledge.

3.3 RESEARCH DESIGN

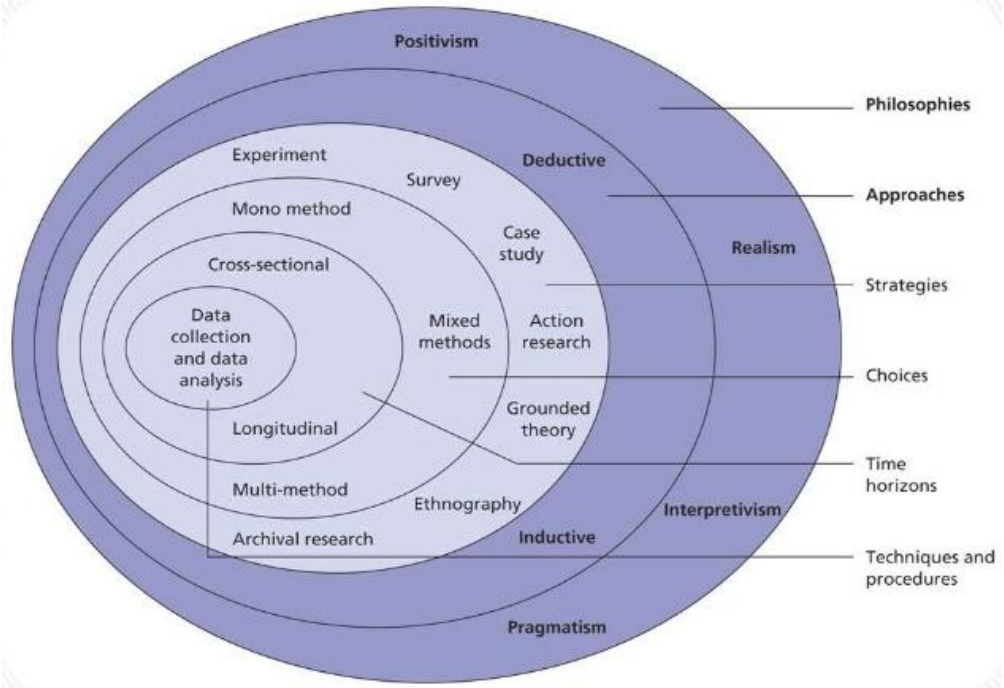


Fig 3.1 The Research Onion

(Source: www.personed.co.uk/saunders**)**

The research design insinuates the general system that we incorporate the distinctive segments of the review. It constitutes the graph for the gathering, estimation, and analysis of the collected data. The function of a research design is to ensure that the result obtained engages are effectively addressing the research issue intelligibly and unambiguously. In sociologies research, getting information apropos to the research issue includes deciding the kind of affirmation anticipated that would test a theory, to evaluate a program, or to definitely portray and review significance related to an issue. There are many sorts of research designs that are enlisted by theorists. A case study analysis is a thorough investigation of a particular research issue rather than a general quantifiable survey or comprehensive comparable study. Causality studies may be considered as understanding a wonder in regards to prohibitive clarifications in the edge. This kind of research is used to gauge what influence a specific change will have on existing models and prepositions. Most social researchers search for causal illuminations that reflect trial of theories. The cross-sectional design can simply measure differentiates between

or from among a grouping of people, subjects rather than a technique of advancement. Descriptive research designs describe characteristics of population or phenomenon and not answer to questions about how, when, why the characteristics occurred. Descriptive research is used to measure central tendency like mean, mode, median, variation and correlation between variables. A graph technique enables the researcher to keep control over all segments that may impact the outcome of a test. Test research is again used where there is time requirement in a causal relationship (cause goes before effect), there is consistency in a causal relationship (a cause will reliably provoke a comparative effect), and the span of the association is phenomenal. The exploratory design is done when there are few or no earlier studies seen. The basic principle of research works on insights and familiarity for later investigation. The research results to new ideas and assumptions and development of hypothesis. Exploratory research is a kind of research coordinated in light of the way that an issue has not been clearly portrayed. Exploratory research chooses the best research arrange, data gathering methodology and selection of subjects. While primary research, generally called quantifiable research, depicts data and qualities about the people. Thusly, on the introduce of the over, the two research frameworks were fitting for the present study.

The following is the outline of the research methodologies used for this study:

- *Questionnaire-based survey approach:* This is used to gain a broad insight of perception of students, faculty and industry executives.
- Various statistical tools have been used to analyze the data obtained from the questionnaire survey. Descriptive Statistics, inferential statistics.
- Regression analysis, multi variate analysis and significance tests have been done on the data related to quality, employability, skill development and knowledge creation.
- Interpretive Structural Modeling (ISM) has been developed for enablers of the Competency Building and Employability of Students in Engineering Institutions.

3.4 RESEARCH STRATEGY

Quantitative and qualitative techniques are the main methodologies used for conducting research. Quantitative aspect stresses evaluation in the gathering and examination of the data and it involves a deducting process to the connection amongst hypothesis and analysis where hypothesis is tried. It expects a characteristic model of positivism specifically and includes a perspective of societal behaviour as an outer edge. The research strategy for this study was quantitative in nature.

The research strategy that was followed for this study is shown is the figure below:

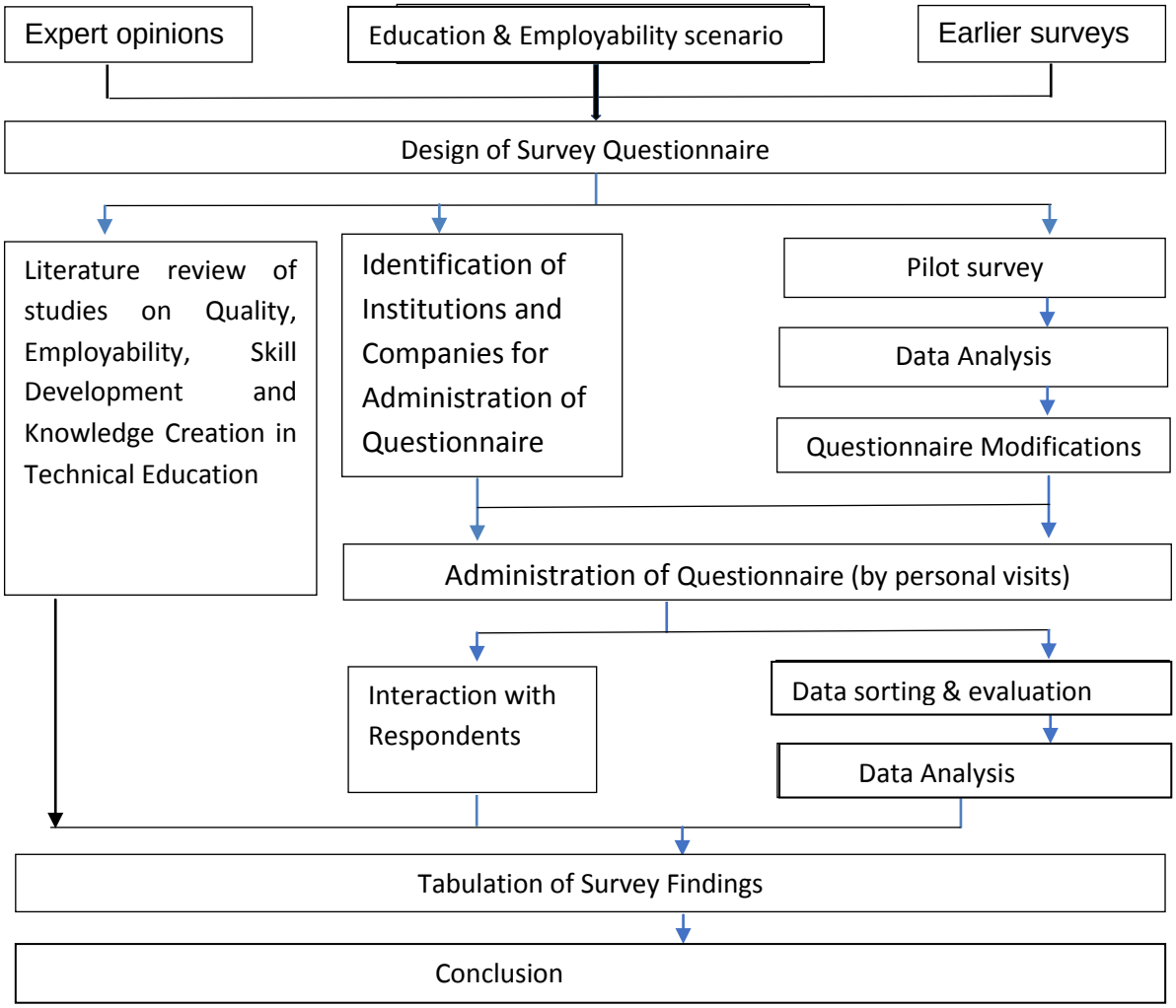


Fig 3.2: Schematic Diagram of Research Methodology

A survey questionnaire was designed that enlisted the aspects of education and employability in terms of actual scenario, expert opinions and earlier surveys. Following a pilot study on this questionnaire and examining other related questionnaires from literature, the quintessential modifications were made in the existing questionnaire. This was further administered by personal visits to the identified respondents of the study. This process was followed by data sorting and evaluation, data analysis and finally concluding the findings in a well-structured report.

3.5 RESEARCH APPROACH

The research strategy alluded to as qualitative and observational in segment covers an assorted quality of approaches that look like each other to a pretty much degree.

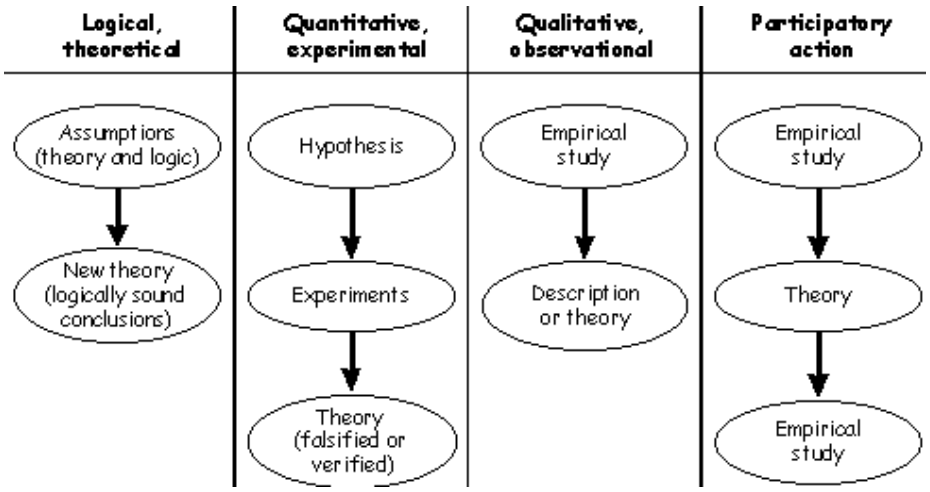


Fig 3.3 Four Alternative Research Approaches

(Source: http://www.idi.ntnu.no**)**

The theoretical logical research approach implies to a formal derivation of outcomes which are logical from an arrangement of statements (maxims). In the event that the sayings are valid and the guidelines are logically stable, the results are valid also. This method of research stands suitable for social sciences as articulated by arithmetic and parts of software engineering.

However, this approach would not consider the advantages of observational work.

A quantitative, experimental approach for doing research is inside the traditional logical worldview of characteristic, "hard" sciences like material science. The logical technique suggests hypothesizing speculations, doing quantitative investigations, and afterward either support or reject the theories in view of factual examination of the deliberate data (confirmation or distortion of theories). The logical technique might be asserted to be the "best" research approach in generally surely understood zones of research and when regular laws can be accepted to exist (as in marvels are repeatable and to some degree controllable). Regardless of the possibility that there are inconclusively numerous speculations clarifying a given arrangement of data, tests might be rehashed and hypotheses can be confirmed.

Qualitative, observational reviews allude to conventions that construct their research with respect to qualitative data (instead of research that is quantitative in nature) and don't effectively and deliberately control the extraneous variables. More researches are on Grounded theories and ethnography, are the examples of this type of research.

Further participatory research alludes to an arrangement of strategies of research on social frameworks where the researcher effectively takes part in the research process. The studies of van Meel (in the same place.) epitomizes this strategy of research: An underlying contextual analysis is carried out for recognizable proof of issues, trailed by hypothesis advancement and execution of a model data framework. At last, the model is utilized where the researcher partakes and showcases the utilization of the model with the performers that are contemplated.

3.6 JUSTIFICATION OF METHODOLOGY

In this research study, empirical research is used to document various processes and practices adopted by technical institutions for being able to provide quality education and develop graduates to meet the expectations of

the industry. Surveys are fairly common in social sciences research (Malhotra and Grower, 1998). The term ―empirical (which means knowledge based on real world observations) is used here to describe field based research, which uses data gathered from naturally occurring situations or experiments, rather than via laboratory or simulation studies (Flynn et al., 1990). Empirical research provides a powerful tool for building or verifying theory.

Survey involves the collection of information from a large group of population. It relies on self-reports of factual data, as well as opinions. Survey research methodology has often been used to compute data from business organizations (Malhotra and Grower, 1998). Flynn et al. (1990) indicated that survey designs with questionnaire are the most commonly used methodology in empirical research. The survey was structured to elicit response on various issues of quality of technical education.

3.7 DEVELOPMENT OF QUESTIONNAIRE

On the basis of discussions with students, faculty, industry professionals and literature review, preliminary questionnaire was developed for pilot survey. Final questionnaires are framed on the basis of information obtained from pilot survey, interactions with industry professionals and experts from academic institutions.

In this study, executives were asked to rate the intensity of each factor for their respective organization on a five point Likert scale (1-Lowest, 5-Highest). Reason for adopting this interval scale is that it can be ranked. Interval scale indicates the relative amount of trait (Best and Kahn, 1986).

3.7.1 Questionnaire Development

The Researcher has isolated Instrument Advancement Prepare into three Phases:

Phase:1

The principal Phase of the Improvement Process as under:

1. Determination of the Scale Sort, which are Ostensible, Ordinal and Interval for the Review.

2. Determination of Correspondence Approach, which are Close to home Contact and Telephonic Contact.

3. Determination of Process Structure, which is organized survey.

Phase:2

The second Phase of the Improvement Process will be:

1. Distinguishing the factors for the inquiries. Here, the contemplated factors are demographical, geographical, psychological, and behavioral factors. Factors are from the literature review.

2. Surrounding of fitting inquiries by considering all the contemplated factors.

Phase:3

The third Phase of the Improvement Process is accompanying undertakings:

1. Utilize channel inquiries to screen prospect.

2. Succession inquiries from general to particular

3. Incorporate skip headings to encourage sequencing.

3.7.2 Testing the Questionnaire

The questionnaire itself was being tested by the researcher to recognize whether it can accumulate the essential data of course by him. The principle purpose behind leading the test is not exclusively to discover whether the questions are straightforward additionally to locate any sort of ambiguous and befuddling questions in the questionnaire. Eight respondents were selected to answer the questionnaire within the sight of the research guide. The criticism was taken and it was accounted for by every one of the respondents that they had no trouble in noting the questions. Nonetheless, the researcher got one general remark from three clients that a portion of the questions were somewhat tedious and long.

3.8 SURVEY ADMINISTRATION

For student and faculty responses eleven institutions are selected from five different states in India in such a manner that the selected institutions represent rural as well urban areas and also state funded and self financing category. For industry the questionnaire is mailed to 200 organization recruiting engineering graduates from the campuses. A covering letter, which describes the objectives of the research and guidelines for completing the questionnaire, was enclosed.

3.9 DATA COLLECTION

Both primary and secondary data sources have been utilized for conducting the study. Primary data essentially is gotten through the directing of questionnaires while secondary sources like past reviews and documents got to from different databases so as to have a superior understanding of the study.

3.9.1 Sample Size Selection

Table 3.1: Profile of the 11 institutes participated in the study

Institute Code	Profile
A	It is one of the best engineering colleges of self-financing category in Delhi. It was established in the year 1999.
B	It is one of the best engineering colleges of self-financing category in Uttar Pradesh located in NCR.
C	It is one of the best engineering colleges of self-financing category in Jabalpur (Madhya Pradesh). It was established in the year 1995
D	It is one of the best engineering colleges of self-financing category in Hyderabad. It was established in the year 1997
E	It is a self-financing category University running B Tech programmes and maintains good reputation in MP State.
F	It is one of the best engineering colleges of self-financing category in Jabalpur (Madhya Pradesh). It was established in the year2003.
G	It is one of the best engineering colleges of self-financing category in Delhi. It was established in the year 2001.

H	It is one of the Institutes of national importance established by Govt of India
I	It is one of the Institutes of national importance established by Govt of India
J	It is one of the good Institutes established by Govt of Delhi in year 2001 and running IT specialized courses at UG & PG level.
K	It is one of the premier Institutes established by Govt of Delhi in the year 1987.

3.9.2 Sample Size Determination

The size of the sample was identified by the logical technique that considers the measure of the populace to be overviewed, the acceptable margin of error between parametric estimations of test and those of populace and level of significance at which the specimen insights will be tried. We go for routine 5% centrality level in ordinary course

The chosen sample from the populace ought to have the component of randomness as it enhances the generalizability of the outcomes acquired. How well the sample speaks to the populace is measured by two indispensable insights: The Margin of Error and the Confidence Interval.

3.9.3 Measurement and Scaling

Estimation in research comprises of allocating numbers to exact occasions, items or properties or exercises in consistence with an arrangement of tenets. Researchers utilize an experimental approach to portray, clarify, and make forecast by depending on data increased through perception or survey. There are four generally utilized orders of estimation scale: ostensible, ordinal, interval and proportion.

In this research work data are measured in nominal scale, ordinal scale and interval scale on the grounds that:

1. The gathering data on a variable that normally or by configuration can be assembled into at least two classifications that are fundamentally unrelated and altogether comprehensive.

2. Including of individuals each gathering is the main conceivable math operation when ostensible scale is utilized.

3. The numbers utilized with ordinal scales have just a rank importance.

Choosing and developing an estimation scale requires the thought of a few elements like: Research Goal, Reaction sort, Data properties, Number of measurements, Adjusted or lopsided, constrained or unforced choices, number of scale focuses, and rater errors. By considering these factors and data sort are Nominal, Ordinal and Interval, the rating scales are:

For Nominal Data:

1. Simple Category Scale

2. Multi-choice, Single Reaction Scale

3. Multi-choice, Multi-reaction Scale

For Ordinal Scale and Interval Scale

1. Numerical Scale

2. Likert Scale

Researcher measure and break down states of mind of protection speculators since demeanors offer bits of knowledge about conduct identified with the elements influencing the purchasing and re-establishing choice of insurance approach.

3.9.4 Period of Study

The present study covers a period of 5 years beginning from 2012 -2013 for secondary data and 2013 – 2015 for the collection of primary data.

3.10 DATA ANALYSIS

The following is the outline of the research techniques used for the data analysis for this study:

- *Questionnaire-based survey approach:* This is used to gain a broad insight of perception of students, faculty and industry executives.
- Various statistical tools have been used to analyze the data obtained from the questionnaire survey. Descriptive Statistics, inferential statistics.
- Regression analysis, multi variate analysis and significance tests have been done on the data related to quality, employability, skill development and knowledge creation.
- Interpretive Structural Modeling (ISM) has been developed for enablers of the Competency Building and Employability of Students in Engineering Institutions.

3.11 SPECIFIC OBJECTIVES & HYPOTHESIS

To achieve further understanding of the theme of the research, the following research questions were framed:

- What are the Institute attributes that students feel are highly desirable for knowledge and competency building?
- What types of relationships exist among the different attributes?
- What is the importance given to different variables of quality of technical education as perceived by the students and faculty?
- What are the expectations of the industry executive towards various variables of quality of technical education?
- What is the relationship among the enablers of improving quality and employability of graduates for implementation by the institutions?

The main objectives of the study are:

a) To understand the key factors effecting Quality of Technical Education.
b) To determine the importance given to these factors in the institutes as per Students' perceptions.
c) To determine the relationship (correlation) among the factors.
d) To determine the perception of faculty for the level of presence of factors affecting the quality of technical education.
e) To determine the expectations of the industry from the graduates of technical institutions.
f) To develop model of the enablers of quality education in technical institutions.

3.12 STATISTICAL TOOLS & TECHNIQUES USED

(a) Reliability Coefficient Cronbach's alpha

Cronbach's alpha is a measure used to study the reliability, or internal consistency, of a scale. After all, the reliability of any given estimation insinuates how much it is a steady measure of a thought, and Cronbach's alpha is one technique for measuring the quality of that consistency.

Cronbach's alpha is figured by correlating the score for each scale thing with the aggregate score for every perception (generally singular overview respondents or test takers), and afterward contrasting that with the fluctuation for all individual thing scores.

(b) KMO and Barrtlett's test for exploratory factor analysis

Kaiser-Meyer-Olkin (KMO) Test shows of how much suited the data is for conducting Factor Analysis. It shows the sampling adequacy for each variable in the model and for the entire model also. The lower the proportion of variance in the data, the more suited data is to Factor Analysis.

KMO gives values in the scale or range of 0 and 1. A general guideline for translating the measurement:

- KMO values in the vicinity of 0.8 and 1 shows the sampling is satisfactory.
- KMO values under 0.6 demonstrates the sampling is not satisfactory and that therapeutic move is to be made. A few authors consider this value at 0.5, so utilize your own judgment for values in the vicinity of 0.5 and 0.6.
- KMO Values near zero implies that there are substantial incomplete correlations contrasted with the aggregate of correlations. As it were, there are boundless correlations which are a huge issue for factor analysis.

(c) Weighted mean

A weighted mean is a sort of average. Rather than every data indicates contributing similarly the last mean, a few data focuses contribute more "weight" than others. On the off chance that every one of the weights are equivalent, then the weighted mean equivalents the math mean.

Weighted mean is those that give each number in a series a value as opposed to regard the numbers as though they are all the same. In this review the analyst utilized the weighted mean as weighted-averaging frameworks attempt to give a more reasonable perspective of a series by giving more profitable numbers more noteworthy weight and, therefore, a more prominent impact on the outcome.

(d) Coefficient of Correlation

Pearson correlation coefficient, generally called r, R, or Pearson's r, a measure of the quality and course of the immediate association between two variables that is described as the (example) covariance of the variables disconnected by the consequence of their (specimen) standard deviations.

The correlation coefficient is a numerical way to deal with measure the association between two variables. In this survey the investigator used the coefficient of correlation to find the association between different variables impacting the way of organizations. Correlation investigation means that the sum and degree of the relationship among variables, this movements from regression examination which is utilized to expect a variable relying on another variable (Tabachnick and Fidell, 2007). It mirrors the way of the connection between two consistent variables (Pallant, 2007). Correlation examination is done before regression investigation to piece solid relationship between the free variables. There ought to be some correlation between the dependent variable and the free variables (Pallant, 2007).

The correlation coefficient values continue running from - 1 to 1; the nature of the association relies on upon the total estimation of the correlation coefficient and the course of the correlation relies on upon the indication of the correlation (Burns and Bush, 2010).

(e) Multiple Regression Analysis

The estimates of the obscure parameters acquired from linear minimum squares in regression are ideal. Estimates from an expansive class of possible parameter estimates under the standard presumptions are utilized for process displaying. It utilizes information efficiently. Great outcomes can be acquired with generally little informational collections. The hypothesis related with linear regression is surely knew and considers development of different sorts of effortlessly interpretable factual interims for expectations, adjustments, and enhancements. Regression is used to find the connection between dependent variable and no less than one free variable and has ended up being common in many research zones (Hair et al., 1998; Tabachnick and Fidell, 2007). Regression is another way to deal with choose the connection between variables; this resembles bivariate correlation as it acknowledges that there is an association between the penniless and free component. Regression analysis is called essential regression analysis when there is only a solitary free element

and is named multiple regressions when there is more than one self-ruling variable. Multiple regressions is more personality boggling than correlation and is used to find the limit of self-governing variables in envisioning the dependent variable (Pallant, 2007). As per Zikmund et al. (2010) regression analysis and correlations are numerically the same in many respects; however the correlation is a relationship strategy and regression is a dependence marker. The affiliation technique does not separate among penniless and free variables; however the dependence procedure perceives poor and self-governing variables. The R square ranges from 0-1 and this demonstrates the measure of the destitute variable is cleared up by the self-governing variables (Burns and Bush, 2010). The higher the R square the more grounded the connection between the destitute variable and the free element (Burns and Bush, 2010). When performing regression analysis regularity is not for the most part required while separating variables. However the results are to some degree improved if the data is frequently appropriated (Tabachnick and Fidell, 2007).

For this research, multiple regression analysis is utilized because there is more than one independent variable. In this study multiple regression analysis was used three different times. The first time, overall service quality was the dependent variable and the service quality dimensions were the independent variables. The second time, satisfaction was the dependent variable and the service quality dimensions were the independent variables. The third time, loyalty was the dependent variable and service quality dimensions were the independent variables.

(f) Interpretive Structural Modelling

Interpretive Structure Modelling (ISM) is characterized as a process which is aimed at helping the human being for better understanding what he/she accepts and to perceive obviously what he/she doesn't have a clue. The ISM process changes indistinct, inadequately explained mental models of frameworks into an unmistakable and very much characterized display. The various researchers mentioned that, ISM is observed to be a well-demonstrated

and generally acknowledged framework displaying approach for breaking down the interrelationships between the factors affecting the framework It helps in critical thinking of the between relationship and brings into thought an arrangement of straightforwardly and in a roundabout way related components, which portrays the complex hierarchical issues. All in all, there exists an immediate connection between different customer receptivity angles. This makes ISM a more regular way to deal with this sort of issues. So as to have solid customer relationship, receptivity angles must be utilized. Business research is supported with an overabundance of ISM application in different fields (Agarwal, et al, 2006; Thakkar et al, 2008). In such manner, the factors affecting the outside customer receptivity have been subjected to ISM. In the present study, twelve focuses which characterize the framework under this is examined in SRRMs and have been distinguished by alluding the past writing and afterward fusing the sentiment from specialists of the association and the scholarly world (George and Pramod (2013), Bolonas, et al, 2005).

Interpretive Structural Modeling was proposed by J. Warfield in 1973 to investigate the difficult frameworks of finance. The fundamental thought of ISM is to utilize understanding and learning to disintegrate a complex and tangled framework into a few components and build a multilevel model. ISM is regularly used to give essential comprehension of complex circumstances.

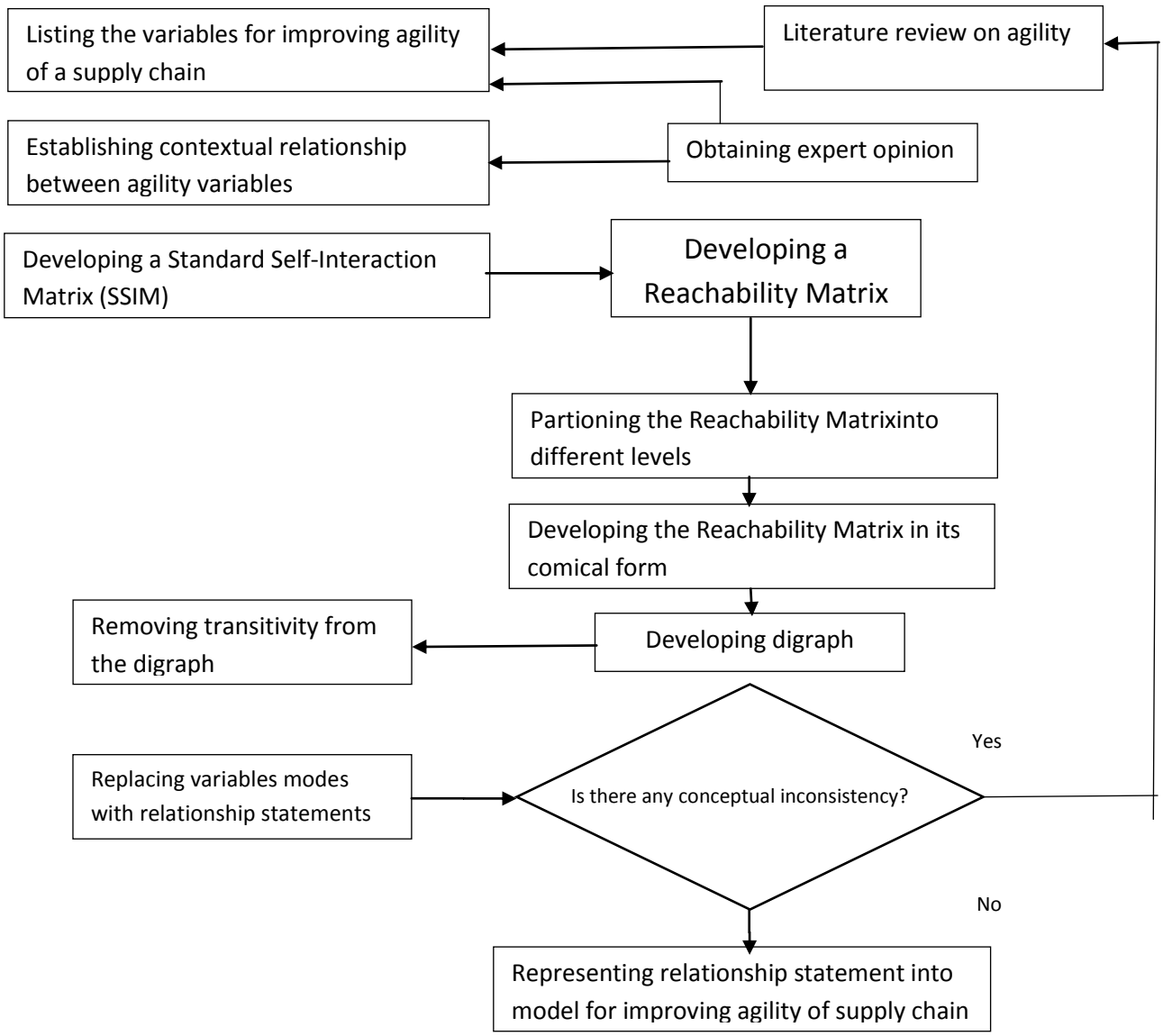


Fig 3.4: Schematic Diagram for Applying ISM Source: (Agarwal et al., 2007)

3.13 CONCLUSION

The importance of quality and employability has been growing among the technical educational institutions in India due to several reports indicating poor employability and many seats remaining vacant in the institutions. The quality related issues of technical institutions have been captured through a questionnaire based survey methodology. The data analysis has been done with the help of statistical tools such as t-test, correlation, regression analysis and factor analysis. For modelling of competitiveness factors, interpretive structural modelling approach has been considered. The next chapter will focus on analysis of various issues related with quality education based on students' responses.

CHAPTER 4

STUDENT EXPECTATIONS AND PERCEPTION

4.1 INTRODUCTION

The technical education in India grew at a very fast pace sometimes called mushrooming growth since 1990. The Government allowed the participation of private sector also in this growth to cope up with the vast requirements. Around 85% technical educations are being delivered by the private sector (World Bank, 2010). This to some extent resulted in overlook on the quality of education and in turn poor employability of the graduates. NASSCOM, a Body to monitor quality of technical education especially in IT field indicated that among degree holder engineers, only 25% are meeting directly employable conditions.

The Government has to put effort, on one side, to maintain and enhance the GER and to enroll maximum number of youth for college education and on the other side to monitor the quality of technical education through Apex Bodies like AICTE and UGC. In this background an empirical study was carried out to understand the students' perception regarding quality of technical education and how the various activities of an institution affect their employability.

4.2 OBJECTIVES

The discussions with academicians and students and the literature review presented in chapter 2 reveal two things:

a) A lot of research has been carried out in different countries to identify the quality aspects in technical education. Although, several papers are based on students' perception and expectations, most of these studies look more at input factors.
b) The literature is missing on identifying the factors and variables that will help the students in competency building along with acquiring knowledge. Competency building is a concept in which system is developed in line with the requirements of the customers and other external conditions.

Thus the objectives of the current research are as follows:

a) To understand the input parameters of an engineering institution, which generally students look at from outside at the time of admission like faculty, infrastructure, reputation, placements, etc. Students were asked to rate these parameters of their institution regarding degree of presence.

b) For employability, it is important to look at the processes that are practiced in providing knowledge and preparing the students for the job market and bright career. For this 43 statements (variables) were listed and students were asked to provide their perception of these statements.

The research objectives will aim to answer following questions:

i. What are the Institute attributes that students feel are highly desirable for knowledge and competency building?
ii. What types of relationships exist among the different attributes?
iii. What are the most prominent factors as identified by the data reduction technique?
iv. What type of dependency exists between the parameters of the institution and the variable to impart knowledge and prepare students for employability?

To answer the above questions, a questionnaire-based survey was done for students of engineering institutions in India. Institute are selected both of self financing and government funded; located in urban and rural areas. Extensive literature review and discussions were held with faculty, students and executives from the industry to prepare the preliminary questionnaire for pilot survey. The final questionnaire was framed by the information obtained from the pilot survey.

In this study, students were asked to rate the intensity of each parameter for their respective institute on a five-point Likert scale (1 – lowest, 5 – highest). A total of 783 students from 11 institutions participated in the survey. Out of 11 institutions, seven are self financing and rest are government funded. Further, six institutions are located in urban areas and others are in semi urban or rural areas.

4.3 INSTITUTE PARAMETERS

As per the objectives of this study the institute parameters are studied using descriptive statistics and scatter diagram and the process variables are subjected to factor analysis to identify the key factors.

The students were asked to rank the 10 parameters for their institutes. A rank of 1 indicates that the presence of the parameter is highest and a rank of 10 indicates that the presence of the parameter is not upto the mark. The mean score of 11

institutions for the 10 parameters is given in Table 2. Parameter 'Faculty' has scored the highest mean score of 2.86, followed by placements (3.62) and focus on skill development (3.78). The hostel facility scores the minimum at 6.45, the other on the minimum side are the location (5.93) and the research culture (5.30).

The premier institution 'k' has the highest mean score of 1.6 for faculty, followed by placements (2.26) and focus on skill development (2.68). It also has good mean score for research culture (3.60), whereas another institution 'J' located in same geography as 'K' has faculty rank average of 4.70; placements 4.98 and research culture 5.04. It is interesting to observe the ranking of attributes of another institution 'A' in same geography but in self financing category. This institute has faculty rank of 3.58, placements 3.50 and research culture 5.35. The focus on skill development ranks for these institutions are 2.68 for K; 4.54 for J and 3.64 for A. It is clear that the skill development focus is closely associated with faculty ranking.

The mean score for focus on skill development are not bad for the Institutions of the private sector as mentioned for Institutions A to G. It has emerged that student perception of good quality faculty, placements and focus on skill development is high in all categories of Institutions. This can be seen from admission trend in premier Institutions to Institutions in private sector. This study is supported by Sahney (2012) where technical institutions that contain quality academic activities have higher rank whereas institutions having excessive non academic activities are on low rank side. A study on student's choice for a University, in Italy by Petruzzellis et al (2006) indicate that for most of the Universities, the quality of lectures are still important and come out as core service of delivery by University.

The research culture and industry association are not being given due importance in most of the institutions. Both these practices require the proactive support of top management. The development of research culture needs good faculty followed by good research laboratories and freedom to pursue academic excellence. The industry association is important not only from placement perspective but also it helps all the academic activities starting with industry relevant curriculum, internships, industry projects and sharing of experiences and technical expertise by the industry executives.

The two way plot between Faculty and Placements is given in Figure 4.1. The plot indicates that the institutes having better rank for faculty also have a better rank for placements. It is also interesting to note that, as given in figure 4.2, the institutes having the high focus on the faculty have a low focus on infrastructure and vice a verse. On the other hand figure 4.3 shows that infrastructure has not much impact on placements. It is also indicated in figure 4.4 that a good faculty leads to a higher rank in skill development of the students.

Table 4.1: Mean rank of Institutes attributes by the students of 11 institutes

Institute	Faculty	Placement	Infrastructure	Focus on Skill development	Industry association	Ranking and brand value	Curriculum	Hostel facility	Location	Research culture
A	3.58	3.50	4.50	3.64	5.10	4.90	4.49	6.88	5.13	5.35
B	2.03	3.85	5.93	3.25	5.55	6.13	6.15	6.68	7.60	6.43
C	3.50	3.59	4.30	3.74	4.46	4.62	4.72	6.34	5.88	4.97
D	3.26	5.11	4.33	4.19	4.55	5.00	4.88	5.92	5.77	5.29
E	2.41	2.83	4.81	3.42	4.50	4.63	4.95	5.86	5.34	5.14
F	3.41	4.28	5.55	4.06	4.76	4.94	5.49	7.35	5.99	5.48
G	2.93	2.37	4.56	3.62	4.66	4.79	5.26	7.09	5.48	5.61
H	2.51	3.51	4.78	3.58	4.77	4.99	4.77	6.20	6.12	4.42
I	1.48	3.36	5.22	4.20	6.26	6.02	5.20	6.15	7.31	6.51
J	4.70	4.98	3.72	4.54	5.20	4.78	4.68	7.22	5.52	5.04
K	1.60	2.26	5.17	2.68	4.77	4.26	3.96	5.38	5.13	3.60
Total	**2.86**	**3.62**	**4.77**	**3.78**	**4.95**	**5.01**	**4.96**	**6.45**	**5.93**	**5.30**

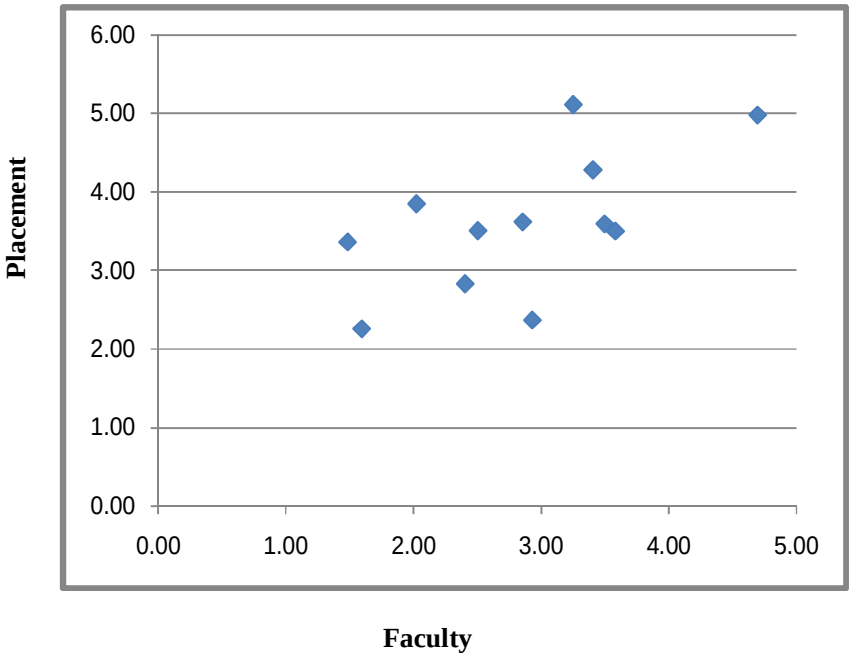


Figure 4.1: Faculty and Placement

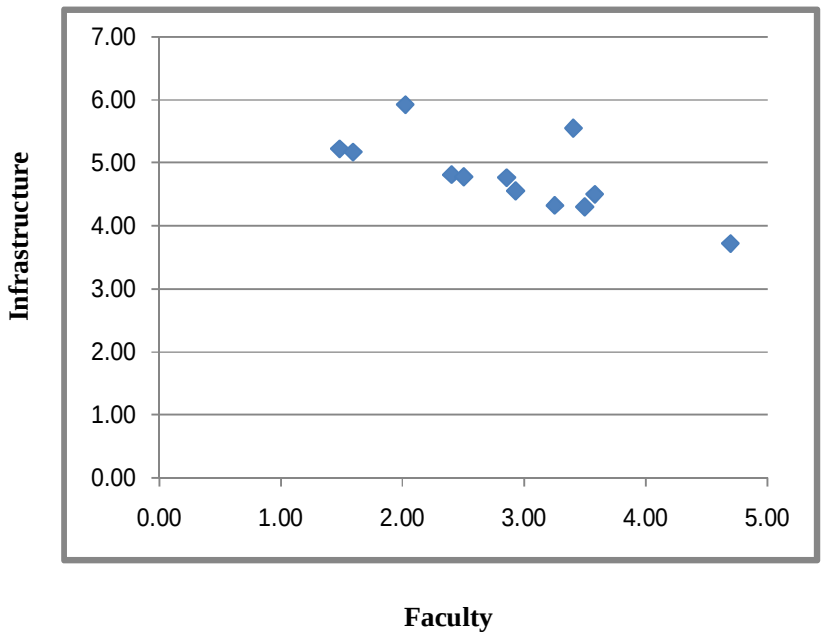


Figure 4.2: Faculty and Infrastructure

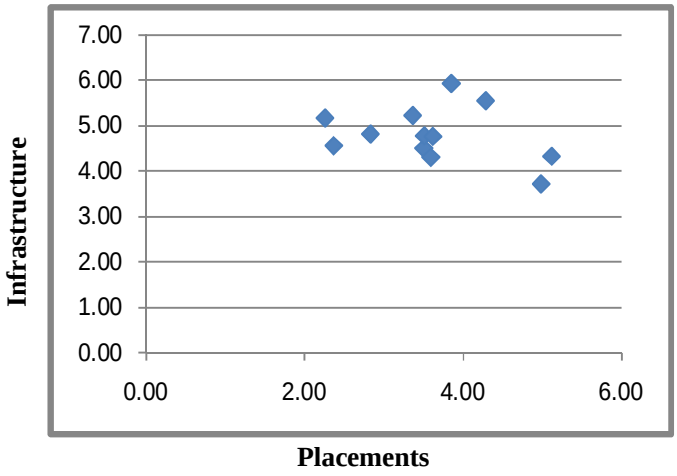


Figure 4.3: Placements and Infrastructure

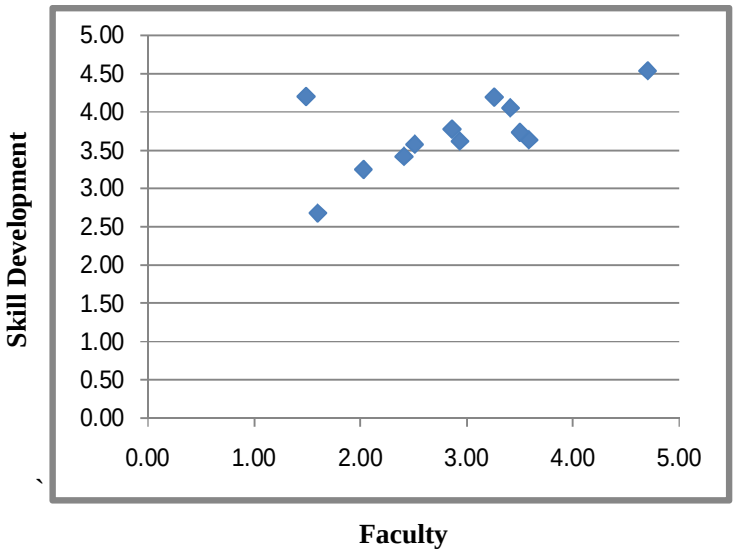


Figure 4.4: Faculty and Skill Development

4.4 SIGNIFICANT ANALYSIS

Table 4.2: Significant Analysis

S. N.	Statements	HD	D	N	A	HA	Mean	SD
1.	The institute has clean, spacious and well-equipped classrooms	21	47	219	308	185	3.75	.988
2.	The institute's library offers adequate books and other resources	52	109	196	254	166	3.46	1.195
3.	The institute has sufficient and latest computers in the labs	39	80	204	286	168	3.57	1.127
4.	The institute has well	48	129	237	241	124	3.32	1.138

	organized fully functional laboratories							
5.	The institute provides clean and safe academic area	14	64	156	329	217	3.85	1.001
6.	Administrative process like registration, examination, etc. are hassle free	70	114	219	260	109	3.24	1.209
7.	The institute provides opportunities to participate and organize sports activities	61	91	200	279	143	3.42	1.203
8.	The institute provides opportunities to participate and organize variety of social cultural activities	47	93	221	279	135	3.43	1.145
9.	The institute provides opportunities to participate and organize variety of co-curricular activities (invited lectures, seminars, conferences, talks, workshops industrial tours etc)	31	74	196	284	191	3.65	1.111
10	The institute provides information and guidance related to Training and Placement	44	77	224	288	141	3.48	1.133
11	The course curricula are balanced, industry relevant and well organized	61	153	267	205	79	3.04	1.174
12	The canteen provides variety of food at convenient hours at affordable price	137	143	209	202	77	2.86	1.300
13	Recreational facilities are available and approachable	86	143	269	202	53	2.88	1.217
14	Healthcare facilities are available and approachable	121	138	205	210	84	2.90	1.331
15	The interaction with faculty is good and motivating	33	60	191	311	182	3.68	1.088

16	The interaction with staff is good and supportive	36	76	211	317	137	3.55	1.071
17	The faculty and staff are competent and keep themselves updated	43	89	263	260	115	3.36	1.126
18	Contemporary teaching methods (case study, simulation, tutorials etc) are used	70	127	237	234	98	3.15	1.219
19	The institute is conveniently located	39	80	174	272	208	3.64	1.185
20	The institute provides ambience conducive to innovations and research	105	160	242	187	69	2.88	1.229
21	The institute is rigorous towards developing Core/basic knowledge in students	57	149	241	224	105	3.19	1.162
22	Your institute is rigorous towards developing Specialized/advanced knowledge in students	70	171	255	198	72	2.98	1.176
23	The institute is rigorous towards developing Decision making ability in students	66	166	240	202	94	3.06	1.207
24	Your institute is rigorous towards developing Communication skill in students	62	112	253	245	101	3.23	1.163
25	Your institute is rigorous towards developing Interpersonal /relationship building skills in students	58	125	277	229	72	3.09	1.163
26	Your institute is rigorous towards providing computer knowledge useful for IT sector	42	116	218	274	106	3.26	1.224
27	Your institute focus on entrepreneurship development	99	166	231	182	71	2.84	1.316
28	Your institute has vision to develop Ethics and morality in students	83	136	230	228	88	3.07	1.238

29	The lab experiments will be useful in your job	104	124	221	191	112	3.00	1.355
30	Your final year project will be useful to your job/ professional career.	35	58	175	282	193	3.54	1.326
31	Your industrial training will be relevant important to your job/ professional career.	29	53	158	298	215	3.68	1.248
32	The assignments given in the class are industry relevant	176	165	189	164	64	2.62	1.338
33	Assignments given in the class develop your analytical capability	147	133	203	202	80	2.85	1.332
34	All the topics and question of the examination is covered in the class by the faculty	58	107	197	280	133	3.38	1.191
35	Results declared by your university is fair and reflect sincere evaluation	104	117	189	238	113	3.09	1.345
36	Your institution gives ample time for the preparation of the exam.	78	131	207	265	93	3.24	1.887
37	Date sheet of the exam gives ample time for revision during the papers.	74	135	222	238	102	3.16	1.216
38	Internal viva helps in preparing for final practical and theory exams.	45	76	196	326	128	3.49	1.135
39	Your laboratory has innovative and creative atmosphere/ environment to conduct the activities.	82	139	260	205	83	3.04	1.197
40	After completing B. Tech, you will prefer working in India	55	59	132	216	290	3.69	1.412
41	After completing B. Tech, you will prefer working abroad	114	111	178	164	164	3.01	1.532

1- Highly disagree (HD) , 2- Disagree (D) , 3- Neutral (N), 4- Agree (A) , 5- Highly agree (HA),

4.5 FACTOR ANALYSIS

With the help of literature review and discussion with faculty and students, a total of 41 variables were listed and the students were asked to rate these variables on the Likert scale (1 for the least present and 5 for the highly present). The responses are subjected to Factor Analysis using Varimax Rotation and seven factors are extracted. These seven factors, the variables under each factor, their Eigen Vector and Cronbach's alpha are presented in Table 4.4. The Cronbach's alpha of all the seven factors are above 0.7 with factor 1 having a value of 0.921 and 13 variables. High value of Cronbach's alpha indicates the high internal consistency of the multiple items measuring the construct.

Table 4.3: Reliability of Students perceived Factors for Technical Quality Education

Factors	No of Measures	Mean	Standard Deviation	Cronbach's Alpha	Eigen Value
Factor 1: Knowledge and competency building environment	13	3.12	0.8380	0.921	4.260
Factor 2: Human Resource of the Institute	3	3.53	0.9567	0.845	1.033
Factor 3: Infrastructure of the institute	5	3.59	0.7950	0.778	.802
Factor 4: Personality Building activities	3	3.36	0.9124	0.800	.633
Factor 5: Project and practical Training	2	3.27	1.1460	0.787	.552
Factor 6: Examination processes	3	3.24	1.0931	0.703	.514
Factor 7: Canteen and Recreational facilities	2	2.87	1.0767	0.732	.499

The variables under each factor and factor loading are given in Table 4.5. Factor one characterized the knowledge and competency building environment. It comprises 13 measures, the most important being the Institute rigour in developing specialized/ advance knowledge, decision making ability, interpersonal /relationship building skills in

the students. Also included in this factor are measures like teaching methods, ambience conducive to innovations and research, industry relevant assignments and developing core/basic knowledge in students. Sohailand Shaikh (2004) also observed that management of institutions must work closely with faculty, which make a substantial contribution to student perception of good quality of service. John and Semith (2012) indicated that in their study with a variance of 15.77% and Cronbach alpha value 0.8829, faculty with updated knowledge in their area and academic infrastructure available to students round the clock is important for student satisfaction. The faculty communication indicated to be a prominent dimension of educational service quality.

Factor two is related to the competency and cooperation of faculty and staff, whereas factor three is of the infrastructure of the institute. The measures coming under this factor are the sufficient and latest computers in the labs, well organized fully functional laboratories, clean, spacious and well-equipped classrooms and academic area, institute's library offers adequate books and other resources. Factor four is Personality Building activities and comprising measure like opportunities to participate and organize a variety of social cultural activities, opportunities to participate and organize sports activities, opportunities to participate and organize a variety of co-curricular activities (invited lectures, seminars, conferences, talks, workshops industrial tours, etc).

Final year project and industrial training are part of factor five, emphasizing the importance of industry relevance activities to build competency. Factor six is Examination processes where the measure like result declared is fair and reflect sincere evaluation and time for the preparation of the exam. Canteen and Recreational facilities are also found to be important for the students and form the factor seven. The study of Angell et al (2008) supported academic & industry linkage as the most influencing factor for engineering students. Both the factors provide support to quality of faculty and placement with industry and act as a prominent link for any good quality Institution.

Table 4.4: Variables included in each factor and factor loadings

Factor	Variables	Loading
Factor 1: Knowledge and competency building environment	Use of contemporary teaching methods (case study, simulation, tutorials, etc)	0.551
	Ambiance conducive to innovations and research	0.620

	Rigor towards developing core/basic knowledge in students	0.635
	Rigor towards developing specialized/advanced knowledge in students	0.745
	Rigor towards developing decision making ability in students	0.698
	Rigor towards developing communication skill in students	0.635
	Rigor towards developing interpersonal /relationship building skills in students	0.693
	Rigor towards providing computer knowledge useful for IT sector	0.581
	Focus on entrepreneurship development	0.622
	Vision to develop Ethics and morality in students	0.508
	Industry relevant assignments in the class	0.683
	Assignments develop analytical capability	0.651
	Innovative and creative atmosphere/environment in the laboratory to conduct the activities.	0.556
Factor 2: Human Resource of the Institute	Good and motivating interaction with faculty	0.671
	Good and supportive interaction with staff	0.703
	competent and updated faculty and staff	0.609
Factor 3: Infrastructure of the Institute	Clean, spacious and well-equipped classrooms	0.696
	Library offers adequate books and other resources	0.567
	Sufficient and latest computers in the labs	0.706
	Well organized fully functional laboratories	0.602
	Clean and safe academic area	0.608

Factor 4: Personality Building activities	Opportunities to participate and organize sports activities	0.763
	Opportunities to participate and organize variety of social cultural activities	0.800
	Opportunities to participate and organize variety of co-curricular activities (invited lectures, seminars, conferences, talks, workshops industrial tours, etc)	0.659
Factor 5: Project and Practical Training	Final year project useful to your job/ professional career.	0.750
	Industrial training relevant and important to your job/ professional career.	0.790
Factor 6: Examination processes	Results declared is fair and reflect sincere evaluation	0.567
	Ample time given for the preparation of the exam.	0.735
	Ample time given for revision during the papers.	0.696
Factor 7: Canteen and Recreational facilities	Canteen provides variety of food at convenient hours at affordable price	0.661
	Recreational facilities available and approachable	0.548

A study by O'Driscoll (2012) on hospitality management students indicated that student satisfaction explicated by the importance of learning and infrastructural facilities followed by a presentation of relevant course by quality teaching. Wilkins and Balkrishnan (2013) made a study on student satisfaction and determined the most influencing factor as quality lecturers, quality and availability of resources and effective use of technology. Tang and Hussin (2011) investigated the perception of students and found teaching and learning, personal development, supporting learning environment as reliable indicators. These supports the present study as these are the attributes covered in the influencing factor one. Sukwadi et al (2011) identified the service quality attributes and found reliability and responsiveness and assurance as influencing factors. These factors include the attributes related to academic performance and human resource of an institution. Sultan and Wong (2010) analyzed the result in their study and found

the influencing service quality attributes like my teachers are well prepared and academics & administrative environment of the university are friendly. These attributes are also part of knowledge & competency building environment factor.

4.6 EXPECTATIONS OF STUDENTSON JOB RELATED ISSUES

(i) Motivation of Taking Admission in Engineering

The students were asked to identify the three most important motivators out of the nine identified through literature review and discussions with educators and students. The results as presented in Table 4.6 are very encouraging and to some extent counter intuitive. Gain technical knowledge has been identified as the most important motivator whereas general perception is getting immediate job offer with good salary.

(ii) Percentage of students joining the job related to their branch

As shown in Table 4.7, students were asked to give their assessment regarding the percentage of students getting job in their area of study. The results shows that 25% students feel that only 25% students get job in their area of study. Another 26% feel that 50% students get job in their area of study. It is quite satisfying that more than 30% students feel that 75% students get job in their area of studies.

(iii) Traits Developed by Education and Training

With the emergence of knowledge based and technology driven economies, we find a surge in the demand for highly skilled and technologically competent workforce. The powerhouses of the new global economy are innovation and ideas, creativity, skills and knowledge. These are now the tools for success and prosperity as much as natural resources and physical labour power were in the past century (Blunkett, 2000, para. 10). In this study, students observed that they have got technical skills (66%), personality development (47%) and communication skills (41%). More results are given in Table 4.8.

To a question to explore the role of various curricular and co curricular activities in preparing them for career, students feel internship training

(24.63%), class room training (22.05%), project and Assignments (21%) play the major role. The results are presented in Table 4.9.

4.6.1 Expectations of the students

To measure the expectations of the students, they were asked (a) most important criteria to consider oneself as successful, (b) Occupational characteristics desired by them, (c) what they want to do after graduation, (d) nature of job they may look for and (e) expectations from the job. The analysis of the responses on these issues is presented in Tables 4.10 to 4.14.

As analysed in Table 4.10, highest number of the students (47%) consider respectable job as the most important criteria to them to be successful followed by service to the society (23%). Regarding occupational characteristics as given in Table 4.11, the students consider growth opportunity, learning opportunity, innovation opportunity and money orientation in descending order of preference. Regarding the composition of job, technical skills, leadership role are the two most sought after roles by the students as given in Table 4.12. Starting the career with a job (49.5%) is the most preferred way followed by higher studies (38.9%). This information given in Table 4.13 can be useful for policy planner in starting post graduate programs in Universities.

Students were further asked to rank the criteria of job selection and the results are presented in Table 4.14. The results show that salary is the most preferred criteria in selection of jobs, followed by opportunity for career development and then the profile of the job.

Table 4.5: Motivation for taking admission in Engineering

SN	Motivation for taking Admission in Engineering	Percentage Respondents
1	Good salary	49.6
2	Immediate job offer after B.Tech.	30.9
3	To gain technical knowledge	64.7
4	Opportunity available in hometown	13.2
5	Trend of the society	14.5
6	Large job opportunity	33.0

7	Contribution to society	22.0
8	To go into R&D	24.3
9	To start own enterprise	21.4

Table 4.6: Percentage of students joining the job related to their branch

SN	Percentage Slabs	Percentage of Respondents
1	Below 25%	24.5
2	Between 25- 50%	26.2
3	Between 50-75%	30.1
4	More than 75%	16.7
	Missing	2.4

Table 4.7: Development Areas through Education & Training imparted during degree programme

SN	Development Area	%age Respondents
1	Technical skills	66
2	Personality	47
3	Communication skills	41
4	Analytical skills	28
5	Decision making skills	35
6	Co-ordination and liaison skills	19
7	Leadership skills	30
8	Group and team skills	35

Table 4.8: Role of various components of Education in preparing students for professional career (100 points distributed among components)

SN	Development Area	%age Respondents
1	Classroom teaching	22.95
2	Project & assignments	20.98
3	Training/Internship	24.63
4	Infrastructure & Laboratory	16.08
5	Extracurricular& co–curricular	15.71

Table 4.9: Most important criteria to consider yourself as successful

SN	Criteria of Success	%age Respondents
1	Money	14.0
2	Respectable position	45.3
3	Service to the society	23.4
4	A good working environment	15.6
5	Missing	1.7

Table 4.10: Importance of Occupational Characteristics

SN		Most Important	Second Most Imp	Third Most Important	Forth Most Imp
1	Growth opportunity	32	28.8	28.4	10.1
2	Innovative opportunity	19.8	30.1	29.4	19.8
3	Money orientation	17.7	22.0	24.1	35.6
4	Learning opportunity	30.7	18.2	16.9	33.3

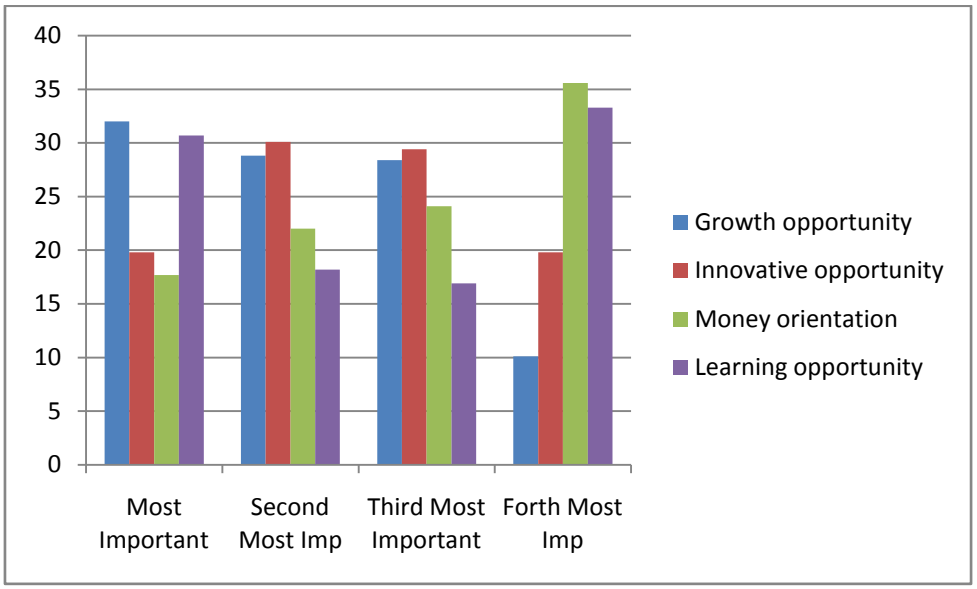


Figure 4.5: Importance of Occupational Characteristics

Table 4.11: Importance of the Characteristics of the job

SN	Attributes	Most Important	Second Most Imp	Third Most Important	Forth Most Imp
1	Technical skills	57	23	12.5	6.9
2	Leadership roles	25.2	42.8	24.6	6.9
3	Administrative tasks	10.5	24.1	42.2	22.3
4	Touring Profile	7.2	9.1	19.9	62.8

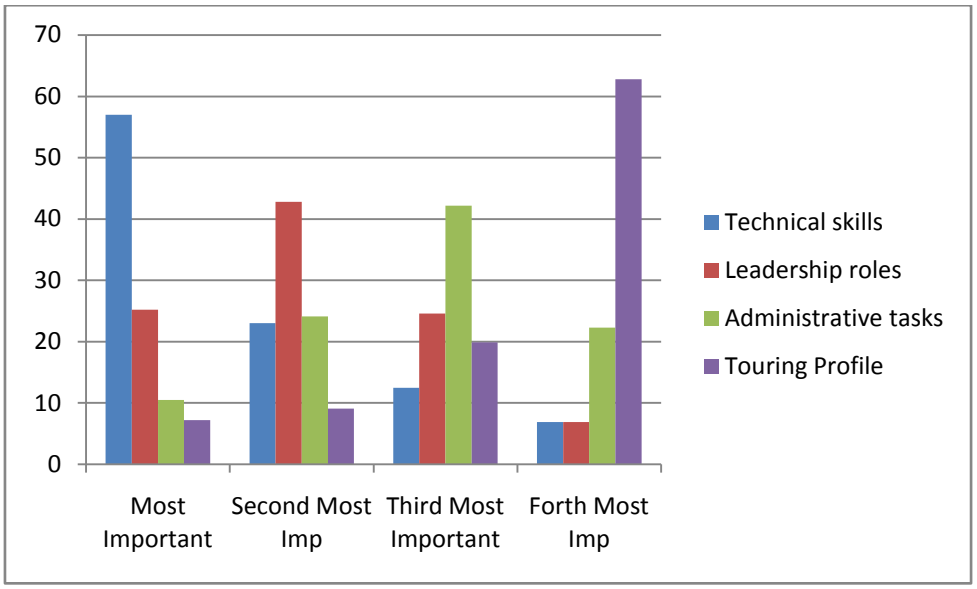


Figure 4.6: Importance of the Characteristics of the job

Table 4.12: Career Options after graduation

SN	Career Option	%age respondents
1	Job	49.5
2	Higher studies	38.9
3	Own venture	7.4
4	Social work	4.1

Table 4.13: Criteria of Job Selection
(Ranked 1-7, 1 most preferred and 7 least preferred)

SN	Criteria of Job Selection	Average Rank
1	Salary	2.88
2	Development	3.25
3	Job profile	3.31
4	Location	4.72
5	Reputation of the Organization	4.16
6	Overseas exposure	5.08
7	Learning opportunity	4.34

4.7 CONCLUSION

In the technical education, across the globe, the pressure on the institutions is to attract good students which depend upon the quality of the education leading to employability of graduates. The expectations of the students are different in different economies and also need different strategy and action plan to meet them. This study conducted to map the students expectations has given some unique insights and few are appears to be counter intuitive. The study has participants from institutions located in rural as well as urban areas and institutions are further of both types, itself financing as well as sate funded. The study indicates that gaining technical skills is the most frequently reported reason for joining the technical education by the students and about 50% students are willing to join the job after completing their graduate studies. In the job also they prefer the application of technical skill along with leadership skills to succeed in the career. The study will be useful for the policy planners and educators to develop the right curriculum, right pedagogy and right teaching learning environment. This will lead to the fulfillment of the expectations of the students as well as industry will be able to get the right type of human resource productive immediately after joining.

CHAPTER 5

ANALYSIS OF FACULTY PERCEPTION OF TECHNICAL EDUCATION

5.1 INTRODUCTION

Technical education is the backbone of the economy of any country. The industrial revolutions of the past and the IT boom of 1990s are having technology and technocrats as its drivers. In India, the focus of the present government is "Make in India". The targets are to make manufacturing contribution in GDP as 25% from the present level of about 18%. It is also understood now that to make "Make in India" a success, it is necessary to boost "invent in India" and "skilling India".

The major stakeholders in the technical education system are students, employers, faculty and other staff, administration and the promoters of the institutions along with the government. In this chapter, the perception of the faculty has been captured to understand the quality aspects of the technical education system in India. The issues raised with them through a questionnaire survey are dimensions of quality, role of skill development and employability of graduates and the importance of knowledge creation. A model as given in Figure 1.1 and reproduced as Figure 5.1 has been developed to link the various aspects and stakeholders of quality education. From the input perspectives quality in the system needs the presence of good faculty, good infrastructure and good processes. The presence of these will lead to the creation of right type of education leading to proper development of technical and allied skills. The presence of proper system will create an environment where the faculty and students can indulge in innovation, creativity, research, development and technology development. These aspects have been named as knowledge creation. Industry has certain specific expectations from the graduates which they look for at the time of their first placement. The presence of these expectations in the graduates can make them employable. These days, employability of graduates have become a very sensitive issue in the technical education in India due to (a) global recession in the economy and (b) lack of focus of the institutions on quality of education and capability development of graduates.

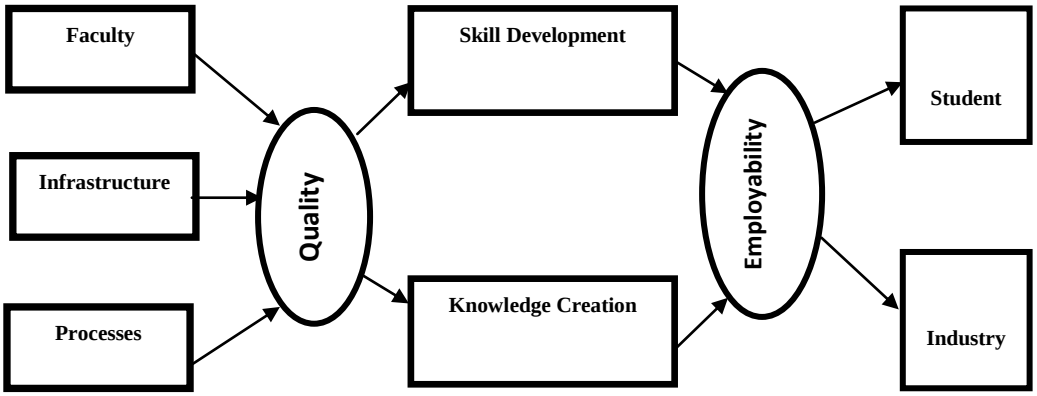


Figure 5.1: Q-SK-E model of the Technical Education

5.2 OBJECTIVES OF STUDY OF FACULTY MEMBERS PERCEPTION

The discussions with academicians and the literature review presented in chapter 2 reveal the following objectives:

(1) To explore the factors affecting quality of education and employability skills in technical education sector.

(2) To examine, analyze and understand the factors affecting perception of faculty members on quality of education and employability skills in technical education sector.

(3) To suggest strategies/model to improve quality of education and employability skills in technical education sector.

5.3 HYPOTHESISOF PERCEPTION OF FACULTY MEMBERS

The following Hypotheses were formulated on the basis of research gap and in-depth interview as follows:-

Here HO represents Null Hypothesis.

Hypothesis 1:-

H01: There is no significant relationship between Faculty perception about available Infrastructure in Technical Institution with that of the improvement in quality of education and employability skills in technical education sector.

Hypothesis 2:-

H02: There is no significant relationship between Faculty perception about curriculum and teaching effectiveness of Technical Institution with that of the improvement in quality of education and employability skills in technical education sector.

Hypothesis 3:-

H03: There is no significant relationship between Faculty perception about quality and motivation of faculty members of Technical Institution with that of the improvement in quality of education and employability skills in technical education sector.

Hypothesis 4:-

H04: There is no significant relationship between Faculty perception about knowledge creation with that of the improvement in quality of education and employability skills in technical education sector.

Hypothesis 5:-

H05: There is no significant relationship between Faculty perception about skill development in Technical Institutions with that of the improvement in quality of education and employability skills in technical education sector.

5.4 RESEARCH DESIGN

The study is exploratory and descriptive in nature. A systemized and organized study was done to reach the desired objectives of the study. The responses obtained from the respondents i.e. faculty members teaching in various technical institutions. This study is restricted to faculty members teaching in technical education sector in India. The importance of this study is that it focuses on identifying factors affecting perception of faculty members on quality of education and employability skills in technical education sector. Here in this study various independent variables are Infrastructure, Curriculum and Teaching Effectiveness, Quality and Motivation of faculty members, Knowledge Creation and Skill Development whereas quality of education and employability skills in technical education sector is dependent variable.

5.4.1 Sources of Data

To cater the need of the research, the researchers have used primary data through self-constructed structured Questionnaire and as far as the secondary data is concerned that was obtained from various reports web sites, and journals etc. to explore the current status of quality and employability in Technical Institutions in India. The data was collected from individual faculty members teaching in various technical education institutions in India using various statistical techniques.

5.4.2 Sampling Technique

As mentioned in Chapter 3, eleven institutions of engineering education were identified to collect the responses of the faculty members. These colleges are from self financing as well as state funded. Further these institutions are so selected that some are from urban areas and others are from non urban areas. A total of 401 responses are received and out of that 126 are from state funded institutions and remaining 275 are from self financing institutions. Further 221 respondents are from the institutions located in urban area and the remaining 180 are from institutions located in non urban areas. A questionnaire based

study was carried out by taking responses of faculty members of different degree level engineering institutions

5.4.3 Statistical Tools Used

IBM SPSS 20 (Statistical Package for the Social Sciences), for data analysis which include descriptive statistics, t – test, Anova and multiple regression analysis, and for the reliability the Cronbach's Alpha was calculated and sample adequacy was tested on KMO and Bartlett's Test. Five points likert's scale is used for measuring responses from strongly disagree to strongly agree.

5.4.4 About the Questionnaire

A self-constructed well-structured questionnaire based on literature review, critical assessment of review of literature and in-depth interviews with faculty members, educationists, students and officials of AICTE, is used for the collection of data. It is designed in such a manner to explore the general perception of various faculty members teaching in technical institutions in India. Responders' ideas and perception related to the technical education industry and influencing factors on quality of education and development of employability skills were asked with the open-ended question in the questionnaire. Electronic mail (e-mail) survey was used to collect information. The questionnaire was developed on five point likert's scale from strongly disagree to strongly agree.

5.5 DATA ANALYSIS AND INTERPRETATION OF PERCEPTION OF FACULTYMEMBERS

5.5.1 Reliability Analysis

In order to prove the internal reliability of the model used, the researchers have performed Cronbach's Alpha test of Reliability. Applying this test specifies whether the items pertaining to each dimension are internally consistent and whether they can be used to measure the same construct or

dimension of quality of education and employability skills. According to Nunnaly (1978) Cronbach's alpha should be 0.700 or above. But, some of studies 0.600 also considered acceptable (Gerrard, et al, 2006; Kenova and Jonasson, 2006).

Table 5.1:Reliability Statistics

Cronbach's Alpha	No of Items
.966	61

In order to check the reliability of the questionnaire, the Cronbach's Alpha was calculated. The value of Cronbach's alpha is found to be more than 0.966 in all the dimensions. As the value of Cronbach's Alpha is more than 0.7, thus the instrument considered to be reliable for the study. The high Cronbach's Alpha coefficient in this study represents a high consistency and reliability among statements in questionnaire. However, Cronbach's alpha value of all items were acceptable, it means that, present data suitable to factor analysis also.

5.5.2 Validity Analysis

The Kaiser-Meyer-Olkin measure of sampling adequacy tests whether the partial correlations among variables are small. High values (close to 1.0) generally indicate that a factor analysis may be useful with data. Bartlett's test of sphericity tests the hypothesis that correlation matrix is an identity matrix, which would indicate that variables are unrelated. Small values (less than 0.05) of the significance level indicate that a factor analysis may be useful with data.

Table 5.2: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.937
Bartlett's Test of Sphericity	Approx. Chi-Square	14639.787
	df	1830
	Sig.	.000

Kaiser-Meyer-Olkin test was done to measure the homogeneity of variables and Bartlett's test of sphericity was done to test for the correlation among the variables used. From table 5.2, it is found that the value for Kaiser-Meyer-Olkin Measure of Sampling Adequacy was more than 0.6 in all the parts of questionnaire, as it is 0.937. Also Bartlett's Test of Sphericity has significant value less than 0.05 at 5 % level of significance in all the parts of questionnaire. Thus it is concluded that instrument is accepted for the study.

5.6 HYPOTHESIS TESTING

Hypothesis 1:-

H01: There is no significant relationship between Faculty perception about available Infrastructure in Technical Institution with that of the improvement in quality of education and employability skills in technical education sector.

Table 5.3: Faculty perception about Infrastructure

S. N	Statements	Mean	SD	p-value	t-value
1	Good class rooms for effective teaching	4.00	.947	.000	21.08
2	LCD projector facility for teaching whenever required	0.65	.971	.000	-48.42
3	Clean, spacious and well-equipped classrooms	4.03	.987	.000	21.00
4	Up-to-date computer labs	4.00	.999	.000	20.10
5	Well organized fully functional laboratories	3.93	1.004	.000	18.60
6	The institute is conveniently located	4.13	1.018	.000	22.17
7	Institute's library offers wide range of resources for students	4.02	.919	.000	22.34
8	The institute provides easy access to information sources, e.g. books, journals, software, information networks to students	3.86	1.009	.000	17.03

9	The canteen provides variety of food at convenient hours at affordable price	3.35	1.187	.000	5.93
10	Recreational facilities are available and approachable	3.43	1.123	.000	7.63
11	Healthcare facilities are available and approachable	3.56	1.059	.000	10.51

Table 5.4: Relationship between Infrastructure and Quality of Education and Employability Skill

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	β		
(Constant)	1.728	0.121		11.529	0.000*
Infrastructure Perception	0.862	0.042	0.827	11.825	0.000*

Table 5.4 indicates that the regression analysis identifies that Quality of Education and Employability Skills in technical institutions are positively affected by Infrastructure conditions of technical institutions. Since the positive relationship is found between both the variables which imply that the better the infrastructure conditions and there is improvement in Quality of Education and Employability Skills in technical institutions. Since p – value is less than 0.01 that means it is significant at 1% level of significance so the alternative hypothesis is supported that is infrastructure conditions are related to the Quality of Education and Employability Skills in technical institutions.

Table 5.5: Regression Analysis – Infrastructure and Quality of Education and Employability Skill

Model	R	R^2	Adjusted R^2	S.E. of estimates	F	Sig.
1	0.827	0.684	0.621	0.7218	132.42	0.000*

a: Predictors: (Constant), Infrastructure Conditions

b: Dependent variable: Quality of Education and Employability Skills

Table 5.5 shows the association between the infrastructure conditions and Quality of Education and Employability Skill in India. The coefficient of correlation between infrastructure conditions and Quality of Education and Employability Skill is 0.827 and the value of R square is 0.684. Thus around three fourth of variation in dependent variable that is Quality of Education and Employability Skill is explained by the independent variable infrastructure conditions. Since the Adjusted R square is found to be 0.621 which indicates that 62.1% of the variation in Quality of Education and Employability Skill is explained by the infrastructure conditions. The significant value is found to be 0.000 which is below than 0.01, thus it is significant at 1% level of significance. Thus, null hypothesis is rejected and alternative hypothesis is accepted. So, there is significant relationship between infrastructure conditions and Quality of Education and Employability Skill in India.

Hypothesis 2:-

H02: There is no significant relationship between Faculty perception about curriculum and teaching effectiveness of Technical Institution with that of the improvement in quality of education and employability skills in technical education sector.

Table 5.6: Faculty perception about Curriculum and Teaching Effectiveness

S. N	Statements	Mean	SD	p-value	t-value
1	The curricula and course content reflects industry and social needs and relevance for students	3.49	.967	.000	10.22
2	The institute provides support in organizing industrial tours & training	3.83	1.039	.000	15.91
3	The institute provides support in organizing guest lecture from industry experts	4.02	1.021	.000	19.88
4	Faculty at this institute works to develop entrepreneurial ability	3.64	.967	.000	13.27

	in students				
5	Subjects students study are useful in their job performance	3.92	.880	.000	20.82
6	Lab experiments are useful in the job performance of students	3.83	.965	.000	17.25
7	final year project is related to job/ professional career of students	3.84	1.127	.000	14.88
8	Summer internship project is relevant in job/ professional career of students	3.83	1.073	.000	15.50
9	Feedback from industry collected and used for improvement	3.25	1.334	.000	3.71
10	You give industry relevant assignments in the class.	3.57	1.045	.000	10.96
11	The institute provides opportunities to organize variety of co-curricular (talks, work shopsetc) activities for students	4.07	.930	.000	23.07
12	The institute has appropriate infrastructure for conducting placements	4.08	.980	.000	22.11
13	The institute industry interface is good	3.80	1.066	.000	14.87
14	The institute has appropriate facilities liaison to contact and invite companies for placements	3.88	1.081	.000	16.35
15	The institute has Sufficient support staff to handle placements	3.79	1.101	.000	14.33
16	This institute has a good collaboration with industry	3.46	1.126	.000	8.11

Table 5.7: Relationship between Curriculum and Teaching Effectiveness and Quality of Education and Employability skills

Model	Unstandardized Coefficients		Standardized Coefficients	t- value	Sig.
	B	Std. Error	β		
(Constant)	2.815	0.114		12.914	0.000*
Curriculum and Teaching Effectiveness	0.711	0.023	0.623	12.251	0.000*

Table 5.7 indicates that the regression analysis identifies that quality of education and employability skills in technical education industry is positively affected by curriculum and teaching effectiveness. It is clear that the curriculum and teaching effectiveness contributes to the quality of education and employability skills. Since the positive relationship is found between the both variables which imply that the better the curriculum and teaching effectiveness and improvement is there in the quality of education and employability skills. Since p – value is less than 0.01 that means it is significant at 1% level of significance so the alternative hypothesis is supported that is curriculum and teaching effectiveness are related to the quality of education and employability skills.

Table 5.8: Regression Analysis – Curriculum and teaching effectiveness and Quality of Education and Employability Skills

Model	R	R^2	Adjusted R^2	S.E. of estimates	F	Sig.
1	0.736	0.542	0.523	0.8221	125.23	0.000*

a: Predictors: (Constant), Curriculum and Teaching Effectiveness

b: Dependent variable: Quality of Education and Employability Skills

Table 5.8 shows the association between the curriculum and teaching effectiveness and the quality of education and employability skills technical education industry in India. The coefficient of correlation between curriculum and teaching effectiveness and the quality of education and employability skills is 0.736 and the value of R square is 0.542. Thus more than one half of variation in dependent variable that is quality of education and employability skills is explained by the independent variable curriculum and teaching effectiveness. Since the Adjusted R square is found to be

0.523 which indicates that 52.3% of the variation in quality of education and employability skills is explained by the curriculum and teaching effectiveness. The significant value is found to be 0.000 which is below than 0.01, thus it is significant at 1% level of significance. Thus, null hypothesis is rejected and alternative hypothesis is accepted. So, there is significant relationship between curriculum and teaching effectiveness of Technical Institution with that of the improvement in quality of education and employability skills in technical education sector.

Hypothesis 3:-

H03: There is no significant relationship between Faculty perception about quality and motivation of faculty members of Technical Institution with that of the improvement in quality of education and employability skills in technical education sector.

Table 5.9: Faculty perception about quality of faculty in Technical Education Institutions

1	Faculty at this institute works to developCore/basic knowledge in students	4.16	.879	.000	26.53
2	Faculty at this institute works to develop Specialized/advanced knowledge in students	3.92	.890	.000	20.77
3	Faculty at this institute works to develop Desire for continuous learning in students	3.86	.971	.000	17.79
4	This institute is known for teaching expertise of the faculty	4.09	.929	.000	23.53

Table 5.10: Relationship between quality and motivation of faculty members and quality of education and employability skills

Model	**Unstandardized Coefficients**		**Standardized Coefficients**	**t**	**Sig.**
	B	**Std. Error**	**β**		
(Constant) quality and motivation	1.524 0.511	0.082 0.031	 0.441	13.423 13.513	0.000* 0.000*

Table 5.10 indicates that the multiple regression analysis identifies that quality of education and employability skills in technical education industry is positively affected by quality and motivation of faculty members. It is clear that the quality and motivation of faculty members contributes to the quality of education and employability skills. Since the positive relationship is found between the both variables which imply that the better the quality and motivation of faculty members and there is an improvement in quality of education and employability skills. Since p – value is less than 0.01 that means it is significant at 1% level of significance so the alternative hypothesis is supported that is quality and motivation of faculty members are related to the quality of education and employability skills.

Table 5.11: Regression Analysis – quality and motivation of faculty members and quality of education and employability skills

Model	R	R^2	Adjusted R^2	S.E. of estimates	F	Sig.
1	0.528	0.279	0.232	0.6223	132.38	0.000*

a: Predictors: (Constant), quality and motivation of faculty members

b: Dependent variable: quality of education and employability skills

Table 5.11 shows the association between the quality and motivation of faculty members and the quality of education and employability skills of technical education industry in India. The coefficient of correlation between quality and motivation of faculty members and quality of education and employability skills is 0.528 and the value of R square is 0.279. Thus more than one fourth of variation in dependent variable that is quality of education and employability skills is explained by the independent variable quality and motivation of faculty members. Since the Adjusted R square is found to be 0.232 which indicates that 23.2% of the variation in quality of education and employability skills is explained by the quality and motivation of faculty members. The significant value is found to be 0.000 which is below than 0.01, thus it is significant at 1% level of significance. Thus, null hypothesis is rejected and alternative hypothesis is accepted. So, there is significant relationship between quality and motivation of faculty members and the quality of education and employability skills of technical education industry in India.

Hypothesis 4:-

H04: There is no significant relationship between Faculty perception about knowledge creation with that of the improvement in quality of education and employability skills in technical education sector.

Table 5.12: Faculty perception about Knowledge Creation in Technical Education

S. No.	Statements	Mean	SD	p-value	t-value
1	Faculty at this institute works towards developing cross-disciplinary knowledge	3.64	.978	.000	13.02
2	Faculty gets ambience conducive to research	3.51	1.098	.000	9.32
3	The institute's library offers wide range of resources for faculty.	3.84	1.025	.000	16.37
4	The institute provides easy access to information sources, e.g. books, journals, software, information networks to faculty	3.77	1.054	.000	14.55
5	This institute is known for academic research	3.64	1.044	.000	12.34
6	This institute is known for consultancy	3.28	1.161	.000	4.82
7	More focus on research and research related activities	3.37	1.141	.000	6.43
8	The institute motivates faculty on consultancy and alternate revenue generating activities	3.31	1.278	.000	4.81

Table 5.13: Relationship between knowledge creation and quality of education and employability skills

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	β		
(Constant)	1.552	0.337		11.652	0.000*
Knowledge creation	0.931	0.010	0.882	11.892	0.000*

Table 5.13 indicates that the regression analysis identifies that quality of education and employability skills is positively affected by knowledge creation. It is clear that the knowledge creation contributes to the quality of education and employability skills. Since the positive relationship is found between the both variables which imply that the greater the knowledge creation and greater is the quality of education and employability skills. Since p – value is less than 0.01 that means it is significant at 1% level of significance so the alternative hypothesis is supported that is knowledge creation is related to the quality of education and employability skills.

Table 5.14: Regression Analysis – knowledge creation and quality of education and employability skills

Model	R	R^2	Adjusted R^2	S.E. of estimates	F	Sig.
1	0.924	0.854	0.832	0.6369	152.81	0.000*

a: Predictors: (Constant), knowledge creation

b: Dependent variable: quality of education and employability skills

Table 5.14 shows the association between the knowledge creation and the quality of education and employability skills. The coefficient of correlation between knowledge creation and the quality of education and employability skills is 0.924 and the value of R square is 0.854. Thus more than three fourth of variation in dependent variable that is quality of education and employability skills is explained by the independent variable knowledge creation. Since the Adjusted R square is found to be 0.832 which indicates that 83.2% of the variation in quality of education and employability skills is explained by the knowledge creation. The significant value is found to be 0.000 which is below than 0.01, thus it is significant at 1% level of significance. Thus, null hypothesis is rejected and alternative hypothesis is accepted.

Hypothesis 5:-

H05: There is no significant relationship between Faculty perception about skill development in Technical Institutions with that of the improvement in quality of education and employability skills in technical education sector.

Table 5.15: Faculty perception about Skill Development in Technical Education

1	Faculty at this institute works to develop Decision making ability in students	3.87	.968	.000	17.90
2	Faculty at this institute works to develop Communication skill in students	3.84	.935	.000	18.02
3	Faculty at this institute works to develop Interpersonal /relationship building skills in students	3.71	.964	.000	14.81
4	Assignments given in the class develop analytical & logical capability of the students	3.96	.881	.000	21.77

Table 5.16: Relationship between skill development and quality of education and employability skills

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	β		
(Constant)	2.415	0.023		13.687	0.000*
Skill development	0.514	0.016	0.428	13.992	0.000*

Table 5.16 indicates that the regression analysis identifies that quality of education and employability skills is positively affected by skill development. It is clear that the skill development contributes to the quality of education and employability skills. Since the positive relationship is found between the both variables which imply that the greater the skill development and greater is the quality of education and employability skills. Since p – value is less than 0.01 that means it is significant at 1% level of significance so the alternative hypothesis is supported.

Table 5.17: Regression Analysis – skill development and quality of education and employability skills

Model	R	R^2	Adjusted R^2	S.E. of estimates	F	Sig.
1	0.617	0.381	0.326	0.9523	142.16	0.000*

a: Predictors: (Constant), skill development

b: Dependent variable: quality of education and employability skills

Table 5.17 shows the association between the skill development and the quality of education and employability skills. The null hypothesis is rejected and alternative hypothesis is accepted. So, there is significant relationship between skill development and the quality of education and employability skills.

5.7 CONCLUSION

Quality of education and employability of the graduates are the two main parameters which determine the success of engineering institutions and thereby the growth of the economy. To some extent these two parameters are inter related, however a specific efforts are required to provide the specific skills to the students so that they get a good job from the campus and are able to perform their duties without much of training and orientation. Rasul et al (2013) investigated the graduate employability for manufacturing Industry. The finding of the study showed that employers place great importance to communication skills, problem solving skill, team work skills and personal qualities. The graduate also need to emphasis on leadership skill, entrepreneur skill, technology skill and information skill.

In this study, as per the opinion of the faculty members, the institutes give emphasis on clean environment, spacious and well-equipped classrooms and library with both digital and physical resources are required for effective teaching. The curriculum is another important component for providing quality education. It should be industry driven by using latest pedagogy. Faculty is the backbone of any academic institution. They are instrumental in providing communication skills, decision making skills etc along with technical and professional skills. In Indian engineering institutions the focus on knowledge generation and skill development is low despite having good faculty and talented students**.**

CHAPTER 6

EXPECTATIONS OF EMPLOYERS: ANALYSIS AND INTERPRETATION

6.1 INTRODUCTION

The Knowledge Commission of India had indicated that the India will require more than 1,500 universities by 2015 to provide adequate opportunities of higher education to Indian young generation. Today the country has more than 700 universities and more than 33,000 colleges which offer a large number of programmes in Arts, Science, Commerce, Finance, Engineering, Technology, Law and Medicine. The country has grown to provide greater numbers of colleges, universities and academic programmes, but still there is a huge gap between the quantity and quality of higher education being provided in India. It is evident that there is draw back in adequate planning, execution and feedback procedures while sanctioning new academic programmes and engineering branches. It has been noticed that majority of the engineering institutions including the most reputed ones are lacking in highly qualified, globally proficient and innovative Professors.

In most of the engineering colleges and universities, the old course curriculum which is not revised or updated for long durations is taught in theory. The students are not imparted practical training and skills to apply the theory in the industry. The programmes and their courses have no interface with the industry and students are made to confine in the class rooms only. This has resulted into a situation where the curriculum often fails to meet the demands of the industries. Neither structural nor applications part of the curriculum have been modified despite rapid development have been taking place regularly in the fields of engineering and technology. New branches of engineering have been introduced with the structure remaining in the traditional mode.

Moreover, the technical institutions are still following the black board and chalk technology of imparting teaching giving little consideration to the fact that the vast pool of knowledge is easily and readily available on the internet and to make students interested and thus to make students interested there is a need to give something extra and innovative so that they attend the classes.

Nowadays it is important to make state of the art knowledge available to the students instead of the delivery of the contents available in the book. The routine assignments may be substituted with in vivo quizzes, innovative paper writing and any interpersonal discussion on research and innovation. The real challenges are to motivate and attract students to fruitful and career oriented learning. Moreover, the examination system is not made tough enough to evaluate the knowledge level of the engineering graduates. The students as well as the faculty members have failed to understand the genesis of the semester system and the ongoing comprehensive evaluation system. This should have been applied to inculcate learning instead of concentrating to get good grades.

The greater employment opportunities in Information Technology sector have also affected the worth of graduates in other conventional engineering disciplines. IT sector is providing more number of jobs and higher salary packages which has attracted students of other disciplines to opt for more and more electives related to IT and do not give much importance on their discipline subjects. Moreover, the HR department of most of the companies/MNCs are giving greater emphasis on soft skills during campus interviews. They give too much importance on the development of soft skills and ignore the subjects of their disciplines. It seems employers have also accepted the fact that students with soft skills can be trained in the industry and thus do not expect a high level of knowledge in discipline subjects.

Thus focus is needed to generate readily- employable technical man power in India. The upgrading of infrastructure, redesign of course content, e-enabled teaching-learning methods and giving good pay packages and conducive environment to highly qualified Professors are only a few steps that could be started by technical institutions. The main challenge is to have an academic atmosphere and education system that enhance and ensure innovative learning. However, it is pertinent to note that there may be large number of external and social factors that should be addressed. As per report, NASSCOM's objective is to incubate fund and support 10,000 technology startups in India over the

next ten years to overcome with unemployment problem. NASSCOM's vision is "to cultivate entrepreneurship, create entrepreneurial capabilities at scale and liberal early stage financial and managerial support for upcoming tech start-ups by bringing together key stakeholders of the eco-system including startup incubators/accelerators, angel investors, venture capitalists, startup support groups, mentors and technology corporations. Appropriate workforce Development with enhancing employability and access to a skilled talent pool is a critical enabler for India's competitiveness. NASSCOM is interacting with large ocean of academia, industry and governments to devise policies, curriculum and assessments that achieve this objective".

In order to increase the employability and competence of the young graduates in India the NASSCOM IT-ITeS Sector Skills Council has started the many programmes to suggest measure enhancement in employability skill to produce industry ready graduates and creating employment to some extent by entrepreneurship The steps taken by NASSCOM are summarised as under:

- "NASSCOM Assessment of Competence (NAC): An assessment and certification framework that ensures a steady supply of quality professionals to meet the present and future requirements of the IT-BPM industry
- Global Business Foundation Skills (GBFS): Programme to help increase the industry readiness of students who intend to have a career with the BPM industry
- Foundation Skills in Information Technology (FSIT): Programme to help increase the industry readiness of students who intend to have a career with the IT industry
- NOS (National Occupational Standards) across verticals in the IT-BPM industry: Performance standards that individuals must achieve when carrying out functions in the workplace, together with specifications of the underpinning knowledge and understanding Enabling Environment. The National Skills Registry (NSR) NASSCOM in partnership with the industry has developed the National Skills Registry (NSR), a unique national database of registered and verified knowledge workers in the sector. Launched in 2007,

this database is managed and run by NSDL Database Management Ltd. (NDML), a fully-owned subsidiary of National Securities Depository Ltd. (NSDL). NSR aims to build a robust and credible information repository on the knowledge professionals in the IT-BPM sector. The benefits of NSR flow across to clients, service providers and employees. NSR has enhanced the value proposition of the Indian IT-BPM industry and raised the bar on security standards in pursuit of excellence and client satisfaction.

- The Data Security Council of India (DSCI) – A not-for-profit organisation established in 2008 with the key objective of building a credible and committed body to uphold data privacy and security standards. The mission of DSCI is to build the trustworthiness of Indian organisations as global sourcing service providers and to send out a message to clients worldwide that India is a secure destination for outsourcing. Its aim is also to reiterate that in India, privacy and protection of customer data is enshrined in the global best practices followed by the industry.
- NASSCOM Foundation (NF) – Was set up as a trust in 2001. It was instituted with the aim of using information and communication technologies for development (ICT for D), and to catalyse Corporate Social Responsibility (CSR) initiatives within the Indian IT-BPM industry. By implementing a diverse range of programmes, NF is taking information and communication tools to underserved communities across the country. It is also channelising the immense potential of the IT-BPM industry towards socio-economic development of the nation.
- The National Institute for Smart Governance (NISG) – Incorporated in 2002, the National Institute for Smart Governance (NISG) is a Section 25 organisation set up in public-private partnership with NASSCOM, the Government of India and the Government of Andhra Pradesh. The key objective of the organisation is to catalyse the roll out of e-Governance projects"

6.2 Industry Needs And Expectations

The following attributes are considered in this study to assess the industry needs:

A Engineering Knowledge

Advancement of engineering knowledge is urgently needed in order to guide engineering education administrators and faculty in meeting the need of engineering industry in the 21st Century. Labour market becoming more skill oriented and depends on in-depth knowledge and skills as the globalization come across in all the industries. The role of knowledge in the rapid economic growth is creating high demands of the core competencies in the workforce. It has been now established with evidences that improvement is needed in the basic competences: basic science and mathematics knowledge, knowledge of fundamental and advanced engineering principles, reasoning and problem solving, systemic thinking as well as conceiving, designing, executing and operating systems in companies and in social context.

The speedy growth of technical education has yielded in incessant expansion of many technologies and resources which may be used in making new products and to design new process. IT enabled and web-based technologies have permitted engineers to enhance the growth of novel artefacts. These developments intensified the competition amongst engineering industries and abridged the life spans of the uses of many engineering products (mobiles and computers). Consequently, the new engineers from the institutions are now expected to creative designs to markets much more rapidly than ever before (Belski et al, 2016).

B Problem analysis

Engineering profession is inter-linked with intensive and extensive problem solving. Therefore the ability to find innovative solutions for the problems has been identified as one of the imperative competencies for graduating students

by engineering associations worldwide (Engineering Council, UK, 2013). Problem solving or critical thinking abilities are the skills that promote technological innovations.

It has been reported that the conventional methods of teaching engineering students do not necessarily inculcate in them the problem solving and creativity skills (Belski et al., 2013; Douglas et al., 2012). (Belski, 2015) have suggested the methods ie. "Smart Little People, the Size-Time-Cost operator and the notion of the Ideal Ultimate Result (IUR) which are likely to help students in acquisition of effective problem reframing and problem definition routines". Availability of positive attitude among graduates also helps in fostering skills such as problem solving, decision making, open mind, trustworthy, able to cooperate and be effective (Buck and Barrick, 1987). Employers value such skills in every individual at the time of interview. Positive attitude towards work has been identified as important employability skill by graduates, and university lecturers employers (Wickramasinghe and Perera, 2010).

C Design/ Development of solutions

Engineering institutions in India have to look for solutions to overcome the challenges of skill development among graduates. This need course content to be modified that incorporate a balance between theoretical and practical aspects of the subject with greater emphasis on industrial utility and relevance. Students' learning practice can be greatly improved by imbibing theoretical knowledge and practical skills that may have lifelong impact. High level of competency in both theory and practice of Professors shall be a key asset to the transformation of learning experience in and outside of the classroom for students and learners. Yeo, 2009 has suggested that the ""success of knowledge facilitation within learning communities begins with the fundamental utilization of instructors' core skills in simplifying complex concepts for the relevance of the current environment". Effective Course or curriculum design emphasizes knowledge creation by providing engineering

graduates with adequate learning opportunities to actively participate in a broad range of research and development activities (Webster and Kenney, 2011).

Glomann (2015) have implemented the Human-centered design (HCD) approach in order to promote experiential learning. It starts with the activity of understanding and specifying the context of use, followed by the specification of the user requirements with reference to design thinking activities. At a later stage, students are required to put their acquired knowledge into practice by producing their own design solutions; these are then evaluated and improved accordingly. In the end, the students will have learned about the foundations of HCD in both a theoretical and a practical way.

D Ability to conduct investigation of complex problems

Theoretical knowledge itself is not useful until it is applied for solving complex problems. In today's rapidly changing competitive world, young graduates need to develop these competencies. They should possess the ability to identify problems faced by society and find out the appropriate solutions. Industry also demands such employees, who respond to the problem quickly, and take right decisions.

E Modern tool usage

The present development of the current working world needs talented workers mainly in fields which involves emerging technologies. Therefore, the engineering graduates must be prepared to upgrade their skills to match the latest technology, particularly applicable for IT engineers. An engineer is expected to be creative enough to widen his horizon of knowledge as per the emerging trends.

The objectives and mission of corporate social responsibility in terms of human resource development and qualifications are not limited to the

commitment to answer questions about corporate needs for relevant competences (what are priority areas and what is the content of competences), but also extend to creating possibilities to acquire experiences during practical training in real working environment through performance of various tasks related to actual production/manufacturing processes for which specific technologies are used. This can be made possible only through the application of modern technological tools (Andriušaitienė, 2014).

Rapid technological development necessitates national business to buy and implement state-of-the-art technologies in order to maintain competitiveness in global markets. In this marathon of growing competition, information and knowledge are changing at an analogue pace. Therefore, teachers educating and training students who represent tomorrow's labor force should teach them skills and competences to be needed by businesses several years later (Andriušaitienė, 2014).

Bhuasiri et al. (2012) identified the key success factors that have marked influence on the acceptance of e-learning systems in developing countries. A popular and meaningful mode of delivering educational materials both theory and practical training in higher education is the E-learning which is adopted by the universities throughout the world. This study discloses the factors that lay greater influence on the success of e-learning systems. Further, comparison has been made which affects the stakeholders group in the developing countries, ICT professions and expert faculty. Bhuasiri et al. study is based on collection of 76 usable samples using the Delphi method and Analytic Hierarchy Process (AHP) approach. It has revealed 6 dimensions and 20 key success parameters for e-learning systems in developing countries. Bhuasiri et al. findings concluded "the importance of curriculum design for learning performance. Technology awareness, motivation, and changing learners' behavior are prerequisites for successful e-learning implementations. Several recommendations are provided to aid the implementation of e-learning systems for developing countries which have relevance for researchers and practitioners".

Gan et al. (2015) described and reviewed numerous examples of web enabled teaching and learning practices at UG level in an Asian institution of higher education. The research reported on "experiences made in the context of an iPad-enabled mobile learning project carried out during a Knowledge Management course (excursion) in support of the university's technology-enabled learning vision. It was followed by reflections on the deployment of a collaborative social learning platform website (Edmodo), wiki-and web page-creation tools (Google Site), animated videos, etc. in elective courses on leadership and human capital management. The research also described a proven project-based learning approach adopted annually by various UG teams of four to six students as part of their compulsory capstone course in the field of information systems. Besides documenting the multiple opportunities which interactive digital technologies offer for both instructors and students in order to learn collaboratively, it was recommended to implement and institutionalize technology-enabled teaching and learning in higher education, besides some challenges".

F Synergy between engineering and society

Keeping in view the effect of globalization in the Indian society, there seems to be a major role of engineering education in upgrading country's technological capacity and it has now become important to transform Indian Education System to knowledge based education and economy. The strategy of educational system should focus on furtherance of technical education. The greater responsibility lies on the technical universities, engineering institutions and Professor to analyze the existing education and further upgrade it to the future perspective, creating new knowledge and assimilating the new ocean of knowledge that is being available across the world (Sharma, 2012).

Institutions need to emphasize towards doing research which result into successful business and contribute to improve in business practices and society at large. They also need to retain a strong recognition of the need for academic independence that produces highly relevant teaching and research to the needs

of society and graduates who are confident, multi-skilled and critical thinkers throughout their lives, as well as to the needs of prospective employers (McMurray et al., 2016).

G Environment and sustainability

Education for sustainable development offers new opportunities for universities where educational, administrative, professors and technical personnel are expected to prepare students to meet complexities in society and take responsibility for sustainability. The focus on sustainable development (SD) has become more and more evident during the last 15-20 years, implying that technical institutions are expected to prepare students to imbibe the ability to integrate economic, social and environmental considerations for future decision making (Lozano et al., 2013; Sibbel, 2009). Among the most appropriate core competencies for the decision makers of future are to solve the complexities of sustainability and to convert the knowledge related to education for sustainable development (ESD) critical thinking, anticipatory, systemic and actions oriented (Rieckmann, 2012). This change is necessary, as the future professionals will participate globally with companies that shall have sustainability on their priority (Kiron et al., 2012). Sustainable development puts high expectations on universities to imbibe SD into the actions of faculty and staff so that sustainability defuses into all activities of a university (Steiner et al., 2013) and is not only offered piecemeal in single course contents. This change in university ESD depends on three functional elements: university activities - SD integration; engineering education for sustainable growth and engineering education for sustainable growth of the society (McKeon et al., 2002).

H *Ethics*

Besides acquiring Core business skills, Problem solving skills, communication skills; Personal ethics also play an important role in competence building among graduates (Jackson and Chapman, 2012). Graduates are now accounting for the social and environmental responsibility of employers in

their career choices and employers are considering the "social/environmental ethics, values and experience of university students as part of their graduate recruitment" (Cade, 2008, p. 3). Availability of core values, social responsibility and accountability is considered important for students seeking 'Manager' profile in reputed companies.

Jackson and Chapman (2011) have argued about 2 types of ethics necessary for competency building namely Personal ethics and work ethics. The Personal ethics means Remain consistently committed to and guided by core values and beliefs such as honesty and integrity and Work ethics means: Go beyond the call of duty by pitching in, including undertaking menial tasks as required by the business. Take action unprompted to achieve agreed goals. It supports the study that ethics is one of skills required by the graduates.

Kazilan et al. (2009) identified various attributes of ethics which includes: Honesty, Responsibility, Sociability, Self Confidence, punctuality, Self Management and efficiency, Adaptable and flexible, self control/ self directed and good work attitude. These attributes are part of ethics.

6.3 QUESTIONNAIRE SURVEY

Based on the discussions with industry executives and literature review, a comprehensive questionnaire was developed and pilot study was conducted with 10 executives from the placement teams visiting campuses. With their feedback questionnaire was improved with respect to reframing the question, making them unambiguous and also adding more aspects. This questionnaire was given to 354 executives and a total of 75 filled responses were received and out of that only 63 which are duly filled are used for analysis.

6.3.1 Level of expectations from Engineering Graduates

The analysis of the responses is given in Table 6.1 and also in figure 6.1. Table 6.1 shows that problem solving skills, design/ development of solution and ability to conduct investigations of complex problems are the three most

important skills expected by the recruiters while selecting a candidate. In a way, these three skills together provide the necessary competency to the students to handle real life complex engineering problems. It is difficult to understand why the importance is very low to the 'modern tool usage'. In academic institutions lot of emphasis is on new tools, software, analytical techniques. Further from the analysis, it appears that the industry is still not showing maturity by not appreciating the need of ethics, synergy between engineering and society; environment and sustainability etc.

The figure 6.1 gives the profile of the responses to A-H attributes on a five point likert scale. It is interesting to note that the executives have responded their expectations as very high to engineering knowledge, problem solving, design and development of solutions and ability to conduct investigations of complex engineering problem.

6.3.2 Correlation among attributes

In a complex real life business environment, it is the combination of skills, rather than one stand alone skills, that helps to perform efficiently and effectively. To understand the need of multiple skills requirements, correlation analysis is carried out and results are presented in table 2. The attribute engineering knowledge (A) has a strong correlation (significant at 0.01 level of significance) with design development of solution (C); modern tool usage (E) and synergy between engineering and society (F). Also seen a strong correlation of problem analysis (B) with design development of solution (C); ability to conduct investigations (D) and ethics (H). Design development of solution (C) has strong correlation with ability to conduct investigations (D). Ability to conduct investigations (D) in turn has strong correlation with ethics (H). Modern tool usage (E) has strong correlation with synergy between engineering and society (F) and also with environment and sustainability (G). This reflects that we need modern tools of engineering to address the issues of environment, sustainability and the much desired synergy with society.

Further strong relations between F and G also between G and H show that environment, sustainability, ethics, synergy with society are inter related.

Table 6.1: Level of expectation from the engineering graduates

Code	Attribute	Mean	SD	P value
A	Engineering knowledge	4.0	1.270	0
B	Problem analysis	4.38	0.888	0
C	Design/ Development of solutions	4.29	0.923	0
D	Ability to conduct investigation of complex problems	4.17	0.908	0
E	Modern tool usage	3.08	1.286	0.626*
F	Synergy between engineering and society	3.02	1.326	0.925*
G	Environment and sustainability	3.13	1.289	0.437*
H	Ethics	3.76	1.201	0

***Significant at 5%level of confidence**

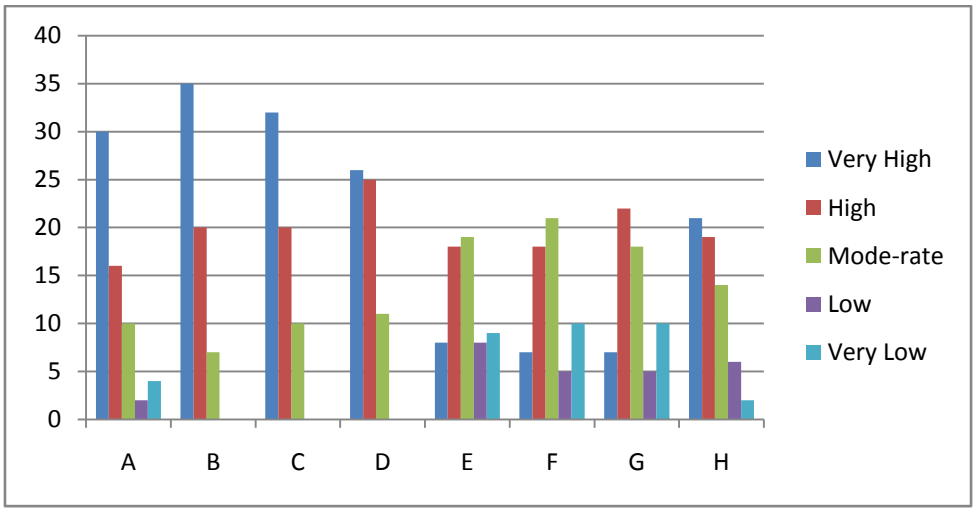


Figure 6.1: Profile of the responses on Likert Scale

Table 6.2: Correlation among Skill Attributes

		A	B	C	D	E	F	G	H
A	Pearson Correlation	1	.315*	.344**	.168	.346**	.412**	.246	.127
	Sig. (2-tailed)		.012	.006	.188	.006	.001	.052	.322
B	Pearson Correlation	.315*	1	.633**	.657**	.128	.132	.169	.510**
	Sig. (2-tailed)	.012		.000	.000	.316	.303	.187	.000
C	Pearson Correlation	.344**	.633**	1	.632**	-.033	.141	.077	.295*
	Sig. (2-tailed)	.006	.000		.000	.798	.270	.546	.019
D	Pearson Correlation	.168	.657**	.632**	1	.043	.199	.215	.512**
	Sig. (2-tailed)	.188	.000	.000		.737	.118	.090	.000
E	Pearson Correlation	.346**	.128	-.033	.043	1	.586**	.451**	.273*
	Sig. (2-tailed)	.006	.316	.798	.737		.000	.000	.030
F	Pearson Correlation	.412**	.132	.141	.199	.586**	1	.697**	.286*
	Sig. (2-tailed)	.001	.303	.270	.118	.000		.000	.023
G	Pearson Correlation	.246	.169	.077	.215	.451**	.697**	1	.489**
	Sig. (2-tailed)	.052	.187	.546	.090	.000	.000		.000
H	Pearson Correlation	.127	.510**	.295*	.512**	.273*	.286*	.489**	1
	Sig. (2-tailed)	.322	.000	.019	.000	.030	.023	.000	
*. Correlation is significant at the 0.05 level (2-tailed).									
**. Correlation is significant at the 0.01 level (2-tailed).									

In higher specialized instruction framework, industry is considered as outside clients though understudies as inward clients. It is imperative to comprehend the point of view of the business administrators in regards to aptitudes

required in building graduates. In the present business condition, graduates with a degree no longer consequently meet all requirements for their first employment. Rather, graduates who have the best information and aptitudes in their space of study are the first to be utilized. The review proposes two concentration regions expertise improvement in designing instruction: one as subject abilities and different as bland aptitudes. Non specific aptitudes allude to certain individual capacities of a person, which can be taken starting with one occupation part then onto the next, utilized inside any calling and at any phase of his/her profession while subject abilities are more applicable to ones vocation. The relationship examination uncovers that the abilities are compelling when they are accessible as an arrangement of aptitudes as there is solid connection among specific aptitudes in their necessities by the business. The review will be valuable to the understudies, workforce and administration of the Institutions in building up the correct educational programs, giving the important abilities and helping the business in giving right human asset along these lines adding to the monetary advance of the nation.

6.4 WORK ASSIGNMENTS OFFERED

Executives were asked two questions, (a) the branches from where they are doing the hiring and (b) the work assignment offered to the graduates on joining. The results are given in Table 6.4 and 6.5. Table 6.4 shows that the core branches like Mechanical Engineering, Civil Engineering, Electrical Engineering, Electronics and Communication Engineering and Computer Engineering are the most prominent braches from where the graduates are being hired by the companies. Further Table 6.5 indicates that Consultancy and Research and Development are the two most prominent work areas where the fresh graduates are deployed on joining. Design and production are the next two and on the lowest side are sales and marketing and Executives.

Table 6.3 Branches from Graduates are Hired

S.N.	Branch	No of Respondents
1	Mechanical	42
2	Electrical	46
3	Civil	42
4	ECE	47
5	Computer	49

Table 6.4 Work Assignment offered to students of different branches

S.N.	Work Assignment	No of Respondents
1	Design	21
2	Executive	6
3	Production	15
4	Research & Development	25
5	Consultancy	31
6	Sales & Marketing	7
7	Supply chain /Logistics	0

6.5 INSTITUTIONAL PARAMETERS FOR HIRING

As mentioned in the initial discussions that there are 3364 engineering institutions in India in 2015 and for any recruiter it is not possible as well as not desirable to hire from all the institutions. The recruited, thus select few institutions for campus hiring. They were asked to identify the criteria they are following in identifying the institutions for hiring. The results are presented in Table 6.5 and 6.6. International Accreditation, reputation of the institution, research orientation of the faculty and curriculum followed are the most important factors being considered by the employers for selecting the institutions for hiring. Table 6.7 gives the analysis of importance of students' related parameters in the selection process. Core basic knowledge, decision

making skills, interpersonal skills and communication skills are the most important parameter in making the students employable and getting selected for placement.

Technical skills, IQ and overall personality are the major parameters being looked into in the selection process by the hiring company executives. The Table 6.8 presents the results of focus areas in the selection process. Training projects and work assignments are next in importance. Programming skill though important with a score 3.13 on a five point likert scale is the least important parameters. On the job orientation is an important activity which helps in migration of an individual from the student life to the life of work. All organizations try to make this transition as smooth and effective as possible. Table 6.9 indicates that giving good idea about the working of the organization is more focused in orientation program rather that software platform training.

Academic institutions feel that industry interact with them only for the purpose of hiring graduates and then also show their resentment that graduates are not directly suitable for putting them to job. In this context it is very important that there should be a mechanism in place where the industry associate itself with the academic institutions and help in developing the right human resource. Table 6.10 reflects on this aspect. The results are highly encouraging that the industry wants to play an active role in the human resource development of the country.

Table 6.5: Institutional Parameters for Hiring

S. N	Institutional Parameters	Mean	SD	P value
1	International accreditation attained by the institute is a key parameter for selection.	3.41	1.159	0.006
2	Reputation of university to which the institute is affiliated play an important role	3.56	0.980	0.0

3	The research orientation of faculty is an important factor for selecting students	3.33	1.164	0.027
4	High weight age is given to the curriculum for selection	3.29	1.156	0.054

Table 6.6: Student Parameters for Hiring

S. N	Student Parameters	Mean	SD	P value
1.	Core/basic knowledge of the students is appropriate to the job	4.27	.827	0
2	Decision making ability in students	4.24	.928	0
3	The communication skill of the students	4.22	.870	0
4	The students have interpersonal /team working skills	4.11	.721	0
5	Cross disciplinary knowledge of the students	3.83	.943	0
6	Ethics and morality in students is beyond doubt	3.83	.890	0

Table 6.7: Focus Areas in Selection Process

S. N	Student Parameters	Mean	SD	P value
1	In selection process the specific work assignments carried out during the studies is considered important	3.60	1.056	0
2	In selection process training projects are considered seriously	3.97	.999	0
3	In selection process emphasis is on IQ	4.13	.813	0
4	In selection process emphasis is on Technical skills	4.17	1.056	0
5	In selection process emphasis is on programming skill of the student	3.13	1.631	0.539
6	In selection, emphasis is on overall personality	4.05	.888	0

Table 6.8: Focus of on the Job Orientation

S. N	Student Parameters	Mean	SD	P value
1	On the job training- orientation- induction is on focus of company	3.73	.766	0
2	On the job training- orientation- induction is on software platform training	2.98	1.529	0.935

Table 6.9: Industry Institution Interactions

S. N	Student Parameters	Mean	SD	P value
1	Industry collaborates with live projects	4.19	.715	0
2	Industry interacts more frequently	4.27	.787	0
3	Industry gives feedback	4.27	.766	0
4	Industry plays an active role	4.48	.644	0

6.6 CONCLUSION

In this chapter the analysis of the responses from industry executives received through a structured questionnaire was presented. The analysis has identified the main focus areas of the recruiters while selecting institutions, students and their skills set.

CHAPTER 7
ISM OF ENABLERS OF QUALITY AND EMPLOYABILITY

7.1 INTRODUCTION

The sufficient supply of skilled employable graduates is required for national, economical and social welfare. Employability mostly depends upon knowledge, skills and attitudes. These assets are utilized to deploy for the potential of employers and context within which the individual works as far as labour market and personal circumstances are concerned (Hillage and Pollard, 1999). The employability of engineering graduates, which is commonly defined as "a set of achievements – skills, understandings and personal attributes – that make graduates more likely to gain employment and be successful in their chosen occupations" (Knight and Yorke, 2004), has become an objective of the governments around the world, for varying extents, imposed on national Higher Education systems (Little, 2003; Teichler, 2007).

In India, the employability of engineering graduates was not a challenge prior to 1990, when the seats were highly limited and many bright students were not having the access to higher education. However, the growth in higher education during the 1990s and entries of new universities in 1992 with multiplication of degree subjects affected the economy and employment market but lower employability became the central concern for many universities, students and others, not only for parents and employers (Knight and Yorke, 2004; McNair, 2003).

According to Sharma (2012),for transforming Indian economy to knowledge economy the role of engineering education with enhancement in countries technological capabilities became important and also the role of globalization on the society. The system and strategy on education should be or advancement of the knowledge. It is the responsibility of the university, institutions and academicians to analyze the future prospective and adjusting knowledge to create, new knowledge and disseminating the new knowledge across the world.

In a study by Adeyemo et al. (2010) in Nigeria, regarding growing employment problem the study has identified two principal factors. One, that high number of people are not absorbed in the job market to sustain the economy. This is the classical example of demand and supply. Secondly, the institutions are not training students with requisite skills that they compete in the global market dominated by information technology.

According to Rao (2015), in Indian context enhancement in employability is a big concern for students of management and engineering field as Indian industry demands for ‘‘first day-first hour productivity’’ from its prospective employees. Further, Indian students are facing unemployability due to lacking in skill rather than unemployment problem. The research indicated that soft skill is required among the students to bridge the gap between institutions and industries. It will also help in creating skill and techniques to enable the students employable.

To achieve the right quality of graduates, the presence of certain enablers is essential. These enablers help the institutions to provide the right environment of education and right learning processes through rights resources. The whole exercise helps producing human resource that is competent to meet the expectations of the employer and thus is employable. Mukhadis (1997) suggested that learning includes several aspects of development, namely: 1) productive creative thinking, 2) decision-making, 3) problem solving, 4) learning how to learn skills, 5) collaboration, and 6) self-management. The sixth parameter strongly favours the development of quality of human resources if it is integrated with both the joints of the education system, good basic education, secondary education, and higher education. The chapter is organized as follows: after this brief introduction, section two outlines the issue of competency requirements and developments for employability. Section three describes the various enabler identified from literature and through discussions with students, faculty and industry executives. Section four outlines the methodology of the Interpretive structural modelling (ISM) and develops the ISM model for competency building in Indian engineering

institutions. Section five discusses the results of the ISM and their implications for educators and administration and last section provides major conclusions.

7.2. COMPETENCY REQUIREMENTS AND DEVELOPMENTS FOR EMPLOYABILITY

According to Kazilan, et al. (2009),the current working environment differs from the one prior to liberalization about two decade back. Now most of the sectors require problem solving skill besides communication skill which is the need of global competition, cultural diversity, latest technologies and the process of new managerial skills. Curriculum should be industry relevant as required by job market and it will facilitate the students challenge for securing the employment. In order to generate productive workforce, the set of employability skill are important which is instilled in each individual. In addition individuals should have the other characteristics like high sense of self, innovative, productive, skilful, competitive and strong will of determination. It will creative the skill to face the challenges across the globe in 21st century. Further, in all profession and in education employability skill plays an important role (Overtoom, 2000).

A large number of researches had determined the employability skill for engineering students. The De Leon and Borchers (1998) studied about the skills for the Texas students working in production industry. The industry was used as research respondent. This study focused on some important skills like, writing, communicating, calculating, reading, critical thinking, interaction in groups, self development, technical system computer skilled, leadership and employability. The employer found, interaction in groups, self-development and employability as the most important skill.

The Employability skill is one of the characteristic required by employer although it is a non-technical skill. The employer also expects technical ability in the employee as another criterion. The major employability skill may be considered as ready, counting, problem solving, decision making, good

attitude and effective communication etcetera (Buck and Barrick, 1987). According to Robinson (2000), an occupation or technical skill is part of employability skill. This derives the job specifications to the respective category of industries, business. The study also indicated that one to get a job and to enable the graduate to perform the job is the main employability skill. The attitude and action are part of this skill. For example, if an employee cooperate with seniors besides the independent opinion, suggestion and decisions by the seniors.

Fugate et. al, (2004) described the employability skill as the active adjustment of individuals in specific occupations and to identify the career prospects with the employer. Further, the working environmental need and coping up ability of the employee also the part of the employability skill.

The fast developments at the global level need the skilled workers with latest technology. Whereas rapid increase in the workforce in the countries like Malaysia where it has increased manifold for example 8.3 million in the year 1995 to 9.6 million in the year 2000. The public and private training institutions had produced skilled and non-skilled workforces but it could not improve employment and unemployment level remains at the average of 3.1% (Malaysian Government, 2001).

The research of Nation's Higher Educational Research Institution (2006) indicated that the concern about the industrial training of the jobs seekers as required by the employers. The study mentioned that industrial training increases efficiency level of productivity by the employee. The employer realized that minimum six months training required to build the confidence and skill level for the job assignment in the industry. Although it may be the loss of employer's time to train the employee for taking the productive outcome.

Petruzzellis and Romanazzi (2010) observed, "A university's value is not based on its buildings, equipment and student revenue streams although these

factors each contribute significantly. The value of a university is a function of the faculty's knowledge and abilities, the faculty's positive interaction among themselves, the faculty's interaction with students, the administration's efficiency, the administration's support of its faculty and students, and public perception of how good a product the university delivers". Senthilkumar and Arulraj (2011) in their model of service quality measurement identifies the following parameters of teaching: relevant curriculum, teaching and learning support, theoretical and practical knowledge of academic staff, course material, degree to which exams are representative of courses taught, extent to which academic staff are upto date in their subject.

Sakthivel et al. (2005) in their paper of TQM implementation in academic institution and student satisfaction identified the five TQM variables: course delivery, campus facilities, commitment of top management, courtesy and customer feedback and improvement. These five parameters are responsible to protect the satisfaction of the students on their academic performance.

7.3. ENABLERS OF COMPETENCY BUILDING AND EMPLOYABILITY

From the discussions and literature review and the discussions with students, faculty and employers, large number of variables are listed. In the list many variables are synonyms of another variable and many variables are subset of another variable. Fifteen variables are identified which helps the academic institutions in building competency among the students and thereby helps in employability.

a. Motivated Faculty

Faculty is the heart of any academic institution and plays the most vital role in providing quality education, bringing satisfaction to the students and leading to their employability, entrepreneuring venture and a good career. As per HOLSKED model suggested by Munastiwi (2015) a teacher should have the competency of pedagogy, professional, social and personal before entering the class and in the class the competency of understanding student behaviour. The motivated faculty always performs good teaching which is defined in a study by

Lee et al (2015) and linked to five commonly evaluated categories of teaching i.e. preparation and organization, knowledge, learning and thinking, enthusiasm and delivery.

In the study by Lee et al (2015), the characteristics identified of a good faculty are: preparation and organization, knowledge, learning and thinking, enthusiasm and delivery. The motivation or enthusiasm is expressed with the performance techniques, teaching strategies and use of humour. Other statements used for motivated faculty are: teach with passion and do not speak in a monotone, vibrant tone, sound exciting to get students' enthusiasm up and eager to teach. Hill et al (2003) noted, based on an empirical study that students appreciated the faculty who are experts in their subjects, are well organized and are ready to listen the problems of the students. Further the study found those faculties who are flexible in delivery of the subject and are compassionate to the individual need for grand success are appreciated by the students.

b. Industry Relevant Curriculum

Curriculum is like a road map to achieve the objectives of engineering education. It provides a framework for both students and faculty to pursue excellence. To build competency and to meet the challenges of the real life work requirements, it is essential that the curriculum to be industry relevant. It is essential to involve the representatives of industry in the initial discussions to chalk out the educational objectives of the program as well as the outcomes of each subject/ course. Hill et al (2003) observed that students have great concern for the course content that was related to their world but broaden their horizon. The study by Kazilan, et al. (2009) suggests "Technical and Vocational Educational Department should provide a curriculum which includes employment element skills which are needed by the employers. The institutions and the industry should also create a compact joint-venture for students need in order to produce higher quality workers".

Liew et al. (2013) made research on various parameters on University Industry collaboration and improvement in curriculum and a prominent enabler in competency building of students. It makes student employable in various technology areas of Industries. John and Senith (2012) studied on service quality dimensions of Indian Technical Education and found one of the dimensions as frequent and industry relevant curricula.

c. ICT enabled Pedagogy

Information and communication technology is driving almost every economic and business activity and it has deep penetrated into education sector also. ICT helps the teaching learning processes in several ways – providing resource material electronically at affordable price 24*7; provide platform for interaction with faculty; submission of assignments, online discussion; web enabled learning; satellite facilitated delivery of lectures; PPT presentations and multimedia enabled teaching for bigger class size; recording and dissemination of lectures by experts etc. In India, several initiatives have been taken by the government in form of NPTEL, etc to develop the resource material through faculty of premier institutions.

Bhusry and Ranjan (2011) studied the effect of information technology (IT) based KM involvement in the teaching-learning process and found a paradigm shift in technological educational institutions as teaching-learning process cannot be limited to the contents in the textbook and IT application did a revolutionary change that student start using the available technology and improved opportunity of employability across the globe.

d. Linkages with Industry

In the fast changing technical knowledge and business practices, it has almost become impossible to provide relevant education without associating industry. Good linkages with industry helps almost at every stage of the education process starting with defining program objectives, topics in each subjects, case studies, internships, projects etc. The lectures by industry experts expose the students to the challenges of the real life work environment. Further, technology

is changing very fast and becoming complex. The institutions are not able to keep pace with the developments due to financial and organizational constraints. Thus to provide the state of the art knowledge and exposure, industry partnership is essential.

Owlia and Aspinwall (1995) in their finding through causal diagram indicated industry linkages with institutions as one of the prominent activity in competency building of students and to make students more employable. Ismail, et al. (2015) studied on Work-Based Learning (WBL) which is a transition from education in institutions to carriers. It combines educational learning with industrial training and creates an integrated experience for the students. Basically, WBL is a learning approach that uses the work place as a medium for learning transfer. This is an ideal example of industry-institute linkages for competency building.

Liew et al. (2013) advocated that Universities need to maintain a strong sense of awareness with regards to research policies, market trends, financial governance, human capital development and day-to-day administration in order to maintain a good sense of control over the outcomes of a University Industry Collaboration (UIC). The research indicate that simple linkages with Industries will not work for competency building as it require other parameters to be taken care as mentioned above.

e. Research Culture

Altbach&Bala´n (2007) have defined research university as "academic institutions committed to the creation and dissemination of knowledge in a range of disciplines and fields and featuring the appropriate laboratories, libraries and other infrastructures that permit teaching and research at the highest possible level" (p. 1). Andreson (2000) and Nixon et al (1998) highlighted the importance of research and the nexus between research and teaching. Research provides an added dimension to teaching and allows the development of a collaborative relationship between faculty and student. In such an environment, the faculty is more accessible and transparent to the student.

The reputed agencies awarding world class ranking of Universities and Institutions like QS World Ranking and Times Higher Education World Ranking awards major weightage of research for giving marks in placement of ranking of Institution. For example Times Higher education gives more than 50% weightage to research and its outcome like citation. Thus research culture is one of the prominent factor in ranking of an Institution which are responsible for competency building of students.

f. Promoters Commitment (Leadership)

To develop a good academic institution, a lot of financial commitment is required from the promoters and management of the institution. Without top management involvement, it is not possible to get good faculty and infrastructure. According to Sakthivel et al (2005), ""top Management through their first-hand supervision of all the processes, should ensure non-dilution of the stated objective at any of the strata of the hierarchy". The institutional administration will evidence itself in the assurance that "what is preached has been practiced".

g. Smart Classrooms

To attain and sustain quality education, certain components of infrastructure are particularly relevant and necessary such as modern educational facilities like class rooms, library learning and living environments, etc. (Mavondo et al., 2000). Smart class can be defined as a class that is equipped with most modern IT systems such as 3G and 4G, uninterrupted audio and video transmission, interactive learning, and recording and uploading the lecture in a website. 3G technology, which relies on broadband internet access, can provide easy access to the Wi-Fi networks (Alelaiwi, et al. 2014). With the developments in ICT, an equal support mechanism in the form of smart classrooms is required which can facilitate the effective delivery of ICT resources.

h. Enthusiastic students

Attracting good students and then maintain and boosting their enthusiasm is an important factor in developing a good academic culture leading to ----. The HOLSKED model suggested byMunastiwi (2015) a student should have the traits like *capability, psychology, motivation and physic.*

i. Knowledge and technical skills

This is the core function of an engineering institution. The achievement of this depends upon the quality of faculty, enthusiasm of students, good infrastructure, relevant curriculum and industry support. According to Raybould and Sheedy (2005), "for graduates to be attractive to employers, it is important that they are able to show evidence of having the ability to cope with uncertainty, the ability to work under pressure, demonstrate action-planning skills, communication skills, information technology skills, team work, a readiness to explore and create opportunities, self-confidence, self-management skills and a willingness to learn".

j. Competency Building and Employability

In the present day environment, the objective of education is not just limited to imparting knowledge. It should also build the competency in the students so that (a) the education is relevant to the industry and (b) it is holistic i.e. the graduate should be able to solve the problems facing the industry and society. This aspect of education is more required in engineering institutions. Thus alongwith education, the system should focus on skill development.

To improve employability, the institution must focus on mainstream skill formation in the formal education system. Further, innovative approaches for the skill creation outside the formal education system should be strengthened. Govt of India has taken several initiatives and launched several schemes of skilling India.

k. Development of Personality and Communication Skill

Soft skills can be defined as, "the Skills, abilities, and traits that pertain to personality, attitude and behaviour rather than to formal or technical knowledge. These are the polite and pleasing presentation of hard skills. These are essential at every level of organization for smooth and successful functioning. Nowadays, employers are looking for these skills at the time of interview. Hence, these skills are also known as employability skills".

Bohm (1996) asserts, ''Soft skills engender automatic chains of psychological, emotional, and physiological responses which have an immensely real impact within the mind, body, and society at large''.

Technical skills and knowledge contribute about 15 % of the reason an individual gets a job, keeps the job and advances in that job. The remaining 85 percent of job success is based on the individual's attitude and performance referred as 'people skills. There is greater emphasis on 'Soft skills in the '21st century as these traits and abilities of attitude and behavior contribute more to the success of industry rather than technical knowledge or academic aptitude.

One can define soft skills as the ability for effective communication with others in an efficient manner with pleasing and polite manner. Besides, soft skills contribute for the effectiveness of hard skills. At present, Indian educational system does not lay emphasis on the teaching of soft skills as students are already have heavy dose of subject course content. The Indian evaluation system lays greater emphasis on the importance of intelligent quotient (IQ) and less emotional quotient (EQ) which is directly related to soft skills.

Rao (2015) emphasizes on bridging the gap and intimate interaction between an academic institution and industry among the professional - management and engineering students to increase their acceptability to the industry. The students and faculty are equipped with creative tools and techniques to acquire soft skills and will further enhance their employability in the industry.

l. **Patents and Research Publications**

The present day engineering institutions are required to be developed as knowledge enterprise. Along with developing graduates, they should also become engines of economic growth through research and innovations. The involvement of students in the exercise of innovation, patents development and research publication will help them to become relevant for the industry and can fetch high end jobs.

In "work-ready" skills training, few will challenge that the primary purpose of a university education system is to enquire intellectual curiosity and inquiry (Webster and Kenney (2011). Being Creative and innovative help in problem solving which is an essential pre-requisite to specific knowledge and skills and a precursor to lifelong learning. Because we live in a world where a wealth of information can be accessed almost instantaneously, the development of generic research competencies beyond information acquisition is essential. Research requires much more than just information retrieval; it is the critical, analytical and integrative thinking that renders information valuable (Webster and Kenney (2011). (Baxter, 2000) observed "Deep understanding is not automatic, but instead requires engaged and sustained research, in which a thorough examination and interpretation of information is conducted within an ever-growing body of knowledge".

m. Students participation in Innovative Projects and Competitive events

Hillage and Pollard (1998) stated that the acceptability of graduates in an organization depended on the graduates' knowledge, skills and aptitudes. Nowadays employers want a graduate who is equipped with interactive, personal (Harvey, 2000) and generic skills (Hager et al., 2002). Participation in innovative projects and competitive events is one of the effective ways to develop communication, team and leadership skills alongwith technical skills.

n. Accreditation

The objectives of accreditation are to ensure that the institutions have developed and implemented best practices to attained the education quality level at par with the global requirements so that their graduated are easily employable as well as eligible for higher studies globally (Alani and Ilusanya 2008). This assures employers and other members of the community that the graduates of all academic programmes have achieved an acceptable level of core competencies in their areas of specialization. Further, it certifies to international community that the academic courses offered in an accredited universities are of high standards and that their graduates are adequate for employment and further studies.

7.3.1. Methodology

To understand the structural relationship among the enablers of competency building, Interpretative Structural Modelling (ISM) technique has been used. The technique helps to deal with complex issues like competency building and helps in decision making. It generates a dia-graph, a visual mapping of the system enablers to obtain new insights helpful for the decision maker. ISM incorporates pair wise comparison, transitive logic and concept synthesis to develop a visual map. ISM can be defined as a process that performs hazy and weakly articulated mental models into system and then into visible, well defined model useful for many purpose.

Some of the key statements which helps understand the ISM methodology has been given by various authors: According to them:

- It is a technique of analysis and decision support.
- It helps to study intricacies of a system
- It helps to understand various interactions among the variables.
- It incorporates experts' subjective judgement and their knowledge base in a systematic manner.
- It portrays the relationships among the elements.

- It generates a visual map of the situation that is used to obtain new insights and constructs new approaches to the problem.
- It consists of structural model that define the contextual relationship among many variables.
- It gives a hierarchy of the elements based on dependence and driving power of the variables
- It aids in identifying the most significant element which acts as enabler for the other elements.
- It is an efficient method to deal with complex matters but lack in theory building and not answer 'why' questions.
- It requires the links to be interpreted conceptually to define the contextual relationship among the elements as provided by the experts.

The structure of the ISM is based on the system requirements like (a) Element A should help achieve element B; (b) Element A may be equal or higher driving power than element B; (c) Element A would cause element B; (d) A should precede B and (e) A is a function of B.

The ISM technique was developed by Warfield (1973) and then various applications are reported by Malone (1975), Hawthrone and sage (1975), Waller (1980), Mandal and Deshmukh (1994), Sushil (1994), Lee (2007), Haleem and Susheel (2012), Agarwal and Vrat (2015).

To develop the ISM for the enablers of competency building, opinion of the experts and stakeholders of the technical higher education was sought to develop the contextual relationship among the pair of elements (enablers) and the logic behind their opinion is also recorded. The opinion regarding the relationship among pairs of enabler is recorded using alphabets 'A', 'V', 'X' and 'O'. Here 'V' expresses that element 'i' helps to achieve element j; 'A' express element 'j' helps in achieving element 'i'; 'X' indicates that the relation is both ways ie 'i' helps 'j' and also 'j' helps in achieving 'i' whereas 'O' denotes neither 'i' nor 'j' helps other. The process of developing ISM, step by step, is outlined below:

Step 1: Identify and define enablers: The first step is to identify and define the enablers which are helpful in achieving the objectives of competency building and employability. For this, enablers are drawn from the literature related to technical and higher education, empirical studies related to student, faculty and industry perceptions and papers related to quality aspects in higher education. Then experts opinion is taken to sort, combine, rename and selecting them for the present study. A total of 15 enablers are identified in the process.

Step 2: Define Contextual Relationship and develop Self Interaction Matrix: As stated above, once the enablers are identified, the next step is defining the contextual relationship between the enablers. For this, an input of experts and stakeholders are solicited and is shown in Table 1. In this four symbols namely V, A, X and O are used. This step make the logical relationship more transparent and thus prevent multiple and different interpretation.

Step 3: Reachability Matrix and Transitivity Check: The contextual relationship defined in step 2 are read logically and converted in to 1 and 0. Here 1 shows the presence of relationship and 0 shows otherwise. This is given in table 2. Table 2 is checked for transitivity rules to achieve the final reachability matrix as is given in Table 3.

Step 4: Partitioning the Reachability Matrix: The final reachability matrix achieved in step 3 is portioned into various levels depending upon the reachability and antecedent sets for each variable, which is known as partioning. This is achieved through a series of iterations and the final levels obtained are given in Table 4.

Step 5: Developing Diagraph: The results of partitioning of elements are arranged graphically, as per levels. This graph being directed called digraph is shown in Figure 7.1.

Step 6: Interpretative Matrix: A binary matrix is framed based on final digraph representing all the interactions by one entry and the interactions are interpreted through appropriate explanations from the knowledge data base.

Table 7.1: Structural self-interaction matrix

j ⟶

i ↓	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	-	X	X	X	V	A	A	V	V	V	V	V	V	V	A
2		-	O	A	O	A	O	V	V	V	V	O	O	O	A
3			-	O	O	A	A	V	V	V	V	O	V	V	A
4				-	X	A	O	V	V	V	V	V	V	V	A
5					-	A	O	X	X	V	V	V	V	V	A
6						-	V	V	V	V	V	V	V	V	V
7							-	V	V	V	V	O	O	V	A
8								-	V	V	X	V	V	V	A
9									-	V	X	X	X	V	A
10										-	A	A	A	A	A
11											-	A	A	V	A
12												-	V	V	A
13													-	V	A
14														-	A
15															-

V – for relation from I to j only;

A – for relation from j to I only;

X – for relation both from I to j and j to i; and

O – for no relation between factors I and j

Table 7.2: Initial reachability matrix

i, j	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	1	1	1	1	1	0	0	1	1	1	1	1	1	1	0
2	1	1	0	0	0	0	0	1	1	1	1	0	0	0	0
3	1	0	1	0	0	0	0	1	1	1	1	0	1	1	0
4	1	1	0	1	1	0	0	1	1	1	1	1	1	1	0
5	0	0	0	1	1	0	0	1	1	1	1	1	1	1	0
6	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
7	1	0	1	0	0	0	1	1	1	1	1	0	0	1	0
8	0	0	0	0	1	0	0	1	1	1	1	1	1	1	0
9	0	0	0	0	1	0	0	0	1	1	1	1	1	1	0
10	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
11	0	0	0	0	0	0	0	1	1	1	1	0	0	1	0
12	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0
13	0	0	0	0	0	0	0	0	1	1	1	0	1	1	0
14	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0
15	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1

Table 7.3: Final Reachability Matrix

i, j	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Driver Power
1	1	1	1	1	1	0	0	1	1	1	1	1	1	1	0	12
2	1	1	1*	1*	1*	0	0	1	1	1	1	1*	1*	1*	0	12
3	1	1*	1	1*	1*	0	0	1	1	1	1	1*	1	1	0	12
4	1	1	1*	1	1	0	0	1	1	1	1	1	1	1	0	12
5	1*	1*	0	1	1	0	0	1	1	1	1	1	1	1	0	11
6	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	15
7	1	1*	1	1*	1*	0	1	1	1	1	1	1*	1*	1	0	13
8	0	0	0	1*	1	0	0	1	1	1	1	1	1	1	0	9
9	0	0	0	1*	1	0	0	1*	1	1	1	1	1	1	0	9
10	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
11	0	0	0	0	1*	0	0	1	1	1	1	1*	1*	1	0	8
12	0	0	0	0	1*	0	0	1*	1	1	1	1	1	1	0	8
13	0	0	0	0	1*	0	0	1*	1	1	1	1*	1	1	0	8
14	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	2
15	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	14
Dependency	8	8	7	10	13	1	3	13	13	15	13	13	13	14	2	146

Table 7.4: Partition of reachability matrix: first iteration

Code	Reachability set	Antecedent set	Intersection set	Level
1	1,2,3,4,5,8,9,10,11,12,13,14,	1,2,3,4,5,6,7,15	1,2,3,4,5	
2	1,2,3,4,5,8,9,10,11,12,13,14,	1,2,3,4,5,6,7,15	1,2,3,4,5	
3	1,2,3,4,5,8,9,10,11,12,13,14,	1,2,3,4,6,7,15	1,2,3,4,	
4	1,2,3,4,5,8,9,10,11,12,13,14,	1,2,3,4,5,6,7,8,9,15	1,2,3,4,5,8,9	
5	1,2,4,5,8,9,10,11,12,13,14,	1,2,3,4,5,6,7,8,9,11,12,13,15	1,2,4,5,8,9,11,12,13	
6	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15	6	6	
7	1,2,3,4,5,7,8,9,10,11,12,13,14,	6,7,15	7	
8	4,5,8,9,10,11,12,13,14,	1,2,3,4,5,6,7,8,9,11,12,13,15	4,5,8,9,11,12,13	
9	4,5,8,9,10,11,12,13,14,	1,2,3,4,5,6,7,8,9,11,12,13,15	4,5,8,9,11,12,13	
10	10	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15	10	I
11	5,8,9,10,11,12,13,14,	1,2,3,4,5,6,7,8,9,11,12,13,15	5,8,9,11,12,13,	
12	5,8,9,10,11,12,13,14,	1,2,3,4,5,6,7,8,9,11,12,13,15	5,8,9,11,12,13	
13	5,8,9,10,11,12,13,14,	1,2,3,4,5,6,7,8,9,11,12,13,15	5,8,9,11,12,13	
14	10,14	1,2,3,4,5,6,7,8,9,11,12,13,14,15	14	
15	1,2,3,4,5,7,8,9,10,11,12,13,14,15	6,15	15	

Table 7.5: Levels of factors

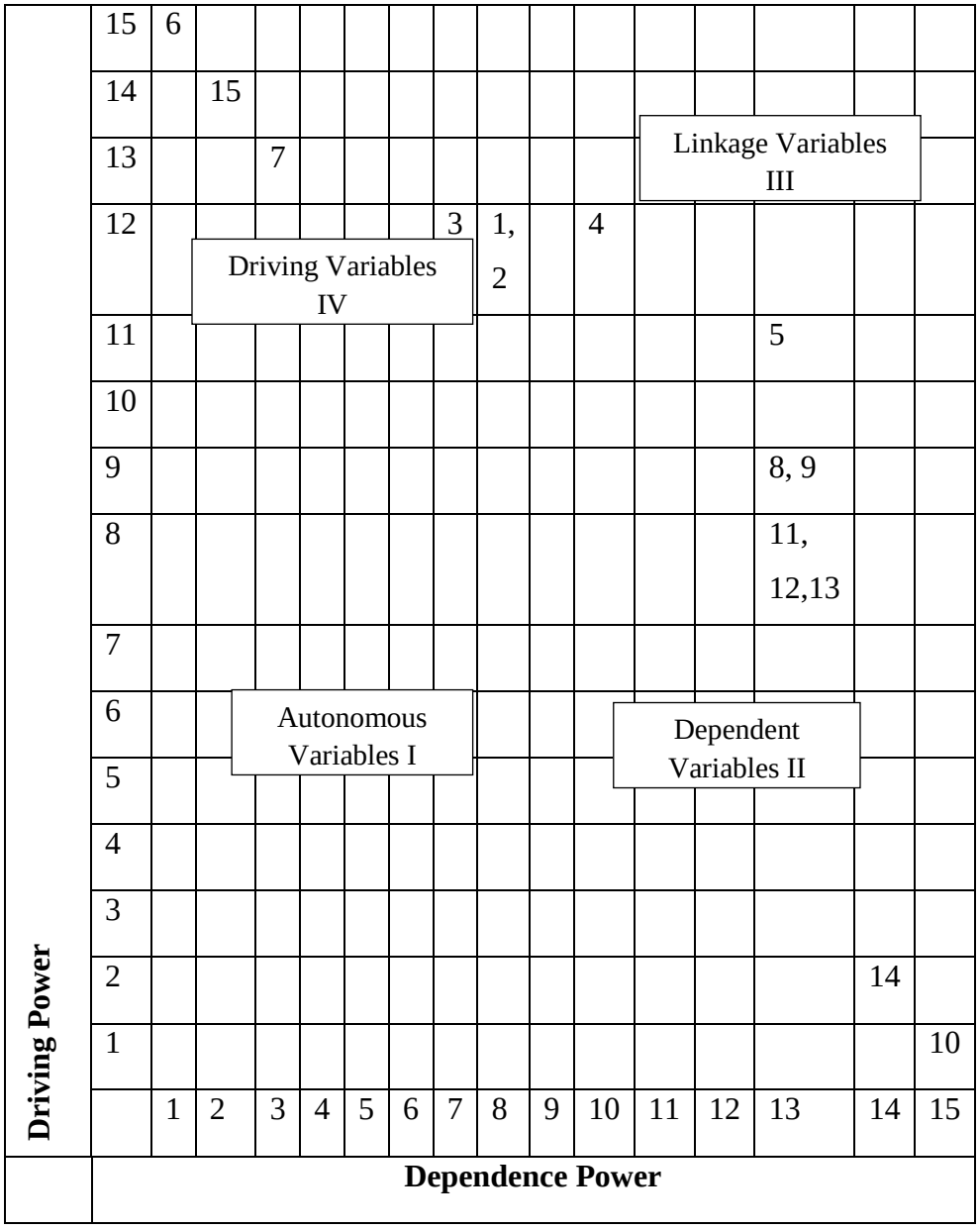
Code	Reachability set	Antecedent set	Intersection set	Level
1	3	3,6,7,15	3	IV
2	3	3,6,7,15	3	IV
3	3	3,6,7,15	3	IV

4	3	3,6,7,15	3	IV
5	1,2,4,5,8,9,11,12,13	1,2,3,4,5,6,7,8,9,11,12,13,15	1,2,4,5,8,9,11,12,13	III
6	6	6	6	VII
7	7	6,7,15	7	V
8	4,5,8,9,11,12,13	1,2,3,4,5,6,7,8,9,11,12,13,15	4,5,8,9,11,12,13	III
9	4,5,8,9,11,12,13	1,2,3,4,5,6,7,8,9,11,12,13,15	4,5,8,9,11,12,13	III
10	10	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15	10	I
11	5,8,9,11,12,13	1,2,3,4,5,6,7,8,9,11,12,13,15	5,8,9,11,12,13,	III
12	5,8,9,11,12,13	1,2,3,4,5,6,7,8,9,11,12,13,15	5,8,9,11,12,13	III
13	5,8,9,11,12,13	1,2,3,4,5,6,7,8,9,11,12,13,15	5,8,9,11,12,13	III
14	14	1,2,3,4,5,6,7,8,9,11,12,13,14,15	14	II
15	15	6,15	15	VI

7.3.2 MICMAC Analysis

The objective of Matrix of cross impact multiplication applied to Classification (MICMAC) analysis is to analyze the driver power and dependence power of enablers. Through this analysis, the enablers are classified into four clusters. The first cluster consists of autonomous variables, which have driving power and low dependence power. Second cluster consist of dependent enablers having strong dependence and weak driving power. In this cluster, the study has enablers like 10 and 14. The cluster 3 has linkage enablers having strong dependence and strong driving power. The enablers like 1,2,4,5,8,9,11,12 and 13 are part of this cluster. These enablers are unstable in the fact that any action on these enablers will have a effect on other variables and also they are affected by the action on other enablers. The fourth cluster includes the independent enablers having strong driving power and weak dependence. The enablers are the most important from the strategy point of view. Any improvement in these variables will positively affect the other variables and also helps in achieving the goals of the system.

Figure 7.1: Driving power- dependence diagram



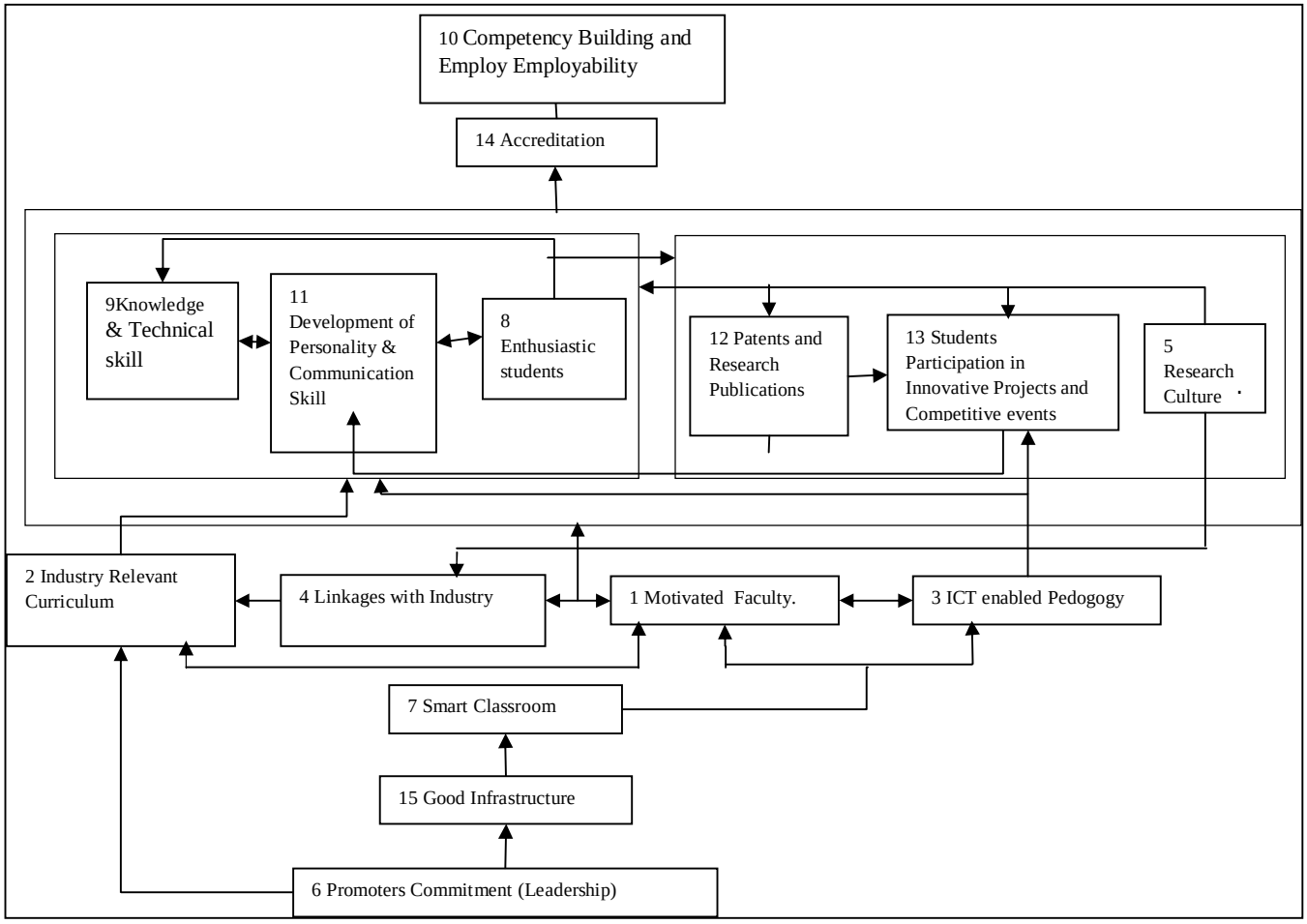


Figure 7.2 ISM MODEL

7.4 RESULTS AND IMPLICATIONS FOR EDUCATORS

The major objective of this paper is to identify the enablers which will help the academic institutions of higher learning to develop graduates who are not only good in basic understanding of their technical knowledge but also have skills suitable for attracting employment and become productive in the organization in a short period. By using the interpretive structural modelling approach, the study found for employability and competency building, Promoters commitment, good infrastructure, motivated faculty and linkage with industry are the major drivers.

The MICMAC analysis provides some important insights about the classification of the drivers, which will help the educators to focus on the significant factors and also can see and monitor their impact on other factors. Out of 15 enablers, nine turned out to be linkage variables. For example the investment in the infrastructure should be to build smart class rooms. Further the top management efforts should be directed to recruit good faculty, create a research culture and develop linkages with industry. Together, these efforts will help in developing industry relevant curriculum and ICT enabled pedagogy.

It can been observed from the ISM as given in Figure 2, knowledge and technical skills as core skill along with personality development and communication skills is required to enhance the capability leading to good employment. Students' participation innovative projects and competitive events also enhance their confidence and enthusiasm. Faculty is crucial and vital elements of any educational institution (Amzat and Idris 2012). The satisfaction and motivation of the faculty are considered as a primary requisite for a successful teaching learning process. It may be noted that this issue is a very complex phenomenon which involves several personal, institutional and social aspects. It is normally perceived that if the academic staff attains academic freedom, autonomy and adequate promotions in their jobs, they would be in a position to fulfill the institutional vision, mission and objectives and its outcome on national prosperity. Academic staff should be given their due credit and must be honored for their contribution in disseminating knowledge to students. Similarly, Jaime and Jamie (1999) concluded in their research done among the teachers in Ohio agriculture teaching staff, "there was a relationship between the achievement, responsibility, recognition, advancement, with the work itself and teaching staff job satisfaction".

7.5 CONCLUSION

Developing employable graduates in technical education institutions is the need of the hour globally and more so in India due to the rapid growth of technical education in last two decades and slow economic growth in last 4-5 years. This has been reported by several studies. This paper helps in identifying the focus area, i.e. the factors which have high driving power and

will improve the other linkage factors in achieving the goal of technical education which expects outcome based education and learning.

There are a number of different studies that suggest that there is a gap between skills acquired by information technology (IT) graduates and skills demanded by industry (Moreno, et al. 2012). Lee and Han (2008) analysed the IS 2002 model curriculum from the industry perspective, and suggested that the skills, like problem solving or knowledge of business should be included in the design of future IS curricula. Kim et al. (2006) also analysed the content of IS curricula sampling employees at one manufacturing firm and found that project management was the highest ranked skill. The topics like system security and end-user computing should be given greater emphasis in IS curricula. Aasheim et al. (2009) studies on "academia had a different perception of the importance of various skills for entry-level IT workers than IT managers", proposed that IT managers place more importance than faculty on issues related to hardware concepts, operating systems, leadership skills or entrepreneurial traits. However, both groups ranked broader categories of skills—interpersonal skills, technical skills, personal skills, organizational skills and work experience—in the same order of importance.

This paper provides a base framework to understand the issues of employability of graduates and their interdependencies. Further strategic framework can be developed for key factors to implement them in a time bound manner by optimal utilization of resources. This study may also be helpful to the faculty and trainers in rationalizing their pedagogy in such a way that a holistic view is incorporated which has components like technical skills or core knowledge, communication skills and social awareness about the need of society, research aptitude to analyse the complex problems and graduates having innovative and creative problem solving skills. It will be interesting to see that how these organizations that will focus their efforts in this direction and also the outcome base education and accreditations processes will help in improving the overall employability of the graduates.

CHAPTER 8

SUMMARY AND CONCLUSIONS

8.1 INTRODUCTION

The research reported in this thesis has made an attempt to study the quality, employability, skill development and knowledge creation in the technical institutions in India. To achieve the objectives expectations and perception of the three main stakeholders of the technical education, namely students, faculty and employers have been obtained using three structured questionnaire one each for each of the stakeholder and the responses are analyzed using both descriptive and inferential statistical techniques. Interpretative structural model is also developed to identify the drives of quality and employability in technical education.

8.2 SUMMARY OF RESULTS

- An extensive literature review to identify the gaps and relevant research issues of Technical Education
- Based on literature review and discussion with academicians and practitioners a questionnaire has been designed.
- Responses from 783 students, 401 faculty members and 63 from industry executives were used in the study.
- Responses are analyzed using descriptive and inferential statistics.
- Quality, Employability, skill development and knowledge creation were studied from the responses of students, faculty and industry.
- ISM based models has been develop for enablers of competency building and employability of students in engineering institutions.

8.3 MAJOR CONTRIBUTION OF THE RESEARCH

- A comprehensive review of the literature and identifies the contemporary research issues related to Quality, Employability, skill development and knowledge creation.
- The driving power and dependence of the enabler variables had been identified in order to improve competency building and employability of students in engineering institutions.

- Relationship between different institute attributes to understand the role of faculty, infrastructure and other inputs on skill development, employability etc.
- Factor analysis to identify the key factors responsible for quality of technical education in India.

8.4 KEY FINDINGS

- The students were asked to rank the 10 parameters for their institutes. A rank of 1 indicates that the presence of the parameter is highest and a rank of 10 indicates that the presence of the parameter is not upto the mark. The mean score of 11 institutions for the 10 parameters is given in Table 4.1. The Parameter 'Faculty' has scored the highest mean score of 2.86, followed by placements (3.62) and focus on skill development (3.78). The hostel facility scores the minimum at 6.45, the other on the minimum side are the location (5.93) and the research culture (5.30).
- The premier institution 'k' has the highest mean score of 1.6 for faculty, followed by placements (2.26) and focus on skill development (2.68). It also has good mean score for research culture (3.60), whereas another institution 'J' located in same geography as 'K' has faculty rank average of 4.70; placements 4.98 and research culture 5.04. It is interesting to observe the ranking of attributes of another institution 'A' in same geography but in self financing category. This institute has faculty rank of 3.58, placements 3.50 and research culture 5.35. The focus on skill development ranks for these institutions are 2.68 for K; 4.54 for J and 3.64 for A. It is clear that the skill development focus is closely associated with faculty ranking.
- The mean score for focus on skill development are not bad for the Institutions of the private sector as mentioned for Institutions A to G. It has emerged that student perception of good quality faculty, placements and focus on skill development is high in all categories of Institutions. This can be seen from admission trend in premier Institutions to Institutions in private sector. This study is supported by Sahney (2012) where technical institutions that contain quality academic activities have higher rank

whereas institutions having excessive non academic activities are on low rank side.

- The research culture and industry association are not being given due importance in most of the institutions. Both these practices require the proactive support of top management. The development of research culture needs good faculty followed by good research laboratories and freedom to pursue academic excellence. The industry association is important not only from placement perspective but also it helps all the academic activities starting with industry relevant curriculum, internships, industry projects and sharing of experiences and technical expertise by the industry executives.
- The two way plot between Faculty and Placements is given in figure 4.1. The plot indicates that the institutes having better rank for faculty also have a better rank for placements. It is also interesting to note that, as given in figure 4.2, the institutes having the high focus on the faculty have a low focus on infrastructure and vice a verse. On the other hand figure 4.3 shows that infrastructure has not much impact on placements. It is also indicated in figure 4.4 that a good faculty leads to a higher rank in skill development of the students.
- The following 7 factors identified

  Factor 1: Knowledge and competency building environment

  Factor 2: Human Resource of the Institute

  Factor 3: Infrastructure of the institute

  Factor 4: Personality Building activities

  Factor 5: Project and practical Training

  Factor 6: Examination processes

  Factor 7: Canteen and Recreational facilities

- The study also examined, analysed and understands the factors affecting perception of faculty members on various attributes of technical education in respect of quality of education and employability skills in technical education sector and after developing hypothesis, regression analysis carried out. The hypothesis developed are
  - There is no significant relationship between Faculty perception about available Infrastructure in Technical Institution with that of

the improvement in quality of education and employability skills in technical education sector.

- There is no significant relationship between Faculty perception about curriculum and teaching effectiveness of Technical Institution with that of the improvement in quality of education and employability skills in technical education sector.
- There is no significant relationship between Faculty perception about quality and motivation of faculty members of Technical Institution with that of the improvement in quality of education and employability skills in technical education sector
- There is no significant relationship between Faculty perception about knowledge creation with that of the improvement in quality of education and employability skills in technical education sector.
- There is no significant relationship between Faculty perception about skill development in Technical Institutions with that of the improvement in quality of education and employability skills in technical education sector

- In this above study the significant relationship established and, as per the opinion of the faculty members, the institutes give emphasis on clean environment, spacious and well-equipped classrooms and library with both digital and physical resources are required for effective teaching. The curriculum is another important component for providing quality education. It should be industry driven by using latest pedagogy. Faculty is the backbone of any academic institution.
- The Faculty is instrumental in providing communication skills, decision making skills etc along with technical and professional skills. In Indian engineering institutions the focus on knowledge generation and skill development is low despite having good faculty and talented students**.**
- It can been observed from the ISM as given in figure 7.2 knowledge and technical skills as core skill along with personality development and communication skills is required to enhance the capability leading to good employment. Students' participation innovative projects and competitive events also enhance their confidence and enthusiasm. Faculty is crucial and

vital elements of any educational institution (Amzat and Idris 2012). Their satisfaction and motivation are considered as a primary requisite for any successful teaching learning process by (Amzat and Idris 2012). This issue is a complex phenomenon involving various personal, institutional and social aspects.

- In the survey, the respondents have reported the location of their institute is good and the institutes have clean, spacious and well-equipped classrooms and are good for effective teaching. The institute's library offers wide range of resources for students is another high score attribute related to infrastructure
- In the survey faculty perceive that institutes provides support in organizing guest lecture from industry experts (score 4.2 on 5point scale), industry tours (3.83) and the institute provides opportunities to organize variety of co-curricular (talks, workshops etc) activities for students (4.07).
- The items 12-16 as mentioned in Table 5.6, related to industry interaction and placements shows the score ranging from 3.46 to 4.08, which is significantly higher than the moderate level at 5% significance level. The institutes have good infrastructure for placements and also have sufficient staff for placement activities. However, the survey shows that the collaboration with the industry need further strengthening.
- The items from 4-10 are related to competency building of the students for placements. The analysis shows that faculty and institute provide and support entrepreneurship, industry relevant assignments, internship, final year projects and industry feedback is also collected for improving these activities. The score of 3.49 for curricula and course content shows its relevance for industry.
- Since the knowledge is developing at a much faster pace and also getting outdated equally fast, getting connected with industry and keeping a tab on recent development will help in developing state of the art employable human resource.
- The quality and motivation of the faculty is essential for good academic processes and teaching- learning environment. The survey has got very high rating for faculty efforts in developing core/ basic knowledge in students

(4.16) and the institute are known for teaching expertise of the faculty (4.09). Further faculty is also making efforts to develop specialized/advanced knowledge in students and in developing desire for continuous learning in the students. Lee et al (2015) investigated teaching effectiveness in various ways such as classroom observation, peer evaluation and self-assessment. The study highlighted the place of teaching strategies and teacher attributes as key factors in effective teaching. In a study by Tang and Hussin (2011), effective teaching & learning has emerged as one of the constructs in quality education.

- In higher educational institutions, knowledge creation is one of the important activities for the development of faculty and keeping abreast the students in latest knowledge. The QS world ranking and Times higher education ranking have high weightage for research, consultancy and knowledge creation. The survey in Indian context also shows that faculty gets ambience conducive to research (3.51) in their institutions and institutions are known for academic research (3.64). The results further show that the focus on consultancy is relatively less.
- Rao (2014) investigated the gap between campus and industry among management and engineering students.
- Motivation of Taking Admission in Engineering: The students were asked to identify the three most important motivators out of the nine identified through literature review and discussions with educators and students. The results are very encouraging and to some extent counter intuitive. Gain technical knowledge has been identified as the most important motivator whereas general perception is getting immediate job offer with good salary.
- Percentage of students joining the job related to their branch: As shown in Table 4.6, students were asked to give their assessment regarding the percentage of students getting job in their area of study. The results shows that 25% students feel that only 25% students get job in their area of study. Another 26% feel that 50% students get job in their area of study. It is quite satisfying that more than 30% students feel that 75% students get job in their area of studies.

- Traits Developed by Education and Training: With the emergence of knowledge based and technology driven economies, we find a surge in the demand for highly skilled and technologically competent workforce. The powerhouses of the new global economy are innovation and ideas, creativity, skills and knowledge. These are now the tools for success and prosperity as much as natural resources and physical labour power were in the past century (Blunkett, 2000, para. 10). In this study, students observed that they have got technical skills (66%), personality development (47%) and communication skills (41%). More results are given in Table 4.7.
- To a question to explore the role of various curricular and co curricular activities in preparing them for career, students feel internship training (24.63%), class room training (22.05%), project and Assignments (21%) play the major role.
- Expectations of the students: To measure the expectations of the students, they were asked (a) most important criteria to consider oneself as successful, (b) Occupational characteristics desired by them, (c) what they want to do after graduation, (d) nature of job they may look for and (e) expectations from the job. The analysis of the responses on these issues is presented in Tables from 4.9 to 4.13.
- Highest number of the students (47%) consider respectable job as the most important criteria to them to be successful followed by service to the society (23%). Regarding occupational characteristics they consider growth opportunity, learning opportunity, innovation opportunity and money orientation in descending order of preference. Regarding the composition of job, technical skills, leadership role are the two most sought after roles by the students. Starting the career with a job (49.5%) is the most preferred way followed by higher studies (38.9%). This information can be useful for policy planner in starting post graduate programs in Universities.
- Table 6.1 shows that problem solving skills, design/ development of solution and ability to conduct investigations of complex problems are the three most important skills expected by the recruiters while selecting a candidate. In a way, these three skills together provide the necessary competency to the students to handle real life complex engineering

problems. It is difficult to understand why the importance is very low to the 'modern tool usage'. In academic institutions lot of emphasis is on new tools, software, analytical techniques.

- Further from the analysis, it appears that the industry is still not showing maturity by not appreciating the need of ethics, synergy between engineering and society; environment and sustainability etc.
- The figure 6.1gives the profile of the responses to A-H attributes on a five point likert scale. It is interesting to note that the executives have responded their expectations as very high to engineering knowledge, problem solving, design and development of solutions and ability to conduct investigations of complex engineering problem.
- In a complex real life business environment, it is the combination of skills, rather than one stand alone skills, that helps to perform efficiently and effectively. To understand the need of multiple skills requirements, correlation analysis is carried out and results are presented in table 6.2. The attribute engineering knowledge (A) has a strong correlation (significant at 0.01 level of significance) with design development of solution (C); modern tool usage (E) and synergy between engineering and society (F). Also seen a strong correlation of problem analysis (B) with design development of solution (C); ability to conduct investigations (D) and ethics (H).
- Design development of solution (C) has strong correlation with ability to conduct investigations (D). Ability to conduct investigations (D) in turn has strong correlation with ethics (H). Modern tool usage (E) has strong correlation with synergy between engineering and society (F) and also with environment and sustainability (G). This reflects that we need modern tools of engineering to address the issues of environment, sustainability and the much desired synergy with society. Further strong relations between F and G also between G and H show that environment, sustainability, ethics, synergy with society are inter related.

8.5 RECOMMENDATIONS

The study carried out is based on primary data collected for empirical study. The stake holders covered in study are student, faculty and employer, which need to be focused if improvement in quality of technical education required in terms of employability, skill development and knowledge competency. The outcome of study can be used by Institutions and government as policy maker.

8.5.1 For the Government

- As such government has initiated steps to promote quality of technical education & responsibility given to monitoring agencies like UGC, AICTE etc. The result of study indicates that student expects quality faculty & association of Institution with industry as placement is one of the important attribute. The students are facing employment problem and opined skill development as important attribute for technical education institution. The government can emphasis more on this front.

- The students of private institutions also of the opinion that quality of faculty, placement, skill development is the important attributes but research culture is missing in these institutions, which need to be given importance by the government.

- For good teaching learning process faculty expressed for availability of quality infrastructure including smart classrooms, laboratory and smart library. The faculty opined that institutions are lacking in LCD projector means ultramodern infrastructure need to be developed. The government need to promote ultramodern infrastructure in all the technical institutions.

- The Industry expectations from engineering graduates are on various attributes and considered problem solving skill and design and development of solution skill as most important. The Policy to be prepared that Institutions are closely working with industries. The requisite skill can be promoted by industrial training as compulsory part of syllabi The faculty from industry are engaged that students get knowledge of updated technology used in Industries. As such government is working on it and more focus can be given on implementation .This will

improve employability and more job opportunities to students that students with innovative ideas are always engaged by Industries besides their routine requirements.

8.5.2 For the Institutions

- Now a days, Government of India is making a lot of efforts that institutions are in competition mode. Since year 2015, MHRD has started National Institution ranking framework (NIRF).Almost all the attributes covered in present study are part of information to be provided for good ranking claim under NIRF.

- As indicated in study that students expects quality of faculty as most important attribute for being a good institution on academic front, the Institutions should put all efforts that quality faculty is recruited that their academic credentials are high and have capability to motivate students for research and innovations.

- The skill development and research culture also to be promoted for which ultramodern facilities to be developed in the institutions.

- The LCD projectors and other smart educational aid should be basic infrastructure in the institutions which includes digital library and IT infrastructure.

- The students to be trained as per requirement of industry and focus to be given that students are engaged in project work and industrial training that their problem solving skill and design/development of solution skill enhanced.

8. 6 LIMITATIONS OF RESEARCH

- Only eleven institutions have taken for the purpose of receiving responses from students and faculty.

- In this research, through ISM, a relationship model of various enablers of competency building and employability has been developed. Yet this model has not been statistically validated. Structural Equation Modeling

(SEM), has the capability of testing the validity of such hypothetical model

- The results of the research can't be generalized since it represents the data of only few institutions in India.

8.7 SCOPE OF FUTURE RESEARCH

- The study can be extended by taking responses from more number of institutions, especially southern part of India, which was the first geographical belt for self financing institutions and also facing the severe issue of enrollment.

- The relationship between various aspects of technical education and also between students and faculty perception can be done to get better understanding of the issues.

- There is further scope to perform comparative studies of quality issues of different sectors and geographies. This may includes self financing, public funding, rural, urban, old, new, accredited, non accredited.

8.8 CONCLUSION

An extensive literature review was carried out to identify the gaps and relevant research issues of Technical Education. Based on literature review and discussion with academicians and practitioners a questionnaire has been designed. Responses from 783 students, 401 faculty members and 63 from industry executives were used in the study. Responses are analyzed using descriptive and inferential statistics. Quality, Employability, skill development and knowledge creation were the major attributes which were studied based on the responses of students, faculty and industry.

ISM based model has been developed for determining the enablers of competency building and employability of students in engineering institutions. A comprehensive review of the literature and identifies the contemporary research issues related to Quality, Employability, skill development and knowledge creation. The driving power and dependence of the enabler

variables had been identified in order to improve competency building and employability of students in engineering institutions.

Relationship between different institute attributes was identified to understand the role of faculty, infrastructure and other inputs on skill development, employability etc. Factor analysis to identify the key factors responsible for quality of technical education in India.

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