

Employability Skills of Engineering Graduates - A continuously evolving "Set" for Sustainable Synergy between Industry and Institute Objectives

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Abstract

Graduate skills and employability discussions have continued to be a contentious issue for both - Universities and employers. The concerns of industry employers stem from their inability to acquire graduates with the requisite skills and competencies to effectively solve arising industry problems. This concern has led employers to cast blames on Higher Education Institutions (HEIs), who they feel are responsible for the development of skills which employers continuously seek from fresh graduates, more so when the current pandemic has kind of induced leaner organizations, work from home situations and stressful work environments. This paper capsules the various evolving skills that are mandated as an outcome of how this pandemic and other crisis situation at one point or the other has impacted industry and marketplace as a whole. It further identifies the present approaches of Universities and employers to develop / harness the required skills among fresh graduates.

The purpose of this study is to report the shift that Universities and employers must make in their approach in order to establish sustainable systems and methods that shall yield desired results despite any uncertainties.

Keywords: Employability, Graduates, Higher Education, Industry, Skills, Skill Gaps, Universities, Uncertainties, Sustainable

Background of the Study - Evolution of Industry and Education

Industry 1.0 marked the beginning of an industrial culture that focused on quality, productivity and scale. This was the era from the late 19th century to the 1980s, when industrial goods grew in volume and variety. Products for Industry 2.0 are still commonly used. By the beginning of the 20th century, electricity became the primary source of power. Eventually, there were machines which had their own power sources making them potable. Industry 2.0 marks the introduction of the second industrial revolution which is called the Technological revolution.

Industry 3.0 began with the first computer era (1970). Towards the first few decades of the 20th century, automated machines were possible with the invention and manufacturing of electronic devices like the transistor and IC chips. Industry 4.0 connects the Internet of Things (IOT) with manufacturing techniques to guide intelligent actions. It also has the introduction of cutting edge technologies including additive manufacturing, robotics, artificial intelligence, and other cognitive technologies, advanced materials and augmented reality.

The Covid-19 pandemic has made organizations rethink almost all strategies and policies which were created during the pre-covid times. The pandemic has pushed organizations to look for critical problem solvers who are agile, who can think out of the box and also who can manage crises. Several organizations have learnt many lessons and have made several changes in the skill sets that they look for in their future hires.

Some of the top skills employees need after Covid-19 is listed below

- 1 **Agility** : Organizations will now look for people who are Agile. Being 'Agile' means working in a highly responsive way so that one can deliver in the way the customer wants.
- 2 **Critical thinking** : Organizations will look for those who have the ability to think critically and also who can solve complex problems at ease.
- 3 **Managing people and managing stress** : The future workplace will have people who work from home and also will have those who work from the office. Stress has physical and emotional effects on an employee that can be positive or negative.
- 4 **Emotional intelligence** : Emotional intelligence is the ability to monitor one's own and other people's emotions.
- 5 **Cognitive flexibility** : Cognitive flexibility refers to the ability to switch between thinking about two different concepts or to think about multiple concepts simultaneously.
- 6 **Ability to inspire and motivate** : Delegation becoming the mantra for success and growing ability to trust and

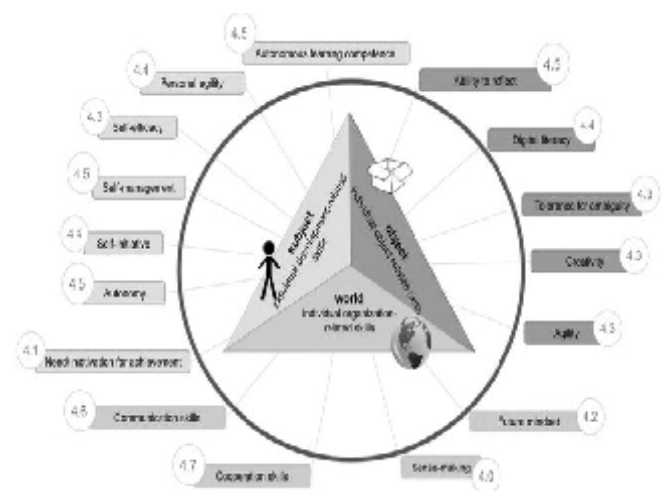
trustworthy individuals are key assets for any organizations to succeed.

Evolution of Indian Universities and the Education Policies

A committee headed by India's second independent president Dr. S. Radhakrishnan in 1948 tried to reorganize the old policies and try to adapt them to the present and the future. The commission also aimed at creating Universities which would provide knowledge and wisdom for an inclusive development of the personality of students. The Kothari Commission in 1966, the National Education Policy 1968 which was entrusted with the tasks of dealing with all aspects and sectors of education and to advise the government on the evolution of national system of education and then 1986, which was amended in 1992 (1986/92). The 3rd NEP in 2019, after a long period of almost 18 years, and the provisions therein, were the key moves in the evolution of education reforms in India in order to shape policies in accordance with evolving challenges.

Higher Education 4.0 puts the learner at the center and enables the student to choose their mode of higher education by structuring an individual path to achieve individual goals. It is both – collaborative and personalized learning – from home, workplace and both.

Figure 1: Triangle Diagram of Higher Education 4.0 [Source: International Report on Future Skills Released, 15 March, 2019]



In line with this and with much thinking from the Indian government, National Education Policy 2020 has been launched. The education philosophy given is extremely broad, circumspect, and detailed

Engineering Education in India

India has one of the world's greatest numbers of engineers. In India, undergraduate and graduate courses in engineering, applied engineering, and science are offered by many technical Colleges. Independent public science and engineering Universities in India are the Indian Institutes of Technology (IIT), and National Institutes of Technology (NIT).

India has total 6,214 engineering and technology institutions in which around 2.9 million students are enrolled. Every year, on an average 1.5 million students get their degree in engineering, but due to lack of skill required to perform technical jobs less than 20 percent get employment in their core domain.

Curriculum and Pedagogy in Technical Education

Engineering pedagogy is aimed at developing higher-order thought ability, familiarizing and incorporating digital learning pedagogy into teaching, and interacting effectively in the classroom (Remadevi & Ravi Kumar, 2015). Education and pedagogy is aimed at reducing rote learning and facilitating holistic development and abilities such as critical thought, imagination, scientific temperament, teamwork, cooperation, multilingualism, computer science fundamentals, data modeling, probability and statistics, system design, soft skills, leadership, management and communication in the 21st century.

Policies and Practices of HEIS and Government in the Direction of Making the Graduates both - Employable and Contributory

AICTE, Central Government and various State Governments have implemented various policies to improve employability skills as well as for providing job givers to the society rather than providing job seekers.

1 Implementation of Design Thinking Approach

The Design Thinking methodology has been rapidly adopted by some of the world's largest brands such as

Apple, Google, Samsung, and GE and Design Thinking is taught at the world's leading Universities, including colleges like Stanford, Harvard, MIT, and GTU (Gujarat Technological University – India).

This course is meant to nurture the creativity and innovation quotient among the engineering graduates for solving complex problems and designing a better solution. The course is designed to understand the Design Thinking methodology with tools and techniques applicable for problem solving and innovation through theory sessions, hands-on practices, project on real issues, case studies which improve critical thinking skills.

Critical thinking is the ability to think clearly and rationally, understanding the logical connection between ideas. (Skill You Need).

Agility and critical thinking skills can be developed using this initiative.

2 Implementation of Personality Development Courses

Courses for personality growth are meant to instill core values, develop inner character, boost morale, and promote critical and innovative thought. This makes it possible for students to enjoy, understand and practice invaluable lessons and to develop the skills to create a brighter future.

This course has intended to help a person learn and understand their role in life, have a positive pattern of thought, build trust, strengthen their actions, connect better, and establish a balanced body at its heart with morals and ethics.

Contributor Personality Development Program: The main objective of the Contributor Personality Development Program is to equip students with not only right skills but also the right mindsets. The Combination of effectiveness with human values is crystallized in the concept of “contributor ship”. (Gujarat Technological University).

Agility, managing stress and managing people, emotional intelligence and ability to inspire and motivate skills can be developed using this initiative.

3 Implementation of Vishwakarma Yojana

Vishwakarma Yojana has included a "Design to Delivery" solution in "Rurban" areas for village growth. Physical infrastructure, social and renewable energy sources for sustainable development are mainly part of development work in the villages that can be carried out according to the needs of the village. Under this scheme, the technical schools of Gujarat Technological University have adopted villages in the 'Rurban' district.

The contribution and the hard work put up by the GTU Students has made this project going on a smooth sail and indeed it is a huge success. Pond development & sunset point development is already implemented in the Ahwa village of Dang district by the authorities. Also the design proposed by students is going to be implemented by village authorities of Bholav, Zadeshwar, & Palej villages.

Cognitive flexibility skill can be developed using this initiative.

4 Implementation of New Internship Policy

Internships are opportunities for education enhancement and career advancement that provide practical experience in a field or discipline. These are organized, brief, and supervised internships, often based on specified deadlines for specific tasks or projects. In order to develop skilled professionals for the industry, introduction of engineering students to the manufacturing environment that cannot be replicated in the classroom, has provided opportunities to learn to understand and enhance technological / management skills on time.

Imagination is the base of innovation. So we should nurture the soft skills and talent of the students to lead their imagination in a proper way. Gujarat Technological University, through GTU Innovation Councils has established close bonding between industries, entrepreneur and students to make research and development at the University relevant to the needs of industries at national and international levels.

Agility, managing people and cognitive flexibility skills can be developed using this initiative.

5 Student Start-up and Innovation Policy

The Government of Gujarat's Innovation Policy for Businesses and Students aims to create an integrated, National level and University level innovation ecosystem to promote young students' inventions and ideas and provide an atmosphere conducive to the optimum use of their innovative activities.

Agility, critical thinking, managing people and managing stress, cognitive flexibility and ability to inspire and motivate skills can be developed using this initiative.

6 Innovation Councils

The foundation of creativity is imagination. So, at Innovation Councils, they have developed the social skills and abilities of students to guide their imaginations properly. Innovation Councils are designed to build strong ties between businesses, entrepreneurs and students to make University research and development important and useful nationally and internationally to the needs of industries.

Critical thinking and ability to inspire and motivate skills can be developed using this initiative.

7 Smart India Hackathon

Smart India Hackathon is a national initiative that aims to provide a forum for students to solve some of the pressing issues facing us in our everyday lives and thus build a product innovation culture and a solution-oriented mindset. The first three editions of SIH2017, SIH2018, and SIH2019 have proven to be extremely effective in fostering innovation among young people, especially engineering students from all over India.

Agility, critical thinking, cognitive flexibility and ability to inspire and motivate skills can be developed using this initiative.

8 Centre for Entrepreneurship Development

The Center for Entrepreneurship Development (CED) was established in 1993 and is an independent research and development, training and advisory organization specializing in entrepreneurial and development-related fields. CED has collaboration on environmental and sustainable development studies, technical advancement and technology transfer with Universities, R&D institutions, and development

agencies in India and abroad. Gujarat Technological University works closely with CED.

Agility, critical thinking, managing people and managing stress, cognitive flexibility and ability to inspire and motivate skills can be developed using this initiative.

Research Objectives

While, on one hand, the government, various other organizations and also the Universities are designing and implementing a variety of initiatives to make engineering graduates employable, there was a need to analyse whether the employers and graduate students of engineering are really reaping benefits of the same. It was important to validate whether the faculty members of engineering Schools are participating in making the required benefits coming through.

Primary Objectives:

- To analyze the gap between perceptions of faculty members and recruiters regarding employability skills.
- To suggest measures for creating employable engineers.

Secondary Objectives:

- To summarise the initiatives taken by various stakeholders in making engineering graduates employable and the employability skills aimed at being developed.
- To analyse what and how dynamics of industry dictate expectations in terms of employability skills in students' of engineering, more so after the covid-19 pandemic.
- To observe current engineering education practices.

Research Methodology and Analysis

On the basis of above discussion at point 5 regarding stakeholders contribution to contribute to the employability skills of engineering graduates and based on the literature

review discussing emergent attributes on account of covid situation a focus group was conducted with final year students of engineering, faculty members of engineering Institutes and recruiters' expectations of employability skills set. The following are the derivations:

A total sum of non – technical attributes : A total sum of attributes beyond technical knowledge, that have been aimed to be instilled in students of engineering are : Honesty, Integrity and Dependableness, Reliability, Teamwork, Willingness to Learn, Entrepreneurship, Self-Discipline, Self-Motivation, Flexibility and adaptability, Understanding and ability to take directions for work assignments, Use of appropriate modern tools / equipment / technologies, Written Communication (in English), Applying knowledge of Mathematics, Science and Engineering, Creativity, Reading, Data analysis and Interpretation, Verbal Communication (in English), Basic Computer skills, Problem Solving, Empathy, Systems Design, Process designing, Business awareness/ Knowledge of contemporary Issues, Advanced Computer and Customer Service Skill.

After identifying above employability skills a survey has been conducted on faculty members (N=68) and recruiters (N=41) to know the perceptions of both of them regarding employability skills

Given below is a comparison of the importance of skills/attributes, expressed by these two groups. The mean scores of importance for different skills range from 2.7647 to 1.8382 for faculty group and from 2.878 to 1.8049 to employer group, indicating, all the skills fell well above half way between 'important' and 'very important' category. Table 1 below gives the skills that found place among the top ten positions, as per the total score received on importance. In Table 2 are listed the other skills / attributes that have also been found to be adding on to the employability potential of engineering graduates.

Table 1 Skills/Attributes under the 'Top Ten' Category, in the Order of Importance

Faculty Perspective N=68			Rank	Employer Perspective N=41		
Total Score	Mean Score	Skill/Attribute		Skill/Attribute	Mean Score	Total Score
188	2.7647	Problem Solving Skill	1	Honesty, Integrity and Dependableness	2.878	118
185	2.7206	Honesty, Integrity and Dependableness Teamwork	2	Teamwork	2.8537	117

Faculty Perspective N=68			Rank	Employer Perspective N=41		
Total Score	Mean Score	Skill/Attribute		Skill/Attribute	Mean Score	Total Score
181	2.6618	Data analysis and Interpretation	3	Reliability Problem Solving Skill	2.7805	114
180	2.6471	Self-Discipline	4	Understands and takes direction for work assignments	2.7317	112
179	2.6323	Self-Motivation	5	Basic Computer	2.7073	111
178	2.6176	Willingness to Learn	6	Self-Discipline	2.6829	110
177	2.6029	Verbal Communication in English	7	Willingness to Learn	2.6341	108
173	2.5441	Apply Knowledge of Mathematics , Science and Engineering	8	Data Analysis and Interpretation	2.6097	107
170	2.5	Basic Computer	9	Self-Motivation	2.5854	106
169	2.4853	Self-Awareness	10	Flexibility and Adaptability	2.5610	105

Findings

We can see the gap in terms of priority; faculty members have given highest priority to Problem Solving Skill while recruiters have given highest priority to Honesty, Integrity and Dependableness. Same way faculty members have given lowest priority to Self-Awareness while recruiters have given lowest priority to Flexibility and Adaptability.

Agility, critical thinking, managing people and managing stress, emotional intelligence, cognitive flexibility and ability to inspire and motivate are the top skills employees need after COVID-19 and various stakeholders have taken initiatives to develop these skills among engineering graduates.

Conclusion

Developing the employability skills of students, as we have seen from these different sources and facts, is a process that needs the utmost dedication of faculty members under the clear vision of Institutions. It takes strategic action, commitment, and cooperation with various stakeholders at different levels to qualitatively raise the level of these skills, achieve global levels, and sustain and improve these skills. The unthinkable becomes possible with a powerful political and social will to do it.

Looking to the results of the study we can say that, Institutes/ faculty members have appreciated the need to improve the employability skills of engineering students.

All the same, the gaps still remains between what the employers expect and what the Institution imparts. This gap needs to be addresses urgently, the priorities of Industry and Academia need to be aligned and matched urgently otherwise this will continue to pose as a very strong hurdle in the process of economic development of our country.

Recommendations to Faculty Members of Engineering Institutes

A dedicated faculty should

1. Establish and maintain an effective industry engagement as part of the faculty culture, with
 - People, processes and resources to ensure strong relationships with the industry;
 - Structural and development support for academics to engage in industry;
 - Employ engineers with industry experience to facilitate student learning;
 - Structured and transparent industry consultation.
2. Use industry-based assignments in engineering programs.
3. Give engineering students great opportunities to work and learn in the industry.
4. Give most students the opportunity to complete industry-based end-of-year projects.
5. Support and acknowledge the industry engagement of student groups.

Recommendations to Employers

Establishing and upholding principles of mutual benefit is of paramount importance. Employers' organizations should:

1. Provide a regular and structured orientation to engineering students and academicians on what and how students can be made employable.
2. Provide for immersion assignments for both students and faculty members of engineering Institutes.

The Way Ahead: Scope for Further Study

India will have labor surplus and will be a large supplier of skilled manpower to labor – deficit markets around the world like UK, Russia, Japan, China, and U.S. etc. While Covid conditions would have been one of its kind and would hopefully occur once in many decades, However, business conditions, market characteristics, technology definitions and applications are all being re-defined and at a very unprecedented pace. Exigencies, emergencies, unexpected and sometime ill-defined paradigms are what the future of businesses hold for the future and yet the show must go on..

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