Employability of Engineering Graduates in India

A View from IUCEE ITF Community

(Draft White Paper)

IUCEE ITF Team

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Overview

In the past two decades, engineering education in India has been transforming significantly with meteoric rise in the supply of engineering graduates to the market. However, the perceived gap between Indian industry, which is the largest demand for these graduates and the capability of graduates seems to be increasing. While recent studies show that 60 % of engineering graduates are unemployable, a 2016 skills report indicates about 52 %. It is evident that not only is the gap between industry and academia huge, it is increasing annually. The intent of this white paper is to examine:

a) the issue of employability and identify specific root causes.
b) suggest some ways to address the issue in a holistic manner

We would be involving all key stakeholders namely the industry, institutions and the students.

This initial activity has been conducted by a group of Industry practitioners (called ITF or Industry Teaching Fellows) in collaboration with IUCEE which is spearheading the initiative to improve quality of engineering education in India jointly with international experts. The white paper needs to be seen as "thought consolidation" exercise which must be built upon and explored further.

1.0 Brief Description of Employability

According to Wikipedia, **Employability** can be defined as "doing **value creating work**, getting paid for it and **learning at the same time**, **enhancing the ability to get work in the future**". A lot of studies have been conducted around the world on defining employability skills and industry expectations. A few of these studies from universities and the work done by STEMNET (a UK based educational charity) have reached similar conclusions on employability skills. According to STEMNET, which conducted a survey among several UK employers, following are the 10 key skills expected by the employers

1. Communication and Interpersonal Skills
2. Problem Solving Skills
3. Initiative and Self-Motivation
4. Time Management and Stress Management
5. Organizational Skills
6. Team work
7. Ability to learn and adopt
8. Ability to use data and Mathematics to support information
9. Diversity and valuing differences
10. Negotiation Skills

In order to support employers to measure some of these skills, organizations like Aspiring minds (http://www.aspiringminds.com/) have developed assessment methods. It is not clear from our study, how popular these methods are with the industry. Besides, these are lagging metrics. For colleges to succeed in maturing employability skills, we need to help them with leading metrics. Similarly, AICTE (All India Council for Technical Education) has also listed similar skillsets under categories of "managerial skills, entrepreneurial skills, leadership skills, communication skills and team-working skills" and mandated colleges and universities to impart these skills from the beginning. For example following

table shows some of the widely accepted and endorsed skills by Colleges as suggested by agencies such as NBA.

Attributes of Undergraduate Engineering Education			
1	Engineering Knowledge	7	Environment and Sustainability
2	Problem Analysis	8	Ethics
3	Design and Development Solution	9	Individual and Team Work
4	Conduct Investigation of Complex Problems	10	Communication
5	Modern Tool Usage	11	Project Management and Finance
6	The Engineer and Society	12	Life Long Learning

Technical skills and knowledge of core engineering is assumed to be fundamental to gain employment but the above skills are required to be employable in a job. ITF team from IUCEE studied various other sources and found a lot of similarity in expectations from the employers. We also observed from various reports that today's job market requires approximately 30 % technical skills and about 70 % soft or professional skills to succeed. These findings may be summarized as three core type of skills required to be employable

a) Technical Skills which consists of core knowledge of the field, its application, programming skills and ability to learn from basics
b) Soft or professional Skills which consists of majority of STEM skills listed above including critical thinking and problem solving skills
c) Professional Attitude which includes some of the STEM skills listed above plus a few additional skills such as ethics, integrity and ownership

As the spotlight on employability is increasing, many institutions in India and the regulatory bodies are aware of these skills gap. Sporadic efforts have also been seen at measuring these skills through psychometric tests, aptitude tests and QS ratings.

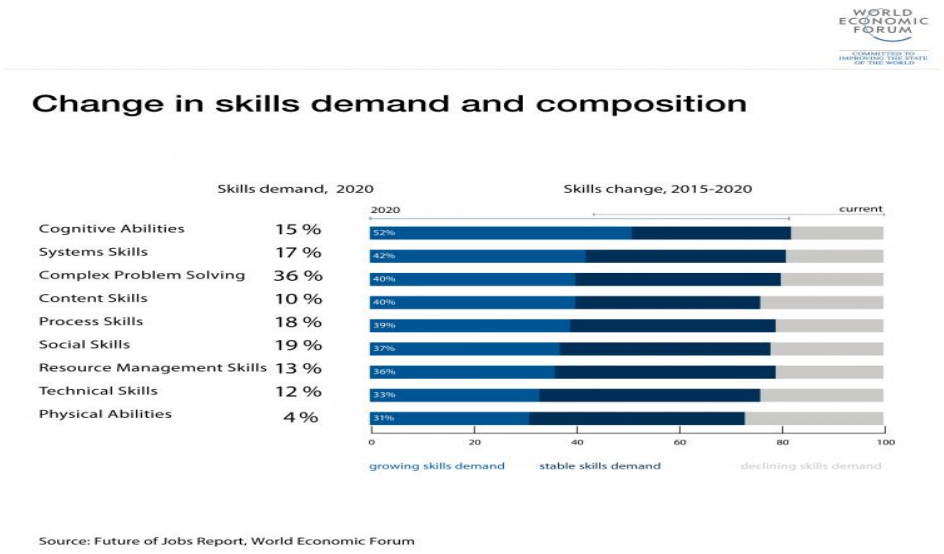

Figure 1 : Employability landscape shift in the next 5 years

Recent World Economic Forum studies on employability skills in relation to accelerated innovation cycles point out that over the next 5-10 years, skill demands would change significantly (Figure 1). Key technology trends driven by AI, Big Data, IoT and Could Computing require engineers to develop not only above skills but higher order cognitive skills. A few years ago, World Economic Forum published a report on “Future of Jobs” which detailed how skill requirement would morph over the next decade. The report concluded that cognitive ability, systems thinking and complex problem solving would be a few of the top skills that today’s education system must address.

2.0 Key Issues – MHRD perspective and ITF Opinions

Given that 60% of the 8 lakh engineers graduating from technical institutions across the country every year remain unemployed and AICTE (All India Council for Technical Education) under MHRD, targets immediate improvement of employability to 60%, it ought to welcome every support that it can muster. Additionally as MHRD plans a major revamp of India's technical education through multiple initiatives, it stands to gain by leveraging well established ongoing programs of IUCEE and initiatives by ITFs, to address the **defined issues** as listed below**:**

Issue 1: *Supply of Engineering Graduates exceeds our today’s national demand.*.

We believe this is a good situation to be in. Our Government is trying to create Engineering jobs in India through its ‘Make in India’ and through all the infrastructure work that we need to design and build. If we had a shortage of engineering talent in the country when we needed it most, that would be a very big handicap. On the other hand if we have well qualified talent, they have opportunities also in International Market, provided they learn the attributes expected from engineering graduates.

ITFs being in the thick of experiencing ever changing business profiles, their related pitfalls and pain-areas are tuned in to find and implement innovative solutions. They are therefore well suited to teach, coach or mentor students and academic fraternity to inculcate the required adaptability.

Issue: *Raise the talent of Engineering Graduates and make them Industry ready*.

The Engineering colleges and Institutions historically have developed its curricula to meet Industries’ technical needs. Over the years colleges have also included ‘hands on training’ to their graduates through summer internships, Co-ops, doing some industry related projects, etc. These changes made by the academics have always been appreciated by Industry who is the recipient of these graduates. However the changes in curriculum need to be more dynamic to keep pace with ever changing needs of industry. This can be achieved by suitable adaptation in curriculum with focus on **3Is** (**I**nteractive, **I**nnovative, **I**nter-disciplinary) besides the conventional **3Rs** (**R**eading, w**R**iting, a**R**ithmatic).

Thus in addition to excellent technical education, in order to make the engineers more compatible for walking through Industry doors, they also need to develop professional skills and proper attitude for work which they otherwise tend to acquire over an year or two. Some institutions like Amrita University has added course work for these skills and have seen improvements in their employability numbers.

ITFs can contribute to achieve this by volunteering to join the BOS (Board Of Studies) of academic institutions. Additionally they can deliver specialized credit courses, covering industry needs related to the engineering streams. Using their decades of practical experience the ITFs can coach or mentor engineering students to imbibe in them such attitude and grasp the essence of transferable skills, in order to develop them on their own. Prevalent platforms of AICTE may well be used by ITFs / Experienced Professionals to further this cause.

AICTE link: http://www.aicte-india.org/downloads/adjunct2.pdf

MHRD Link: http://mhrd.gov.in/sites/upload_files/mhrd/files/GuidelinesFacultyHiring.pdf

Issue: *Just 15% of engineering programs offered by 3,200+ institutions are NBA accredited - to be raised to50% by 2022.*

To assure consistence Quality and Relevance of Education, accreditation to NBA is indeed the way forward. However to bridge the big gap more resources and programs need to be in place.
The percolation of IUCEE Gurukul program and its adoption by several Engineering Institutions is a propitious development. Further, providing platforms for sharing best practices through Faculty Conclaves has added momentum not only to raise the standard of technical education but also support accreditation.

Issue: *Making annual teacher training as mandatory for engineering faculty.*

The IIEECP (IUCEE International Engineering Educators Certification Program) for training and certification of faculty to learn, adopt, and use effectively multiple ways of imparting engineering education, can perfectly fill this need. A very effective way of raising the aptitude of engineering faculty is provide them platforms for sharing best practices on the transformation that they plan and their achievements, within their fraternity.

The research papers on education presented at the ICTIEE (International Conference on Transformations in Engineering Education), is a great platform to collate the advancements achieved and those in progress.

A 'working group' set up to effectively utilize the suggestions made in such Research Papers as a pilot in few progressive Engineering Institutes with their management consent, can help to widen its reach through engineering faculty. ITFs' involvement in such working group can enhance deployment of such pilots and foster its spread.

Issue: *Ensure that 75% of the students get industry exposure in the form of summer internships*.

ITFs associated with IUCEE can provide coaching to faculty and students in formulating internship programs that cover the basic curriculum and are relevant to industry. Besides providing more internship opportunities, this will make the internship more effective to the students and garner resources for industry.

The gap between lower demand and much higher supply of Engineering Graduates can be better perceived and addressed, through AICTE's Industry Institute Partnership Cell (IIPC) and systematic involvement of Industry Members with Engineering Institutes, preferably by Industry Associations like CII 'Confederation of Indian Industry' under their I3 (Industry Institute Interaction) activities.

Issue: *Only about a third of our Engineering graduates from Tier 2 & 3 engineering colleges are gainfully employed.*

The mandate for Tier 1 engineering institutions to coach at least ten Tier 2 & 3 engineering colleges through faculty time-sharing or deputation is nice as a perspective. However the Tier 1 colleges themselves are short of faculty and would certainly require additional resources to fulfill such add-on obligations. ITFs located in geographical proximity can be of help to fill-in such gaps.

3.0 Industry Perspective

As industries in India compete globally, need for essential and high end skills continue to increase and employability of core engineering graduates would be a key issue at the bottom of the pyramid. Indian industries may be classified into 3 major segments – a) Manufacturing or Product Industries which develop products, whether hardware or software b) MNC R&D and Engineering organizations which support engineering programs for global customers including India and c) Engineering and IT Service providers who support a) and b) above working together as partners in the eco-system. A bulk of Indian Engineering graduates get absorbed in the industry in one of these segments.

Each of these industries, depending on the nature of their business, ha~~ve~~ developed their in-house "academic-to-industry" transition programs. These programs range from 3 months to 1 year duration. Although there is no quantitative data about incubation period for productivity of new engineering graduates, it is generally observed that this period ranges from 1 to 3 years. Often industries consider this as a major investment for lack of stronger alternatives.

From industry perspective, employability of engineering graduates goes beyond securing a job and includes time period to become reasonably productive towards output of the organization. A strong effort to reduce this incubation period would be in the interests of the industry. Thus, roping in industry expertise to assist upgrading employability of graduates should be widely acceptable to the industry. Efforts of IUCEE in the last few years, to connect industry and academia through ITF has had reasonable success among member institutions. However, in order to sustain this initiative in the longer run, it is imperative that we set up a structured mechanism to accomplish this by involving all stakeholders including regulatory bodies such as AICTE in this process

4.0 Institutional Efforts – Initiatives from selected institutes

Over the last 2-3 years, ITF group has been interacting with several IUCEE member institutions. Many of them are actively pursuing initiatives to enhance core employability skills of their graduate engineers. It is also apparent that many of these efforts have some common threads across the institutions and have led to visible successes. Notable among these institutions are KLE University, Thiagaraja College of Engineering and VIT University. Listed below are a few of these initiatives and these may be considered as best practices for other institutions to follow. By no means, this is an exhaustive list

a) Leadership and governance model – A strong board and academic council with passion and freedom to try new initiatives and question the status quo. Quick implementation of these initiatives.
b) Curriculum Innovation – Introduction of engineering exploration projects in first year and multi-disciplinary projects in 4th year.
c) Industry involvement in the curriculum – Involvement of industry experts in board of studies and courses taught by industry experts either independently or jointly with a faculty
d) Funding for faculty for industry internships
e) Identification of socially relevant projects with interdisciplinary participation
f) Generative role in regional development: Attract and support external entrepreneurs. Introduction of minor in Entrepreneurship.
g) Research experience for undergraduate students

h) Unique R&D theme for each department with structural change from top-down to lateral
i) Setting up of center for educational research and propagating best practices across departments
j) Global benchmarking of the university with surveys from students, international faculty and advisory board
k) Strong alumni network with participation of alumni in development of the institute
l) Tech events such as SAE Baja, hackathons etc.. with evaluation from the industry

5.0 ITF Suggestions – Short Term Engagement Action

Over the last 2-3 years, IUCEE ITF group has acted as a "think-tank" for generating a lot of ideas to improve employability. The initiative started with a "personal story with suggestions" from ITF members to IUCEE member colleges which have been archived. Following this, IUCEE has launched several initiatives such as "Gurukul" with member colleges to assist them in improving quality of education. ITF continues to meet on a regular basis and brainstorm on this important topic to develop suggestions. In addition, IUCEE has acted as a nodal agency to rope in industrial expertise in these initiatives. Following table is a consolidation of several of these suggestions with a focus on improving employability

Skill	Perceived Gap	Possible Reasons	Potential Fixes
Foundation Technical skills	Strong fundamentals in core areas of study – Know the concept, not the details, nor applicability	a) Courses not application-oriented b) Faculty not experienced in applications c) Little internships for students	a) co-teach core courses with a ITF b) Allow faculty internships in industry c) Increase student internships
Soft Skills such as communication, presentation skills, team skills, organization skills, initiative etc..	a) Poor technical communication skills b) Ability to independently organize their work and complete on-time c) Doing things beyond "just what's asked"	a) No focus on humanities courses b) Few opportunities to build other soft skills c) No "extra credit" concept for doing things beyond what's asked	a) Mandatory course in technical and communicative English b) PM and Activity Management course c) Tailor course to credit "initiative"
Complex Problem Solving skills	a) Inability to solve problems that go beyond one area of expertise b) Lack of structure in problem solving	a) Limited exposure to such projects b) No training in structured problem solving methods	a) Introduce course projects which are multi-disciplinary (collaborate) b) 1 credit course on system-level structured problem solving

Currently, a lot of Tier 1 and Tier 2 institutions in India already engage with industries actively. Most of these initiatives are voluntary or driven by initiatives taken by the colleges themselves. In our opinion, this constitutes possibly a small percentage of colleges which produce the top 20-30 % of highly employable graduates. If this model needs to spread across majority of the institutions, following are a few of the suggested ideas to accomplish this.

1. AICTE- website includes Scheme and format for application for Adjunct Professor : (XX) Web link is: http://www.aicte-india.org/Adjunct_Faculty.php. AICTE- Chairman has also announced the policy for COE's to utilize the Industry Experts as Adjunct Professors up to20% of the strength of Faculty Members.

    a) COE's of beyond Top 100 may like to utilize this resource from ITF's of IUCEE on mutually convenient basis. Purpose could be dual : **I)** Industry Expert provides structured inputs of Industry Expectations especially the gaps and if possible gap analysis and **II)** ITF's may be useful in boosting the placement through their connections and may take steps such as Sponsored Mini Projects(3rd year); Final year Project (4th year), internships etc. till initiation of Campus Interviews etc.

    b) Upon due confirmation from AICTE for acceptability of this point, in principle ITF's and others with Industry background who are yet not connected to IUCEE as ITF – may utilise (XX) web link mentioned in point # 1 above and thereafter AICTE may like to provide this information periodically to the COE's interested in utilizing this resource for enhancement of employability

    c) AICTE needs to agree to be the interface between Demand at the COE's for such an effort and Supply – Resource of ITF's … (The match and mismatch between Demand and Supply could be left to reality. As the number of Engineering Colleges beyond top 100 are more than 3000; more likely that the interface may find good success as numbers reach sensible figure like 100 Industry experts available to COE's in the capacity of Adjunct Professors.

    d) During interaction with AICTE, IUCEE/ITF may get to know the present status of utilization and degree of success to Policy decision of 20 % industry experts for COE as Adjunct Professors

2. Offices of Chambers of Commerce of developed countries such as USA, Canada, UK, Germany, France, Japan, Australia and similar others exist in India and some of them are in place for more than a decade. Members of these Chambers of Commerce are more often the Companies/Factories in India with Principal's in respective foreign country.

    a) There is a good possibility of exploring this avenue for Internships for Engineering Graduates during 4 year degree course and if such things shape well it can extend the same to Internship/Jobs after graduation. For example IGCC- Indo German Chambers of Commerce – It has over 700 companies located in India as their Members having their factory set ups across India and principals in Germany. Membership database is over 200 pages each of 25 entries available at the web link: http://202.154.165.79/igcc_members
    b) If IUCEE takes on associate membership of IGCC – there is a good possibility of 100 such companies out of a total database of 25*200+ =5,000+. This in my opinion is untapped resource.

c) Annual fees for Associate Membership of IGCC is around INR10/15K –and since the companies are located all over India – benefit could be all four regions North, East, West and South. Concept of Internship is more matured in such foreign countries.

d) Apart from Germany, we could pursue Chambers of Commerce of other Countries e.g. Australia CC office is at Chennai

e) Majority of the present manpower in such factories/companies is from local Indian technical talent and hence in principle it is not a misfit, the success remains to be seen.

3. Confederation of Indian Industry has one of their verticals named Industry Institute Interaction. More info at http://ciiindustryinstituteconnect.in/event/cii-sr-industry-institute-interaction-session/

a) CII pune has nearly 250 Industry Members in Pune
b) The web link above is dedicated to CII – Industry- Institute Connect - with further info for Find Industry Projects, Find Internships for Students etc.
c) Industry may link through this route

6.0 Long Term Solution – A Maturity Model

Although many of the suggestions above are already implemented by “pro-active” institutions and a few “reactive” colleges, we feel strongly that sustenance of such initiatives require long-term thinking where the eco-system needs to work on a structured model of improvement where current state can be assessed, gaps may be identified and future state can be reached through systematic enablers. A parallel may be drawn to industry standard practices such as ISO 9001 or CMM where improvements in a process is obtained through a structured maturity model. If we consider employability as a product of this education process, improvement of such a “product” needs to be done through a systematic maturity model. Institutions that have limited resources or lack of clarity may lean upon such a model to assess their current state of employability, identify gaps and measure their state as they work on improvements. In order to develop such a structured maturity model, it is necessary to collaborate jointly in the eco-system with institutional management, industry experts and academic experts. A task team funded and supported by a nodal agency such as MHRD or AICTE to carry out this activity and come out with such a model would be largely beneficial for the institutions. This is squarely the view of ITF from IUCEE.

7.0 Summary and Conclusions

This white paper is a quick and exploratory look at employability issues and potential ways to address them. It is based on brainstorming sessions and inputs from several colleges and IUCEE interactions. Several Tier 1 and Tier 2 colleges in India are already using some of these methods to improve their curriculum. However, a systematic scaling up of this initiative calls for a strong partnership among all players of the eco-system. This white paper focuses on this key point. A detailed development of these ideas would require structured engagement.

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Appendix 1

Brief biographies of contributors

To Be Updated