International Conference on Innovative Research in Engineering, Management and Sciences
International Journal of Scientific Research in Computer Science, Engineering and Information Technology
© 2019 IJSRCSEIT | Volume 4 | Issue 9 | ISSN : 2456-3307

Engineers: Ensuring Excellence In and Beyond the Campus

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ABSTRACT

Every Engineering College in India invariably has the phrase "ensure academic excellence" in its vision statement. Survey reports in the last 10-15 years by various organisations in India, including NASSCOM, tend to cast a shadow on these claims of engineering colleges being institutions of excellence. These surveys indicate a growing gap between the number of engineering graduates passing out every year from the campus and those entering the corporate world. This paper looks at the reasons for the decline in academically qualified engineering graduates not being considered "qualified" for entry into the corporate world. It further explores the role of the stake holders and the means to mould raw students into qualitative engineers who can excel in their personal and professional fronts.

Keywords : Engineering graduates, Academic excellence, Quality, Employability

I. INTRODUCTION

In the year 2015, The United Nations General Assembly adopted the 2030 agenda for Sustainable Development Goals (SDGs), listing 17 SDGs. SDG 4 talks about Inclusive and Quality Education for all. It underlines the importance of equity and quality attached to education across the globe.

GOAL 4: QUALITY EDUCATION

"Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all".[1]

https://www.undp.org/content/undp/en/home/sustainable-development-goals/goal-4-quality-education.html

The Vision statement of Carneige Mellon University College of Engineering, ranked at number 4 in "Best Engineering Schools" in the US, reads as follows:

"Our vision is to be a world-class engineering college recognised for excellence, innovation and the societal relevance and impact of its pursuits". [2]

https://engineering.cmu.edu/about-us/leadership/vision-mission.html

What does excellence in engineering signify?

Education is what remains after one has forgotten everything one learned at the school".

Albert Einstein

Quality education is not just delivering the contents of the syllabus. Excellence in engineering education should be able to mould and deliver students who are productive, capable of

understanding problems and provide solutions to challenging Domestic and global societal requirements, current and future.

Engineering colleges in India also have their Vision and Mission statements which echo similar idealistic objectives. Almost all of them use phrases like "Excellence in technical education" "Innovative Research programmes" , "Skilled and trained Engineers of highest quality" , "Core human values" as an integral part of their vision statements.
While they may match the Vision and Mission statement of Carnegie Mellon University Engineering College in terms of phrases used, none of them seem to have produced tangible results to evidence the claim envisioned in their Vision and Mission statements. In fact, only three Indian institutes -- IIT-Bombay, IIT-Delhi and IISc-Bangalore -- have found place among the top 200 in the prestigious Quacquarelli Symonds (QS) World University Rankings [3]

II. OBJECTIVE

- Identify the major factors for academically qualified engineering graduates not getting industry acceptance in recruitment.
- Evaluate the current role and behaviour of the stakeholders, viz. AICTE/Universities / Colleges, Teachers and Students.
- Identify the limitations faced by the stakeholders
- Suggest proactive steps by the stake holders to bridge the structural gaps and build competencies

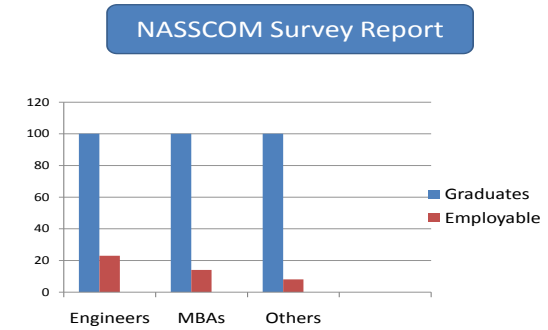
III. METHODOLOGY

- Combination of quantitative and qualitative research,
- Observations and assumptions during the periodical interaction with the faculty and students of engineering colleges during training sessions

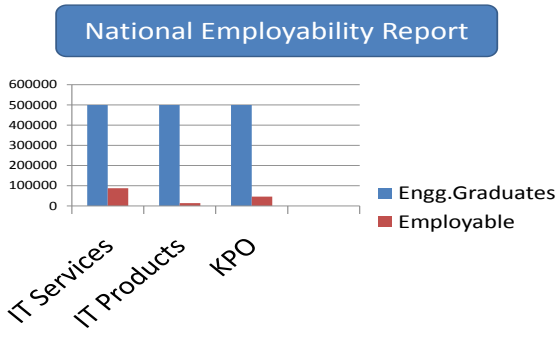
The paper proposes to identify the underlying issues and explore the policy and behavioural contribution of each stakeholder and its impact on the declining quality of engineering graduates in pursuit of their career.

IV. FINDINGS

- According to the NASSCOM-McKinsey report "Perspective 2020: Transform Business, Transform India" (2009), only 26% of India's Engineering graduates are employable as they lack employability skills, despite technical knowledge in traditional engineering. [4]



- As per National Employability Report Engineers Annual Report 2019, by Aspiring Minds, 80% of Engineers are not deemed fit to be employed due to their skill gap vis a vis industry expectations.
- 97% of engineers cannot speak English fluently. 67% of engineers cannot perform any language skill like listening, reading, writing and speaking.
- Only 2.5% of engineers are good at next generation technological skills like Artificial Intelligence, Data Science, Machine Learning etc., [5]



• A recent statement by the CEO of Tech Mahindra also echoes a much grave sentiment, where he affirms that 94% of IT graduates are not employable.

V. ANALYSIS OF STAKEHOLDERS' ROLE

A. Government Policies/ AICTE:

The policies adopted by various state governments over the years in sanctioning new engineering colleges can be cited as a major reason for the decline in employability percentage of engineers. At the time of Independence in 1947, India had a sanctioned intake of 2500 engineering students. [6]

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With the global demand for engineers, state governments across India indiscriminately sanctioned hundreds of colleges year after year. According to AICET, for the academic year 2018, the student intake capacity was 16,62,470, with the actual enrolment being 8,18,787. Around 42% of them have been placed in various industries, up from 29% during the academic year 2013-14. [7]

From the above, it can observed that, when the sanctioned intake is 4-5 times disproportionate to the industry requirements and the enrolment is more than twice the opportunities, it naturally causes a glut resulting in non-absorption of approximately 60% of the engineering graduates.

So, is over capacity intake a major reason for the high percentage of unemployability among engineers?

On the positive, having recognised the engineering crisis in India, AICTE has recommended not to create new capacities in traditional engineering courses for the next two years.

B. Engineering Colleges / Universities:

Engineering colleges in India can be categorised into:

• Institutes of National Importance (23 IITs, 31 NITs)

• State Government owned Universities and Private Engineering Universities/colleges.

Conferring the status of Institutes of National Importance on IITs and NITs, tells a lot about the high quality of education that these institutes offer. What make IITs and NITs institutions of excellence are the infrastructure, world class labs to experiment and apply the engineering concepts learnt, state of art of machines, introduction of new generation courses, opportunity to explore current trends by attending national and international conferences, industry exposure through internships, libraries to aid research facilities and above all, exposure to lectures by world class professors. One of the major factors for the establishment of the above facilities is government support. While the student intake in IITs and NITs is just 3% of the total number of students enrolling for engineering education, 50% of the government fund towards higher education goes to these Institutes of National Importance. No wonder, the cream of meritorious students vie to get admission into these institutions through the tougher JEE qualifying examination. It is this creamy layer of scholarly students who confer the distinction of IITs and NITs clocking 75%-80% in campus placements with hefty salary packages.

On the other hand, most private engineering colleges lack these facilities which have a bearing on the poor quality of engineering education offered in these colleges. Barring about 100 colleges of longstanding and repute which are managed by academic professionals, the rest are run by wealthy businessmen whose motive is more oriented towards profit than quality education. A newly started engineering college needs to satisfy statutory requirements stipulated by regulatory and assessment bodies. Approval from AICTE to run an engineering college, a high grade of accreditation (A, A+, A++) from National Assessment and Accreditation Council (NAAC) for the institution, periodical accreditations of its programmes by National Board of

Accreditation (NBA), ranking of its standard of education by the National Institute Ranking Framework (NIRF) are some of the major statutory requirements to be fulfilled, before it makes an imprint as an institute of repute. That is when the institution starts attracting meritorious and talented students and faculty. In the build up to attract quality students, it has to first have quality infrastructure which entails huge investment and working capital. This is a major limitation and challenge for newly established colleges.

Despite these limitations, quality conscious institutions are constantly striving to provide better facilities to the students. New initiatives undertaken by some institutions to improve the students' technical skills and employability skills are:

- On the academic front, quality conscious colleges are collaborating with foreign governments and institutions through student exchange programmes and certifications from foreign universities.
- To provide cutting edge technology to students, colleges, in partnership with industries are establishing Centres of Excellence (CoE) for each stream of engineering study

Centre of Excellence bridges the gap between what is taught in engineering colleges and what the industry needs. CoE is a specialised training centre related to various cutting edge technologies. The CoE, apart from imparting engineering knowledge, helps create research environment by providing opportunities to carry out joint research projects by students, faculty and industry. CoE helps the students to guage their interest and mend their mind towards research, a very vital part of Engineering. Through this, students develop the two crucial skills, creative thinking and critical thinking.

- Colleges need to be proactive in bringing about awareness about industry expectations by imparting employability skills and life skills.

On the Employability skills front, it has been observed that many colleges make a half-hearted approach by outsourcing trainers to provide 1-3 weeks' placement training to 7th semester students. Does a pre-recruitment training of a short duration, just a few weeks before the recruitment drive, help students gain employability skills like leadership, teamwork, time management, critical thinking, creative thinking, analytical thinking, problem solving, decision making skills, interpersonal skills, communication skills, professional ethics? Isn't it one of the reasons for students not being industry ready?

It is recommended that colleges do not treat pre-recruitment training as a yearly ritual for final year students, but prepare the students well in advance to be industry ready by understanding industry expectations. The lead taken by New Horizon College of Engineering, Bangalore by establishing a dedicated "Centre for Life Skills and Lifelong Learning" is worth mentioning. The Centre focuses on imparting language and communication skills right from the first semester and follows it with life skills training in the second year of engineering. Students are initiated into goal setting, team work, group discussion, ownership, swot, critical and creative thinking among others. A novel initiative is the Self-study programme, where teams of students branch out to corporate offices and interact with the industry HRs to gain in-person, in-depth idea about what the industry expects from fresh engineering graduates. The experience enables students to understand industry needs and work well in advance on the skills expectations of the industry.

C. Teaching Faculty

Education is not simply a content delivery system; rather, it is a system designed to help all the students reach their full potential and enter society as full and productive citizens.

"The value of a college education is not the learning of many facts, but the training of the mind to think"
- Albert Einstein.

Training engineering minds to excel is the responsibility of the teachers. Engineers need to be innovative and creative, as the nation's economic development depends on the role engineers play in nation building. They need to develop critical thinking process to find solutions to complex problems in the fields of telecommunication, information technology, machine learning, AI and Robotics etc. Hence, it is imperative that teaching should address application of problem based and project based learning of engineering education. The calibre of teachers and their teaching methods are critical to achieve this objective. But very few students develop these skills, which are critical at the workplace.

The application of Bloom's Taxonomy in the teaching field is relevant to develop these skills among students.[10] But, how equipped are teachers to train engineering minds in developing analytical, critical and creative skills? At a recent workshop on Bloom's Taxonomy, the question papers prepared by engineering faculty were analysed. After explaining Blooms levels L1 to L6, the participating faculty were given past question papers prepared by their department colleagues. Then they were asked to match the questions to the Bloom's levels marked against each question. It was very clear from this exercise that the nature of most questions did not match the L3 to L6 levels marked against them, indicating a mismatch between application (L3), analysis (L4) and evaluation levels (L5) indicated. Faculties need to train themselves on how ask questions appropriate to the levels. Hence, training the faculty to frame appropriate questions according to Bloom's level is imperative to train the students to understand the questions, apply concepts, analyse the problem and evaluate the options to solve problems.

- **Proactive curriculum:**

The rapid improvement in technology platforms has led to a huge gap between industry requirements in terms of technical know-how and student learning in the classroom. While the industry engages updated technology, classrooms teach outdated technology. Engineering college faculties play a crucial role in bringing next gen technologies to the classrooms through timely curriculum changes. Worth noting is AICTE's recommendations that emerging technologies like Artificial Intelligence, Internet of things, 3D printing, Block chain etc. should be made part of the curriculum. The same is endorsed by NASSCOM-BCG study and FICCI-NASSCOM-EY study. [7].

It puts the faculty also to be on the front foot in learning these technologies and master the knowledge to train the students in these domains.

- Qualitative Benchmark Assessment System:

"Quality is more than a promise, it is genuine performance".

The quality of an institution is interdependent on standards the institute sets for assessment. It is an assurance that the product certified by the institution is really worth the value printed on the certificate and is a guarantee to the employer as regards the knowledge and performance of the certificate holder. When a graduate from IIT shows his or her marks sheet, employers trust the assessment, as they are aware that IITs use standard testing benchmarks and the academic assessment of the candidate is genuine. But do the score cards of private and autonomous engineering colleges truly reflect the candidate's knowledge, ability and capability? There is lot of resentment among the teaching faculty that quality of assessment is diluted due to pressure from the college managements to show a higher pass percentage. It is imperative that the academic heads of colleges interact with the college management and brainstorm the need to frame a qualitative assessment system that builds employers' trust in the finished products of the institution. Dilution in assessment criteria is a major cause for deterioration

in the quality of engineers, resulting in their non-employment.

D. Students

The role of an engineer is vital to the well-being of the society and the economic development of a nation. Be it the field of manufacturing, transport, construction, aviation, petrochemicals, medical equipments etc., engineers strive to make living better for the people. The present rapidly changing technological era demands that engineering minds keep pace with the rapidly changing needs through innovative and critical approach to emerging problems and provide simple solutions.

Emerging engineers need to address current challenges facing humanity. The environmental crisis, conserving water and energy, food crisis, access to education beyond classrooms, technological advances in healthcare, cyber security, space exploration are some of the great challenges engineers are faced with. [8]

When we talk of quality, it is not just the learning environment, the quality of faculty and the methodology of teaching that matters. What matters most is the learner's passion towards exploring the plethora of opportunities, embrace challenges and visualise immense possibilities to make the world a better place to live.

- Are our current generation of engineering students passionate about taking up these challenges?

Over the years, classroom interaction with the students has thrown some light on the answer to this question. It has been observed that roughly 25% of students are into engineering courses because of parental pressure are not of self volition. Another 40% fancy engineering as a student's social status and put up only 50% effort, thus falling short of industry expectations. The rest nourish the ambition to become engineers right from their school days. Out of these about 10% -15% are focussed with clarity on their area of specialisation. This possibly reflects on the employability quotient of the graduate engineers.

- Most students do not have career goals.

Majority of the final year students are unclear and confused about their career goals and career growth. This was evidenced during the Resume writing part of the pre-recruitment training. Majority of the students do not have a clear cut career vision, and just do a cut and paste job of career objectives found of career websites.

The silver lining is, at New Horizon College of Engineering, Bangalore, the students are briefed at the beginning of their 3rd semester about resume building rather than resume writing which is normally done in the final year of engineering. It is highly recommended that colleges tune their students on how to build their resume right from the time they step into engineering.

- **Employability Skills.**

Employability skills are "a set of achievements, understandings and personal attributes that make individuals more likely to gain employment and to be successful in their chosen professions".

Over 95% of the students are unaware of the term "employability skills", let alone bother about the importance of developing the skills that are essential workplace skills. Skills can be classified under

- Basic skills
- Critical skills
- Crucial skills

Basic skills: Listening, Speaking, Reading and Writing

Communication skills in English is a basic skill without which, engineers of today, wouldn't fit into the global employment scenario. While requirement of skills that fall under critical skills may vary from

industry to industry and job role to job role, the one skill that is always mentioned in candidate eligibility list communication skill. Workplace communication involves fluency in speaking English, proficiency in writing, along with listening, reading and comprehending abilities.[9]

While all the students, without exception, are aware that one's communication skill is tested at all stages of the interview process in the form of Verbal ability test, Group discussion, Technical and Personal interview, hardly a small percentage of students put in conscious efforts to develop communication skill.
According to National Employability Report for Engineers by Aspirin Minds, 97% of Indian engineers cannot speak English and 67% of all engineers do not possess any language skill (reading, writing, listening and speaking). This is a problem inherited by students from their school years. Engineering Universities in India have made only a cosmetic approach to impart communication skills at the graduate level. This is a major factor affecting employability, especially students who have done their early education in tier 2 and tier 3 places.
Critical skills: Team spirit, Leadership skills, Time management, Initiative and enterprise, Positive mental attitude, Planning and organizing, Self-motivation, Interpersonal skill.

Students should be incentivized to imbibe some of these skills. It is recommended that a part of the internal assessment marks could be ear marked for exhibiting some of these skills during the course. For example, students are given individual assignments in each subject of the semester. While 75% of the internal marks can be set aside for the quality of the assignment, the remaining 25% can be awarded for timely submission (time management). Student participation in club activities, organizing events, new initiatives that display team spirit, leadership, initiative, planning and organizing could be other means to make the students develop skills for personal and professional growth.

Students should be made aware of the importance of these critical skills in the workplace. While life skills classes, through individual and group activities foster some of these skills, students should be self-motivated to inculcate these skills as part of their personal traits and outlook.

Crucial skills: Analytical thinking, Critical thinking, Creative thinking, Decision making, and Problem solving.

These skills are also known as managerial skills, which are required for career growth to the managerial level. Once a student imbibes these skills mentioned under critical skills, these crucial skills will also develop naturally over a period of time, as one gains more of professional experience.

VI. CONCLUSION

Survey of engineering students in India indicate that majority of them are unlikely to be employed by major corporate. The reason cited is that, technically they lag behind in keeping update with emerging next gen technologies. They are also woefully inadequate at personal and workplace skills that complement fresher-industry requirements and expectations .It is the responsibility of the stakeholders to bridge the structural gap. AICTE has recommended curriculum updation to keep pace with rapid technology changes. Though the college managements have acknowledged the skill gap in their students, they are yet to swiftly respond and create the industry ready atmosphere on their campus. The faculty in engineering colleges have a greater role to play in moulding the students into productive engineers. They should devise benchmark assessments to encourage students to work on the skills fundamental to career and personality growth. The quality of students is a cause for worry as many of them lack the passion and academic urge to upskill themselves. It is highly recommended that colleges should work closely with industries to engage industry -student interaction through Centre of

Excellence, internships and expert talks. Students, on their part need to motivate themselves to improve their skills, especially communication skills, critical and creative thinking skills. We are in the middle of an engineering crisis. To ensure that India prospers through qualified engineers, all the stakeholders should work towards improving the quality of education imparted and make their campus a centre of excellence.

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