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Challenges for Holistic Engineering Education Development in India

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ABSTRACT

The new challenges for engineering education go more than the need to keep students abreast of cutting edge technology and calls for a better equilibrium in the various areas of engineering. There is considerable concern that upholding of the old standard by engineering institutions will all but degrade the quality of engineers as well as difficulty in adapting to the growing difficulties of the worldwide marketplace globally. This requires the new development model for the holistic growth of engineering education. However, adaptation of new development model will not be easy since lots of our research universities are faced with monetary pressures. Indian government has made significant contribution toward this growth phase for the development of nation. This paper addresses for an assessment study of the methods developed by reputed engineering institutions in India to lay the foundation for future engineering education. The result and discussion segment of this paper provides suggestions and plans for engineering education in India.

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1. INTRODUCTION

Engineering is the application of science and technology in order to design, build and maintain structure, machine, and device. India is in unique position where it has developed a reasonable infrastructure in engineering and technology in some of the fields. India produces a huge number of engineers annually. But still industry leaders grumble about the dearth of engineers with good quality for their industries. The future achievement of Indian industry subjected to the expansion of quality of engineering education, especially since Indian industry is contending internationally in regions like software, chemicals, vehicles and engineering. In India, the intelligent students opt for engineering after completing the 12th class. This has resulted in burst of engineering institution, primarily in the private sector. Yet, there is significant joblessness among engineers, due to poor technical values of engineers [1],[2]. International comparison contrast that the majority of Indian institutes have not developed from teaching institutions to teaching and research institutions. Our schooling scheme offers amalgamation of courses in the senior secondary level such that a learner by choosing these colonies can pursue engineering or medicine, even though these two areas call for entirely poles apart aptitudes. The best higher secondary system would acquaint the student towards evaluating their aptitude and choosing to pursue any stream of his or her liking. This would ensure that the chosen course matches aptitude of learner. That is not occurring in India currently. In the lack of proper direction, parents and their wards follow wrong methods while opting for branch of study in the college. During counseling, it is seen that the choice of a branch of study is based on the various myths. This paper addresses change related to the totality of attributes that define the new development model. The exact purpose of the present paper is to provide some perspectives while calling for a new development model in engineering education. The various stakeholders in the future of engineering education – administrators, faculty, students, parents, industry and government leaders, as well as many others – should better see the

shape and dimensions of the dilemma in which they are immersed, be stimulated to debate, and motivated to continue acting along workable paths to implement widespread reform to ensure the vitality of engineering education in India. The numerous stakeholders in the engineering education future such as government officials, administrators, faculty, students, parents, industry persons etc should better see the gravity of the situation and should act for workable paths to implement widespread reform to ensure the vitality of engineering education in India.

2. EXISTING SITUATION OF ENGINEERING EDUCATION IN INDIA AND CHALLENGES

India has huge potential of the youth power which is now being engaged in higher education including engineering. However, the resulting quality of the engineering graduates does not fully satisfy the requirements of the global market. Self financing private engineering colleges are producing about 86% of the engineering students in the country. The poor quality of the graduation is due to the following reasons:

1. Poor physical infrastructure.
2. Lack of faculty
3. Rigid and obsolete curriculum.
4. Poor learner quality.
5. Dearth of R & D activities.
6. Poor quality of training.
7. Ineffective linkage with industry.
8. Poor gender ratio.

Not as much of 10 percent of the students entered to undergraduate programs at IITs (Indian Institute of Technology) are girls. The male-female ratio in higher education has been gradually moved in support of the females ever since the 1970s in US while it is not so in India. In India, large sized classes consequential of expansion results in unimaginative work perpetuate in teaching and learning. Also, emphasis has shifted from learning and acquiring skills to passing the exam. This has resulted in an overemphasis on theory at the cost of practice. A study has revealed that 75% of the engineering graduates are unemployable. This is because of the poor regulation and performance of most of the self financed private engineering colleges.

The 5 Indian Institutes of Technology (IIT) set up between 1951 and 1961 have established a great reputation for undergraduate engineering education, as good as and, in fact, better than most institutions in the world. But this achievement did not extend to postgraduate engineering education, particularly the training of Ph Ds leading to cited publications, exploitable patents, innovative products and entrepreneurship [3],[4]. The political system, bureaucracy, financial constraints, vested interests, etc. play their games and what get implemented are often a far cry and a mere shadow of the well articulated recommendations. But we should be optimistic to identify and quantify our deficiencies and failures before we can find possible solutions and pathways, however painful they may be. The postgraduate engineering education forms the core for training of future teachers and researchers and for building up international reputation through publications, patents and entrepreneurs. These professional leaders are capable of transforming the industry. China, with a comparable population as India, has three times the GDP and produced 12 times as many engineering Ph Ds as India in 2008. Compared to the US which has a quarter of the population and three times the GDP, China produced nearly twice as many engineering Ph Ds as the US. This shows that purposeful actions and leadership can overcome many difficulties. The number of professionals with doctorate degree and capable of directing research is not growing at a sufficient rate to meet the requirements of academia and R&D institutions. The five older IITs together started awarding about 1,000 Ph D degrees in engineering per year after being in existence for 50 years! Considering the major global role the Indian IT industry has been playing, it is amazing that less than 50 Ph Ds are produced in India in computer science engineering per year. The ratio of engineering Ph Ds to science Ph Ds is 1: 4 in India and greater than 2: 1 in Japan. For 2009-10, a comparison of Gross Enrollment Ratio (GER) for higher education in India from other countries is cited in bar chart Fig 1. GER for higher level education in India was 17 percent in 2010 approximately. However, the enrolment level varies across different regions across country. It is also to be notices that enrolment is faraway below several other countries

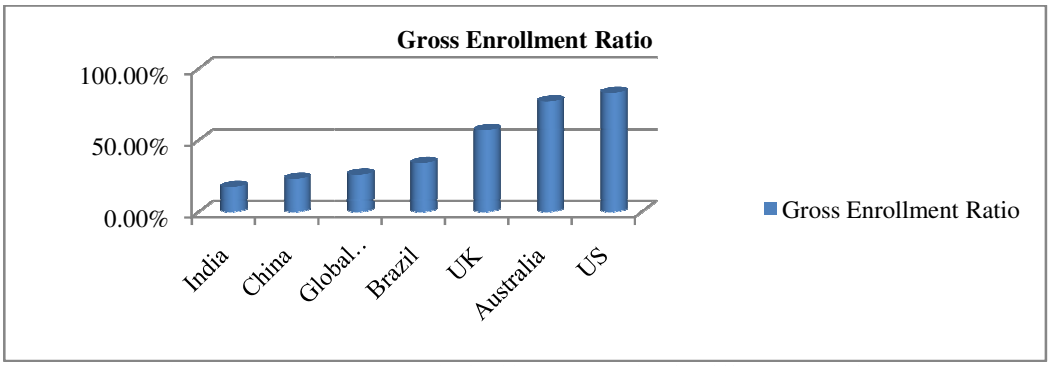

Fig 1. Gross Enrollment Ratio for higher education in different countries

The placement statistics available for Bachelor degree (B.Tech) and master degree (Mtech) students holders within campus is found to be degrading in general for M.tech students in even reputed engineering institute like IIT, NIT and other government and private universities etc . Data for IIT Madras, NIT Hamirpur and one state engineering university VSSUT, Odhisa is given for comparative analysis. Also, there is shortage of faculty in India as compared to other countries. As stated by a report of HRD Ministry, leading educational institutes like the Indian Institute of Technology (IITs) and the Indian Institute of Management (IIMs) are facing a faculty shortage with nearly one-third of the posts empty. While in order to surmount this, government is planning to have quick-fix measures like increasing the retirement age in teaching posts from 62 to 65 years and augmentation in salaries and other profits for teachers. Also some long-time actions have also been started for pulling young people to opt for teaching career. These include augmentation in fellowships and nice beginning grants in various areas. There is shortage of faculty in India as compared to other countries. According to a recent report of HRD Ministry premier educational institutes like the Indian Institute of Technology (IITs) and the Indian Institute of Management (IIMs) are facing a faculty crisis with nearly one-third of the posts vacant. However in order to overcome this, government is planning to have temporary measures like raised the retirement age in teaching posts from 62 to 65 years and augmentation in salaries and other benefits for teachers. Also some long-standing measures have also been initiated for attracting young people to opt for teaching career. These include enhancement in fellowships and attractive grants in various disciplines.

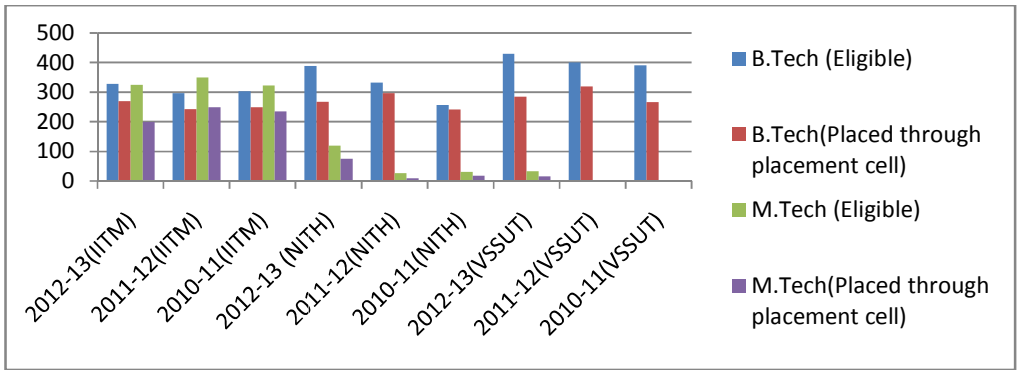

Fig 2. No. of students eligible for placement and number of students placed through placement cell of campus of respective years

Some other challenges in front of India are as follows:

- Big, under-funded, unmanageable institutions.
- Less investment in libraries, IT, laboratories, and classrooms make difficult to provide good-quality education or engage in advanced research.
- Stream of English medium schools are run by an elite set of institutions intended for an elite section.
- Costly higher Education coaching for engineering competitive examination that limits the talent from poor section of society.
- Some places where Indian languages are used as medium of instructions have failed to undertake translations on a big scale.
- Sciences and Technology institutions remain firmly fixed to English language. Society remains divided

between the upper classes which take benefit of English and the lower classes have to do with provincial language.

3. HOLISTIC QUALITY MANAGEMENT AND ACCREDITATION METHOD

Accreditation of educational programme is globally carried out. All the accrediting agencies follow the procedure as mentioned below:

- Submission of report by the Institution seeking accreditation in a format arranged by the accreditation agency.
- Justification of the report of accreditation seeking institution by an inspection team visit to institution location.
- Final decision by accreditation agency.

In India AICTE is responsible for quantitative and qualitative growth of engineering education. It has established National Board of Accreditation (NBA) in September, 1994. The Holistic Quality Management philosophy focuses on the continuous improvement of the quality of the process and product by involving all the people at all the levels of functional areas of the organization. Accreditation calls for demonstration of quality of all the aspects of engineering education including infrastructure, admission process, faculty recruitment and its development, learning and evaluation, industry interaction and placement etc. One of the important objectives of Holistic Quality Management is to motivate institutions for quality improvement. It requires the involvement of management, faculty, employees and students. In order to obtain accreditation, an institution should adopt Holistic Quality Management approach, by designing quality manual and implementing the quality policy. Internal audits of quality achievements should be made at regular intervals of time [5].

In US, UK, Singapore, Japan, and Australia accreditation organization have altered their accreditation procedure from the conventional resource-directed approach to result-based approach. Quality such as talent to apply knowledge, designing skills, performance under stress, problem solving skills, technical aptitude, capability to do job in multidisciplinary groups, communication skills, compassion towards community, and environmental matters, and compassion towards moral and professional matters, and willingness for all-time learning have been recognized as compulsory. The Indian universities and engineering institutes and accreditation agency should be encouraged to undertake serious analysis for curriculum plan according to the demand by industry. Further, faculty's inexperience should be vanquished with real time engineering projects as well as research on learning. If these suggestions are implemented, it will vastly perk up the quality of engineering education in India.

4. NEW DEVELOPMENT MODEL FOR ENGINEERING EDUCATION

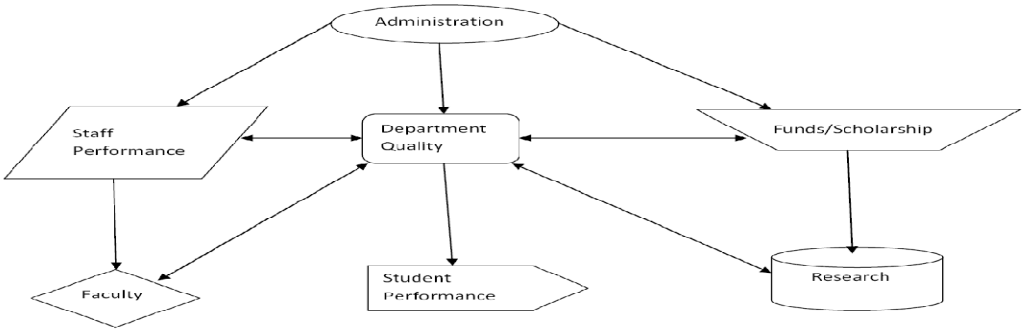

Fig 3.Development model for holistic engineering education development

Development model shown in Fig. 3 shows the higher education quality factors involved for the development of engineering education. Engineering students should first need to be educated in accordance with a engineering-education development model for holistic development. The new development model calls for engineering education is keyed to the fact that current and future demands will be for the solution of problems involving human values, attitudes, and behavior, as well as the interrelationships and dynamics of social, political, environmental, and economic systems on a global basis. The attributes that needs to be addressed to reflect the industrial perspective as follows:

1. Encouragement of diverse student academic backgrounds and faculty dedicated to developing emerging professionals;
2. Connection of solid mathematics and scientific knowledge foundation with engineering practices;
3. Maintenance of regular, well-planned interaction with industry – including industry-based projects;
4. Amalgamation of subject material, issues, concepts and ideas– including relationships to past subject material.
5. Importance on inquiry-based learning and grounding for lifelong learning, with much less reliance on lectures;
6. Stress on inquiry, thinking, listening, speaking, reading, writing, teamwork problem-solving skills.
7. Focus on design issues involving life-cycle economics, environmental impact, sustainable development, ethics, timeliness, quality, health & safety, manufacturability, maintainability, social, legal, standards and ad hoc concerns.

This development model should ensure that the following quality in students so as to have a useful engineering education in institutions from industrial perspective:-

- An ability to function on multi-disciplinary teams.
- An understanding of professional and ethical duty.
- An ability to converse effectively.
- The wide knowledge necessary to understand the impact of engineering in a global, financial, ecological, and communal framework.
- An aptitude to engage in lifelong learning.
- Information of contemporary issues.

Thus the new development model which must lay emphasis on quality attribute of engineering education stakeholders and students is shown in Fig 4.

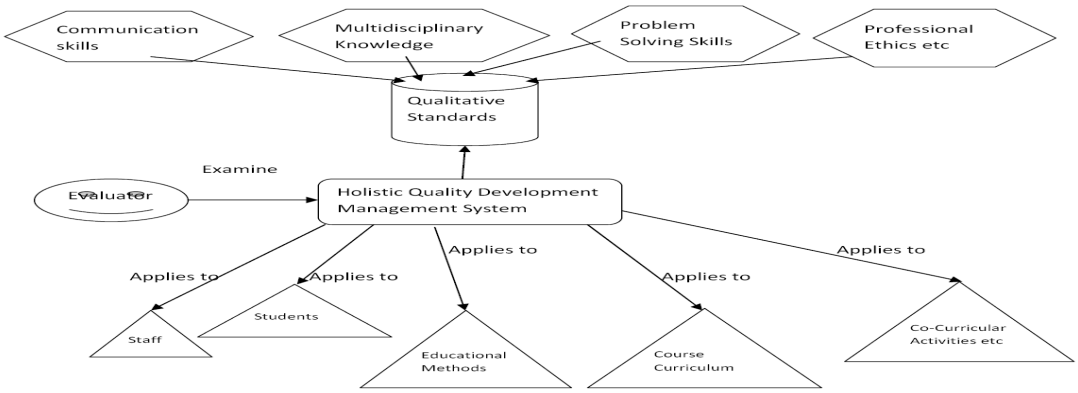

Fig 4. New Development Model bases for holistic engineering development.

5. METHOD FOR HOLISTIC DEVELOPMENT

Having understood the education situation, parents should liberate themselves from some myths that surround them, and build a reasonable decision relating to the future of their ward.

Myth 1 One must do a degree to become a trained doctor, lawyer or engineer to succeed. Other degrees are useless in current scenario.

Myth 2 Marks fetched in higher secondary are a true indication of one's aptitude, and the one who get 90 percent or above is brighter than others who don't.

Myth 3 Those students who studied higher secondary education in colloquial medium cannot shine in professional courses taught in English medium.

Myth 4 Unemployment is soaring, so campus placement is the whole thing for students.

Myth 5 An engineering degree in the most admired branch in India and internationally as well, so engineering degree with 8.0 CGPA and above will certainly fetch a job for student.

How to make the choice

There are some practical and viable rules to be followed in choosing an engineering education.

1. The concern of the candidate and his/her preference of branch should be the standard for admission.
2. Parent should familiarize the child towards finding out their natural curiosity and the aptitude for the particular subject of study.

3. Parents should keep away from choosing the field for the candidate.
4. It is not prudent to join a branch of study as it is popular or for the reason that the job opportunities are high in that area.
5. The choice of organization is also critical factor in selecting the course of study.

So, it is the high time for shifting the development model from old to new from both applicant and institution side. On comparing the Indian education system with US, following points were notices which required to be addressed for future development of engineering education in India:-

- Indian education and social systems are very hard on school students. Students are pushed to study from the age of 3 and students who don't perform well are not treated well and disliked by parents and society. While the US school system put stress on individual capability and progress. It encourages school students to express themselves and their thoughts. Because of this most of Americans are way better at getting their point across as compared to people from other countries.
- The flexibility of the US education system is its greatest power .Students can select among a mass of courses in high school and institution. This means they can change their field of study midway in institution if it is not suitable to them. This usually means that students in the US receive more exposure to a multiplicity of subjects and consequently they are more conscious of their career options and opportunities.
- In the Indian system, individuals are not asked to stand up in front of the whole class and recite somewhat. While students in the US allows more timid students to participate and overcome their fear of public speaking and thus students become more frank to speak do well in class and outside class too. In Contrast, the Indian students on the other hand find it hard to learn to speak up or express their opinions. Classroom discussion and asking questions to the professors is encouraged. However, in India, professors expect you to treat them like supernatural being and often use their almost tyrannical powers against students who disturb them in some manner.

And for the holistic development of engineering education some of the tools are:

1. Scholarships.
2. Social Networking.
3. Tutoring and vocational courses.
4. Mentoring.
5. Curriculum: general reform and multicultural elements

6. HOLISTIC DEVELOPMENT SUPPORTS

The main initiatives of the government to enhance the quality and further development of higher education in India are as follows:

1. A proposal to stop and penalize educational malpractices.
2. A proposal for setting of an independent National Commission for Higher Education and Research for approved standards of academic worth and policies for progress of knowledge in higher educational organizations.
3. Decree for mandatory evaluation and accreditation in higher level education through an self-regulating organization.
4. Making of a national record of academic qualifications created and maintained in an electronic way which would provide huge assistance to employers, colleges and students as well.
5. A proposal to make 14 innovation universities aiming at world class standards.
6. Establishment of 10 new National Institutes of Technology (NITs).
7. Initiation of a new plan of subsidy on educational loans for professional studies by the economically weaker section.
8. According to reforms in All India Council for Technical Education (AICTE) norms, the HRD Ministry declared a raise of about 200,000 seats in engineering courses, with 80,000 seats in management and 2,200 seats in architecture study courses. Ministry also made it obligatory for technical institutions to reserve 5 percent seats for the backward class of society.
9. HRD ministry has liberalized the rules for land constraint for engineering colleges. Nowadays lesser space will be required for setting technical colleges. While an engineering college in rural part of India will require 10 acres of land, and 2.5 acres of land will be required in urban locations.
10. AICTE approved institute started to conduct special session in the evening for the areas of Technology, Engineering, Architecture, Pharmacy Town Planning and Hospitality.
11. Opening of Section 25 Company's Act to allow good quality corporate to set up Technical Institutions according to their need.
12. Appraisal of the operation of present Deemed Universities.

13. Introducing the Right of Children to free of charge and mandatory education bill.
14. Introduction of programmes like TEQUIP (Technical Engineering Educational Quality Improvement Project) which is currently in second phase aiming to produce more employable and high quality engineers and prepare more post-graduate students to reduce a faculty shortage. In order to join TEQIP, institutions must agree to execute a set of reforms that encourage academic and administrative independence, which is critical to improve the quality of education. In 2002, the World Bank's International Development Association provided finance for TEQIP, the foremost World Bank project in higher education in India, which was intended to buttress the Indian government's existing education policy.

7. RESULT AND DISCUSSION

As per the present situation of the higher education in India following recommendation is given in order to meet the future challenges:

1. Government should put forward tax relief and financial incentives for setting up campuses of higher education with private or corporate organizations.
2. Open Universities should be appraised to offer quality programmes at the less cost.
3. Government should encourage foreign universities to reach to India to make independent institute or work in partnership with existing Indian Institutions.
4. A regulatory organization is required to make certain that there is no cheating or trick and, fixation of charge should not be in control of state.
5. There is great requirement for providing internet connectivity to every student along with low priced computer ease of access.
6. First-class salary and profits to the faculty so that high-quality brains can be attracted to the teaching.
7. Private sector should run universities not for a profit but as a branch of a corporate social responsibility.
8. Involvement of foreign partnership and involvement as 100% foreign direct investment (FDI). [3]

Thus, the government can encourage this initiative to improve the quality of formal education, particularly, in government run institutions. The universities must conquer strong disciplinary barricades; jealousies as well as they should enter into a broad conversation for their mutual benefits. Perhaps the Corporate agencies can also play a positive role in altering the present picture of Indian Engineering education by changing unemployable candidate in the marketplace to that technologically efficient; soft skilled and purpose oriented empowered engineering graduates to presume the role in competitive corporate environment.

8. CONCLUDING REMARKS

In view of the continuously increasing challenges of the technical manpower all over the world, expansion of the engineering education institutions is desirable. However, this should not lead to deterioration of quality otherwise such expansion will become unsustainable. Therefore, it is high time to enhance quality into the technical education as to produce the technically ready engineering graduates which will hold not only the task of nation building efficiently, but will also be able to perform successfully at the international level. The global understanding is that accreditation of educational programme is a successful and viable means of ensuring adequacy of the professional towards job performance. It is a great opportunity for technically qualified youth of India to display their competencies for fetching the jobs across the national boundaries. In this respect the responsibilities of engineering education provides greatly increase to impart the holistic quality education as per the principles and practice of Holistic Quality Management model. Finally, we cannot know exactly what the future will bring; however, we can predict with certainty that engineering institutions and engineers will be called upon to satisfy a multiplicity of needs in the years to come.

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