

Role of Industries in Technical Education in India: Past, Present, and Future

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Abstract

Engineering education in India is passing through trying times. Over the last century, Industries bloomed and stabilized only to slow down due to globalisation and rise of China as the global manufacturing hub. Technical education in India had a humble beginning but over the last two decades has seen mushrooming of institutions with a commercial intent and the very purpose is defeated in majority of the cases. In the quest to grow the quantity, quality of education has taken backseat. The growth of IT sector contributed to the mushrooming of institutions in cities where they were located. Major core sector industries have grown but to improve productivity have adopted technological upgradation and thus did not result in increased manpower absorption. Not many industries have set up technical institutions and hence their role was quite limited. Graduating engineers are mostly absorbed by industries and hence the role of industry is paramount. There are many ways wherein the industries play a role but the following seven are promising and contribute to a larger extent. They are: curriculum development, accreditation, internship opportunities, guest talks, industrial visits, projects by students and trained manpower. This paper shall dwell on these seven topics in detail.

Keywords: Accreditation, engineering curriculum, internships, projects, engineering education

INTRODUCTION

Today, India has over 3400 institutions offering undergraduate engineering education to over 35 lakh students [1]. With 1.3 billion population the number of graduating engineers of 8 lakhs do not find suitable employment opportunities. Accreditation concept is picking up in India and NBA is undertaking the accreditation of engineering institutions [2]. Ex-Infosian Mr Mohandas Pai [3] in his article in June 2018 has commented that 10 crore young Indians in 20–35 years age bracket do not possess the right skills and hence are underemployed or not employed. Similar statement by Tech Mahindra CEO Mr Arvind Gurnami [4] on engineering graduates not possessing required coding skills and hence unemployable is also deplorable. India does have over million strong IT professionals

who have contributed immensely to the growth of the nation. It now looks as if it has saturated, and the exponential growth is now flattening up. Core engineering sector like manufacturing too has reached a peak and stabilized.

Industries are the major employers of engineers in the world today. Industries have made rapid strides due to immense contribution by engineers. Humanity at large has benefitted by better standards of living, health care, and transport due to the strides made by the engineering fraternity. Globally, industries have come a long way from the steam era to today's automation era. As the industries have grown, so are their diverse

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Received date: August 30, 2024
Accepted date: October 03, 2024
Published date: October 14, 2024

Citation:

Suresh D. Mane. Role of Industries in Technical Education in India: Past, Present, and Future. International Journal of Telecommunication and Emerging Technologies. 2024; 10(2): 17–21.

requirements. Industries can be classified into manufacturing industry, service industry, design and development, research and design, support industries, etc. Transport industry deals with aviation, railways, water transport, personal vehicles, which have seen tremendous growth in the last two decades. Manufacturing industry deals with the manufacture of components and uses both conventional and state-of-the-art equipment. Quality of few industries in India match the global standards, such as IT industry, electronic industry, pharmaceutical industry, textile industry, aviation industry, automotive industry, cement, and steel industry, etc. There are opportunities for growth in few sectors too.

Basically, India started with jute industry, handloom industry, steel industry, which were labour intensive and had dated technologies. Due to globalisation, many sectors, such as leather sector, handloom sector, and jute industry have reduced their size of operations over the last few decades.

Due to the increased manufacturing activity by China in past two decades at competitive prices, over the world, there is demand for Chinese products. China today is global leader in manufacturing from toys to electronic devices to technical equipment like solar PV panels, power generating turbines, and generators, etc. This growth in Chinese manufacturing sector has seriously affected the manufacturing sector of many a nations and India is no exception to it.

INDUSTRY 1.0 TO INDUSTRY 4.0

Britain's Industrial Revolution marked a significant shift from agriculture to factory-based manufacturing in the 19th century. The second industrial revolution saw advancements in steel production, leading to the electrification of factories and early forms of mass production. The third industrial revolution involved a transition from traditional technologies to digital ones, occurring from the late 1950s to the 1970s. The fourth industrial revolution focuses on integrating high-tech applications with digitisation.

Industry 4.0 refers to the convergence of traditional manufacturing with modern technology. It utilizes the Internet of Things (IoT) and cyber-physical systems to enhance automation, communication, and data analysis. This technology-driven approach is transforming various industries, from consumer electronics to manufacturing. Factories are becoming more automated and interconnected, with machines capable of self-diagnosis and communication. This increased efficiency allows human workers to focus on more complex tasks.

Industry 4.0 calls for the new breed of engineers who can think ahead of their times. The extensive use of electronics and software in automobile industries and electronic gadgets has now led to the requirement of engineers with interdisciplinary topics unlike before. Today, we find the engineering curriculum do offering open electives professional electives in multi-disciplinary areas.

In medical education, we do have long-term internships where the undergraduate students spend a year and a half working in various divisions of a hospital. Similar long-term interaction between students and industry is lacking today. These interactions will boost the knowledge, hard skills, and confidence of the student fraternity as well as introduce discipline and other soft skills among the students.

AICTE this year has introduced model curriculum, which is being planned to be implemented from this year onwards in many universities across the nation. This curriculum does provide flexibility to the universities, institutions, and students to add subjects and for the choice of electives. In the recent decade, lot of technical universities have sprung up and the states have also set up their own technical universities to oversee the technical educations. VTU in Karnataka and BATU in Maharashtra are two

such examples that are doing well in their respective states. These state technical universities have hundreds of self-financing technical institutions affiliated to them and cater mainly to curriculum design, conduction of examinations, and declaration of results.

ROLE OF INDUSTRIES IN PRESENT ERA

Presently, there is industry–institute interaction going on gradually but a lot of avenues of cooperation still exist. Worldwide institutes like Massachusetts Institute of Technology (MIT) and Stanford have excelled due to heavy industry interaction and support, which is lacking with Indian institutions. These institutions top the rankings globally be in QS ranking [5] or Times higher education rankings [6]. It is studied that there is a huge gap between the industry and the institutions in India [7]. Outcome-based education is incomplete without robust collaboration between industry and engineering institutions [8]. In the past two decades, rapid technological advancements have occurred, encompassing both software and hardware innovations. This convergence of information, communication, and artificial intelligence has led to a digital transformation. While the implementation of Industry 4.0 intelligent systems is still under debate, Industry 5.0 emphasizes a broader focus beyond profit-driven production of goods and services. This shift requires a new mindset and approach. The blurring of lines between various disciplines due to technological convergence necessitates a re-examination of engineering education. Future engineering education must adapt to these changes to equip professionals for the challenges and opportunities of the evolving technological landscape [9]. This study [10] aims to identify the educational needs arising from Industry 4.0 and analyse the common trends emerging in engineering education to address these requirements and to achieve this, they conducted a study of 124 engineering departments.

There are many ways wherein the industries play a role but the following seven are promising and contribute to a larger extent:

1. Curriculum development.
2. Accreditation of institutions.
3. Internship opportunities for students and faculties.
4. Guest talks by experts from industry.
5. Industrial visits by students and faculties of institutions.
6. Projects by students for pre-final/final year requirements.
7. Trained manpower from industry can get into academics.

Curriculum Development

Curriculum development is important phase in academics as it must consider the present and future requirements of skills by the graduating engineers. AICTE in 2018 has called upon experts from industry and institutions of national importance to draft the model curriculum. In the past core subjects were included all along but with the advent of computerisation, many computer-based subjects now find place in all UG curriculum. Computer-aided engineering drawing, design and analysis, computer-aided machine drawing, etc. find place in mechanical as well as civil engineering curriculum and the manual drafting and drawing practices of the past are laid to rest. Circuit branches are changing at a rapid pace and are coping up with the changes in revisiting their syllabus at specified intervals. Even major IT industries, viz. Infosys has a campus connect option where they give the curriculum to students to get trained in institution before being screened and absorbed by the IT giant to have industry ready engineers and reduce time, energy, and effort in training the fresh engineering graduates. Even major banks like Citibank and HDFC bank have similar options for MBA students opting for finance specialisation. Industries do interact with autonomous institutions which have the academic freedom for designing and developing their curriculum. Curriculum design should investigate the present as well as future requirements of knowledge and skills.

Accreditation

Accreditation is a process of quality certification and has caught up the attention of top academic

administrators. ABET is a top US certification for technical education and in India NBA investigates program accreditations of technical institutions in addition to NAAC, which basically investigates whole institution accreditation. Due to the spurt of technical institutions over the last two decades, the quality of education has eroded drastically and as such the nation now seeks to reverse the trend by making accreditation mandatory. Institutions approach the concerned industries to partner with them in the accreditation process along with other stake holders. Thus, the program documents viz. PEO, PO, PSO, and CO can be evolved out of the curriculum with interactions by industry experts.

Internship Opportunities for Students and Faculties

Today, we hardly find people from industry joining academics. Faculties have very little exposure to real life industries. At this rate, the knowledge imparted by these faculties to the budding engineers too suffers. Thus, internships have been lately introduced for UG students in higher semesters. Like medical students engineering students too should visit few industries and get hands on experience. These internships of few weeks are fruitful if the student displays interest in learning and contributing back. There can be initiatives to make internships mandatory for the teaching faculties too.

Guest Talks by Experts from Industry

Industry personnel are totally involved in their day-to-day production activity and have little contacts with the academia. Efforts are being made by majority of institutions to have guest talks by the industry personnel. Even option of having adjunct/guest faculty has been introduced by AICTE since last two years to accommodate the retired technical personnel duly relaxing the requirement of PG and PhD qualification. This initiative needs to catch up and can make a real difference as the young students like to hear from experienced persons who have first hand information. The industry experts' presentations are highly regarded and valued by the students. Students find the talks given by industry experts informative and beneficial. The student community enthusiastically receives the insights shared by industry experts.

These talks do hold the potential to kindle the flame of interest among the students to take up career in the fields explained by the industry personnel. As on today, very little knowledge about industries and working practices is available with the faculties and students.

Industrial Visits by Students and Faculties of Institutions

Due to the availability of internet and smart phones, students of present generation have access video clips of industries and manufacturing processes. Industrial visits in person are of great interest to students as they see for themselves, interact with field experts, and have many take aways. These visits are cherished by the students and go down their memory lanes. In non-circuit branches like mechanical and civil engineering field visits should be more common to add value to the program. During the visits, the students learn about technologies in use and can explore the possibility of tie up for industry related projects. For example, energy conservation, energy audits are being taught to UG students. These students can undertake the energy/environment/safety audits and add value to the industries.

Industrial Projects by Students for Pre-final/Final Year Requirements

By virtue of greater interactions, the institutions can approach industries to solve their problems to start with smaller ones. Institutions need to develop linkages with industry and mentor them. With greater interactions of the faculties, the students should be able to undertake projects and offer solutions. Software development can be a project if the industry needs so. By adding value to the industries like improving quality, reducing rejections, reducing costs, improving safety, and environment, etc. Today's youth are highly innovative and creative, offering industries valuable potential.

Trained Manpower from Industry Can Get into Academics

In Israel, it is mandatory for all citizens to undergo military training and similar fashion the

faculties too should get adequate quality exposure in industries. Due to early burnout, many industry personnel are turning back to their places and taking up agriculture and allied activities. Industry can also contribute to the teaching pool in academics and that shall be a rewarding experience to the students.

CONCLUSION

Industries have played a pivotal role in shaping technical education in India. In the past, the growth of industries spurred the need for skilled professionals, leading to the establishment of technical institutions. These institutions provided the necessary training to meet the demands of the burgeoning industrial sector. However, the curriculum often lacked practical relevance, focusing primarily on theoretical knowledge.

In the present day, the relationship between industries and technical education has evolved. Industries are actively involved in curriculum development, internships, and industry–academia collaborations. These partnerships ensure that students acquire skills that are aligned with the current and future needs of the market. Moreover, many industries have established their own training centres to provide specialized training to their employees.

The future of technical education in India is inextricably linked to the growth of industries. As the country continues to industrialize, there will be an increasing demand for skilled professionals. To meet this demand, technical institutions must adapt their curricula and teaching methods to align with the latest technological advancements. Additionally, greater emphasis should be placed on practical learning, internships, and industry–academia collaborations. By fostering strong partnerships between industries and educational institutions, India can create a skilled workforce that drives economic growth and innovation.

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