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Management of Technical Institutions—New Challenges

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The management of technical institutions has to face new challenges which have emerged both from the resource crunch on the one hand and the added constraints of manpower development to absorb the explosion of knowledge in science and technology sectors on the other. The paper reviews the strengths and weaknesses of the present system. An action plan to redress some of the teething problems is outlined.

HUMAN resource development in engineering and technology has assumed an added significance in the present era of science and technology revolution. It is therefore not surprising that the whole purpose of education is being questioned in the context of the explosion of knowledge in science and technology and its compelling influence on the economy of nations all around the world. Education, not merely for gaining knowledge, but *education for wealth creation* should be on the agenda of planners and policy-makers both in the developed and the developing countries. The issue at hand, therefore, is how in the face of this globalization, Indian manpower—especially in engineering and technology—is to reorient itself to meet these challenges. The management of the technical institutions has therefore to face the new challenges which have emerged both from the resource crunch on the one hand and the added constraints of manpower development to meet global needs.

THE JAPANESE EXPERIMENT

It is becoming increasingly clear that countries like Japan could overtake the USA, the UK and other European countries primarily because of the orientation which Japan gave to its technical education system. Japan has been successful in making science and technology education a valid means of wealth creation. The Japanese system has been able to support both the growth of knowledge as well as the growth of prosperity of the people of Japan and has succeeded in making a definite contribution to the quality of life of people of the world at large. Japan has clearly retained an emphasis on a well-planned engineering education in its educational programme and has ensured that those aspiring for engineering degrees make a definite contribution to the development of technology. It is important to note that about two-thirds of Japanese firms are headed by chief executives who are engineers and scientists by education and training, and there is no doubt that this gives them a definite advantage in the development of new products and processes. Technical education in Japan has been targeted to 'wealth creation' and it has succeeded in its aim. The management of the technical institutions in Japan has responded well to the challenges faced by the explosion of knowledge. The management of these institutions has retained its focus on institution–industry interaction and thus has enjoyed the benefit of an industrial management in a truly academic environment.

THE INDIAN EXPERIENCE

Compared to Japan, when we look at the Indian technical education system, we get a feeling that, by and large, the prime objective in India has been to create a pool of trained manpower to support and sustain developmental activities both at the industrial as well as the scientific fronts. What has not been aimed at is a clear emphasis on becoming world leaders in at least a few selected areas of engineering and technology. It is in this respect that despite having one of the largest pools of scientific and technical manpower we have not been able to achieve at home what could have been possible given the infinite reservoir of talent that we possess. It is therefore high time that we review the present status of technical education in India and work out an action plan to respond to the emerging trends in technical education, so as to be able to improve upon the effectiveness of utilization of Indian scientific and technical manpower in the future. The very dependence on the government for support for manpower generation in engineering and technology is the crux of the problem. If manpower is to contribute to the growth of industries

The views expressed in this paper are the personal views of the author.

and enterprises, the meagre resources of the government are not really sufficient, especially now that scientific and technical innovations are outstripping the knowledge-base every 2–5 years.

TECHNICAL EDUCATION PATTERN IN INDIA

The pattern of technical education in India was conceived some 50 years ago, wherein three levels of engineering and technology institutions, namely universities, polytechnics and engineering colleges, were instituted to provide a structured technical human resource development to support the industrial and developmental needs of India. The Wood and Abbot Committee gave its recommendations in 1939. Professor W. W. Wood was the first Principal of the Delhi College of Engineering. The manpower from these institutions trained three categories of manpower: the first being mainly trade-proficient, the second and third being supervisory in character. The main difference between a polytechnic diploma and a degree was in terms of the learning towards practise of technology in polytechnics and learning towards analysis and design in engineering degree programmes. A fourth level of engineering institutions, namely the five IITs, were added later to cater for the requirements of teaching and research at undergraduate and post-graduate levels, as well as to help absorb the technology transfer from the advanced west.

Unlike history and geography, which are localized to a particular nation, science and engineering are essentially universal in nature, and hence developments in science and technology in one country spread across the world. A science and technology educational system must therefore retain its universal character. The IITs laid a clear emphasis on both the quantity and quality of technical education and they succeeded in attaining world-wide recognition for their products, with the collaborative support from the advanced nations. That undergraduate education in IITs is superior to most universities in the US is a view commonly held by top management in the US. It is therefore not surprising that IIT graduates find attractive placements in American universities. The best of the engineering talents thus migrate to the advanced west, depriving India of the benefits of their life-time contribution. While the brain-drain from the IITs, which is of the order of 30–40%, is causing serious concern, what is most worrying is the fact that those who are left behind in India prefer to join marketing, administrative or managerial cadres. By and large, Indian industries and enterprises are dependent for their technical manpower on the turn out of the country's 300-odd engineering colleges. It is ironical that these colleges, who are the bread-winners for Indian industries, are facing teething problems of faculty shortages and lack of laboratory facilities.

The brain-drain, though sizeable, has not been much of a concern for Indian industries which flourished in a protected market economy until recently. However, in the last few years, Indian industry has opened itself to come of age both in quality and cost. A renewed emphasis on much greater technology inputs in industry has become evident. An era of competitiveness and quality consciousness has begun. The demand for the manpower to meet this new requirement is a challenge that must be met by India's engineering institutions.

A further point of concern about the Indian technical education system is that it has not been able to enthuse its students to aspire to make a contribution to the development of technology know-how to solve the country's pressing problems. It has limited itself to teaching what is written in the textbooks with little or no practise of application of knowledge, especially in the Indian context. Even the IITs, which have a strong bias for research and development, have not been able to retain their focus on Indian needs, though they have produced good-quality research, largely for the benefit of advanced countries.

IMPROVEMENTS DESIRED

There are visible deficiencies in the technical education system in India and these must be corrected if technical education is to become a meaningful proposition for the growth of prosperity of Indian people.

The first and foremost problem is that it has totally *lacked the environment necessary for nurturing the innovative and creative talent* of its students. The burden of enormous course work leaves little or no room for the expression of talent, which requires initiation and encouragement. The curriculum has to be examined in this context so that an optimal mix of engineering science and engineering technology is provided, leaving ample room for interdisciplinary pursuits for the students to attempt to improve product design, manufacturing techniques and analytical skills.

The second, and perhaps the most important problem, is the *obsolescence in laboratories* and the quality of the faculty and technical supporting staff. The worst part is that there has been a genuine deterioration in laboratory exercises and a definite deterioration in the quality of teaching, despite a large investment in removing obsolescence in the laboratories and quality improvement of the teachers. Merely the purchase of equipment does not remove obsolescence in laboratories. What is really required is the use of new equipment to develop innovative experiments for the students. It is in this respect that the quality improvement programmes for laboratory technicians are of high value. The input of new technology in the laboratories requires trained technical manpower, which has so far lacked training and continuing education, thus depriving the benefits of the modernization drive to the students and the faculty. *A planned drive for improvement of the quality of the technical staff in engineering institutions needs to be carefully worked out and implemented with speed*.

The third is the *alarming shortage of teaching faculty* in engineering institutions. This shortage in some places is as high as 50%, which highlights the unattractiveness of the teaching profession, even to unemployed youth, and has badly handicapped the engineering institutions in their quest for improving the quality of teaching and commitment to R&D. Class-rooms require teachers—teachers who should have excellent communication skills besides possessing an in-depth knowledge of the subject and the ability to progress in a profession through innovative and creative R&D.

ATTRACTING MOTIVATED FACULTY

Engineering institutions continue to receive the very best school-leavers who come to the engineering colleges with the expectation of catching up with the state of the art in science and technology, and to receive the training in design, manufacturing and managerial functions that will be required from them in a professional career. It is in this respect that the role of the engineering institutions and the engineering teachers in particular is important. Teachers in engineering institutions have to keep themselves fully informed of the latest developments in engineering science and engineering technology. They themselves have to be seekers of knowledge and must be able to assimilate the growth of knowledge in their teaching schemes. A high level of commitment and quality is really called for from teachers in engineering institutions.

The faculty shortage is not easy to explain given the fact that the turn out of post-graduates and Ph.D. degree holders in engineering and technology in India has been phenomenal over the last two decades. The IITs alone have produced 3000 Ph.D.s and master's degree holders over the last 15 years. Why such a highly qualified workforce does not turn toward teaching is something worth researching in India. Compared to this, in the USA there is a mad rush for teaching positions!

Seen from the salaries and promotional avenues, the teaching profession has been made highly attractive by the recent revisions made by the AICTE. It has even lowered the recruitment qualification from master's degree to bachelor's degree for induction at the lecturer level. It is worth noting that the minimum qualification in universities in the USA is a Ph.D, and so it is in the case of the IITs where the lecturers are inducted at a scale higher than that prevailing in other engineering institutions. The lowering of the recruitment qualification to the bachelor level, the revision of scales and the provision of a three-tier (lecturer/assistant professor/professor) system is not enough to attract skilled and highly qualified Indian manpower to the engineering colleges. This matter needs a detailed study as the success of our technical education system hinges around the faculty in engineering educational institutions.

Highly motivated and qualified professionals will be attracted to teaching only if the educational institutions provide an environment to enable them to flourish as expert technologists alongside their teaching role. After all, the USA, the UK, Japan and other developed countries have been successful in attracting the very best to teaching by giving a high priority to this profession, as its quality and commitment directly affects industrial advancement and the quality of human resources. In India the reluctance to join teaching is also due to the value system of our society, which does not acknowledge or recognize the value of those who create wealth, while it fully acknowledges and recognizes the role of the managers and administrators of the wealth of the nation.

THE ROLE OF AN ENGINEERING TEACHER

There can be no doubt that the role of a teacher is vital in the growth of technical education and in upholding the quality of human resource development. What is not unanimously upheld, however, is the view that teachers in engineering institutions should devote themselves not only to teaching but also to R&D and industrial consultancy. That teaching activity should be given top priority is well understood, but what is not acceptable is that the teacher teaches from books and notes alone. With the explosion of knowledge in science and technology, books and notes become fast out-dated. The *new techniques* of mathematical analysis, computation, design and drafting, and above all manufacturing and management technology, which flood the academic world each year, *require teaching minds to engage themselves in active research beyond literature surveys*. After all, what is taught needs to be relevant four years later when students qualify. The teaching process has to assimilate dynamically the growth of knowledge into its teaching methodology. If done at the level of the USA or Japan, teachers in engineering institutions will be the generators of knowledge, and the institutions will be the centres of not mere learning but of technology innovation and research. Teachers will then perform a triple role: teacher, scientist and expert practising technologist. The ultimate beneficiary will be the students, the human resources for tomorrow. Industries will benefit greatly as they will be able to rely with confidence on the expertise available in the Indian institutions, and above all the government will be relieved of the fiscal costs of R&D, as the bulk of R&D in the engineering institutions will then be largely funded from sponsored research and industrial consultancy.

Technical education will then in the true sense become 'Education for wealth creation'.

RESEARCH AND DEVELOPMENT IN EDUCATIONAL INSTITUTIONS

Teaching alone, or both teaching and research, as the responsibilities and job functions of teachers in engineering institutions, is a matter still being debated in India. There is a feeling persisting in academic circles that diversion of the efforts of a teacher towards R&D usually sacrifices teaching interests. There are teachers who are highly devoted to teaching, and spend much of their spare time in preparation of teaching materials and devising innovations in teaching to sustain interest among their pupils. They obviously do not have much interest in R&D, which besides being time consuming, deprives them of the intellectual freedom they enjoy as teachers. As a time-bound and result-oriented process, R&D demands that the teacher devotes a considerable amount of time to the success of the work, which often involves managerial functions besides expert guidance. Being financially rewarding and a means of recognition in the profession, R&D acts as a catalyst to sustain one's interest in innovation and creative research. It also helps a faculty member to aspire for a greater original contribution to the growth of knowledge and brings added satisfaction from the application of the knowledge to solve real-life problems. The teaching style of such teachers has a strong element of professional bias, highly relevant to the students who are to take up challenges in their professional career, once they leave college. It must, however, be realized that there is a basic difference between teaching and research.

Teaching, unlike research, requires excellent communication skills. The interest in teaching stems from one's desire to let pupils benefit from the depth of knowledge that the teacher possesses. This interest is further enhanced if those taught respond to learning. Researchers, on the other hand, work alone, or at the most with a team, on a challenging problem and their interest in R&D is basically from the satisfaction derived from the outcome of their research. Researchers create the necessary facilities for their investigations from sponsored R&D projects and the hard work pays in the long run as their research establishes them in the profession. The recognition of research is world-wide, while motivated teachers are at best recognized and rewarded within their own institutions.

Students in engineering institutions need to be taught by those who take pains in sustaining the interest of the students by constantly updating their teaching material while at the same time commanding a high reputation as practising technologists, something similar to what is done in medical colleges.

INSTITUTIONS-INDUSTRY LINKAGES

The academic environment in an engineering institution needs to be enriched both by the analytical as well as practical aptitude. Such an environment can be effectively created if linkages between institutions and industries are strengthened. Such linkages should provide a dynamic environment in which the expertise from academic R&D could be effectively utilized by industry, and the real-life problems of the industry are taken as challenges both by the expert faculty and the students. Presently there is an element of practical experience in the technical education system via the laboratory exercises and vocational training in industry. This is not adequate as the laboratory exercises are basically aimed at illustrating the basic concepts and the vocational training, by and large, remains observational in nature.

The effective linkages between industry and institutions could take the form of MOUs (memoranda of understanding) allowing each other to take advantage of and to support each other's activities. Greater participation of students in solving industrial problems can be ensured by designing the project work in consultation with industry. Such projects will provide a meaningful opportunity for the students to express their innovative and creative skills. The project work will thus induct the students into the research methodology even at the undergraduate level where the mind is often highly innovative and creative. It is also highly desirable that students be provided with much greater contact time with experts from industry and R&D organizations so that they can effectively interact and perceive the value of their studies. Such visits can become more meaningful if a more direct linkage is established with selected industries and organisations. *The idea should be to involve students in the real-life situations while they are still at their studies.* Special courses with a committed intake designed specifically for industry can also help develop the relevant human resource.

The linkage between institutions and professional societies is also highly important. Such a linkage will help inculcate an attitude of professionalism in young minds and will help the student community to aspire to a contribution to the profession on leaving the college.

The *strengths and weaknesses* of the present technical education system should be analysed in the context of the success or otherwise of Indian industry and other related organizations. The problem of poor quality and the remarkably high price of Indian products is perhaps an outcome of unenthusiastic technical human resources working in an uninspiring industrial environment. While the technical education system has a strong bias for analysis and tutorial exercises, it has lacked the environment for the pursuit of innovation and creativity. It has not fully exploited the mental capabilities of its students to give them the orientation necessary to enhance one's commitment to the cause of technology development for the betterment of the quality of life of the people of their country. The curriculum has also missed on educating its learners about the human face of technology.

As we rapidly advance towards the much-awaited 21st century, it is necessary that we work out a model curriculum for engineering education. This model curriculum must have the strength of a sound base of science and scientific enquiry into products and processes. It must assimilate the growth of knowledge of the emerging areas of engineering science and technology. The package must have a suitable element of humanism and organizational and social behaviour patterns, and without fail it should have a leaning to the local and national perspective of the problems which are awaiting the application of engineering science and technology, and yet retain its universal character with which science and technology education is characterized throughout the world. The course-work must necessarily leave adequate room for innovation and creativity so that the students become active partners in the growth as well as the utilization of the knowledge of science and technology.

CONCLUDING REMARKS

The following issues have been raised in this paper:

- Redefining the purpose of technical education.
- Under-utilization of science and technology manpower in India.
- Lack of environment for innovation and creativity.
- R&D in engineering institutions.
- Shortage of teachers in engineering institutions.
- Attracting motivated, talented youth to join teaching positions.
- Role of an engineering teacher.
- Removal of obsolescence—funding for equipment is not the only answer.
- Need for quality improvement of technical staff in laboratories.
- Flexible curriculum to provide ample room for application of science and technology knowledge.
- Resource crunch—government funding is not the only way to finance engineering educational institutions. Avenues for resource generation.

The managements of engineering institutions in India have to address themselves to the above issues and work out a plan of action to make science and technology education a valid means of wealth creation.

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