# Engineers and Engineering Societies

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*The primary agents responsible for technological changes are engineers and engineering societies, and hence their impact on people and society assumes tremendous significance. Statistics relating to the Indian economy reveal that the contributions of engineering industries to investment in the industrial sector, industrial output, employment and non-traditional exports are considerable and commendable. Largely as a consequence of the nature of the education and training they receive and the public image engineers command, they are denied opportunities for decision-making at the highest levels, and for heading even technical departments and organizations. The main reason is that they are not assertive, nor do they organize themselves into professional engineering societies for making an effective impact. Most of the existing professional societies are oriented toward inconsequential activities, and they display indifference to important national issues. The need of the hour is for engineers to have values and ideals, in the realization of which not only the professional societies but also industry have a stake and an obligation. It is desirable to confederate all like-minded professional societies under an umbrella organization in the nature of a United Engineering Societies of India. The Japanese Quality Control method offers a possible strategy for achieving self-generated and self-motivated solutions to the problems that engineering education is facing in India today.*

THE THEMES 'technology and society' and 'technological change—its impact on man and society', have been discussed at great length in many forums. These discussions have stemmed from the following points, which are of great importance to engineers:

- Developments in technology create new opportunities to achieve new goals and to do things in new ways.
- Society as people and groups of people organize themselves and their activities to utilize these newer opportunities.
- Such reorganizations are reflected as social changes. Consequently, social changes are attributed in part to technological changes.
- The primary agents responsible for technological changes are the engineers and engineering activities, and, therefore, the importance of engineers and engineering activities, and their impact on man and society.

The above points may be substantiated from a few statistics relating to the Indian economy. In the industrial sector, 31% of investments belong to engineering industries. The output from these engineering industries accounts for 32% of total industrial outputs. In the employment sector, more than 28% of employment is accounted for by engineering industries. Nearly 30% of non-traditional exports are from engineering industries. By any method of measurement, the share of engineering industries in the national economy is commendable. Economic factors also considerably affect social changes.

These two aspects, namely technological changes and economic factors that bring about social changes, are mentioned to stress the importance of engineers and engineering activities. Viewed from this angle, the role of engineers in society is an extremely important one. They are one of the very effective agents of change. As the structure and needs of a society change, the tasks of an engineer also change. As technology advances become more and more complex, the engineer's role changes accordingly; the role is a dynamic one and not a static one.

What is the picture of an engineer as an individual in the society? As an individual, an engineer is not very much different from any other individual in our society. By and large, he/she is a shy person not eager to thrust themselves into public view. Because of the type of training they have received, they are well-organized individuals, a little bit more methodical than their companions. Generally, they are poor in expressing themselves and consequently do not make good politicians. The public view of them is as a fixer of things. If a fuse blows, they are expected to replace it. If the mixer at home is not functioning, they are expected to set it right. If the car or moped does not start, they are supposed to fix it. They are expected to be handy with a hammer, a screwdriver or a set of spanners. To an ordinary person, there is not much of a difference between a mechanic, a technician, a technologist and an engineer. They are all doers; persons who are expected to set things right whenever they go wrong. In this context, an engineer is like a general medical practitioner. Anything wrong with a human system—from a common ailment to a serious affliction—a doctor is expected to cure. Similarly, anything going wrong with a mechanical or an electrical gadget—big or small,

simple or complex—an engineer is expected to set it right—or face ridicule. They have earned their reputation because of a unique quality they possess: their willingness to try to set things right. Their satisfaction lies in seeing things functioning. They do not expect much of a reward and they are silent workers. As a result, they are not ambitious, which is one of their serious drawbacks. This is the public image of engineers. Because of their reluctance to push themselves into the limelight, people do not expect them to hold high administrative positions.

An engineer is a professional. This means that they have gone through a carefully planned system of training, and have acquired a specific body of knowledge. This systematic training and acquisition of specific knowledge is necessary to solve a class of problems, called engineering problems. These engineering problems and problem-situations are integral parts of our society and of our development processes. Irrigation systems, industrial operations, manufacture of goods, transportation and communication systems, are some of the examples of these engineering problems. Solutions to such engineering problems are obtained from engineers. There was a time before the industrial revolution and the advent of space age when life was much simpler and technology was not as complex as it is today. In those days, solutions could be provided by individuals working at their own pace with a minimum amount of risk. But the situation has changed enormously. The world of today belongs to professionals and specialists. As technology advances, systems become more complex, giving rise to complicated situations, demanding immediate solutions. One can recall the Bhopal tragedy and recent aircraft disasters. In this context, engineers cannot shirk their responsibilities: they have to provide solutions; society holds them accountable.

Herbert Hoover, in his memoirs, wrote the following about engineers and the engineering profession:

Engineering is a great profession. There is the fascination of watching a figment of imagination emerging through the aid of science to a plan on paper. Then it moves to realization in stone or metal or energy. Then it brings jobs and homes to men. Then it elevates the standards of living and adds to the comforts of life. That is the engineer's high privilege.

The great liability of the engineer compared to men of other professions is that his works are out in the open where all can see them. His acts, step by step, are in hard substance. He cannot bury his mistakes in the grave like the doctors. He cannot argue them into thin air or blame the judge like the lawyers. He cannot, like the architect, cover his failures with trees and vines. He cannot, like the politicians, screen his shortcomings by blaming his opponents and hope that the people will forget. The Engineer simply cannot deny that he did it. If his works do not work, he is damned. That is the phantasmagoria that haunts his nights and dogs his days. He comes from the job at the end of the day resolved to calculate it again. He wakes in the night in a cold sweat and puts something on paper that looks silly in the morning. All day he shivers at the thought of the bugs which will inevitably appear to jolt its smooth consummation.

Accountability is an extremely serious responsibility thrust upon an engineer. Technological changes and developments are directly attributed to them, and for all failings in such areas, engineers are held accountable. One can witness this every day. For all the ills of the country, the first target of attack is the technical education system, then the engineer and next comes the engineering industries. Have we come across, at any time, a physicist or a chemist or a biologist or a mathematician being accused of doing things wrong? The time, effort and money spent on the education and training of these persons are not in any way very much smaller than those spent on the education and training of an engineer. Even if the cost of training an engineer is a bit higher than that of a scientist, this would still be justifiable on account of the significant contribution made by an engineer to the national economy. Be that as it may, for some inexplicable reason, society—particularly Indian society—is prepared to accept the non-accountability of a scientist. Even a medical doctor is not held accountable. Least of all, of course, is the politician. The politician, the scientist—whether a physicist, chemist or a biologist—the sociologist, the economist and the mathematician, they are all put on a different pedestal from an engineer. Every one, except the engineer, is allowed to work in various degrees of abstractness, but engineers are not expected to do so. They are held accountable and their activities should be relevant to the needs of the society.

In one sense, there is nothing wrong in these expectations. But having made these expectations, society and the decision-makers should make adequate provisions for them to function. When more than 30% of India's economy is directly attributable to engineering and engineering activities, the support and encouragement given to engineers in our country is deplorably little. The mistake is that of engineers themselves. They have failed to assert themselves and have stood too long behind the scenes, engrossed in fixing and taking care of things. They have to come forward, become visible and shout for their due share. Unfortunately, the training they have received did not provide this ability—the ability of assertion.

Rarely does one find an engineer occupying important administrative positions. The occasional representations that one finds here and there, like minority representations, are meant to be displayed rather than for effective use. Engineers are deliberately side-stepped and overlooked. The number of physicists and chemists occupying

important decision-making positions are much more than what our country can support. They are luxuries we cannot afford. We can do extremely well without a large proportion of them.

Instead of fighting and asserting themselves, engineers have sold out. They feel proud to be called a scientist rather than an engineer. To be addressed as an engineer-scientist takes them to dizzy heights. To say the least, the situation is very comical. In the name of science, we are destroying engineering. In many official forums and official documents, it is common practice to mention only science and then say in parenthesis that science includes engineering. No; science does not include engineering. Engineering makes use of scientific principles; the methods adopted by an engineer can be as scientific as that of any true scientist. But, the extraordinary ability to understand the scientific principles and to make use of them in producing a product that can be used by society for its good, this extraordinary ability belongs to an engineer. It is this ability that qualifies a person to be called an engineer. It is because of this ability that engineering has been able to contribute more than 30% to India's economy.

In spite of all this, why then do engineers feel diffident about their place in society? Why do they not get the position they rightfully deserve? What are the reasons for them not occupying important decision-making positions? There are many reasons for these. A few of these have already been mentioned. Our engineering curricula, while they help in analysing and solving technical problems, do not give any training in management skills. They do not provide engineers with enough reasons to be proud of their discipline. While great scientific discoveries are discussed, the curricula do not mention even half a dozen examples of great engineering and technological feats. Our irrigation projects, complex communication and transport systems, huge industrial infrastructure, production processes, power generation and distribution systems, etc., do not find even a mention in our engineering curricula. People talk of scientific temper. No one talks of technological culture. There are several science academies, but only a single engineering academy. Every year, there is an Indian National Science Congress, but no similar engineering or technology congress. Government talks of science policy, but renders only lip-service to technology policy.

Where does the fault lie? Is it with the engineer as an individual or is it with his/her tribe? The engineer, as a professional, has realized that society can be served better if he/she associates with their fellow-beings, to form a group and tackle the complex societal problems in a collective manner. These engineering societies, in order to function effectively and to promote their professional activities, have evolved for themselves a set of aims and goals. Their activities are within a framework, reflected in the form of a code of ethics. In India, there are a very large number of such professional societies, particularly engineering societies. Since these societies consist of professionals as their members, each society forms a reservoir of intellectual power. One would imagine that such a reservoir would be able to exercise enormous influence in shaping society or in influencing the decision-making processes of the government. But, unfortunately, Indian engineering societies are totally ineffective. Most of them are preoccupied with their membership drives and their own examination systems. A few day-to-day activities are undertaken with no specific goal or aim. None of the professional societies has long-range goals or aims enunciated and a plan of action to achieve them. By and large, the office-bearers are elected because of their non-controversial nature and their *bonhomie*. None of them have influenced government policies either at the state level or at the national level. They have exhibited minimum interest or concern in the field of technical education. With the number of technical institutions mushrooming throughout the country, the professional societies have not expressed any views either in support or against. When there is continuous erosion in the standard of technical education, these societies have not taken a single step to rectify it. When the financial allocation for technical education, either at state level or at national level, is being reduced, neither concern nor a strong plea to change the situation is made. When the right to give affiliation to a college is taken over by the government, no protest is voiced by the professional societies. When positions of power are being taken over by the so-called scientists and IAS persons, no professional society has given a thought to the consequences. One can go on and on, noting down how much engineers are let down by their societies. The time has come when we have to start making amends for all these faults immediately. Yes, the societies are active in organizing lectures, continuing education programmes, raising their membership numbers, etc., etc. They are all busily engaged in activities that are inconsequential. This is indeed a very sad state of affairs. One of the most important reasons for this sad situation has been due to the continued indifference exhibited by our professional societies to issues of great importance. This continued indifference has made all our professional societies impotent.

Becoming ineffective and weak due to continued indifference is indeed a big mistake that most of our engineering societies have committed. A few years ago, when US President Reagan awarded a medal to a person belonging to the Jewish community, who had suffered a great deal in a Nazi concentration camp, the Jewish person said that he had come to realize, after having lost all his family members in the concentration camps, that the opposite of love was not hatred, but indifference. It was this indifference by the German public that made Hitler and his associates commit the crimes. The German citizen thought that so long as he or she was not directly a party to the crimes committed, he or she could not

be accused of the results. But history has shown that one cannot be absolved on the grounds of indifference. This is indeed a great truth that is of particular relevance to India. How often have we, as individuals and groups of individuals, protested against wrong policy issues that were imposed on us due to political conveniences? Many foreigners, particularly academics, have accused the Indian intellectual community of meekness. It does not protest against issues that it believes to be wrong. An indifferent intellectual community is extremely dangerous to the progress of a nation.

In a recent Golden Jubilee inaugural lecture delivered by the Noble Laureate Professor S. Chandrasekhar at the Indian Academy of Sciences, said:

That the occasion [i.e. the Golden Jubilee] is also precious to me on scientific grounds, derives not only from my having been a Fellow of the Academy for all of its fifty years, but equally from the purposes to which this Academy is dedicated. Unlike other national academies, it has not sought nor has it strived to influence the public policies of the national Government, nor has it followed the practice of awarding innumerable prizes, lectureships and medals.

For me, this is very difficult to accept. To advocate that a reservoir of tremendous intellectual power like the IAS should exhibit indifference and not even strive to influence the government on certain public policies, which may be of great relevance to the scientific community, is to nullify the very existence of such an academy. It is such indifference at professional levels that has reduced us to a state of ineffectiveness or impotency.

While engineers as professionals and engineering societies as professional organizations have both forsaken their responsibilities, engineering industries have also remained aloof. As business is their main objective, they can afford to make some compromises; but only to a certain extent. Unfortunately, they have been the most silent spectators so far as engineering as a profession is concerned. They have exhibited no involvement whatsoever in technical education. Nor have they shown any responsibility towards the training of engineers. Utter disregard towards quality, standards and safety has brought disrepute to engineering. Today's industries are run not by engineers but by semi-trained management people. Somehow, for some inexplicable reason, the engineers and professionals have forsaken all their responsibilities to society. Making a fast buck with no holds barred appears to be the guiding principle of the industries. Who can fight against these industries, who work in consort with politicians? Only the public can. But the public associates industry with engineers and engineering. So, the reputation of an engineer or engineering sinks to abysmal depths.

The only way to get out of this mess is for an engineer to have values and ideals. These values and ideals have got to be inculcated in the training of an engineer. Professional societies have to play a significant role in this regard. They have to get out of the rut and set for themselves some national goals and objectives. In order to achieve these goals and objectives, they must evolve a variety of strategies. Engineers as individuals and engineers as professionals must assert themselves. They must not only fight for their cause, but also fight for the cause of society. They are the creators of jobs and the developers of new opportunities. They are doers of things that society needs. They must rise up to the surface and stay there, asserting their position as an arbiter.

Engineers as individuals can fight only that much. They cannot be a crusader all by themselves; the professional societies and engineering industries should come to their rescue. The professional societies, in addition to doing the regular little, little things, should have national perspectives. These national perspectives should be in terms of the promotion of engineers and the engineering profession. The societies should aim to see that as many engineers as possible are in decision-making positions at the state level and at the national level. The situation should be such that the opinions of these societies are sought in all policy-making issues. To achieve these goals, the societies should have appropriate strategies. The support of engineering industries in these tasks is extremely important. They have a powerful lobby. While this lobby is used for their own promotional aspects, they should not forget their fellow-engineers, who keep the wheels turning. Engineers as individuals, the professional societies and the industries should band together and work as one unified organization.

The Indian Society for Technical Education is in a way a small society—but it has a unique feature, namely that a very large number of its members are teachers in the field of technical education. In this sense, it is a reservoir of intellectuals. It is really a powerful think-tank. Being composed mainly of teachers, it is weak in influencing political decisions, but it can afford to be impartial in its assessment and judgement. It can command a certain degree of respectability. It can influence other engineering societies to take a definite stand and assert their views. It can help in formulating an action plan. Every action that is suggested should stress engineering and engineering activities.

We have today an industry association called the Confederation of Indian Industries (CII). A fairly large number of Indian engineering industries are members of this association. We do not yet have an association of professional societies, particularly those of technical societies. I think, without much delay, we should form an Association of Indian Engineering and Technical Societies—AIETS. There are many engineering professional societies whose membership strengths are below the required critical levels. Such societies, by joining hands with other professional societies, can form a united front.

One could call such a union AIETS or the United Engineering Societies of India—UESI. Perhaps I may mention something that is closely parallel to what I am suggesting. In April 1985, France proposed to its European partners a project called the Eureka Project, for the creation of a technological Europe. This Eureka project is based on the desire to overcome the widening technological gap between Europe on the one hand and the USA and Japan on the other. Europe is not lacking in technological potential, and the combined R&D spending of European countries as well as their stock of scientific personnel are comparable to those of the USA, and two and a half times more than Japan's. But the fragmented European domestic market for high-technology products, and duplicated and dispersed R&D efforts between European firms and countries, explain why Europe is trailing behind its two main competitors in the field of high technology. This weakness of the European countries was exposed by the American Strategic Defense Initiative. Within three months of this proposal's launch, 17 European countries announced their full support for Eureka.

I strongly believe that a UESI could bring new life to engineering and engineering activities in India. One may list activities that such an association or a union of societies can take up; such a list should emerge after discussions among the member societies of the union.

It is also necessary to be concerned about the present quality and standard of technical education in India. The current situation is very disturbing. It is alarming when we compare the rapid pace at which technology is developing elsewhere and the continued decline in the standards in our system. Something has got to be done immediately and steps taken on a war-footing. The few odd solutions like short-term programmes, summer and winter courses, QIP schemes, etc., have become too traditional, with no excitement. Somehow, many of us feel that they have lost their effectiveness. All these solutions have one serious drawback, namely

that these are externally imposed solutions. What is required and most desirable are self-generated and self-motivated solutions. In other words, the solutions have to emerge from within the system, i.e. from the technical education system itself. The question, of course, is how to achieve this.

All of us are aware of the innovative aspects of Japanese technology. We are also aware of the high quality and standards of their industrial products. Japan has also told us how they were able to achieve this through the implementation of quality circles within each industrial organization. The essential feature of the quality circle method is to make every one within the organization become not only conscious of the necessity of producing high-quality products, but also to discuss and adopt practical methods of achieving that quality within each activity centre. The important point is to involve the mechanics or the technicians or the persons at the worker level in this exercise. The interesting aspect of this is not that changes take place dramatically, but that over a period of time, a continuous dialogue and minor modifications incorported each time have a tremendous cumulative effect. This technique has been discussed and elaborated in many discussions and workshops in India.

The quality circle method can be modified and adopted to achieve quality in most of our educational activities. When the question is how to improve the quality and standard of technical education, the modified quality circle method should be adopted to identify the solution space. A continuous dialogue and discussions should be carried out. Initially, one may feel that one is facing a blank wall. But, when the exercise is carried through again and again, solutions emerge little by little, and as mentioned earlier, they will have a cumulative effect. Initially, of course, there will be a lot of cynicism; but this has to be ignored. It will be an extremely interesting experiment to carry through. The techniques of this quality circle method can be adopted with advantage by a large number of activities.