EMR

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Introduction

Never heard of EMR? Well, well, it stands for Engineers' Moral Responsibility. What makes it relevant and important is the growing realisation that much of the mess in the world has been created by the engineers and only engineers have the ability to clear it.

No one has denied, nor can anyone deny, the contributions made by engineers to the society. But it is also true that the contributions have also created unintended results that are adverse to environment, ecology and society. Let us take a few obvious examples:

- Waterlogging near canals
- Noise, effluent and emission associated with engineering activities
- Provision of water supply but without adequate arrangement for wastewater
- Man-made disasters in the form of structural collapse

Now let us go deeper and find what went wrong, why and how should it now be addressed.

Genesis

In competition with Nature

Competition with each other and support for each other are two basic instincts in all living beings. So also in man. Man went further: he competed with Nature herself. Thus if Nature has given our legs the strength to walk a distance of six kilometres in an hour, man invented machine after machine to move faster and still faster. Likewise, man invented devices to see much more than eyes can see, grow more food than a field normally yields and started storing a variety of goods in warehouses. Associated with such activities are the problems we encounter, such as in traffic, transport and generation of large quantity of wastes.

Indiscriminate provision of goods and services

Goods and services were identified by economists as wealth generated. Engineers participated enthusiastically in generating more and more goods and services and marketing experts fostered consumerism to obtain those goods and services. As a result, for example, we have far too many cars than our roads can carry and we have place for parking.

Narrow project-wise approach

Each organisation has its own engineering outfit to get the proposed works implemented. These engineering outfits do not come in contact of each other during planning or implementation of their projects. The result is often experienced in successive digging up of roads for water supply, sewerage, gas, telecommunications, etc. Inconvenience, accidents, extra costs are all possible to be mitigated to a significant extent by co-ordinated planning and implementation of proposed infrastructure.

Operational disadvantages apart, the worst effect of project-wise approach is the failure to anticipate and provide for mitigating the cumulative impact on environment and ecology. A cascade of dams and barrages on a given river can get clearance for construction when appraisal is done project-wise.

Focus on beneficiaries

Cost have been a matter of concern to the engineer from the very beginning. Later, the economists focussed their attention on the benefits to justify incurring the costs. This was picked up by the engineers, beneficiaries were identified, benefits were quantified and the projects were justified. What was missed was the adverse effect on society and environment. Compensation for cost of land acquired found a place as an item of cost of proposed works but social aspects like trauma of displacement, loss of livelihood, lack of ability to properly utilise the sums received as compensation were factors that were learnt only after bitter experience.

Ruled by Practice

Field engineers get used to thumb-rules and code of practice from the date they start to work as an apprentice. Seniors and superiors almost always like to see that the practice is followed. Sometimes they refer to the meaningful saying that in theory, there is no difference between theory and practice but in practice, there is. How practice rules is illustrated by public health engineers assuming a loss of 20% of water consumed even in housing estates in which sewage treatment plant is located in the basement and all sewage pipelines are watertight.

Indifference to R&D

By and large, engineers are a set of proud people. The field engineer is proud of what he calls his experience and the academician is proud of what he calls his knowledge. A proud person is a happy person but is a very poor learner. So, the field engineer does not value R&D and the academician is content with the publication of his papers. The blame game starts: the field engineer thinks that the universities and research organisations are not bringing out anything practically applicable and the researchers pity the field engineers for their incompetence to pick up new applications. R&D suffers, at least the benefit it can bring is often lost.

Lack of caution

Engineers seem to suffer from a fallacious notion that caution denotes lack of confidence. Perhaps that explains why public health engineers did not find the water quality problems caused by fluorides and arsenic until medical report confirmed the irretrievable damage to the health of affected population. Likewise, that is how urban sprawl became uncontrollable, floods were aggravated by arrangements to control floods, groundwater table was allowed to be lowered to unmanageable levels and waterlogging was repeated in relatively recent Indira Gandhi Canal in Rajasthan when it was well experienced earlier near unlined canals.

Fancy for the spectacular

Politician, bureaucrat, engineer -- each one wants to demonstrate his performance. That prompts them to go for large infrastructure projects that are spectacular. Such projects make a good impression that much has been or is being done. For example, what is certain to catch the fancy of decision makers is a project for construction of a large hospital rather than a project for disinfection of water though both have comparable effect for the public by either recovering health or by safeguarding against disease. Likewise, highways are made to look impressive with their signage and other appurtenant facilities but the inadequacies in cross-drainage become known after flooding is experienced. River valley projects, with a spectacular dam and reservoir, also have the same ready appeal and undesirable consequences.

Staying away from innovation

Innovation has been the foundation of many path-breaking inventions and applications. Majority of innovators are non-engineers. Why do engineers stay away from innovation? First, there is a notion that innovation is sub-professional and a professional should go only for well-established practice. Secondly, engineers are particularly scared of failure and innovation seldom provides adequate assurance of success. Thirdly, the link between research and the field is, in general, too weak to carry ideas that could be tried out.

Perception of conflict between environment and development

The author recalls an early presentation of the proposal for interlinking of rivers. It was some twenty years ago. The word 'environment' came only once while referring to environmental clearance which was one of the topics under the heading named 'hurdles'. The term ecology did not come up at all. This was just a manifestation of the perception of conflict between environment and development.

In 1980s, much work was done to study the relationship between development and environment culminating in the report of the Bruntland Commission set up by the United Nations. The report is titled 'Our Common Future'. The conflict was seen as clearly resolved in the concept of sustainable development fully endorsed in the World Summit held in 1992. Nearly a quarter of century has passed without the concept becoming a norm for design and operation of large engineering developments.

Misconceptions about development

There are three fundamental fallacies in conceiving development: first that all development projects are taken up as stand-alone while the impacts are always cumulative; second that development planning is resource-based while it should, in addition, be function-based and third that investments compelled by neglect are erroneously included in development. These are illustrated below.

- Cumulative impact of diverse developments at the same place have great potential of compromising sustainability. The disaster that occurred at Kedarnath in Uttarakhand in June 2013 had roots in the cumulative impact of tourism, transport, building construction, disposal of muck and interference with the river in addition to intense rainfall.
- An example will illustrate the difference between resource-based and function-based development planning. Resource-based approach to river management will remain almost confined to water flow while a function-based approach will also encompass sediment transport and ecological habitat provided by the river.
- The third fallacy is illustrated by the booming bottled water industry, the domestic water purifiers, booster pumps and supply of water by tankers --- all of which have been compelled simply by the neglect in maintaining safe quality of water at the tap.

Definition

No definition is readily available for EMR. An attempt is stated below:

Engineers' Moral Responsibility is the collective and individual commitment by engineers to ethics, service to society and quality of life through forethought, research, planning and design, incorporating care in all their contributions.

EMR Code

Engineers will need a code to guide them in the discharge of their moral responsibility in the various activities they get engaged in. A preliminary attempt for evolving such code is made below. It enumerates certain strategic policies which will need to be elaborated subsequently through a collaborative effort.

1. ***EMR should be measurable***. For this purpose, parameters have to be selected that are measurable and reflect the commitments stated in the definition, viz., ethics, service to society and quality of life. At present, ethics is covered by such regulations as Government Servants' Code of Conduct. Service to society is measurable in terms of performance and socio-economic benefits. Quality of life, as distinct from standard of living, is well defined by the United Nations in the principles for working out the index for human development. Improvement in this matter will be a never-ending process.

2. ***The impact of engineering projects should be equitable***. Equity is lost if a set of project-affected persons is deprived of the benefits of the project. Siting of hydropower station and alignment of high tension transmission line has required acquisition of land from persons who do not get power supply.

3. ***Engineers should not fail to learn from mistakes***. A glaring example is waterlogging caused by the Indira Gandhi Canal in Rajasthan, a relatively recent project, when the sad experience of waterlogging along irrigation canals had already been experienced on several projects constructed much earlier.

4. ***Concern for environment and compassion for all living beings should stay in the mind of engineer at all times.*** These attributes are specifically mentioned in the amendments to the Constitution of India

    a. Article 51-A (g) under Fundamental Duties: It shall be the duty of every citizen of India to protect and improve the natural environment including forests, lakes, rivers and wild life and to have compassion for living creatures.
    b. Article 48 -A under Directive Principles: The state shall endeavour to protect and improve the environment and to safeguard the forests and wild life of the country.

5. ***No defect no effect:*** As propounded by Prime Minister Narendra Modi, engineers should translate the precept of 'no defect no effect' in all their activities. This shall encompass the quality of product to be the best possible as also the technology to be such as not to cause adverse impact on environment, ecology and public health beyond acceptable limits.

6. ***Innovation should be an integral part of engineering***: Despite shining examples of success of some innovators (such as Steve Jobs), innovation has neither received the attention nor the respect it deserves. Admittedly, innovation does not lend itself to be codified and regulated. But, quite often established professionals look down upon innovation and there is hardly any system that has provision for supporting and getting recognition for innovation. It needs to be realised that there is plenty of scope of innovative applications in many areas, such as material science, product design and waste disposal.

Epilogue

Legal responsibility can be imposed but moral responsibility has to be voluntarily assumed. As the leading professional body among engineers, the Indian National Academy of Engineering and her Fellows have to step forward to set an example of being responsive towards moral responsibility. INAE has strived to strengthen the link between senior engineers and those under training to emerge as professional engineers. Through this link, INAE may invoke awareness and commitment towards EMR from an early stage in the career of engineers. In this manner, the commitment to discharge moral responsibility will be generated both by wisdom and by emotion.