

GLOBALIZATION

Globalization means integration of countries through commerce, transfer of technology, and exchange of information and culture. In a way, it includes acting together and interacting economies through trade, investment, loan, development schemes and capital across countries. In a different sense, these flows include knowledge, science, technology, skills, culture, information, and entertainment, besides direct human resource, tele-work, and outsourcing. This interdependence has increased the complex tensions and ruptures among the nations. For the engineers, the issues such as multinational organizations, computer, internet functions, military development and environmental ethics have assumed greater importance for their very sustenance and progress.

MULTINATIONAL CORPORATIONS

Organisations who have established business in more than one country, are called multinational corporation. The headquarters are in the home country and the business is extended in many host countries. The Western organizations doing business in the less-economically developed (developing, and overpopulated) countries gain the advantage of inexpensive labor, availability of natural resources, conducive-tax atmosphere, and virgin market for the products. At the same time, the developing countries are also benefited by fresh job opportunities, jobs with higher remuneration and challenges, transfer of technology, and several social benefits by the wealth developed. But this happens invariably with some social and cultural disturbance. Loss of jobs for the home country, and loss or exploitation of natural resources, political instability for the *host* countries are some of the threats of globalization.

International Human Rights

To know what are the moral responsibilities and obligations of the multinational corporations operating in the host countries, let us discuss with the framework of rights ethics. Common minimal rights are to be followed to smoothen the transactions when the engineers and employers of MNCs have to interact at official, social, economic and sometimes political levels.

At international level, the organizations are expected to adopt the minimum levels of (a) values, such as mutual support, loyalty, and reciprocity, (b) the negative duty of refraining from harmful actions such as violence and fraud, and (c) basic fairness and practical justice in case of conflicts.

The ten international rights to be taken care of, in this context are:¹

1. Right of freedom of physical movement of people
2. Right of ownership of properties
3. Freedom from torture
4. Right to fair trial on the products
5. Freedom from discrimination on the basis of race or sex. If such discrimination against women or minorities is prevalent in the host country, the MNC will be compelled to accept. MNCs may opt to quit that country if the human rights violations are severe.
6. Physical security. Use of safety gadgets have to be supplied to the workers even if the laws of the host country do not suggest such measures.
7. Freedom of speech and forming association
8. Right to have a minimum education
9. Right to political participation
10. Right to live and exist (i.e., coexistence). The individual liberty and sanctity of the human life are to be respected by all societies.

Technology Transfer

It is a process of moving technology to a new setting and implementing it there. Technology includes hardware (machines and installations) and the techniques (technical, organizational, and managerial skills and procedures). It may mean moving the technology applications from laboratory to the field/factory or from one country to another. This transfer is effected by governments, organizations, universities, and MNCs.

Appropriate Technology

Identification, transfer, and implementation of most *suitable* technology for a set of new situations, is called *appropriate technology*. Technology includes both hardware (machines and installations) and software (technical, organizational and managerial skills and procedures).

Factors such as economic, social, and engineering constraints are the causes for the modification of technology. Depending on the availability of resources, physical conditions (such as temperature, humidity, salinity, geographical location, isolated land area, and availability of water), capital opportunity costs, and the human value system (social acceptability) which includes their traditions, beliefs, and religion, the appropriateness is to be determined.

For example, small farmers in our country prefer to own and use the power tillers, rather than the high-powered tractors or sophisticated harvesting machines. On the other hand, the latest technological device, the cell phones and wireless local loop phones have found their way into remote villages and hamlets, than the landline telephone connections. Large aqua-culture farms should not make the existing fishermen jobless in their own village.

The term *appropriate* is value based and it should ensure fulfillment of the human needs and protection of the environment.

MNCs and Morality

The economic and environmental conditions of the home and host countries may vary. But the multinational institutions have to adopt appropriate measures not to disturb or dislocate the social and living conditions and cultures of the home countries. A few principles are enlisted here:

1. MNC should respect the basic human rights of the people of the host countries.
2. The activities of the MNC should give economic and transfer technical benefits, and implement welfare measures of the workers of the host countries.
3. The business practices of the multinational organisations should improve and promote morally justified institutions in the host countries.
4. The multinationals must respect the laws and political set up, besides cultures and promote the cultures of the host countries.
5. The multinational organisations should provide a fair remuneration to the employees of the host countries. If the remuneration is high as that of home country, this may create tensions and if it is too low it will lead to exploitation.

6. Multinational institutions should provide necessary safety for the workers when they are engaged in hazardous activities and ‘informed consent’ should be obtained from them. Adequate compensation should be paid to them for the additional risks undertaken.

ENVIRONMENTAL ETHICS

Environmental ethics is the study of (a) moral issues concerning the environment, and (b) moral perspectives, beliefs, or attitudes concerning those issues.

Engineers in the past are known for their negligence of environment, in their activities. It has become important now that engineers design eco-friendly tools, machines, sustainable products, processes, and projects. These are essential now to (a) ensure protection (safety) of environment (b) prevent the degradation of environment, and (c) slow down the exploitation of the natural resources, so that the future generation can survive.

The American Society of Civil Engineers (ASCE) code of ethics, has specifically requires that “engineers shall hold paramount the safety, health, and welfare of the public and shall strive to comply with the principles of sustainable development in the performance of professional duties” The term *sustainable development* emphasizes on the investment, orientation of technology, development and functioning of organizations to meet the present needs of people and at the same time ensuring the future generations to meet their needs.

Compaq Computer Corporation (now merged with HP) was the leader, who exhibited their commitment to environmental health, through implementation of the concept of ‘Design for environment’ on their products, unified standards all over the world units, and giving priority to vendors with a record of environmental concern.

Engineers as experimenters have certain duties towards environmental ethics, namely:

1. *Environmental impact assessment*: One major but sure and unintended effect of technology is wastage and the resulting pollution of land, water, air and even space. Study how the industry and technology affects the environment.

2. *Establish standards*: Study and to fix the tolerable and actual pollution levels.
3. *Counter measures*: Study what the protective or eliminating measures are available for immediate implementation
4. *Environmental awareness*: Study on how to educate the people on environmental practices, issues, and possible remedies.

Disasters

1. Plastic Waste Disposal

In our country, several crores of plastic bottles are used as containers for water and oil, and plastic bags are used to pack different materials ranging from vegetables to gold ornaments. Hardly any of these are recycled. They end up in gutters, roadsides, and agricultural fields. In all these destinations, they created havoc. The worse still is the burning of plastic materials in streets and camphor along with plastic cover in temples, since they release toxic fumes and threaten seriously the air quality. Cities and local administration have to act on this, collect and arrange for recycling through industries.

2. e-Waste Disposal

The parts of computers and electronic devices which have served its useful life present a major environmental issue for all the developing countries including India. This scrap contains highly toxic elements such as lead, cadmium, and mercury.

Even the radioactive waste will lose 89% of its toxicity after 200 years, by which time it will be no more toxic than some natural minerals in the ground. It will lose 99% of its remaining toxicity over the next 30,000 years. The toxic chemical agents such as mercury, arsenic, and cadmium retain toxicity undiminished for ever.

Indian Government expressed its concern through a technical guide on environmental management for IT Industry in December, 2004. It is yet to ratify the ban on movement of hazardous waste according to the Basel Convention. A foreign news agency exposed a few years

back, the existence of a thriving e-waste disposal hub in a suburb of New Delhi, operating in appallingly dangerous conditions. Our country needs regulations to define waste, measures to stop illegal imports, and institutional structures to handle safe disposal of domestic industrial scrap.

3. Industrial Waste Disposal

There has been a lot of complaints through the media, on (a) against the Sterlite Copper Smelting Plant in Thuthukkudi (1997) against its pollution, and (b) when Indian companies imported the discarded French Warship *Clemenceau* for disposal, the poisonous *asbestos* compounds were expected to pollute the atmosphere besides exposing the labor to a great risk, during the disposal. The government did not act immediately. Fortunately for Indians, the French Government intervened and withdrew the ship, and the serious threat was averted!

4. Depletion of Ozone Layer

The *ozone* layer protects the entire planet from the ill-effects of ultraviolet radiation and is vital for all living organisms in this world. But it is eaten away by the Chloro-fluro-carbons (CFC) such as *freon* emanating from the refrigerators, air conditioners, and aerosol can spray. This has caused also skin cancer to sun-bathers in the Western countries. Further NO and NO₂ gases were also found to react with the ozone. Apart from engineers, the organizations, laws of the country and local administration and market mechanisms are required to take up concerted efforts to protect the environment.

5. Global Warming

Over the past 30 years, the Earth has warmed by 0.6 °C. Over the last 100 years, it has warmed by 0.8 °C. It is likely to push up temperature by 3 °C by 2100, according to NASA's studies. The U.S. administration has accepted the reality of global climate change, which has been associated with stronger hurricanes, severe droughts, intense heat waves and the melting of polar ice. Greenhouse gases, notably carbon dioxide emitted by motor vehicles and coal-fired power

plants, trap heat like the glass walls of a greenhouse, cause the Earth to warm up. Delegates from the six countries — Australia, China, India, Japan, South Korea and US met in California in April 2006 for the first working session of the Asia-Pacific Partnership on Clean Development and Climate. These six countries account for about half of the world's emissions of climate-heating greenhouse gases. Only one of the six, Japan, is committed to reducing greenhouse gas emissions by at least 5.2 per cent below 1990 levels by 2012 under the Kyoto Agreement.

About 190 nations met in Germany in the middle of May 2006 and tried to bridge vast policy gaps between the United States and its main allies over how to combat climate change amid growing evidence that the world is warming that could wreak havoc by stoking more droughts, heat waves, floods, more powerful storms and raise global sea levels by almost a meter by 2100.

6. Acid Rain

Large emissions of sulphur oxides and nitrous oxides are being released in to the air from the thermal power stations using the fossil fuels, and several processing industries. These gases form compounds with water in the air and precipitates as rain or snow on to the earth. The acid rain in some parts of the world has caused sufficient damage to the fertility of the land and to the human beings.

Human-centered Environmental Ethics

This approach assumes that only human beings have inherent moral worth duly to be taken care of. Other living being and ecosystems are only instrumental in nature. Utilitarianism aims to maximize good consequences for human beings. Most of the goods are engineered products made out of natural resources. Human beings have also (a) recreational interests (enjoy leisure through mountaineering, sports, and pastimes), (b) aesthetic interests (enjoy nature as from seeing waterfalls and snow-clad mountains), (c) scientific interests to explore into nature or

processes, and (d) a basic interest to survive, by preservation as well as conservation of nature and natural resources.

Rights ethicists favor the basic rights to live and right to liberty, to realise the right to a live in a supportive environment. Further, virtue ethics stresses importance of prudence, humility, appreciation of natural beauty, and gratitude to the mother nature that provides everything.

However, the nature-centered ethics, which ensures the worth of all living beings and organisms, seems to be more appropriate in the present-day context. Many Asian religions stress the unity with nature, rather than domination and exploitation. The Zen Buddhism calls for a simple life with compassion towards humans and other animals. Hinduism enshrines the ideal of oneness (advaita) in and principle of *ahimsa* to all living beings. It identifies all the human beings, animals, and plants as divine. The eco-balance is the need of the hour and the engineers are the right experimenters to achieve this.

COMPUTER ETHICS

Computer ethics is defined as (a) study and analysis of nature and social impact of computer technology, (b) formulation and justification of policies, for ethical use of computers. This subject has become relevant to the professionals such as designers of computers, programmers, system analysts, system managers, and operators. The use of computers have raised a host of moral concerns such as free speech, privacy, intellectual property right, and physical as well as mental harm. There appears to be no conceptual framework available on ethics, to study and understand and resolve the problems in computer technology.

5.3.1 Types of Issues

Different types of problems are found in computer ethics.

1. Computer as the Instrument of Unethical Acts

- (a) The usage of computer replaces the job positions. This has been overcome to a large extent by readjusting work assignments, and training everyone on computer applications such as word processing, editing, and graphics.
- (b) Breaking privacy. Information or data of the individuals accessed or erased or the ownership changed.
- (c) Defraud a bank or a client, by accessing and withdrawing money from other's bank account.

2. Computer as the Object of Unethical Act

The data are accessed and deleted or changed.

- (a) *Hacking*: The software is stolen or information is accessed from other computers. This may cause financial loss to the business or violation of privacy rights of the individuals or business. In case of defense information being hacked, this may endanger the security of the nation.
- (b) *Spreading virus*: Through mail or otherwise, other computers are accessed and the files are erased or contents changed altogether. 'Trojan horses' are implanted to distort the messages and files beyond recovery. This again causes financial loss or mental torture to the individuals. Some hackers feel that they have justified their right of free information or they do it for fun. However, these acts are certainly unethical.
- (c) *Health hazard*: The computers pose threat during their use as well as during disposal. These are discussed in # 5.3.2 and # 5.2.1, respectively, in detail.

3. Problems Related to the Autonomous Nature of Computer

- (a) *Security risk*: Recently the Tokyo Stock Exchange faced a major embarrassment. A seemingly casual mistake by a junior trader of a large security house led to huge losses including that of reputation. The order through the exchange's trading system was to sell one share for 600,000

Yen. Instead the trader keyed in a sale order for 600,000 shares at the rate of one *Yen* each. Naturally the shares on offer at the ridiculously low price were lapped up. And only a few buyers agreed to reverse the deal! The loss to the securities firm was said to be huge, running into several hundred thousands. More important to note, such an obvious mistake could not be corrected by some of the advanced technology available. For advanced countries like Japan who have imbibed the latest technology, this would be a new kind of learning experience.¹²

- (b) *Loss of human lives*: Risk and loss of human lives lost by computer, in the operational control of military weapons. There is a dangerous instability in automated defense system. An unexpected error in the software or hardware or a conflict during interfacing between the two, may trigger a serious attack and cause irreparable human loss before the error is traced. The Chinese embassy was bombed by U.S. military in Iraq a few years back, but enquiries revealed that the building was shown in a previous map as the building where insurgents stayed.
- (c) In flexible manufacturing systems, the autonomous computer is beneficial in obtaining continuous monitoring and automatic control.

Various issues related to computer ethics are discussed as follows:

5.3.2 Computers In Workplace

The ethical problems initiated by computers in the workplace are:

1. Elimination of routine and manual jobs. This leads to unemployment, but the creation of skilled and IT-enabled service jobs are more advantageous for the people. Initially this may require some upgradation of their skills and knowledge, but a formal training will set this problem right. For example, in place of a typist, we have a programmer or an accountant.

2. *Health and safety*: The ill-effects due to electromagnetic radiation, especially on women and pregnant employees, mental stress, wrist problem known as *Carpel Tunnel Syndrome*, and backpain due to poor ergonomic seating designs, and eye strain due to poor lighting and flickers in the display and long exposure, have been reported worldwide. Over a period of long exposure, these are expected to affect the health and safety of the people. The computer designers should take care of these aspects and management should monitor the health and safety of the computer personnel.

3. *Computer failure*: Failure in computers may be due to errors in the hardware or software. Hardware errors are rare and they can be solved easily and quickly. But software errors are very serious as they can stop the entire network. Testing and quality systems for software have gained relevance and importance in the recent past, to avoid or minimize these errors.

5.3.3 Property Issues

The property issues concerned with the computers are:

1. Computers have been used to extort money through anonymous telephone calls.
2. Computers are used to cheat and steal by current as well as previous employees.
3. Cheating of and stealing from the customers and clients.
4. Violation of contracts on computer sales and services.
5. Conspiracy as a group, especially with the internet, to defraud the gullible, stealing the identity and to forge documents.

6. Violation of property rights: Is the software a property? The software could be either a Program (an algorithm, indicating the steps in solving a problem) or a Source code (the algorithm in a general computer language such as FORTAN, C and COBOL or an Object code (to translate the source code into the machine language). How do we apply the concept of property here? This demands a framework for ethical judgments.

Property is what the laws permits and defines as can be owned, exchanged, and used. The computer hardware (product) is protected by patents. The software (idea, expression) is protected by copyrights and trade secrets. But algorithms can not be copyrighted, because the mathematical formulas can be discovered but not owned. The object codes which are not intelligible to human beings can not be copyrighted.

Thus, we see that reproducing multiple copies from one copy of (licensed) software and distribution or sales are crimes. The open source concepts have, to a great extent, liberalized and promoted the use of computer programs for the betterment of society.

5.3.4 Computer Crime

The ethical features involved in computer crime are:

1. Physical Security

The computers are to be protected against theft, fire, and physical damage. This can be achieved by proper insurance on the assets.

2. Logical security

The aspects related are (a) the privacy of the individuals or organizations, (b) confidentiality, (c) integrity, to ensure that the modification of data or program are done only by the authorized persons, (d) uninterrupted service. This is achieved by installing appropriate uninterrupted power supply or back-up provisions, and (e) protection against hacking that causes dislocation or distortion. Licensed anti-virus packages and firewalls are used by all computer users to ensure

this protection. Passwords and data encryption have been incorporated in the computer software as security measures. But these have also been attacked and by-passed. But this problem is not been solved completely.

Major weaknesses in this direction are: (a) the difficulty in tracing the evidence involved and (b) absence of stringent punishment against the crime. The origin of a threat to the Central Government posted from an obscure browsing center, remained unsolved for quite a long time. Many times, such crimes have been traced, but there are no clear *cyber laws* to punish and deter the criminals.

5.3.5 Privacy and Anonymity

The data transmission and accessibility have improved tremendously by using the computers, but the right to privacy has been threatened to a great extent. Some issues concerned with the privacy are listed hereunder:

1. Records of Evidence

Service records or criminal records and the details of people can be stored and accessed to prove the innocence or guilty. Records on psychiatric treatment by medical practitioners or hospital, or records of membership of organizations may sometime embarrass the persons in later years.

2. Hacking

There are computer enthusiasts who willfully or for fun, plant virus or “Trojan horses” that may fill the disc space, falsify information, erase files, and even harm the hardware. They breakdown the functioning of computers and can be treated as violation of property rights. Some hackers opine that the information should be freely available for everybody. It is prudent that the right to individual privacy in limiting the access to the information on oneself, should not be violated. Further any unauthorized use of personal information (which is a property), is to be considered as theft. Besides the individual privacy, the national security, and freedom within the economy

are to be respected. The proprietary information and data of the organizations are to be protected so that they can pursue the goals without hindrance.

3. Legal Response

In the Indian scene, the Right to Information Act 2005¹⁴ provides the right to the citizens to secure access to information *under the control of public authorities*, including the departments of the central government, state governments, government bodies, public sector companies and public sector banks, to promote transparency and accountability of public authorities. Right to information: Under the Act, section 2 (j), the right to information includes the right to (1) Inspect works, documents, records, (2) take notes, extracts or certified copies of documents or records, (3) take certified samples of material, and (4) obtain information in the form of printouts, diskettes, floppies, tapes, video cassettes or in any other electronic mode.

ENGINEERS AS ADVISORS IN PLANNING AND POLICY MAKING

Advisors

The engineers are required to give their view on the future such as in planning, policy-making, which involves the technology. For example, should India expand nuclear power options or support traditional energy sources such as fossil fuels or alternative forms like solar and wind energy? In the recent past, this topic has created lot of fireworks, in the national media.

Various issues and requirements for engineers who act as advisors are:

1. Objectivity

The engineers should study the cost and benefits of all possible alternative means in objective manner, within the specified conditions and assumptions.

2. Study All Aspects They have to study the economic viability (effectiveness), technical feasibility (efficiency), operational feasibility (skills) and social acceptability, which include environmental and ethical aspects, before formulating the policy.

3. Values

Engineers have to possess the qualities, such as (a) honesty, (b) competence (skills and expertise), (c) diligence (careful and alert) (d) loyalty in serving the interests of the clients and maintaining confidentiality, and (e) public trust, and respect for the common good, rather than serving only the interests of the clients or the political interests.

4. Technical Complexity

The arbitrary, unrealistic, and controversial assumptions made during the future planning that are overlooked or not verified, will lead to moral complexity. The study on future is full of uncertainties than the investigations on the past events. On the study of energy options, for example, assumptions on population increase, life style, urbanization, availability of local fossil resources, projected costs of generating alternative forms of energy, world political scenario, world military tensions and pressures from world organizations such as World Trade Organisation (W.T.O.) and European Union (EU) may increase the complexity in judgment on future.

5. National Security

The proposed options should be aimed to strengthen the economy and security of the nation, besides safeguarding the natural resources and the environment from exploitation and degradation.