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DO WE NEED A NEW KIND OF ETHICS?
Some Remarks on Engineering Ethics[1]

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Abstract

The author deals with matters of ethics of our technological civilization and describes their main characteristics. As a kind of applied ethics engineering ethics has become of central importance because establishing sustainable growth requires new way of thinking: Related to high technology a new type of engineering responsibility is being born.

This applied ethics is not brand-new. It induces an application of general traditional moral principles and a way to preserve them.

Describing general characteristics of human beings the article argues for the necessity of law and ethics as basic forms of social control of human actions. Related to our technological civilization the author establishes the need for a new kind of ethics. Accepting the concept developed by Jonas the author outlines a future oriented responsibility ethics. The need for that is based on moral consequences of using modern technology, this great power.

The need for engineering ethics is a result of a historical development: the engineering occupation has become profession.

The article ends up with analyzing the IEEE code of ethics taken as model for others.

Keywords: ethics, applied ethics, engineering ethics.

1. Technological Development and Ethics

1.1. *Why Do We Need Law and Morality?*

Some people ask me: Living in a world without morality why do we speak about ethics? Under present circumstances many people, firms, institutions are oriented toward short-term survival and they do not care about interests of others. Rough selfishness is a widespread attitude among citizens of our country. Some people want to survive the crisis at the expense of their fellow citizens.

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Besides there is a great confusion of social values and norms in Hungary. The obvious value crisis makes us uncertain about relevance of moral evaluation for our survival. I think it would be misleading to identify a crisis situation with a normal one and it is worth considering the issue in general.

As a starting point we can accept the idea that human beings can survive only if they cooperate. And there is no cooperation without equity and justice. As H. L. A. Hart pointed out it is not necessary to assume that there is an inherent human feature like 'will to survive' it is enough to take this as a contingent, historical fact. Humans can act in another way: the self destruction is also an option. We have to assume that humans are interested in life.

There are some general truths about nature and environment which support certain norms of law and moral. Without these norms survival as minimum aim cannot be realized. If these norms are not followed then there is no reason for observing any other norm.

Such norms form the common core of legal and moral concepts in any society where law and morality provide social control. These universally accepted norms of behaviour based on the above-mentioned truth about humans, their natural environment and intentions can be taken as minimal content of a modest and acceptable natural law.

According to Hart they are as follows:

1. Humans are vulnerable.
2. They are nearly equal. This virtual equality indicates no situation could arise in which a human is likely to dominate or oppress others alone, without help.
3. The altruism of humans is limited. Humans are beings between an 'angel' and a 'devil'.
4. The quantity of available goods is restricted. This fact in itself entails a minimum form of institutionalized property.
5. The comprehension and willpower of humans are limited.

Summarizing the consequences Hart speaks about the necessity of sanctions. These not only provide motivation for following norms. They also guarantee protection of the interests of people volunteer to observe norms. Otherwise these people would be at risk to be deceived and manipulated.

The threats of this situation require people to cooperate voluntarily within an enforced order (Hart, 1961).

Now I can respond to the question. We human beings need morality and law for control of our activity for two reasons:

1. Experience shows that we are intended for survival and

2. our actions require both previously mentioned forms of social control because of our basic characteristics.

If we consider the enormous power of mankind-produced technology we must formulate the question:

1.2. In What Way Modern Technology a Subject of Ethics?

1.2.1. Against Technological Determinism

An analyst says that 'technical progress today is no longer conditioned by anything other than its own calculus of efficiency.' (ELLUL, 1964). This technological determinism is based on an unproved and false assumption, i.e. that it is always possible to find 'the one best way' for technological decisions.

The person who accepts this has no reason to judge better or worse consequences. According to Ellul 'The one best way so runs the formula to which our technique corresponds. When everythinghas been measured and calculated mathematically so that the method which has been decided upon is satisfactory from the rational point of view, from the practical point of view, the method is manifestly the most efficient of all those hitherto employed or those in competition with it, then the technical movement becomes self-directing. I call the process automatism.' (ELLUL, 1964).

In Ellul's view there are no alternatives in the technological choice and choice can be made a priori. Applied into the life of the state technology becomes the only criterion of action. So political doctrines are merely explicative and justifying. It is about only the correctness of the use of technology (ELLUL, 1964).

The crucial point of this argumentation is the 'one best way' formula concerning technological decisions and development. This formula is expressed in the slogan of the Chicago World Fair of 1933, that science discovers, genius invents, industry introduces the new things and we adapt ourselves to them and are formed by them (PACEY, 1983).

Technological determinism describes technical development as a linear progression. But this description rests on arbitrary handling of facts, and on disregarding of the possibility of alternative outcomes at the turning points. The criticism of this view was developed e. g. by Pacey (PACEY, 1983).

The social constructivist view starts from the assumption of alternatives of technological development and rejects the autonomy of technology. It can offer us an acceptable alternative to that. Social constructivists say that 'the social environment, for instance, shapes the technical characteristics of the artifact'.

With their emphasis on social shaping, 'they' deny technological determinism. Borrowing and adapting from the sociology of knowledge, they argue that the social groups that constitute the social environment play a critical role in defining and solving the problems that arise during the development of an artifact. ' ... they' point out that social groups give meaning to technology and that problems ...are defined within the context of the meaning assigned by a social group or a combination of social groups. Because social groups define the problems of technological development, there is flexibility in the way things are designed, not one best way. ...They '... also introduce the concept of closure. Closure occurs in science when a consensus emerges that the 'truth' has been winnowed from the various interpretations; it occurs in technology when a consensus emerges that a problem arising during the development of technology has been solved. When the social groups involved in designing and using technology decide that a problem is solved, they stabilize the technology. The result is closure. Closure and stabilization, however, are not isolated events, they occur repeatedly during technological development.' (BIJKER–PINCH, 1990a)

The relevance of the social constructivist model was demonstrated, for example, by reconstructing of development of bicycle and Bakelite. (BIJKER PINCH 1990b, BIJKER, 1990)

Another approach to technological change coming from history of technology is the system approach. 'The argument is that those who build artifacts do not concern themselves with artifacts alone but must also consider the way in which the artifacts relate to social, economic, political, and scientific factors. All these factors are interrelated, and are potentially malleable. The argument is, in other words, that innovators are best seen as system builders' (LAW, 1990).

Its originator, T. P. Hughes, gave a good example for its relevance in his works. (HUGHES, 1979 and 1983)

John Law summarizes Hughes' argument as follows: 'Edison's problem was simultaneously economic, (how to supply electric lighting at a price that would compete with gas), political, (how to persuade politicians to permit the development of a power system), technical, (how to minimize the cost of transmitting power by shortening lines, reducing current, and increasing voltage) and scientific, (how to find a high resistance incandescent bulb filament). That Edison succeeded in resolving this set of problems reveals his success as a system builder, and it also shows that, as Hughes puts it, 'the web is seamless' that the social was indissolubly linked with the technological and the economic' (LAW 1990).

This has important consequences regarding engineering activity. This model integrates technological and non-technological elements into a complex system.

As Law says, 'the stability and form of artifacts should be seen as a function of the interaction of heterogeneous elements as these are shaped and assimilated into a network. In this view, then, an explanation of technological form rests on a study of both the conditions and the tactics of system building.

Because the tactics depend, as Hughes has suggested, on the interrelation of a range of disparate elements of varying degrees of malleability, I call such activity heterogeneous engineering and suggest that the product can be seen as a network of juxtaposed components' (LAW, 1990).

I think the previously mentioned arguments are convincing enough to reject technological determinism. Accepting either of the two versions of constructivism we can explain technological development and its ethical aspects can be defined.

If we take engineering activity as integrating heterogeneous elements into a system then the meaning of elements depends on the whole system. If that is the case then social, environmental and even moral relations can be as important as technological ones. As a consequence of an argument, moral aspects of modern technology can legitimately be a focus of our interest.

By means of high technology mankind is able to destroy the living conditions on Earth. This enormous power connected with its application requires social assessment from the point of view of our well-being. Therefore we may already pose the question about the relation of ethics and technology.

1.2.2. Five Reasons Why Modern Technology Is Subject of Ethics

Hans Jonas listed five reasons why modern technology is a subject of ethics. These are as follows:

1. ambiguity of its effects,
2. necessity of its application,
3. the global range of its effects (it has far-reaching and long-term consequences),
4. going beyond anthropocentricity,
5. raising the metaphysical question about the survival of humanity. (JONAS, 1987).

A novel approach to ethics is required by the situation produced by the above-mentioned features of modern technologies. In his view the approach of traditional ethics is not adequate for understanding these phenomena.

Jonas summarizes the main characteristics of traditional ethics regarding technology as follows:

1. the whole domain of technology is ethically neutral,
2. anthropocentricity,
3. the entity 'human being' and its environment is taken as constant rather than changing.
4. Moral norms are related to the immediate environment of the factors only. Far-reaching and long-term effects are not taken into account.
5. Cognitive aspects of moral are limited to common sense. Theoretical knowledge as an aspect of morality is out of sight (JONAS, 1984).

We can say that these norms of traditional ethics are valid but their validity is restricted to face to face relations although even these are influenced by the effects of collective actions, including technology. Therefore new dimensions of responsibility have come into existence.

In his view these are the following:

1. Vulnerability of nature. We have increased power by means of modern technology and therefore created responsibility. What kind of responsibility do we have for nature? Are we responsible in a purely utilitarian way? That is, we do not want to kill the goose that lays the golden eggs, or are we responsible in another way?
2. Knowledge becomes duty, especially that kind of knowledge will be of vital importance by which we can predict effects of our technological activity. The gap between technological and predictive knowledge cannot be filled, and admitting this gap will be a part of ethics.
3. Has nature intrinsic moral value? If we say yes then this standpoint would change our practical and theoretical relation to nature and we should have to reconsider the fundamentals of ethics (JONAS, 1984).

This ambiguity is a characteristic of modern ethical thinking because philosophers are divided on the issue.

According to Jonas, the ethics of technological civilization should be future-oriented (JONAS 1984).

Searching for a basic principle for his new 'future ethics' Jonas considers the Kantian categorical imperative: ' Act only on that maxim through which you can at the same time will that it should become a universal law.'

Jonas rejects this kind of imperative because of its logical character: 'There is no self-contradiction in the idea that mankind will no longer exist and therefore there is no self-contradiction in the idea too that the welfare of the present or next generation is being bought at the price of misfortune or even nonexistence of later generations. ... But the series of generations should be continued' (JONAS, 1984).

Our duty is to respect future generations. From that comes a paradox: we must take into account something nonexistent. This requirement goes beyond the traditional moral principle of reciprocity, according to that my right appears to another person as something to be respected and his/ her right is to be respected by me. That is his/her just claim is for me a duty to be fulfilled and inversely.

'But this idea is not appropriate for our purpose. Because something can be claimed by existent human beings only. ... But the required ethics should deal with something yet nonexistent and its responsibility principle should be independent of any idea of right, that of reciprocity as well,' says Jonas (JONAS, 1984). So the principle of reciprocity should be abandoned and the 'future-oriented ethics' extends its responsibility principle to yet nonexistent future generations.

In my opinion the principle of human responsibility should be extended to nature: to animals, plants, inanimate things and processes because we live in an ecosystem and our activity can rebuild the nature. If there is no moral constraint on how we deal with nature, then we will risk our survival because of necessarily allowing global environmental crises.

That is the reason why modern technology is a subject of moral reasoning. So far we have dealt with matters of general morality. Having given reasons for a new, future-oriented ethics for our technological civilization I think it is time to turn to special moral issues of a technological profession, that is to engineering ethics.

2. Engineering and Ethics

2.1. From Occupation to Profession

If we want to speak about special moral aspects of an occupation we must know 'whether there are professional ethical roles. Or, more completely, we want to know whether there are occupations whose defining characteristics provide the basis for one or more distinct ethical roles for anyone pursuing one of the occupations' (WINDT, 1989).

Considering the issue our task is to distinguish a profession from an occupation. The easiest way is to investigate some occupations which are generally taken as professions and their features can be empirical evidences for professionalism. Such professions are law and medicine, and they can as serve as models for definition.

Windt lists their features as follows:

'*Expertise.* It is characteristic of law and medicine, as well as many other plausible candidates for the status of profession, that they involve mastery of a large and complex body of information and skills, which is based on a sophisticated theoretical foundation. Extensive education and training are required to learn this theoretical foundation and to acquire the knowledge and skills that are based on it.

Authority. The expertise possessed by the physician or lawyer is frequently expressed in the form of authoritative advice or guidance, that is, advice to be followed by patients or clients without their understanding why it is good advice, and often in spite of their inclination not to follow it. Often, too, members of these professions are called upon to guide the information of public policy concerning their areas of expertise in the same authoritative way. (It is important to see that expertise and authority are two related but different qualities. It is possible to have either one without the other.)

Social importance. The expertise and guidance provided by lawyers and physicians are important both to individuals who need their services and to society in general. Our health, lives, and liberty depend upon the quality of the services provided to us by these professionals.

Autonomy and self-regulation. Both these professions have been relatively independent of external controls. Standards of acceptable practice come from within the professions, and much of the responsibility for maintaining the quality of practice remains within the professions. These professions also control the structure and content of education and training, as well as the power to determine who will be allowed to enter the profession. In addition, individual lawyers and physicians have largely been free to choose the kind of service they will provide, both in selecting a specialty or kind of practice and in choosing which clients or patients they will serve.

Professional commitments. By the time they begin to practice, members of these professions have undertaken a number of commitments that are supposed to provide ethical guidance for their conduct as professionals. These include a commitment to promote the interests and well-being of the patient or client; a commitment to protect and promote the well-being of the community; a commitment to promote excellence in the practice of their professional arts and skills; and a commitment to regard other members of their profession in a fraternal way. These commitments are presented in one or more codes of ethics, which have been drawn up and formally adopted by various professional organizations and their members.

Rewards. In comparison with other occupations, both law and medicine offer a number of substantial rewards, including good economic rewards, high social prestige and influence, and the satisfaction that comes from engaging in interesting and worthwhile work' (WINDT, 1989).

The profession is a product of professionalization of an occupation. Taking into account the phases of that process it seems to be obvious that only some of the occupations can reach this level.

According to Wilensky the process of becoming a profession has the following stages:

(1) Became full-time occupation, (2) First training school was established, (3) First university school was founded, (4) First local organization and (5) First national professional organization were founded. (6) First state license law was enacted. (7) First formal code of ethics was adopted (WILENSKY, 1964).

Engineering is relatively new compared to other traditional 'learned professions,' to law, medicine or ministry. It became a full-time occupation in the seventeenth and eighteenth centuries, its first university school was established in the eighteenth century and its first formal code of ethics was adopted in the beginning of the twentieth century.

Although engineering activity can be best seen as 'heterogeneous', integrating different technological and social elements into a system, there are two potential social roles which can be played by an engineer: (1) 'technocrat' who 'believes, on the one hand, in the capacity of technology to solve all social problems without recourse to value considerations and, on the other hand, in the importance of integrating engineers into the political power structure of society.' Another role is (2) a 'professional technologist' role. In accordance with this role model, an engineer would be guided by an explicit orientation of professional service in his relations with the technological system of a society ' (EVAN, 1968).

Evan risks a prediction related to chances of institutionalization of the two kinds of role: in democratic societies where an antielitist ethos prevails, the professional technologist role has better chances of that; in nondemocratic and elitist societies the technocrat role has better chances (EVAN, 1968).

The engineers because of their complex activities cannot work as 'pure' technologists. The social aspects of their tasks entail moral problems to be solved, too.

2.2. Engineering Ethics as Applied Ethics

'Engineering ethics' is a kind of 'applied ethics' as taken in this paper. In my opinion there is no need for a brand-new ethics but there is a need for application of general, traditional ethical principles to new conditions of technological civilization. Applying general principles to special and new situations we have to translate them into a language which can be interpreted by practitioners of technology: They legitimate their practice by special conditions: ethicists construct their argument by using general terms like justice, equality, respect for nature, etc...

The difficult task to be performed is as follows: Considering long-term and global effects of modern technologies there is a need for a kind of 'early warning' of potential problems. This function can be fulfilled by an anticipatory applied ethics. The moral void created by autonomous technological development should and could be filled by socially acceptable technology policy only. (JELSMA, 1992). The two functions: the applying and warning are special features of modern ethics, engineering ethics included.

2.2.1. Applied Ethics – Public Policy

If we look for a chance of realization of moral values we can find it in evaluating individual and public choices.

Environment is a common good and related to it public choices are proper. Engineering ethics and environmental ethics are partly common in their intention and values. Their intention is that their moral assumptions are to be integrated into technological processes, devices, projects by engineers. Their special values can be taken as translations of general moral norms like equity and justice. The common value of both ethics is the value of protection of public interest. Both overlap as promoters of an ecologically sustainable growth.

Let us take an example: Polluting water as a common practice of chemical plants for many years.

Why could they afford to do it for a long time?

The first reason for it was that they had to pay for the production only and not for the pollution. Therefore the costs of production were low for the maker because environmental damage was simply imposed on local inhabitants. This is an example of externality: 'an externality is an effect of one economic agent's behavior on another's well-being, where that effect is not reflected in dollar or market transactions' (SAMUELSON–NORDHAUS, 1985).

Samuelson and Nordhaus state, 'Whatever the specific approach, the general remedy for externalities is that externality must be somehow internalized. ... Thus the external costs must be made internal to the decision maker if he is to be given the incentives to undertake the efficient amount of pollution abatement' (SAMUELSON–NORDHAUS, 1985).

There are market and government failures regarding private and collective goods, too. So they should be corrected by several methods. One of the causes of failures is an ethically unacceptable collective decision on public goods, or a private decision on private or collective goods.

There are policies to correct externalities. Two of them are not governmental, but private actions: private negotiations and liability rules: 'Thus, say that I am spilling chemicals upstream from you and doing damage to your fish. In such case, the two of us would have a powerful incentive to get together and agree on the efficient level of dumping.' (SAMUELSON–NORDHAUS, 1985).

The 'second approach uses the legal framework rather than government intervention is through the liability system. Under this, the generator of externalities would be legally liable for any damages caused to other persons. ... Thus, in most states, if you are injured because of negligent behavior of the driver of an automobile, you can sue for damages.' (SAMUELSON–NORDHAUS 1985)

There are collective or government actions to correct externalities:

1. Direct controls by standards. Their effectiveness is dubious, because when setting such standards mostly no cost-benefit analysis is being made. Their enforcement is often casual. And standards are not properly set and so these rules do not efficiently allocate pollution reduction among firms.
2. Emission or pollution taxes: '... firms would have to pay a tax on their pollution equal to the amount of external damage.'

This is a good kind of regulation, but there are 'only a handful of externality taxes, as compared with thousands of regulations.' (SAMUELSON–NORDHAUS, 1985).

According to Samuelson a reason for failures of US government is in this aspect: 'Unrepresentative Government. In principle democracy is' one person one vote'. In practice, dollars win elections. ... Because money talks in politics, we often see programs enacted that confer large average benefit on a small group and exact small average costs from a large group. ... How is it that a small minority can persuade a majority of the legislature to pass programs that benefit a small majority? In many cases, legislators face two constraints: votes and money.

They maximize their popularity subject to the constraint that they raise enough money to be reelected ; and the easiest way to raise the necessary campaign contributions is by voting for a few wellfinanced causes.' (SAMUELSON–NORDHAUS, 1985).

Another reason is: 'The bureaucratic imperative: Few can resist the temptation to increase their own influence or power. Governments are the same. ... One reason for the tendency of government to overexpand is that there is no profit check (or what business people call 'bottom line') on individual projects.

'If the government builds too many dams, too many bombers, too many government office buildings there is no profit or loss statement by which the economic worth of these projects can be calculated. The only support such projects need is a legislative majority, and this may be obtained by the small minority's providing campaign financing for a sufficient number of legislators.' (SAMUELSON–NORDHAUS, 1985)

These failures do not mean that we 'should abandon the visible hand of the government for the invisible hand of market. ... a repaired invisible hand may be more efficient than the extremes of either pure laissez faire or of unbridled bureaucratic rule making.' (SAMUELSON–NORDHAUS, 1985).

The role and function of applied ethics are to help by establishing a 'repaired invisible hand' because it is evident that neither market nor government can provide us tools for solution of the problem and therefore we have to work out concepts, strategy and means for our long-term survival. A part of that is the integration of moral values into the political and economic, technological decision-making process. Our task is to create the conditions of sustainable growth, which requiring a change in our value system. This change should be practical: moral values should get relevance in decisions because these express the interests of our long-term survival.

A double problem should be solved: On the one hand, the traditional moral values should be translated into the language of practical matters.

On the other hand, another problem has emerged: that of the environment. If nature has value in itself, then we must make compromises in case of value conflict with natural values. I think we must give up the traditional instrumental attitude to nature and become committed to ecologically sensitive projects which can be sustained. Human beings are a part of nature.

Another old-fashioned claim of mankind is to dominate nature. These together can lead the humanity to destruction of its own living conditions, to self-destruction.The old private ethics is not enough. The collective of government, local authorities and firms need special new branches of ethics. Engineering ethics as a special kind of applied ethics must be placed in relation to these.

The characteristic conflicts of engineers come from their social position. The engineer as employee in an economic organization fulfils tasks given by the management. The firm has to win or at least survive in the market competition and its main guiding values are: marketability, economic efficiency and profitability. Its survival depends on realization of these values, which are different from that of environmental survival. If an engineer takes into account other values than that of the market then he can get into conflict with the management. These tensions seem to be unavoidable if firms do not change their guidelines. A modification of market activity is required: environmental values must be integrated into the aims of firms.This process can be a result of governmental policy which is an answer to the challenge of organized environmentalists. Therefore, it is very important to get consensus in matters of environment, technology, energy and economy policy so the long-term orientation can be enforced by constraints of the market.

Taking professional commitment seriously, engineers – and only they – can develop technologies realizing environment friendly technologies. The public interest is protected by these technologies. But engineering activity as well as managerial activity are tested by the market finally.

The main problem of internalizing external effects is that future effects are regularly discounted and their market price cannot be counted properly. Therefore it seems to be useful to complete market with planning. Regarding governmental action we must not have too many illusions. But government failures can also be corrected and engineers can make the general public informed. They can design, construct and run the requested environmentally safe technologies.

Public pressure plays a vital role in this process. And professional honesty of engineers can be decisive in such matters. Engineering societies as organizations of professionals take their commitment to public interest seriously and adopt codes of ethics to formulate moral standards of a profession, duties and responsibilities connected with it.

2.2.2. Codes of Ethics for Engineers

The 'ideal' of true professional described in codes of ethics is the subject of a professional code of conduct. Why is it important to formulate that for a profession?

It is an obvious fact that professional occupations have special knowledge and skills vital for the society, for laymen, for the public. Usually laymen cannot do what they provide, so members of professions have a privileged position. So they claim highlevel financial reward for their service to the community. But respect is not automatic, social position is a result of a historic process. Therefore occupation must struggle for social recognition and it takes long until an occupation becomes profession (as we have seen in the previous part.)

Engineers have to have their reputation accepted in the society and later on they have to maintain it. So a code of ethics can demonstrate their service orientation and commitment to the public interest for the general public. The special ethical role of engineers is to protect the common good and this is the common ground upon which professionals agree in general.

Now I think it is the time to examine a code of conduct which is generally accepted as a model for others. It is the ' IEEE Code of Ethics for Engineers' adopted 1975 by Institute of Electrical and Electronics Engineers (FLORES 1980).

The code has five parts: a preamble and four articles. The preamble defines as engineers role that they 'affect the quality of life for all people in our complex technological society.' To be professional means for engineers ethical conduct in work and therefore to be appreciated by colleagues, employers, clients and the public.

The first article is focused on the engineers and requires that they 'shall accept responsibility for their actions.' This is of crucial importance because all other norms can only be fulfilled if this is taken as valid. Although it is very difficult to state responsibility of an engineer in a way which covers specific cases, any moral consideration is useless if engineers reject this principle. This code is intended mainly for employee engineers and their general problem is the following: an engineer as a member of a staff is seldom in a position to decide alone whether a project must be realized or not. Besides, modern legal systems are oriented on individual responsibility and the issue of corporate responsibility has not been settled so far.

Therefore engineers can pose the question: Why should I take responsibility for the social consequences of a project, if managers decided on its realization without asking my opinion. Engineering autonomy requires answering this question but to tell the truth this answer has not been found so far.

Other values connected with conditions of taking responsibility are: honesty in estimates from available data and that in undertaking engineering tasks:

'Undertake engineering tasks and accept responsibility only if qualified by training or experience, or after full disclosure to the employers or clients of pertinent qualifications.'

Two other valuable activities are to be performed: maintenance of professional skill and dignified professional practice for adequate recompensation.

Article II is about engineers' relation to colleagues and co-workers. The basic values are here equality, equal treatment of others, honest critical spirit, acceptance and offer of honest criticism, readiness to help and assist colleagues and coworkers in their professional development, readiness for professional enlightenment by reporting, publishing, disseminating freely information to others, subject to legal and proprietary constraints, social activity in professional societies and acting according to this code.

These values belong to an open-minded, democratic, critical, helpful, honest and responsible personality embodying the ideal of the professional engineer.

Article III speaks about the engineer's relation to employers and clients. The relevant characteristics are: loyalty in professional and business matters, secrecy in business and technical matters, openness revealing possible sources of conflict of interest, unbribable personality, readiness for technological enlightenment . 'Engineers shall ... assist and advise their employers or clients in anticipating the possible consequences, direct and indirect, immediate and remote, of the projects, works of plans of which they have knowledge.'

This duty of technological enlightenment is closely connected with the modern methods of technology assessment. I am not able to decide which requirement is more difficult to be enforced: the elimination of bribery or the day to day dissemination of results of the technology assessment, but if we want to give a chance to future generations we cannot abandon these norms.

Let me remind you of the unsolved problems of nuclear waste management. Professional honesty would require to inform clients and not only them but everybody, of its consequences.

I think the duty of technological enlightenment cannot be limited to the engineer-employer, engineer-client relations. If it is about relevant facts then all affected persons should be informed, if it is necessary the general public, too.

Article IV describes engineering responsibility to the community. There are four norms in this part: 1. Protection of safety, health and welfare of the community, 2. Public criticism against abuses in these areas affecting the public interest; 3. Helping organizations of civil society serving public interest and 4. Popularization of the engineering profession.

Maybe the fourth point is the most important from point of view of the engineers, but I think the general public can rather appreciate the others.

Now I make some general remarks. The first problem to be mentioned is connected with the fact that this and other codes are enacted by the professions themselves. It is possible that a profession knowing its dependency from the goodwill of the society adopts a code which contains empty rhetoric only and its only function is to improve the image of the profession. The proper function of codes of ethics is to regulate the behavior of its members to satisfy basic needs of the society.

The vulnerable society must be certain the professional power will not be misused against it. And the main function of ethics and that of applied, professional one, too, is the defence of the vulnerable ecosystem, including human beings.

The interpretation of these codes requires professional skill and moral sensitivity. The very detailed codes are difficult to be used; the empty and general formulations are easy to be misused. A proper code is between the two.

Another problem is their enforcement. It is evident that these norms are not legal ones, but they are worth nothing if nobody is bound by them. Engineering societies try to enforce them by their means. Their ultimate sanction is exclusion from engineering professional organizations but an engineer can work without being a member of a professional association and so that is not effective enough.

The other way to achieve their enforcement is, when an engineering organization tries to have principles of codes of ethics considered in a legal action. For example an engineer was dismissed because he was leaking information about a project which was threatening lives and health of the public. Because he was not loyal to the firm, it did not care about reason of leaking and fired him.

If the court rules that dismissing an engineer because of his adherence to norms of the code of ethics is breaching labour contract by the firm, then chances of enforcement of codes of ethics will increase.

3. Conclusions

Starting from necessity of ethics I have pointed out that our technological civilization needs a new kind of ethics taking into account conditions of modern technology. This future oriented ethics of our time must be a kind of responsibility ethics: because of global and long-term effects of modern technology we must take responsibility for future yet nonexistent generations and for nature, too. The reciprocity requirement as the main moral principle should be replaced by this new kind of responsibility principle.

Engineering ethics as a kind of applied ethics should be related to public choices and matters of environment, too, and therefore its 'translated' general principles must be completed by environmental values.

The ideal of engineer described in codes of ethics for engineers should be taken seriously because of his/her contribution for establishing the sustainable growth which is the only way of survival for the mankind.

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