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RIGHTS AND MORAL ENGINEER'S RESPONSIBILITY. ETHICS AS WAY TO REDUCE TECHNOLOGICAL RISKS

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Abstract

The social importance of engineering in modern society is extremely high. Its appearance fundamentally changed all spheres of public life. However, before the engineering work became wide spread, it was strictly controlled or even prohibited. This situation was surmounted only through providing engineers with several categories of rights (right to free labor, right to privacy, right to fair remuneration, right to access to economic resources, etc.). As a result, the engineer gained, in some way, control over society. However, responsibility for his actions is often short-term and does not take into account long-term effects on nature and society.

The ethical level of the engineer is not high enough. The main reason for this is the limited planning horizon of the engineer. If the engineer focuses on the most time-consuming processes, his activity is automatically ethical. Therefore, the main task is to increase his awareness and ability to fully understand cause-and-effect relationships.

The purpose of the article is to identify factors that affect the level of ethics of the engineer. The article offers a list of factors that may have a mathematical expression or expert assessment that allows including them in account design documentation for engineering objects. As a result, the finished technical project will describe technical aspects, social relations and business contracts that provide the required level of engineering ethics. This will reduce technological, environmental and other risks. As a result, the ethics of an engineer will become the factor of production.

Keywords: Ethics, technologies, morality, risks, planning, rights.

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1. Introduction

The main purpose of engineering is to serve man and fulfillment of his needs. However, we see that achieved results are often far from expected. For example, thanks to engineers monotonous and hard work was facilitated by a variety of tools, mechanisms and machines (Sukhodolov 2018). However, after more than 200 years of engineering development, humanity is still forced to work most of the day. The exhausting competition has tremendously escalated and forces to work more intensively.

It cannot be denied that the level of comfort and protection of a person today is very high. Nevertheless, the growth of organization and order in this area is accompanied by an increase in disorganization and disorder in another – humanity with each new generation is becoming more physically weak, painful and pampered.

The success of engineers in the processing of natural resources has led to an avalanche-like growth of available goods. However, it turned out that the growth of consumption destroys the environment and increases environmental risks for mankind (Sukhodolov, 2015).

Thus, very often advances in engineering result in new problems, including insufficient attention to ethics. However, for a long time it was believed that science and technology are ethically neutral in the sense that moral problems arise only in the process of application of science and technology (Rudyakov, 2017). «Prometheus spirit of man is not able to master the technique he created, to cope with the unprecedented energies.... The technique replaces the organically irrational one with rationally organized. But it creates new irrational consequences in social life» (Berdyaev, 1985).

2. Problem Statement

The problem of correlation between the engineer's rights and responsibilities has been the subject of research for a long time; however, according to the common opinion, there is no satisfactory explanation for this phenomenon yet. It is obvious that the rights and responsibility of the engineer are determined outside the sphere of production.

A review of historical examples suggests that the prerequisite for the activation of engineering is increasing the degrees of freedom of the engineer that leads to the release of his creative potential. At the same time, it leads to a change in the system of interests in society and can cause significant social upheaval, both internal and external

3. Research Questions

In history one can find many cases where inventions were made for centuries and even millennia before their mass introduction during the industrial revolution of the XVIII—XIX centuries. For instance, first prototype of a steam machine (aeolipile) was invented and used by Heron of Alexandria (Heron-Mechanic) around the second half of the 1st century AD (Kushner, 2015). Archimedes invented a water-lifting screw, a multiple-reduction gear unit, a worm gear, and, according to some sources, was able to install a steam engine on the galley (Gliozzi, 1970). Leonardo da Vinci created the concepts of aircraft, helicopter, parachute, military vehicles and much more.

This list can be continued further, but the examples already given show that in the history of mankind there have already been both technical knowledge and scientific apparatus sufficient for the emergence of

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industrial production. However, instead of a wide practical application of the invention it was used to create mechanical tricks and toys. Even in the military sphere these inventions were in little demand.

These examples occurred in different parts of the Earth, in different cultures, with different levels of available resources, but often with the same result – without any impact on the technological paradigm. In this regard, we should agree with the opinion that «scientific and technological progress is a factor that is formed outside the economic system, beyond its borders» (Grigoryev, 2014, p. 275).

From this perspective, it is necessary to answer the questions: what factors allow mass application of engineering design, how this relates to the system of rights of the engineer, whether it is possible to reduce the risks of its activities.

4. Purpose of the Study

The purpose of the study is to identify factors that affect the level of ethics of the engineer. It is assumed that an engineer with a high level of ethics has balanced rights and responsibilities. In the process of identifying this list of factors it may be possible to express them mathematically or to evaluate them by an expert. This will make ethics one of the sections of the project documentation and reduce technological, environmental and other types of risks.

5. Research Methods

The engineer has to challenge not only established production practice that is extremely difficult. But before that, he has to overcome the social prohibitions and barriers that any socio-economic system has. In other words, every revolutionary technological solution destroys the system of economic income appropriation in the state, thus inevitably colliding with the interests of different social groups. For instance, William Lee invented the stocking frame knitting machine in 1589 and presented it to Queen Elizabeth I requesting a patent. The Queen refused, saying: «You're swinging too high, master Lee. Think of what this could mean for my poor subjects. This will certainly hit them, as it will deprive them of their jobs and make them beggars» (Robinson, 2015). William Lee received a similar answer in France from James I (1603-1625), successor of Elizabeth I.

This means that an engineer should be a revolutionary in technological, social and economic terms at the same time. Such individuals are likely to be vanishingly rare, but even if they exist in statistically significant quantities, they are powerless unless they are motivated by a sufficiently powerful social force that can be both internal and external. Thus, the Napoleon’s European conquests led to the elimination of the guild of artisans and feudal rights in the conquered countries. In addition, local legislation was replaced by Roman law with the idea of legal equality (Napoleonic Code). Similarly, Japan's industrial development began in the XIX century, when, in July 1853, four American warships entered Edo Bay, demanding trade preferences from the Japanese authorities. This destroyed the former balance of interests in the country and created the possibility of development of new industries.

Consequently, scientific and technological progress follows social changes, and more precisely, changes in the system of rights in society. First of all, it concerns the rights of the engineer. In our view, his rights can change from zero (denial of the human right to free work and free time) to the maximum in the form of the right to influence the change of taxes and other duties (Fig. 01)

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In the first case, the society actually bans any new technological activity, because really fundamental inventions can be created only by voluntary labor and enthusiasm of a free citizen that owns property, has the necessary economic resources, and is confident of his own safety.

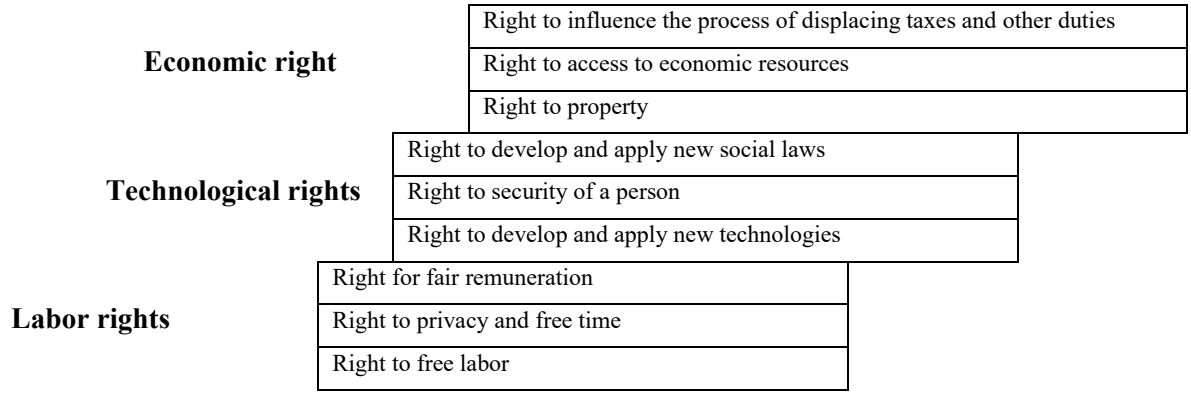

Figure 01. Hierarchy of social rights of engineer

As the engineer obtained his technological rights, his activities became more and more extensive. This can be illustrated by technological paradigms (Glazyev, 1993):

I paradigm (1770-1830): individual engineering and invention; organization of scientific research in universities and engineering societies.

II paradigm (1830-1880): creation of research institutes and intellectual property protection systems.

III paradigm (1880-1930): creation of research departments in corporations; use of university-educated scientists and engineers in production processes; national institutes and laboratories; universal primary education.

IV paradigm (1930-1970): specialized research departments in most of the companies; public subsidies for research; development of secondary, higher and vocational education; technology transfer through licensing and investment by transnational corporations.

V paradigm (1970-2010): computing networks and collaborative research; government support for new technologies and university-industry cooperation.

VI paradigm (2010 -?): transition to a continuous innovation process; computer modeling and simulation

Responsibility of the engineer should increase in accordance with extension of his social rights. However, in practice, very often not the engineer, but the whole society takes this responsibility.

6. Findings

It seems that the reason for the insufficient responsibility of the engineer is primarily in his limited planning horizon. The consciousness of the engineer may embrace the following periods of time:

1. Activity limited to the shortest period. In this case, the engineer is unable or unwilling to look into tomorrow, so he strives to maximize profits today. As a result, the engineer prefers to receive immediately all available benefit from his invention or technical solution to the detriment of future utility. Such distorted understanding of utility makes it prone to selfishness and can cause significant damage to society.

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2. Long-term period. The accumulated experience gradually changes the behavior of the engineer and increases his ability to predict. He is aware of the cause-and-effect relations between his own and others' actions and understands that he is an element of society, each member of which depends on the actions of all other members. Therefore, other actors are no longer perceived as competitors or obstacles on the way to his own selfish goals, but as participants in the game. The condition of their own prosperity is to take into account the interests of other participants. In his professional activity, the engineer is becoming more and more careful. Ethics becomes a social value.

3. Period of time exceeding the life expectancy. The ethical level of the engineer forces him to increase the social aggregate utility, sometimes even at the expense of personal utility. He is willing to sacrifice short-term personal gain for high moral values. Thus, this understanding of life leads to the maximum harmonization of social life and reduce technological, environmental and other risks.

Consequently, there is demand for mechanisms that shift the thinking of an engineer to a long-term planning period and raise his ethical level. Following factors can give this effect:

1. Engineer's reputation. As a rule, the longer the engineer carries out his activities, the more he values his name. Opinions of customers and users are rated very high, so the error for him can be crucial.

2. Reputation of the professional union of which the engineer is a member. If this union has a real impact in the industry, it should develop mechanisms to prevent long-term negative consequences from engineering activities. The legal responsibility of such alliance for the decisions of its members can be an effective way to extend the planning period.

3. State standards of engineering activities aimed at eliminating long-term negative consequences from engineering activities. Such standards may include the imitation of engineering projects in a safe environment, the development of mechanisms to eliminate possible threats, as well as a ban on technological activities, if environmental and other risks cannot be reliably determined. All these measures lead to high costs and are, therefore, prohibitive for innovative technological activities. This limits scientific and technological development, but at the same time increases the long-term sustainability of society and nature.

4. Formation of social groups interested in minimization of technological risks. These groups may be local communities that, on the one hand, are interested in new jobs and the development of the local economy, and, on the other hand, in maximizing public long-term utility. In case when the necessary level of competence and cohesion of such communities can be ensured, the technological risks can be effectively reduced.

5. Consumers and users of engineering objects that are interested in their long-term and effective functioning. If such consumers and users plan to operate engineering facilities for as long as possible, their engineering solution requirements will be cautious and aimed at minimizing technological risks.

6. Moral climate in the country. If the society is focused only on the race of consumption, and business – on achieving quick profits, the short-term benefits will inevitably lead to long-term losses. A similar situation will arise in case of crises in society or destruction of the habitual way of life, when individuals are concerned only with their own survival. Promotion of moral values and social trust in society can significantly increase the level of ethics in engineering, reduce control costs, as well as technological risks.

7. Involvement of an engineer in horizontal networks that use the technical objects created by the engineer. In this case, the engineer will indirectly use his creation and will be objectively interested in eliminating long-term technological risks. Most often, this happens in the technological chain linking the engineer and the customer of the technical object.

7. Conclusion

The above-mentioned factors that change the way of thinking of the engineer and improve his ethical level should be taken into account at the design stage of the technical object and included in the project documentation. Some of these factors may have a monetary value or a mathematical expression. As a result, the finished project will describe not only technical aspects, but also social relations and business contracts that provide the required level of engineering ethics.

Currently, economists widely criticize the fact of slowing down scientific progress. Specifically, A. Yu. Chernov (Chernov, 2006; Tagarov, 2014) draws attention to the transition from revolutionary to evolutionary development. Even in such important spheres as defense industry, power engineering, medicine the main achievements were made during the 2nd half of 1960ies, and after that revolutionary technologies for some reasons ceased to appear. Thus, on the basis of the arguments given in the article, it is possible to suggest that the next impulse should be made by providing engineers with the rights of the highest level: ethical and ideological.

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