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**SIGNIFICANCE OF ETHICAL PRINCIPLES IN TRAINING OF  
ENGINEERS IN TECHNICAL UNIVERSITY**

L.G. Rudykh (a)\*, O.G. Stepanenko (b)

\*Corresponding author

(a) Irkutsk National Research Technical University, 83 Lermontov Street, 664074, Irkutsk, Russia, e-mail:  
lili.rudih2011@yandex.ru, 89247015033

(b) Irkutsk National Research Technical University, 83 Lermontov Street, 664074, Irkutsk, Russia, e-mail: ols-  
tep@yandex.ru, 89025126039

*Abstract*

The present article seeks to analyze key engineer training requirements based on specific ethical principles. They involve knowledge of manufacturing technology and management and an ability to follow ethical principles in professional settings. The article concludes the fact that technical universities have to implement professional ethical principles in the educational process and teach students active and responsible behavior.

Community commitment of future engineers depends on their engagement in civil society development. Student lives are determined by various factors. Students have to overcome psychological, moral and institutional difficulties. The current education system should focus on development of innovation abilities and adaptation skills, on the development of students to be able to make responsible decisions, training knowledge of foreign languages for project preparation and for work in foreign countries. Knowledge of ethical business communication contributes to successful work of engineers. Engineering education should not and cannot be field specific. Rapid social changes and technosphere modernization impose high requirements on university engineering education, which determines the prosperity of Russia. The systemic nature of engineering activities predetermines engineering thinking (knowledge in different areas). To perform required tasks, including designing, all aspects of creative activities (aesthetic, economic, ethical, psychological) and main engineering labor safety requirements should be taken into account.

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## 1. Introduction

As you know, understanding comes with age: the ideal profession is not only favorite, but also in demand.

In the twentieth century, there was an urgent need for the division of labor. There are currently over 40,000 different professions. In conditions of overburdening of the labor market and constant growth of demand for goods, narrow specialists were required.

After the collapse of the Soviet Union, many factories have been destroyed; a new era has begun in the labor market – the development of services. New promising professions appeared after 2000: a builder, a bricklayer, a plasterer, a manager, a waiter, a tourist business specialist, etc. The youth chose well-paid professions of a lawyer or an economist. They considered them the most promising. As a result, there were a lot of lawyers and economists in the the labor market.

Technology development in Russia contributed to new professions which appeared after 2015. These professions well have been relevant until 2020: surgeons, architects, design engineers, nanotechnologists, chemists, biotechnologists, petrochemicals. Loggers, locksmiths, textile workers and others will be in demand as well.

In Russia, priority male professions are a sailor, a pilot, a miner, a plumber, a bodyguard, a military officer, a builder. The most promising professions are:

- an engineer;
- a designer;
- a programmer;
- a worker of the aerospace industry.

The female professions which will be popular in Russia by 2020 are as follows:

- a doctor;
- and advertising manager, a tourism manager;
- a psychologist;
- a journalist;
- a nanomedicine expert;
- a fitness coach.

Currently, research and development areas are changing rapidly. Quality education and training of high profile competitive professionals in engineering fields are crucial tasks of high technical educational institutions.

## 2. Problem Statement

Theoretical foundations of engineering training turned out to be untenable and found irreconcilable differences:

- need for improving professional training of students able to make responsible decision and the lack of active attitudes to life contributing to independent decision-making;
- need for project preparation in order to work in foreign countries and poor knowledge of foreign languages;
- excessive education emphasis on theory and inability to put knowledge into practice;

- –implementation of innovation products, a large amount of information, development of applied and knowledge intensive industries require material resources which are available only in a small number of universities which constitutes a bar to training of high profile engineers.

### 3. Research Questions

New industries, applying modern equipment, force their engineers to learn new technologies, have proficient knowledge of a foreign language, be creative, develop abilities to carry out innovation activities, make non-standard decisions and use ethical business communication skills.

As can be seen, requirements a modern engineer should meet are rather high. They have to be well-educated persons, follow ethical principles and have knowledge of modern manufacturing technology and management (Verrax, 2017).

Due to increasing responsibility of engineers for their working results, special attention should be paid to development of self-organization skills which involve an ability to set and achieve goals. Project work and engagement in scientific conferences are useful practices as far as preparation involves independent searching for required information.

Independent work under the guidance of teachers is a basis for self-education and an incentive for further training (Ooi & Tan, 2015).

Authors' experience of teaching in the engineering university shows that students, having the right to choose a research object and the inconvenience of guidance, develop creative individuality when solving complex engineering tasks. Self-cognition forms ideas of own abilities, talents, contributes to objective assessment of own results.

Thus, students' individual work (SIW) performs several important functions. Casual relations are manifested in motivation, self-cognition, self-organization, self-reflection and are based on transforming core values determining ethical social responsibility of future engineers (Belyaeva, 2003).

Intellectual activities result in knowledge systematization, critical and creative thinking development. It contributes to a wide variety of student interests, an ability to assess a situation, identify problems and find alternative solutions, an ability to collaborate with colleagues following ethical principles (Rudykh, 2017).

Over the last years, we have heard that engineering education should not and cannot be field-specific. Despite this fact, when studying ethics-oriented disciplines (philosophy, business communication ethics, etc.), some future engineers argue that this knowledge is not relevant and useful for their careers.

Many Russian technical universities observe that students have poor knowledge of jurisprudence and management disciplines, natural sciences and humanities (Bakstanovsky & Sogomonov, 2007). It should be noted that the only goal of some students is to have a higher education diploma. They have vague ideas of the role of an engineer, his social responsibility, ability to solve complex tasks, and engineering ethics.

The first code of ethics of engineers was drafted in the UK in the mid-nineteenth century. The very first codes mainly regulated issues related to entrepreneurship and advertising, and in the middle of the 1970s, a new code appeared in America, which reflects the specifics of engineering ethics and defines the responsibility of the engineering community for the health, well-being and safety of people (Lenk, 2011).

It was from that moment that engineering issues were incorporated into the new curricula of many American higher education institutions. Currently, the engineering ethics is a set of relevant ethical areas: digital, computer, bioengineering, nanotechnology ethics, and others (Bond, 2009).

Currently, ethical standards are prescribed by codes of professional European and Russian engineering communities and regulative acts (Farahani, 2014). They contain an active moral component, for example:

- take part in projects and bear responsibility for decision-making;
- do not show jealousy of colleagues' success and do not harm their work;
- show regard for opponents;
- respond to criticism positively;
- do not transfer sympathy and antipathy to technical aspects of collaboration (Berulava, 2000).

A moral component should be a part and parcel of engineering education.

Russian engineers should:

- put paramount the safety and health of society;
- perform work only within its competence;
- respond objectively to inquiries of the public;
- act as client's agents and avoid conflicts;
- build their professional activities on the basis of decency;
- improve their professional development;
- be ready for creative communication with representatives of related professions;
- be able to highlight the civil and ethical problems associated with the search for new knowledge, engineering solutions;
- fight against conservatism and stagnation in creative activity (Kanke, 2003);
- critically evaluate the results of their work;
- minimize adverse effects on human beings, society and the environment caused by the use of technology;
- raise the prestige of a Russian engineer;
- be a patriot, take care of the good of Russia;
- be organized and disciplined in actions and thinking;
- show good faith, which is primarily concerned with the exclusion of negligent labour.

Presenting the dynamics of ethics of an engineer today, one can see a fundamental change in the social and cultural contexts (Harris, Pritchard, & Rabins, 2000). A modern engineer is an active participant in the network communities, in this regard, his ideas about ethical behavior, moral attitudes have changed dramatically in comparison with the previous generation of engineers (Davis, 2006). In this situation, the community of engineers need to improve the level of self-awareness, moral responsibility for the work done, on which depends the well-being, and sometimes the lives of people. Scientists note that "professional engineers are well aware of the ethical risks of engineering activities due to the technical logic of this activity, the logic of possible corporate connections practicing engineers, their psychology as agents of private interests, preferences and preferences. But the honor and dignity of the profession are confirmed

against all this, and the meaning of the profession is seen in an honest and decent work for the benefit of society” (Apresyan, 2013).

Unfortunately, dehumanization processes devaluated the significance of the moral imperative. Both teachers and students of engineering universities observe this fact. Students of Irkutsk National Research Technical University (INRTU) speaking at scientific conferences show distrust in moral values. The following example supports this statement. A geology student says: “Justice is a wide ethical category which determines human relations, both personal and social ones ... Since childhood, people have been experiencing injustice, for example, when a nursery teacher praises a child because his/her parents have senior positions and pays no attention to other children whose parents have a lower social status”. In his conclusions about ethical principles, the student notes that “when graduates being professionals in their fields are employed, they get lower positions because higher ones are held by chief’s relatives who are not professionals”.

To determine personal features of students, during a scientific conference, future engineers were asked to answer what is more important for an engineer

- a) competency or purposefulness?
- b) self-motivation or emotional balance?
- c) stress resistance or sociability?
- d) creativeness, originality or excellent examination marks?
- e) mobility or industry, decency, accuracy?

Students had to reason their opinions using objective facts.

One of the tasks was to list the following personal traits of a modern engineer in an importance order:

- general education;
- confidence;
- competency;
- sociability;
- decency;
- self-motivation;
- purposefulness;
- decisiveness;
- excellent marks;
- stress resistance;
- emotional balance;
- flexibility;
- mobility.

The next tasks involved a question about requirements; a modern engineer should meet (e.g., experience, qualification, etc.).

Today, a competitive engineer should not only possesses the skills of oral and written speech, but also skillfully operate with the peculiarities of professional knowledge, possess the skills of public speaking, negotiate and conclude contracts (Rudenko, 2015).

As it turned out, some of our students are impressed that, for example, the French business negotiations begin at eleven o'clock in the morning, and after an hour and a half the negotiators are offered a traditional French Breakfast with wine. Other students liked the fact that the Germans have to agree on the time of the upcoming meeting in advance, carefully worked out the issues under discussion; and the Italians' key to the success of the negotiations is good knowledge of their culture and history; the Swedes primarily appreciate professionalism.

Most students support the specifics of the Russian negotiation mentality, which is characterized by friendliness, emotionality, openness and trust.

Some students cannot write correctly, explain purposes of their researches, they lack economic knowledge. As a result, young engineers find it difficult to implement their research results. They are not able to claim author rights (Stepanenko, 2014).

#### **4. Purpose of the Study**

The article seeks to analyze new ethics-based approaches and requirements for training of engineers.

#### **5. Research Methods**

The article uses general research methods (simulation, analysis, synthesis, etc.); theoretical methods (comparison, generalization, classification, concretization, induction, deduction, idealization, analogy, etc.); philosophical methods (dialectics, metaphysics, phenomenology); interdisciplinary methods (synthesis, integration). Special attention is paid to objective principles (determinism, systematicity, development, historicism). The authors identified some objective regularities, and causal relations characterizing development of ethical principles in technical education. The authors also used historical system analysis.

#### **6. Findings**

Current specific technogenic processes have done irreparable damage to fundamentals of engineering ethics. Easy access to uncontrollable online information makes things only worse. It is difficult to understand what information is reliable, to gain insight into a variety of laws, definitions, and theories.

Unfortunately, due to low salaries, a motivation level of young Russian engineers is rather low. Therefore, young engineers prefer to work abroad rather than improve their skills in Russia.

Professionalism and competency, a typical American business communication style, are opposed to Russian ethical principles. American negotiators are more independent when making engineering decisions than other nationalities.

The British people are rather reserved, scrupulous and accurate. They promise young engineers a fast track to the top of the career ladder.

One of the important tasks of modern education is to develop a high professional competency level in engineering students and teach responsibility for social, cultural and ecological consequences of their professional behavior. It is crucial to illustrate drawbacks of the technogenic approach which ignores an ethical component of engineering education.

## 7. Conclusion

Technical engineering universities have to implement professional ethical principles in the educational process and teach students active and responsible behavior.

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