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THE VALUE POTENTIAL OF AN ENGINEER IN A HIGH-TECH ENVIRONMENT AND DIGITALIZATION OF THE ECONOMY

Abstract

The article examines the socio-philosophical aspects of the formation of value orientations of modern engineering personnel in the context of high technologies and the digitalization of the economy. We analyzed such philosophical concepts as: "value", "value orientation", "engineer", "engineering", "technical culture". Particular attention is paid to the consideration of the social functions of engineering in modern society. The mechanisms of the formation of value orientations of future engineers in higher education are considered. The conclusion is made that in conditions of high technologies, the functions of engineering activity change. In particular, the predictive function of the engineer is increasing, as well as the requirement for his social and environmental responsibility. The process of forming the value orientations of the future engineer is particularly influenced by social, humanitarian and philosophical education, which contributes to the interiorization of information about such values that are necessary for successful professional and civic activities: life, health, morality, peace, preservation of the environment, professionalism, communication, humanism.

Keywords: higher education, value orientations, engineering activity, high technology, digital economy.

Introduction

The evolution of technology is directly related to the growing employee, and, in this regard, the requirements for the professional and social activities of an engineer are changing significantly. In a high-tech environment, engineering tasks expand significantly and go beyond the traditional range of professional responsibilities. Today, engineering activities are directly related to the social sphere. In this regard, the successful solution of modern engineering problems requires certainty in value orientations from a modern specialist. Only then will he be a real professional in his field. It should be noted that a person becomes a professional not at the university but once they have already gained work experience. At the university, the social formation of the personality is especially active, especially its orientation towards preparation for specific work activities. Therefore, we can say that the value component of higher education can be one of the important criteria for establishing a correspondence between the training of a specialist and the requirements of modern reality (Kraev & Tikhonov, 2019). His future development as a professional depends on how much the future specialist will be focused on socially significant values.

The formation of value orientations of future engineers is experiencing a contradictory, sometimes opposite influence of social groups and processes. The activity of many subjects during the period of active development of the foundations of the worldview and professional activity leads to the fact that the level of risk of value disorientations significantly increases.

Value Orientations and the Essence of Engineering

The study of the problems of values and value orientations has a long history. The theory of values was the first to be developed by philosophers in the second half of the XIX century. The founder of axiology as a philosophical doctrine is Rudolf Hermann Lotze, who brought to the fore the concept of value in the field of logic and in metaphysics. G. Münsterberg made a significant contribution to the development of axiology, who revealed in the course of psychophysical analysis the fact of the universal importance of volitional states. Fundamental concepts and concepts of axiology received their in-depth development from the neo-Kantians of the Baden school - W. Windelband and G. Rickert. They believed that the further development of philosophy is possible only as a "critical science of universally binding values" (Windelband, 2011). Following them, the concept of "value" as a philosophical category was absolutized, and the representatives of the phenomenological direction M. Scheler, N. Hartmann, B. Hildebrand and others, substantiated the theological doctrine of values.

According to V. Windelband and G. Rickert, value is not an objective reality but an ideal being. Values are seen as independent of human desires. These include good, truth, beauty, which have a self-sufficient meaning, are goals in themselves and cannot serve as a means for any other purposes. Thus, value is not a reality, but an ideal, the bearer of which is "consciousness in general," i.e., transcendental subject. In addition, values are considered in this concept as norms that do not depend on a person and form a common basis for specific values and culture.

According to M. Scheler, values form the ontological basis of personality. But the values that are in objects should not be identified with their empirical nature. Just as, for example, colour exists independently of the objects to which it belongs, so values (pleasant, majestic, good) can be contemplated regardless of the things of which they are properties. Cognition of values and their contemplation is ultimately based on feelings of love or hate. The values are higher, and the more durable they are, the higher is the satisfaction we get from them. In this sense, the least durable values are those associated with the satisfaction of sensual desires and with material goods. Higher values are the values of "beauty" and "cognitive" values (Scheler, 1994).

In the modern sense, value orientations can be considered as the orientation of the subject (personality, group, society) towards goals that he perceives as positively significant (good, correct, high, etc.) in accordance with the standards adopted in society (community) and available life experience and individual preferences. This orientation is a set of stable motives underlying the subject's orientation in the social environment and his assessments of situations (Lukov, Val. A. & Lukov, Vl. A., 2008).

Analyzing the value potential of an engineer in a high-tech environment, it is necessary to turn to the essence of engineering activity and its role in modern society. For the first time, the word "engineer" in Russian-language sources occurs in the middle of the XVII century in "Acts of the Moscow State" (Fasmer, 2004). Etymologists believe that it came to Russia from Poland, which, in turn, borrowed from German and French – "Ingenieur", which goes back to the Latin "Ingenium" – "Ingenuity, witty invention", "Mind", "Talent", "Ability", "Genius", "knowledge". The word "engineer" was first used to denote a special kind of occupation in the ancient world, apparently not earlier than III century BC. Initially, this was the name of the persons who controlled the war machines, as well as the inventors of these machines.

A modern engineer is defined in a completely different way, in particular as a person capable of inventing, a scientist constructor (but not residential buildings, but other structures of various kinds), a specialist with higher technical education, etc. The above definitions are clearly differ-

ent, but they contain common features. In particular, O. V. Kryshtanovskaya notes that despite the expansion of the scope of interpretations of the concept of "engineer", what remained unchanged was what engineers were called educated technicians. These were specialists with technical knowledge, as a result of the application of which a variety of technical, i.e. man-made structures, were produced artificially (Kryshtanovskaya, 1989). The process of creating such technical structures can be divided into a number of stages, in particular: the birth of an idea (in the case of its originality, this stage is called an "invention"), its consistent material embodiment in a drawing, model or finished product (depending on the complexity of the idea, the degree of division of social labour, the level of development of production technology, etc.). It should also be noted that since ancient times, the most important function of an engineer has been the intellectual support of the process of creating technology. This is due to the fact that engineering activity arose only when the separation of mental labour from physical labour was outlined in handicraft production. The engineer himself does not create a material object but only develops a way to create it. Based on this, it is possible to draw a line between the professional groups that provide industrial production, namely, between engineers and artisans, workers. Engineering activity is associated mainly with mental labour, and the activity of a craftsman or worker is associated with physical labour. Thus, the purpose of engineering work is to develop means, methods and technologies for transforming the environment for the creation of certain technical structures - production. Based on the goal of engineering, one can single out its essential basis - the creation of technical innovations. It is the innovative activity that is one of the main driving impulses for the development of productive forces, without which scientific and technological progress, in general, is impossible (Tikhonov & Novikov, 2020). Since the XX century, this function of engineering activity was recognized by public opinion as the main, if not the only one. At present, it remains dominant in the minds of a significant part of engineers as well.

During all periods of its existence, engineering activity was closely related to the management function since any cooperative work requires a certain organization. In particular, the engineers of the Roman army not only created new technical means but also directed their operations. This activity included both the management of technology and the management of people (Shchedrovitsky, 1996). Moreover, before the emergence of the capitalist factory, the managerial function of an engineer was closely related to his technical function and did not exist separately as a separate type of labour. A significant contribution to the disclosure of the essence and social significance of engineering activity was made by P. K. Engelmeyer, outstanding philosopher of technology, the creator of the theory of technical creativity. He stood at the origins of the Russian automotive industry, and patents contributed to the development of Russian electrical engineering and technical education. P. K. Engelmeyer was the first to formulate the ideas of the humanitarian social and philosophical dimension of technology and engineering activity in an expanded form. In fact, he was the first to be able to reveal the true essence and social significance of engineering. He regarded the engineer as "the creator and leader of the economy", who in the modern state is given the "leading role". In his work "In defence of general ideas in technology", P. K. Engelmeyer noted the complexity of the training of engineering personnel. In his opinion, an engineer must prepare for a leading state role from four sides at once: technical, economic and legal. P. K. Engelmeyer noted that the training of engineers should not be limited only to technical knowledge. It should also include "factual knowledge of technology, economics, jurisprudence, politics, psychology and ethics". P. K. Engelmeyer (1912) viewed engineering activities as a kind of art. In his opinion, the engineer carries out creative and directing activi-

ties, and the technician carries out the execution. P. K. Engelmeyer developed the foundations of the science of creativity – eurylogy. In the book "Theory of Creativity", he considered various aspects of the creative process, not only in technology but also in science, religion and art. In this work, he proposed a theory of three acts, which consists of three stages: desire, knowledge and skill. In the first act, the invention is assumed, and everything begins with the intuitive appearance of a hypothetical idea; in the second, a plan is proved and developed (the invention is transformed into a logical representation); in the third, it is carried out. The third act is not directly related to creativity since the implementation of the plan can be entrusted to the appropriate specialist. In his opinion, in the first act, genius is manifested, in the second - talent, and in the third - diligence. Also, in this work, P. K. Engelmeyer offers his own version of dividing the arts into graceful (aesthetic) and useful (utilitarian). Based on this classification, he offers his own interpretation of the concept – "benefit". In his opinion, everything that facilitates the achievement of the intended goal and increases labour productivity is useful. In this regard, he notes that this is precisely the "function and main goal of technology, as a profession and as an art". As a result, he defines technique as art aimed at benefit and art aimed at beauty.

In work "Creative personality and environment in the field of technical inventions", P. K. Engelmeier formulates the main contradiction of the innovation process, considering the interaction of the environment and the personality as a struggle between two elements: "A creative person cannot be silent about what is obvious to him, but the mass cannot but follow the laws of inertia". In this work, P. K. Engelmeier also addresses the question of "healthy invention", that is, an invention that has "internal and external success", and a "sick invention" associated with "internal and external failure." He notes that an inventor is happy when the following conditions are met:

1. creative genius;
2. the necessary knowledge;
3. skill in handling matter;
4. commercial streak and knowledge of people;
5. luck.

In "Philosophy of Technology", P. K. Engelmeier considers such a concept as - technicism. In general terms, he defined it as the construction of life. Within the framework of the technicalism of P. K. Engelmeier proposed a three-act theory of creativity, the main provisions of which are as follows: a person creates an artificial world - culture, which, in turn, is divided into the material (material, external for a person) and spiritual (created by a person within himself). Due to the fact that human life is directly related to activity - technicism is teaching about human life. Generalizing the theory of creativity, P. K. Engelmeyer proposed the triune essence of a creative person: feelings, reason and will. He divided human activity itself into three acts: intuitive, discursive (rational) and reflex (Engelmeyer, 1912). The ideas of philosophers of the early XX century are still relevant today. Of particular interest is the fact that engineering activity is perceived by him as an organic combination of technical and humanitarian aspects.

Formation of Value Orientations of Students of Engineering and Technical Universities

Scientific research carried out over the past 30 years shows that in the minds of young people, including students, the significance of universal human values is growing, their interest in eternal truths and questions about the meaning of life, the essence of good and evil, conscience, justice, etc., that is, to humanitarian knowledge, which constitutes the foundation of the human person. The transition to a post-industrial society has led to the following: dominant production resource is information and knowledge; service sector has a priority development and prevails over the volume of industrial production and agricultural production; the most valuable qualities are the

level of education, professionalism, learning ability, personal qualities and creativity of the employee.

These factors put forward new requirements for the professional activity of an engineer, and its content is filled with socio-humanitarian meaning. The fundamentally new nature of the activity requires high-tech workers such qualities as the ability to make independent decisions, the ability to readjust to perform new tasks, responsibility, conscientiousness, the ability to quickly perceive and respond, etc.

In the professional activity of a modern engineer (regardless of the industry in which he is involved), high-tech products satisfy the ever-increasing needs prevail. The competitiveness of such products depends on the quality of development and the choice of the optimal number of required technologies. Moreover, nowadays, the sphere of technology includes not only the use but also the very production of scientific and technical knowledge technological processes. Obviously, a higher technical school is called upon to provide conditions for the formation and comprehensive development of the creative potential of future engineers, in which the intellectually-professional and social-personal qualities of a specialist are integrated (Schaer & Andre, 2020). According to Zh. T. Toshchenko, creativity is closely related to such a concept as technical culture, which is "an organic addition to the general culture of a person, a form of realizing the potential of an employee in the field of scientific and technical thought and at the same time an independent social reserve of labour that personifies the spiritual wealth of society" (Toshchenko & Tsvetkova, 2012). The emergence of technical culture is due to constantly changing requirements for the qualifications of an employee, scale of socialization of labour and economic efficiency. Technical culture largely determines the employee's compliance with the actual objective needs of the time, is the key to the successful development of production and the employee and is also an integral part of the know ledge economy.

It is obvious that higher engineering education should contribute to the improvement of technical culture. The training of modern engineering personnel should ensure the unity of knowledge, beliefs and practical actions of a person, as well as the coincidence of a person's abilities and the objective needs of social development in the field of used technology (Vorontsova, Arakelyan, & Baranov, 2020). Modern engineers must be ready to use and constantly update their technical knowledge. An engineer must also be able to see the benefits not from technology in general, but in relation to his work, to his life, to his work collective, etc. A modern engineer is not just a technical specialist who solves narrow professional tasks. He must know not only the basics of technology but also the technology of its management. A fundamentally new nature of engineering activity entails significant social changes, receives an assessment of a new level of civilizational development, becomes a factor in various social changes, and influences the development of social structures (Mikhailov, 2013).

This is its transformative function, the implementation of which requires the engineer, on the one hand, to have creativity, and on the other, to take into account social, environmental, economic aspects and constraints, as well as health and safety issues. In this regard, it is especially important for future engineers to develop an understanding of the social significance of their professional activities at the university. It is in the university that the younger generation faces the problem of a clearer awareness of their place in the system of social relations. During the period of study at the university, an idea is formed about the place and role of their future profession and professional achievements in human life, about the goals of professional activity and how to achieve them (Mikhailov, 2013). The mechanism for the formation of value orientations of university students is interiorization. The essence of this mechanism is the acceptance by an indi-

vidual of the information about the existence of a value and the conditions for its implementation (Lohbeck & Retelsdorf, 2021). The transmission of information about values is carried out, first of all, through social and humanitarian education, which in itself is heterogeneous and is carried out at the university through its humanitarian environment. The humanitarian environment of the university includes socio-humanitarian disciplines, faculty, extracurricular (educational) work of the university, student-centred learning technologies, etc.

At the same time, it should be noted that episodic impact is not enough for the effective formation of students' value orientations. It is necessary to use a systematic approach to the design and organization of the educational process. The system approach to the cognition and transformation of any object is the leading general scientific approach. The essence of the system approach is that relatively isolated elements of the system should be considered not just as independent components but in their interaction, development and dynamics. The system approach can be applied as a methodological basis to ensure the quality of the educational process in higher education (Issakova, Kaltayeva, Ibrayeva, Kudaibergenova, & Bakhtiyrova, 2021). The system approach allows isolating simple technological operations of the learning process from the complex processes of education quality formation, manageable, improve the stability of their functioning and, very importantly, find the problems in the organization of training that require a change in approaches or a fundamentally new solution. The purpose of the implementation of the proposed approach is the holistic development of students as future specialists with clear value orientations and high social responsibility for the results of their professional activities.

Discussion

The scientific novelty of the authors' developments consists in determining the methodological foundations for the formation of value orientations of students of technical universities in the context of the transformation of the social functions of engineering activities, as well as in the context of the constant evolution of engineering and technology. The results obtained by the authors suggest the use of a systematic approach, which will allow the formation of an effective model of the humanitarian environment of the university, which contributes to the successful internalization of socially significant values by students. Also, the identified methodological foundations create a basis for further research on the problems of forming the value orientations of future engineers, including taking into account the impact on student youth of social groups and processes not related to the educational process.

Conclusion

The most important regulator of a specialist's professional activity is his value orientations. A modern engineer must correlate existing knowledge with a system of value orientations and direct professional activity in accordance with a set of social requirements for it. In the high-tech era of the digital economy, the functions of an engineer are changing significantly. From a specialist who maintains the production process, he turns into a professional who designs, organizes, predicts and ensures its implementation. The predictive function of the engineer, as well as the requirement for his social and environmental responsibility, increase significantly.

The process of forming the value orientations of the future engineer is particularly influenced by social and humanitarian education, which contributes to the interiorization of information about the values necessary for a successful professional and not professional activities, in particular: in life, health, morality, peace, preservation of the environment, professionalism, communication, humanism. The importance of the listed value orientations for the engineer today is explained by the change in his functions in the

changing production the increased requirements for him, in particular, social and environmental responsibility. This, in turn, is due to the deteriorating state of the natural environment, humanization and intensive informatization of all spheres of life. Under these conditions, the tasks of engineering activities include not only providing comfortable conditions for the life and activities of people but also the comprehensive development of human potential.

References

Engelmeyer, P. K. (1912). Philosophy of technology. *Congresso Internationale de Philosofia, Bologna, 3*, 242.

Fasmer, M. (2004). *Etimologicheskii slovar' russkogo yazyka* (Etymological dictionary of the Russian language, in Russian). Moscow: Astrel.

Issakova, G., Kaltayeva, G., Ibrayeva, K., Kudaibergenova, S., & Bakhtiyarova G. (2021). Formation of professional competence of university students based on a systematic approach. *International Journal of Emerging Technologies in Learning, 16*(10), 163-178.

Kraev, V. M., & Tikhonov, A. I. (2019). Risk management in human resource management. *TEM Journal: Technology, Education, Management, Informatics, 8*(4), 1185-1190.

Kryshtanovskaya, O. V. (1989). *Inzhenery: stanovlenie i razvitie professional'noi gruppy* (Engineers: The formation and development of a professional group, in Russian). Moscow: Nauka.

Lohbeck, A., & Retelsdorf, J. (2021). Assessing value beliefs among university students: Validation of the value beliefs questionnaire for university students (VBQU). *Studies in Educational Evaluation, 70*. doi: 10.1016/j.stueduc.2021.101052

Lukov, Val. A. & Lukov, Vl. A. (2008). *Tezaurusy: Sub"ektnaya organizaciya gumanitarnogo znaniya* (Thesauri: Subject organization of humanitarian knowledge, in Russian). Moscow: Institute of Business.

Mikhailov, A. A. (2013). Socio-humanitarian training of engineers. *Social and Humanitarian Knowledge, 3*, 157-166.

Schaer, E., & Andre, J. (2020). *Process engineering renewal 3: Prospects*. USA: Wiley-ISTE. doi: 10.1002/9781119751267.ch1

Scheler, M. (1994). *Izbrannye proizvedeniya* (Selected works, in Russian). Moscow: Gnosis.

Shchedrovitsky, G. P. (1996). *Filosofiya. Nauka. Metodologiya* (Philosophy. Science. Methodology, in Russian). Moscow: Shkola kulturnoi politiki.

Tikhonov, A. I., & Novikov, S. V. (2020). Modern organization effective functioning evaluation. *Quality-Access to Success, 21*(178), 3-6.

Toshchenko, Zh. T., & Tsvetkova, G. A. (2012). *Sociologiya truda* (Sociology of Labor, in Russian). Moscow: Center for Social Forecasting and Marketing.

Vorontsova, Yu., Arakelyan, A., & Baranov, V. (2020). Smart technologies: unique opportunities or the global challenges of transhumanism. *WISDOM, 2*(15), 68-75. doi: 10.24234/wisdom.v15i2.335

Windelband, V. (2011). *Prelyudii. Filosofskie stat'i i rechi* (Preludes. Philosophical articles and speeches, in Russian). Moscow: Socium.