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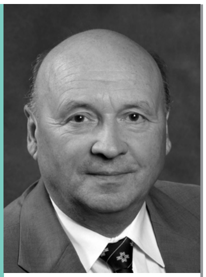

DEAR READERS!

In the latest issue of the journal "Engineering Education" we would like to present you various articles in which the authors share their views on current problems and challenges in engineering education and try to find ways to solve them. The topic of this issue "Engineering Education in Russia: Challenges, Problems and Solutions" is outlined in the sections, titled Problems and Challenges, Solutions, Modernization of engineering programs and disciplines, Scientific discussions. However, the layout of papers by category is rather nominal, and you can find a description of the problems, theoretical and practical recommendations concerning the improvement of engineering education in different articles throughout all sections.

This issue of the journal "Engineering Education in Russia: Challenges, Problems and Solutions " covers an undoubtedly relevant topic. Over the last year the problems in this field have drawn attention not only of those who are directly involved in this area, but also government, institutional and public structures representatives at all levels, such as the Russian State Duma, the Council of Federation, the Russian Union of Industrialists and Eentrepreneurs (RSPP), the Chamber of Commerce and Industry of the Russian Federation, the Association of Technical Universities, the Association for Engineering Education of Russia (AEER) and others. In recent years, a number of parliament and public hearings, conferences and seminars on issues in engineering education were held in our country; an analysis of the causes of underdevelopment of engineering education, specific recommendations to remedy the situation in the field of education were made.

In this regard, the most important becomes the fact that the problems in engineering education attracted the attention of the President of Russia D. Medvedev, who took quite concrete and effective measures to deal with them. A few years ago Vladimir Putin during his presidency also focused his attention on these problems "...there are a lot of people with higher education degree, but we are sorely lacking in real modern professionals. Today, large companies pay a lot of money attracting professionals from abroad."

And yet, engineering education in Russia still faces difficulties. To some extent, the hope for positive changes is connected with the establishment of federal and research universities in the country. However, most specialists in the field of engineering and technology are prepared in higher education institutions that are not rained down by financial prosperity. And even after gaining additional investments in the development of leading universities it is often quite difficult to use them for solving problems in engineering education because of bureaucratic constraints. Moreover, to solve the problems in engineering education we need to take holistic measures that will impact not only on higher education system but beyond it as well.

The experts of the Association for Engineering Education of Russia conducted a research study to get to the root of the current problems in engineering education within several training seminars. Such seminars were held during the 2010/2011 academic year in Moscow, St. Petersburg, Rostov-on-Don, Novosibirsk, and Tomsk. The list of experts consists of rectors, vice rectors, deans, department chairs, professors, associate professors, teachers of technical universities - those who are directly involved in the training process of specialists in the field of engineering and technology in Russia. Unfortunately, according to the opinion of the vast majority of AEER experts Russian engineering education today is going through systemic crisis, critical stage or stagnation.

The key characteristics of the crisis are: a notable decline of public prestige of the engineering profession, employers' dissatisfaction with the poor quality of training, lack of competitiveness of Russian engineering developments on the world markets, outdated facilities of universities and industrial enterprises, where practical training of future engineers takes place. At the same time with the ever-changing world of technology come new challenges in engineering education and only joint efforts of government, business, scientific and educational community can help to respond them. I hope that articles presented in our journal will contribute to overcome the crisis in engineering education in Russia.

Sincerely,
Editor-in-Chief,
Prof. Yury Pokholkov

Contents

Engineering Axiology or Why Is Engineering Education in Crisis?

Vyatka State University
S.L. Smagin, T.G. Ivantseva

The article is devoted to the cause clarification of engineering education crisis. According to the authors' point of view, this is the world complex nature characterized by the moral human autonomy. Crisis overcoming problems will be solved by the social justice modeling praxis in the educational process. It must be stressed that interdisciplinary module development aimed at humanitarization of engineering education is of great significance.

Key words: *crisis of engineer's education, humanitarization of engineer's education, moral human autonomy, phronesis technologies, social justice.*

S.L. Smagin

T.G. Ivantseva

The crisis of engineering education is doubtless. Moreover, it has the status of legitimate nomination. After the parliament hearings "Modern engineering education as a significant component of engineering modernization in Russia", the participants discussed the problem of engineering professional staffing in Russian economics and came to the conclusion that neither the engineering education infrastructure, administration (including legal support), and the age qualification of the faculty staff, nor the amount of research and development financing activity meet the modern demands of engineering knowledge in the domestic manufacture [1].

The resulting crisis of education is due to the "juvenility trap" (by V. Polterovitch) where Russia was caught into, when modern economical growth is characterized by the significance of the scientific and engineering progress and intellectualization of the production principal factors [2].

The main activities to overcome the crisis are of institutional character. They are aimed at the reconstruction of the engineering education key status which would be appropriate to the technical engineering role in the national innovation system, especially in the scientific research activity and personnel training [2]. However, speaking of the crisis in engineering education, we think that the essence of the matter is in the existence of a human being in the time of the science-based world situation.

First, the existence of the present institutional barriers among science, education and areal sector of economics should be explained, so far, as the global history process is characterized by the social complication in the solidary space and time i.e. by the tendency of the present social institutions autonomism and the formation of new ones. Why does the natural autonomism of social institutions become the institutional barrier in the Russian reality? The answer to this question will allow to identify of the nature of the engineering education crisis and, thereby, to development of the adequate measures for its overcoming.

The engineering education crisis has the complex world character. The fact is that the external engineering educational environment is characterized by the "imported reality" [5] operating in the resource routine of the national economy development. It is just the "imported character" that explains the low demand for the engineers in the Russian Federation, particularly for the experienced ones (engineering elite) according to the engineering education terminology submitted in "The major principles of the national doctrine" by the engineering education Association in Russia [6]. The low demand for the innovation key specialists, moreover, the clear mobilization tendency in the conversion development confirm the fact that the crisis of engineering education is, indeed, the existential one. Global history says that the modern reality of the reflexive society with the nonlinearity in the social and economical processes is the historically identified form of the moral human autonomy as the form adequate to the historical progress with its science and advanced technologies.

The understanding of the engineering education crisis essence is based on the fact that engineering activity in the high education society is the phronesis. The phronesis sphere (according to Aristotle) [7] is connected with the human deeds, with the praxis and poesies of the human life, i.e. when the knowledge in natural science modus is transformed into the knowledge in the modus of good. I.G. Fikhte, the European industrial revolution thinker, said that philosophy teaches us to find everything in ourselves (Ego). Only through the human being's Ego the dominated rules are distributed around him up to the borders of his investigation. The more he develops his investigation, the farther his harmony and order are [8].

Human autonomy of the objective reality as the highest unreliability widens the innovation problem area up to the ontic – ontological problems of the human objective reality. Hence, theoretical and methodological innovation monopolization by economists and financiers is not considered to be relevant to the existential sense. "Merchant time" is the term coined by the French historical school representative (Jaques Le Goff) means that time commercialization as an independent variable contradicts the engineering activity praxis. As some investigation results show, the investigation idea is the result of the creative activity of the staff within the company, but does not relate to the market demand and changes in the market. A new idea is chosen for the commercial value only at the latest stages of investigation. R. Nayak and D. Katteringham, innovation process investigators, claim that market seeking is being done after the problem has been solved. In some cases the field investigation is carried out simultaneously. We couldn't find any example of the market demanding the realization of the product until the researcher made it [9].

It is necessary to withdraw the christian-technocratic approach from the engineering education, and it is a sufficient term to form the adequate historical mission for the engineering strategy (e.g. if the idea is significant when the governor of Khabarovsk, V.Shport, wishes to realize it as an engineering forum). In this case the engineering education crisis by its ontic- ontological sources allows to identify the only foundation stating the problem area of the entire system of challenges and risks in Russian Technical Engineering. The foundation like this one is thought to be the social justice praxis modeling during the period of reindustrialization and post industrialization in Russia. Social justice means the social and economic process authors' belief, that the stable possibility field development provides equal access to the principle development resources.

Social justice praxis modeling will allow formation of the value score of the engineering education. It means to create the uniform conditions for ontic – ontological, deontological (ethical) constituents of the training, education and rehabilitation processes for the engineer. It is the social justice praxis that locates the universal knowledge inside the individual due to the specific content of the objective reality fundamental pragmatics (M. Khydegger).

Social justice methodology praxis development will allow actualiz ation of liberal education programs for engineers (humanitarization). By the humanitarization we understand the formation of scientific and educational activities organization structures that should provide the humanities knowledge under the logocentrist trend for the professional education program (i.e. the required program manager, tutor institution, etc). Liberal education as compared to the regional world picture ontology and technological engineering world, formulates deontological conclusiveness constant [10].

Educational humanitarization is based on the methodological procedure called sublimation of the backbone didactic units for the educational professional lofty matter program cycle in the ethic and legal matter. Metaphysical sublimation in the educational praxis suggests "theological standard" [11] development for the professional education activity and phronesis technologies [12], which cultivate morals and transform the existing moral dilemma into the practical side for future engineer's educational activity.

Phronesis technologies structuralizing the educational resources so as moral fundamentals of the professional activity become imperative of its existence, allow to actualization of metaethical problems of good and evil. Since phronesis social practices present the society as the natural condition for the human being to self create, these allow reviving the fundamental idea of the society as a reasonable community and a priori contemplation of categorical "Ego" [13].

Historical innovative moral fundamentals of the modern world under the conditions of the democratization process and imperfection value created absolutely new social matter, the backbone core of which is the total human responsibility till the problem raising in natural law and people. In this case, didactic presentation in educational activity and intensive science technologies as the interdisciplinary entity hybrid – is the science personified in technology, science as practice, technoscience, which is capable to be put into practice due to the education activity emphasis on the relationship analysis between the science and society. Notably, by Ch. Logino, on the social expression, or social science face [14].

The first stage to realize the phronesis ideas in the educational practice is to develop the interdisciplinary modular unit pertaining to the humanities for the value-oriented university – level professional education programs. The modular unit objective to become proficient in the moral problems stating and solving the professional ethic competence is essential, but introspection is poor. Poor determination for the benefit of morality dooms the human being to roam in the juvenility trap even in the day time with fire, since the actual human morphology exists, at least, in 6 modality mode. Human autonomy rushes among the following: 1) known and unknown (epistemology); 2) granted and forbidden (deontics); 3) good and bad (axiology); 4) necessary and impossible (aletics); 5) past and future (time); 6) here and there (space). But deontics is primary, because for the trainee to become a skilled engineer he should leave the knowledge space for the time and space of engineering activity as it is the social one. This very transcendence is very urgent on modern Russia today. The country is short of the engineering component – human capital; the engineering society needs resources – social capital. In the modern world where the social processes associated with high technologies (and it is proved by the international legal nomination "Critical technology") dominate, inadequacy of engineering component in the development resource base of the country allows to qualify the crisis of engineering education as a peculiarity of the territory relating to an overtaking type during the civilized development. This is a challenge for modern Russia, because, due to the large scale and rate of the globalization world the science and innovation nowadays are becoming the most significant components for the cultural and socio-economic development for the human being, society and nation. Engineering elite mass limit absence among the skilled and well – educated people in Russia leads to the fact that the country is unable to provide real and steady development on the endogenous foundation. So, Russia has less chances of success not to fall out of the global history.

REFERENCES (ALL TITLES IN RUSSIAN)

1. Recommendations of the parliament hearings "Modern engineering education as a significant component of engineering modernization in Russia" Moscow; May 13, 2010 [computer resource] / Russian Federation Ministry of Education and Science // [Engineering education in Russia - site] URL: http://aeer.cctpu.edu.ru/winn/documents/parlam_13may2010.pdf (29.09.2010).
2. Glazyev S. Y. Russian economics development in the global technological changes [computer resource] // synergy: Kurdyumov's site – URL: http://spkurdyumov.narod.ru/GlazyevSUr.htm 12.05.2011).
3. Innovation development - Russian economics modernization principles.nat.report– M.: RAS, 2008, p. 168.
4. Vallerstein I. World system analysis/ N. Tukina's translation. M.: The territory of the future, 2006, p. 248.
5. Invention of the future. Strategy 2012 [computer resource] // Polit.ru].– URL: http://www.polit.ru/img/ggl/future2012_15_02_2011.pdf 10.05.2011).
6. Engineering education basic national principles [computer resource] // Engineering education in Russia - site] – URL: http://www.polit.ru/img/ggl/future2012_15_02_2011.pdf. 10.05.2011).
7. Aristotle. Nikomachov's ethics. Works in 4 volumes. M. Mysl, 1983, V4, p. 830.
8. Fikhte I.G. Human merits. Works in 2 volumes. St. P.: Mifril, 1993. V.1, p. 437.
9. Alekseev N. S. Management theory of "the objective laws epoch" [computer resource// corporative management site]. – URL: http://www.cfin.ru/press/management/2000- /0 .shtml 0.11.2006.
10. Yaspers K. Introduction to philosophy. Minsk: Propilei, 2000, p. 53.
11. Prokofiev A.V. Human being nature and social justice in the modern ethic aristotleship [computer resource // IF RAN]. – URL: http://ethics.iph.ras.ru/em/em2/ .html (12.05.2010).
12. Bakshtanovskiy V. I., Sogomonov Y. V. Applied ethics: idea, fundamentals, way of existence // Voprosy philosophii. 2007. - №9, p. 39-49.
13. Fikhte I.G. Consciousness facts. Works in 2 volumes. St. P.: Mifril, 1993. V.2, ch. IV-VI, p. 798.
14. Surkova L. V. Science value: In the search of a new vector for a traditional problem: disc.on ontol. approach (review) // Philosophy in the 20th century: in 2 p.: collected reviews and abstracts / RAN ISI, scientific humanitarian information center., philosophy department; managing editor Andreeva I. S.; compiler Panchenko A. I.– M.: ISI, 2001. –P. 1. – p. 8–97.

Engineering Thinking Formation and Negative Formality Effect in the Students' Knowledge

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The article describes the competences for the modern engineer to have. Engineering thinking formation problems and formalism knowledge causes are identified. Basic ways of fundamental and professional knowledge integration aimed at overcoming the knowledge formalism are discussed.

Key words: *the engineer, engineering thinking, a formalism of knowledge*

D.A. Mustafina

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Engineering education improvement and prestige are the state strategy objective in Russia. Highly qualified and competitive engineers with the innovation and reasonable approach, capable to integrate the ideas from various scientific and engineering fields and fully apprehend the production process are needed for the stable development of the modern industry. According to the mass media statistics, 555 universities train students, and 200 thousand specialists, on average, are graduates. But only 1\3 works according to their major, because the salary does not meet the specialists' requirements. Moreover, 50% of all engineering positions are occupied by the specialists without the university-level technical education. This really has a negative impact on the work and output quality of the enterprises.

Modern society standards need qualified engineer training but there came problems due to the high technical education diversification, low background university entrants' knowledge, self-sufficiency, motivation for successful training and future professional activity, demographic decrease, high school skilled lecturers flight, obsolete equipment and teaching methods, advanced information technology scarcity.

Modern research analyses made by Bakharev N.P., Bobrikov V. N., Belonovskaya I.D., Petruneva R.M., Pecherskaya E.P., Pokholkov Y.P., Prikhodko V.M., Selesneva N.A., Tatura Y.G., Fedorov I.V., Chuchalin A. I. indicate the growing interest to the quality of engineering education and its problems.

Taking into account the demands of the employers, requirements of the third generation educational standard (analyzing the state-of-the-art technologies and own professional experience) the following competences, necessary for a modern engineer, were distinguished to solve quality education problems (general view).

1. Proficiency in fundamentals:

- engineering thinking (professional mobility and determination to self-development, mental outlook, humanitarization – ability to subject any technical research to be harmless to people and nature);
- knowledge, abilities, and practical professional skills;
- communicative competence (initiative, activity, leadership, discussion skills).

2. Market knowledge:

- informative competence (specific skills to use technical devices – from the telephone to the PC and computer network); to get information from various sources including electronic communication links, to understand information, to structure it, to evaluate it and use effectively; to know the analytical processing methods and dataflow in the subject field.

3. Psychological availability to competitive behavior (to act in the contest situations, mobility, opponent activity prediction, ability to assign priorities, professional intuition):

- necessity of successful activity (the objective realization, organization skills);
- responsibility (vital energy to complete the work, response reaction, participation in public affairs).

4. Starting position (fundamental knowledge, experience, level of culture, natural gifts):

- creativity – ability to create new specific ideas and answers, sensitivity to unusual details, contradiction and uncertainty, flexibility to switch over to something different, ability to work in various environment, to use associations for expressing the thoughts, and skill to see the complex in the simple and simple in the complex) .

5. Ability to self regulation, self organization and adequate consideration, professional and personal qualities self evaluation:

- engineering consideration (wish to critically self-evaluate the results of own activity, knowledge of the matter and the purpose of the engineering consideration; self-development necessity understanding; ability to analyze the activity and evaluate the professional potential, to predict self-development);
- independency (interest and persistence in solving engineering problems, skills to use rational solving methods).

6. Social and legal competence:

- legal competence (interest and persistence in the law knowledge and the ways of solving law problems; knowledge how to solve them).

One of the main obstacles influencing the modern successful engineer formation is student knowledge formalism.

The term "formalism" means the form isolation from the content. The form becomes a key aspect in the education and training problem solving. These processes are going on without regard for essential mechanisms and sometimes contrary to them. The problem solving achievement is only for show claimed as a fact [1, c. 3].

When analyzing the technical university students' training process in fundamental disciplines we came to the conclusion that knowledge formalism occurs for some reasons: discipline area – short time period to study; complication (fundamental education is done apart from the special disciplines, so, students get "dead knowledge", useless in solving professional problems); interdisciplinary absence or lack of interdisciplinary relationship (most students can't understand the connection between the fundamental, technical and special disciplines); didactic methods are unsuccessful (teaching methods are obsolete); insufficient resource base of the institute; insufficient science language work; professional – weak future students' professional knowledge and relationship between the fundamental disciplines and future profession; personality – no motivation to study, subconscious future profession choice, insufficient use of the student creative potential, no differentiation in training; social – poor interest and needs accounting, practical training impossibility. Military service avoidance and higher educational diploma are the only reasons for the motivation to study.

To overcome knowledge formalism in the educational process it's necessary to integrate fundamental and special disciplines. The principle way to realize this is through the relationship between the up-to-date fundamental science achievements and advanced technologies of the subject matter; solving professional problems in the laboratory work, organization of mini research on the base of some disciplines; the student involvement in the professional project realization in the department, institute or enterprise.

Knowledge formalism prevents future engineers from the opportunity to use the university knowledge in their future work. So, this diminishes the study interest. Thus, to overcome the knowledge formalism through the engineering thinking is the urgent problem.

Engineering thinking is a special thinking formed and revealed during technical problems solving; that provides quick, accurate and original solving aimed at meeting technical knowledge, ways and technique demands to create technical means and technologies having the following structure: **technical thinking** – skills to analyze composition, structure of a device, its principle of operation in the changed environment; **constructive thinking** – problem solving model design ability, i.e. skill to combine theory and practice; **research thinking** – innovation problem identification, skills to compare, prove and conclude; **economic thinking** – process quality consideration and activity result due to the market requirements (not only the knowledge in the major but also skills to present the students' potential and activity results are necessary).

Engineering thinking of the future specialist is identified by the following 3 stages:

- low stage – ability to use the required minimum of technical information, but inability to understand in corpora the importance of technological knowledge for the professional growth; no competitive persistence; occupies the position of "a forced leader (assigned)", no wish to self-organize and to be a team-leader for the successful activity; goes from one extreme to another; absence of creative ideas, is taken aback, hard to switch over to another activity; regular help is necessary; can't overcome problem- disputed situations;

Table 1.

Development levels	Technical thinking result evaluation	Constructive thinking result evaluation	Research thinking result evaluation
Low	13 %	60 %	76 %
Middle	41 %	30 %	19 %
High	46 %	10 %	5 %

- middle stage - ability to use the major part of the required minimum of technical information, able to understand the importance of technological knowledge for the professional growth; adequately oriented in the competitive situations, creative, desire to oppose his "own idea" though it can't always be realized in corpora; occupies the position of "a situational leader"; needs help in unconventional situations, slow to switch over to another activity; can't solve tricky problems.
- high level – wide mental outlook, broad-minded person, capable to persist in his\her opinion, has effective personal work system, knowledge and new product sure-method of use and creation; ability to present the result; sensitive to unusual things, quick-minded, independent.

To identify the engineering thinking formation problems, component-specific test was introduced. It covered the students of engineering-economics and automechanic departments at Volzhskiy Polytechnic Institute. Bennet's test was used to identify the technical thinking level [2, p. 305 - 320]. The very test is aimed at evaluating blueprint reading, technical circuit and the operating principles understanding, the simplest physical and technical problem solving.

For designing and research ability identification, the secondary school mathematics test was used. The following amount of tasks was included: 30% - aptitude for checking out process, 30% - for research aptitude and 40% - for designing aptitude [3, p.148]. Checking out designing abilities was the foreground test because of technical requirements claimed to the engineering specialities. Analytical data results are given in Table 1.

Test results showed that the 1st year students had weak designing and research skills; level of technical thinking was insufficient.

To know the student thinking level in economics, A.P. Vyatkin method was used [4, p. 99-102]. So, testing proves that students don't yet have an active economic thinking; situations for rational solving are ignored if a guaranteeing problem solving is a competitive one.

To form the engineering thinking during the future engineers training, the following activities are required: teaching material should be aimed at raising the knowledge level; level tasks due to didactic, methodical and personal conditions which allow for motivation of independence, to create ways and methods, to make optimal activity layout, to analyze the results.

To overcome knowledge formalism, educational activity should be creative, favorable atmosphere oriented; knowledge development, skills and experience – self-organized; activity increase and independence in problem solving – critically self-assessed.

To solve the engineering staff deficiency problem it's necessary to create favorable conditions where the engineer will be socially protected by the quality and professional opportunities due to his\her education and by the adequate salary.

RFERENCES (ALL TITLES IN RUSSIAN)

1. Romantseva N. F. Experimental problems as means to overcome student knowledge formalism at Pedagogical University: candidate thesis in pedagogics, Krasnoyarsk 2000, p.196.
2. Nemov R. S. Psychology. Student's book for High Educational Institutions. In 3 books. Book 3. Psychodiagnostics. Scientific Psychological Research Introduction and the elements of mathematical statistics. 3d edition., M.: VLADOS, 1998, p. 632.
3. Mustafina D. A. Future computer experts' competitiveness formation at the technical University: candidate thesis in pedagogics, Volgograd, 2010, p. 164.
4. Vyatkin A.P. Test on rationality economics// Sib.ped.jour., 2005, №22, p. 98 -104.

The Approach to the Problem of Transition to the Two-level Education System in Russian Engineering High School from the Perspective of the "Learning" Organization Theory

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V.A. Pushnykh

The paper analyzes the transition to the two-level education system in Russian engineering Institutions of Higher Education from the perspective of the "learning" organization theory. It highlights that many issues, connected with the transition, are not so much caused by the factual reformation of education nature, as by their unwillingness to change their views on modern graduates. There brought forward some ways that will let us change steady attitude and thus successfully carry out new education system in Russia.

Key words: *engineering education, learning organization, "Bachelor- Master" system of education.*

V.A. Pushnykh

In modern organization theory there is a term "learning organization", defined as an organization, where each employee and the whole organization itself not only follow certain values but also observe certain rules for taking decisions. However, it is capable to modify them in accordance with surrounding changes [3, 4, 5, 6].

P. Sengue enumerates 5 disciplines which are to be mastered theoretically and practically by every would-be "learning" organization [4, 5]:

- **personal skill** includes both the staff need of their permanent skill development and creative approach to achieving target goals and creating the atmosphere encouraging workers to do it in the organization;
- **mental models** – re-thinking, specification and improvement of the external world perception and understanding its influence on the organization decision-making and actions. It is not as easy as you might think [1]. While acting people acquire certain behavioral stereotypes in particular situations (mental models). The more often these stereotypes lead to success ("single loop"), the more often they are used and the more difficult it is for people to analyze the failure reasons and find new rules of behavior ("double loop"). It is much easier to accuse other people (colleagues, authorities, government) of these very failures.
- **common perspective** – common for all the organization members' vision of the future, some kind of a "common dream" of all the workers who have it as a personal aim. This vision is accompanied by principles and behavior rule of thumb people may use to achieve the dream.
- **team learning** – combination of a discussion (opinion confrontation) with a dialogue (searching for the purport) [2], when a team gathers collective intellect which exceeds

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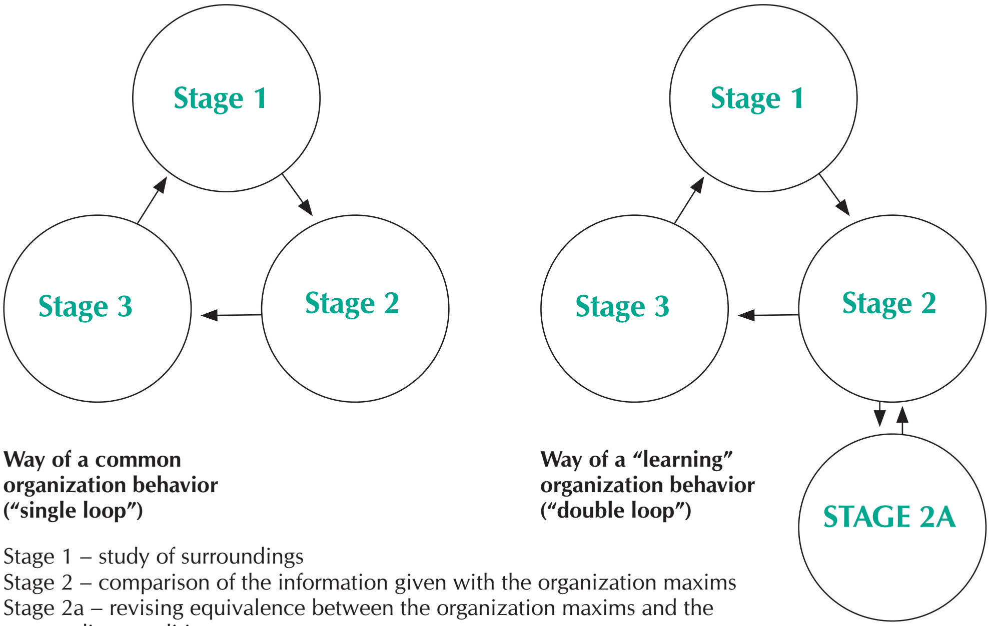
Figure 1. Common and "learning" organizations.



Way of a common organization behavior ("single loop")

Way of a "learning" organization behavior ("double loop")

Stage 1 – study of surroundings
Stage 2 – comparison of the information given with the organization maxims
Stage 2a – revising equivalence between the organization maxims and the surrounding conditions
Stage 3 – making and implementing relevant decisions

arithmetical sum of the team members' intellects.

- **system thinking** within the context of "learning" organizations means:
  - problems perception generally (without their fragmenting and structuring);
  - learning how to respond quickly to changes of surroundings and make changes in the organization;
  - learning of understanding the way our actions influence us and the surroundings;

On the one hand, mastering these disciplines requires establishment of organization culture capable for changes, on the other hand, it appears to be this very culture on its own.

As a rule, in the process of making changes caused by dramatic transformations of external conditions in the organization, new aims brought objectively by external conditions do not correspond to the current organization culture. If implementation of these aims is performed rapidly (mainly in a dominative way), there appears a very strong opposition to innovations within the limits of the current organization culture, which leads to the critical delay of achieving aims and in the worst-case scenario – to the organization breakdown. On the other hand, trying to add new aims to the current organization culture will lead to fast neglect of these new aims and to return to the familiar life, which means the organization languishing death in the context of changed surroundings.

As organizations, universities are also able to master the above mentioned disciplines and turn into the "learning organizations".

As an illustration of the "learning" organization theory application in universities we can study the transition to the two-level system of higher education – Bachelor and Master – in accordance with Bologna declaration signed by Russian government in September 2004.

This system has both advantages and disadvantages. There are the following possible disadvantages:

- volume reduction of technological knowledge in Bachelor education compared to Specialist one (the reason – reduction of academic hours);
- there are some fields which require a great number of technologi-

cal knowledge. It is impossible to use Bachelor degree there (aviation, mining, medicine, navigation, atomic energy industry, etc.);

- production sector is not interested in Bachelors because employers underestimate Bachelors' skill level.

These drawbacks are really serious if we deal with educational system and its interaction with business and society within the limits of existing and long-standing image, values and maxims, i.e. within the limits of the "single loop" scheme (Fig.1). These rules include many well-established believes, such as: the idea that a person has to study at the university only once and gain as much knowledge as possible; the idea that a person has to be devoted to the profession he/she has chosen early in life; the idea that career development and professional growth are chiefly dependent on gaining experience, etc.

- Let's try to study the situation alternatively – changing values and maxims in accordance with the "double loop" scheme (Figure 1). For example, the third disadvantage - the problem that production sector is not interested in Bachelors because employers underestimate Bachelors' skill level. Indeed, a lot of organization heads and personnel department officers consider Bachelors to be "unprepared" specialists who are not trusted to do skilled work. However there is much less skilled work demanding from a specialist total volume of knowledge and skills gained from the university than it seems at first. In addition to that, employers, speaking of need in highly educated specialists, often mean not so much of specific knowledge, as of employees' defined level of thinking, i.e. they confuse learning – mastering specific knowledge – with education – learning plus mastering methodological education in cognitive, axiological and communicative activities.

We can see it well from the training results (Tomsk Polytechnic University, the end of 2007). There took part about 30 TPU instructors and 20 employers' representatives on the level of heads and chief officers from the leading branches of industry, including nanomaterials and nanotechnologies, modern energy sector and energy saving, oil and gas industry, IT systems and technologies, etc.

The training objective was to work out technical skills set of TPU graduates. Based on the training results, these competences were formulated as follows:

1. Knowledge of fundamental disciplines.
2. Knowledge of principled foundations and latest achievements in certain professional occupation.
3. Ability to apply knowledge to analyze problematic situations, set goals, formulate and solve problems, create/ make up engineering models in certain professional occupation.
4. Ability to carry out engineering design using innovative methods.
5. Ability to use scientific and engineering literature effectively, knowledge of normative and technical documentation and its technical writing.
6. Ability to conduct scientific researches, particularly carrying out individual experiments in workshops and laboratories ("hand craft skill"), challenge and analyze measured data and draw relevant conclusions.
7. Ability to apply knowledge from different branches of engineering to solve integrated engineering problems.
8. Knowledge of engineering practice and particular production.
9. Knowledge of ethical, legislative, economical and ecological peculiarities of engineering in certain professional occupation.

Observing this list of skills set, one can see that the universities have always tried to implant such skills to their graduates to some extend, regardless of transition to the multi-degree educational system. That is why transition to the two-level degree education system (Bachelor's and Master's programmes) is not so black as it is painted and represents the differentiation of the above-mentioned skills.

The universities can set the goal to help society in forming new need – in Bachelors and Masters. It will appeal to modern management policy in successful companies which do not follow customers but are followed by them [3, 8]. It is the more especially as this goal is encouraged by social changes connected, as it was mentioned above, with turning the society into the one built upon knowledge and where universities play a key role [7]. To solve this problem universities have to work out other educational standards and principles of forming curriculum for Bachelor and Master students which will meet newly formed demands. At present they are worked out, as a rule, by means of mechanical transformation and repetition, but in modern parlance, by means of standards and curriculum in engineering education.

- Educational standards are to meet newly formed needs. School and university curricula are to be interconnected. The university subjects identical to the school ones are to be excluded from the curriculum, even if they upgrade school knowledge quality. We should not aim at including into the educational standard all the knowledge which can be necessary for graduates to use. The educational standard system is to encourage graduates to their permanent skill development. A lot of knowledge is seldom used by Bachelors in their working process; when this knowledge becomes necessary after a person's promotion - a Bachelor forgets it. It would be efficient if we established such an educational system when everybody would have an opportunity to gain necessary knowledge at just the right time but not in advance (education throughout the life). To do this we have to develop the extended education system in every possible way and tie it clearly with other educational systems. Now there is no such a tie. For instance, at the present day it is really hard to clear up what quality of knowledge one can document with a professional retraining diploma and to what extent this quality of knowledge equals the one documented with Bachelor's or Master' degrees. Requirements for high standard of knowledge in some branches (aviation, mining, medicine, navigation, atomic energy industry, etc.) are in fact not so much requirements for knowledge itself as requirements for responsibility and experience of the people working in these very branches. The system "Bachelor-Master" can appeal to these branches:

- Firstly, by means of complexity differentiation of production targets and thus differentiation of job specifications for Bachelors and Masters;
- Secondly, we may divide Master's degree into two categories: first category – Master of Science (MSc in Mechanical engineering, in Geology, in Chemistry, etc.) – for those who intend to dedicate themselves to scientific work and teaching; second category – Master of certain production branch (Master in Mechanical engineering, in Geology, in Energy production, etc.) – for those who intend to dedicate themselves to production activities. We may also rule the following: to gain the other category within the limits of the certain branch of learning, all the candidate has to do is to write one more master thesis on the corresponding (scientific or production) theme.

Summing up, change of maxims and transition from unreflective compliance with the employers' elastic requirements to cooperative taking decisions corresponding to surrounding conditions can result in successful development of universities in brand new conditions.

REFERENCES (ALL TITLES IN RUSSIAN):

1. Ardzhiris K. Organizational learning. Moscow: INFRA-M, 2004. – 563 p.
2. Sengue P. Development of learning organizations// Vestnik of Saint-Petersburg State University. Line 8. – 2004. - № 8, issue 1. – p. 113-134.
3. Morgan G. Images of Organization. – London: SAGE Publications, 1996. – 483 p.
4. Sengue P. The fifth discipline: skill and experience of self-learning organizations/ P.M. Sengue [et al.]. – M.: JSC "Olymp - Business", 1999. – 406 p.
5. The Fifth Discipline Fieldbook / P. M.Senge [et al.]. – London: Nicholas Brearly Publ., 2002. – 593 p.
6. Dance of changes: current problems of self-learning organizations/ P.M. Sengue [et al.]. - M.: JSC "Olymp - Business", 2003. – 624 p.
7. Development of knowledge-based society. New goals for institutes: translated from the English. – M.; Publ. "Ves mir", 2003. – 232 p.
8. Belkovskiy A.N. Reinventing management techniques (T. Peters' lessons)// Management in Russia and abroad. – 2004. - № 2. – p. 3-8.

Development of Innovative Informational and Educational Framework in Technical Subjects

Polytechnic Institute of Novgorod State University
I.I. Zoobritskas

The paper analyzes the problem of development and introduction of informational and educational framework into the teaching situation. This potential framework is supposed to use both modern information technologies, such as electronic books and educational Internet portal, and innovative methods of distance education, organizational and methodical resources, complex of hardware and software for storage, processing and transfer of data which provide on-line access to the information important for teachers and provide the opportunity for students and professors to communicate.

Key words: *information - the educational environment, modern information technologies, electronic textbooks, electronic educational resource, an educational portal, innovative methods in education, distance education*

I.I. Zoobritskas

The change of state and society educational requirements is caused by modern strategic guidelines in economics, politics and social service development. Institutions of higher professional education have to be ready to meet contemporary conditions with keeping fundamental polycultural priorities available.

To provide necessary conditions for high-quality education there are major priority goals and set of measures for implementing educational policy at all management levels proposed in the "Modernization concepts in Russian education up to 2010", in the "Federal Targeted Programme of education development for 2006-2010", in the project "Russian education – 2020: educational model for knowledge-based economics".

National educational doctrine of the Russian Federation sets the strategy and guidelines of educational system development at the state level, identifies needs for modernization processes in the whole educational sphere.

Impelling need for integration into the world educational system, based on Convention on the Recognition of Qualifications Concerning Higher Education in the European Region (Lisbon, 1997) and Bologna Declaration (1999) ideas, also actualizes educational system modernization. To progress to the next stage of professional education development it is necessary to use innovative methods in education, frequent application of modern information technologies and development of new variative learning models [1-7].

For the educational system to meet modern requirements we have to get through certain reformations based on using modern information technologies. In this respect many scientists connected with educational sphere professionally are extremely bearish on the development and maintenance of informational and educational framework in on-site and distance education, on development of electronic books and multi-agent techniques in educational Internet portals [1-7].

At Polytechnic Institute of Novgorod State University the "Automobile vehicles" the department staff have developed and implemented the informational and educational framework (Figure1), which uses both modern information technologies, such as electronic books and educational Internet portal, and innovative methods of distance education.

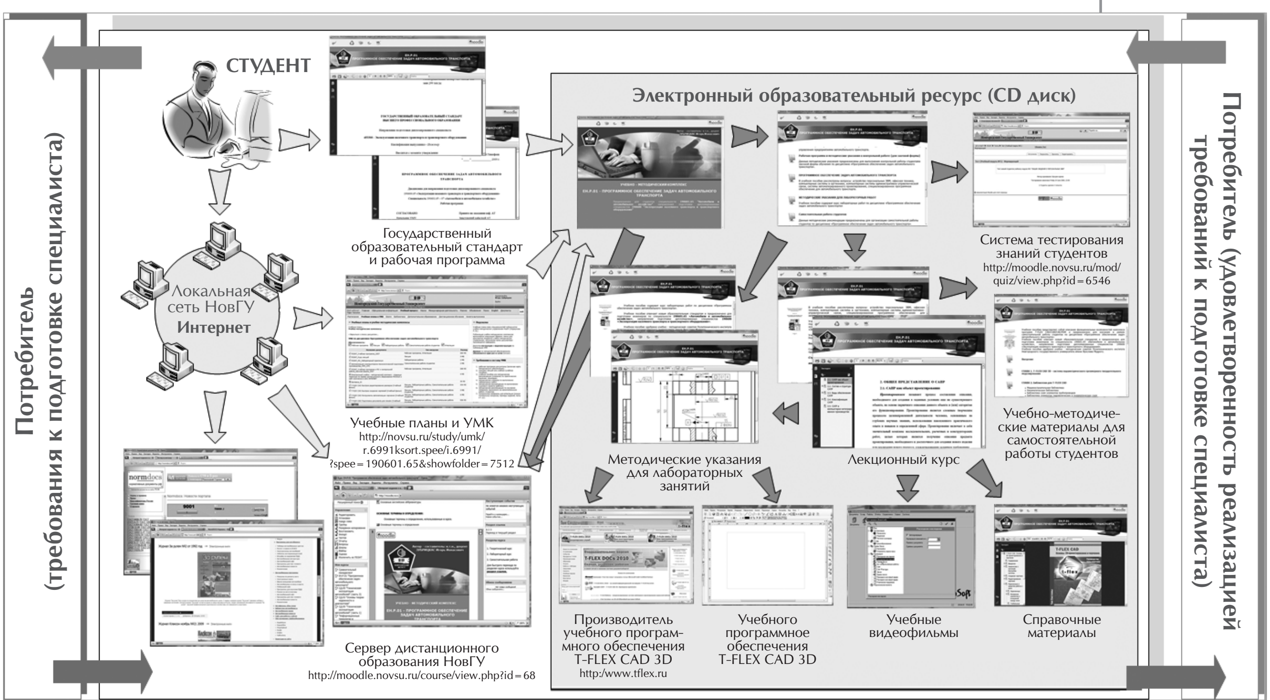
In scientific literature the term "informational and educational framework" has the following definition: it is a software-telecommunication framework based on computer technology deployment and providing students and professors with qualitative information support by means of unified technology vehicles and their interrelated nature. The definition guarantees that such a framework is to include organizational and methodical resources, a complex of hardware and software for storage, processing and transfer of data which provide on-line access to the information important for teachers and provide the opportunity for students and professors to communicate [1-7].

It should be noted that the framework given was developed and introduced into a number of subjects for the specialty 190601.65 "Automobile vehicles and vehicle fleet":

- Fundamentals of reliability engineering and preliminary treatment;
- Technical maintenance of automobile vehicles (Parts 1 and 3);
- Functional software of automobile vehicles;
- There were also introduced some subjects for the specialty 080502.65 "Economics and company management" students:
- Fundamentals of production works and auto service;
- Industry-specific factory management;

Hereafter it is necessary to study the development of informational and educational framework in studies of techniques by the example of the subject "Functional software of automobile

Figure 1. Here you can see a scheme of the informational and educational framework.



vehicles" for the specialty 190601.65 "Automobile vehicles and vehicle fleet".

The basis of this informational and educational framework is an electronic educational resource - electronic book (Figure 2) - the interlink which unites different educational and informational resources, distance education resources and means of education quality control.

The electronic book represents a compact or digital video disc (CD or DVD) which students can use both at university and at home. The disc appears to be a full-range electronic educational resource consisting of several main parts. These are:

- certain subject syllabus;
- theoretical part which outlines the backbone of the subject;
- laboratory operation manual;
- laboratory tasks with task performance examples;
- information for students' solitary work;
- educational software;
- educational videos;
- references;

The theoretical part represents Package Definition Files (.pdf) which suit technics best due to a great number of formulas and symbols. For the instructors to hold in-class learning there is a presentation file which allows introducing the subject theoretical part to students in layman's terms (Figure 3).

The electronic book has all the properties necessary for academic material, as follows:

- completeness of statement, defined as adequateness to the subject accepted syllabus;
- intelligibility of information statement;
- scientific character of information which represents adequateness of the information to the current condition and the latest advances in the corresponding academic field;
- logic nature and coherence of the information statement;

Moreover, the electronic book has a number of other specific properties, such as:

Figure 2. Here you can see a welcome page of the electronic book.

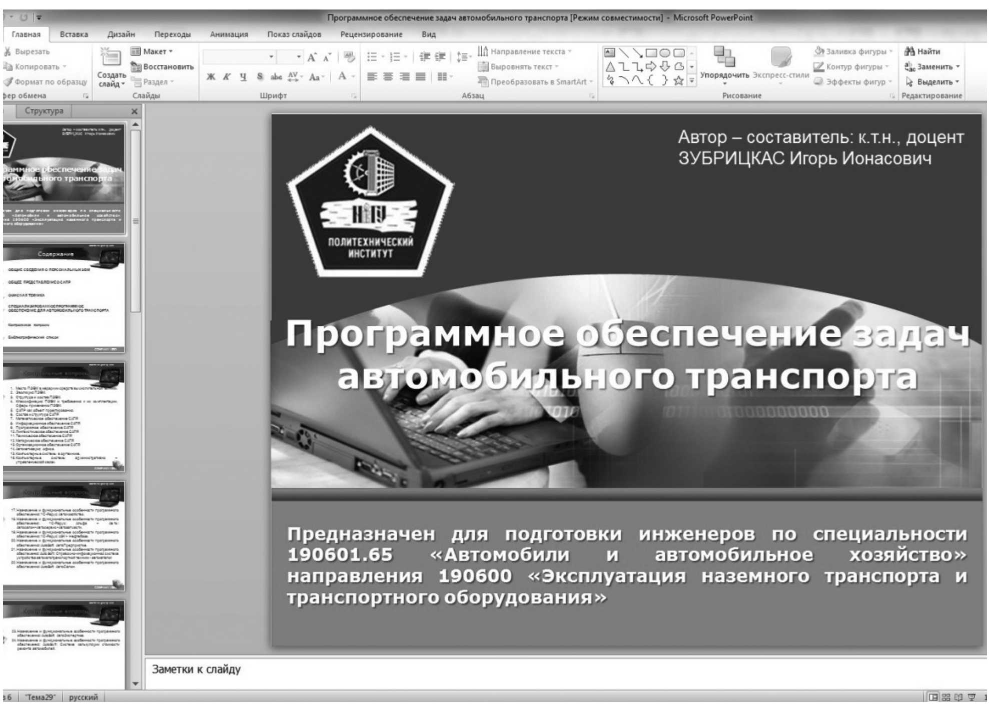
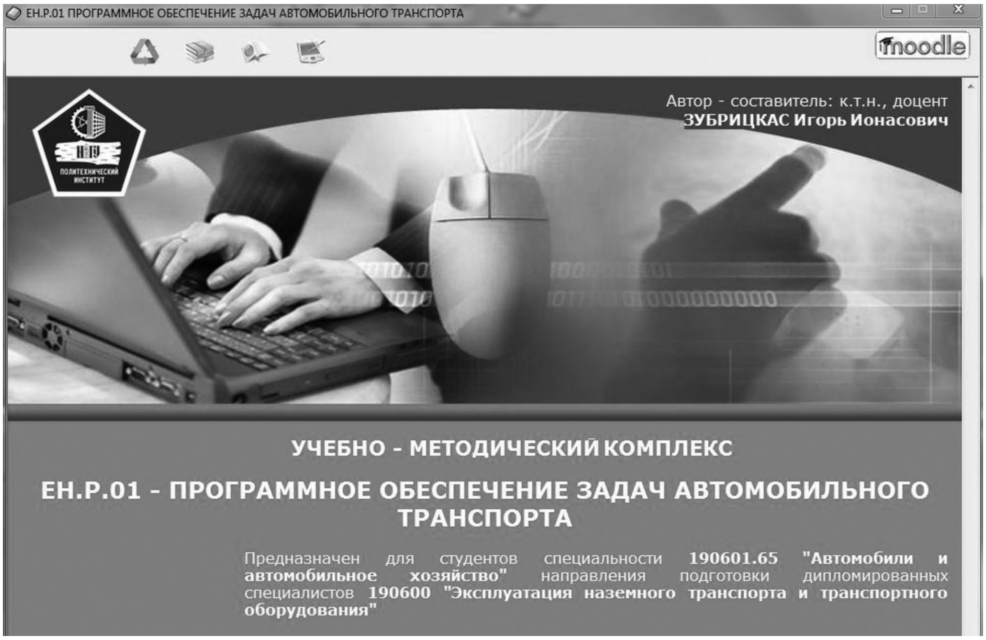


Figure 3. A welcome page of the theoretical part – presentations.



- demonstrativeness;
- interactivity;
- adaptivity;
- intellectuality;

Thanks to combination of the properties mentioned above we can improve speed and quality of the class material digestion, while implementing modern toolbox results allows the teachers to present the material in a needed way and makes the book use easier.

One more strand of this informational and educational framework is the educational portals and their frequent application (here "portal" means a user-centric informational web-system with the unified access point to a wide range of information concerning certain subjects). User access to the portal is possible through the browsers in client PCs. There are two types of educational portals in the educational framework given: firstly, it is Novgorod State University portal itself which grants access to the subject academic material (Figure 4); secondly, it is a specifically developed educational portal dedicated to the certain subject (Figure 5).

And, finally, there is the third cornerstone in the informational and educational framework - distance education server (Figure 6) which is based on the MOODLE platform and represents a combination of technologies providing:

- students with the main information necessary;
- interactive communication of students and professors in educational process;
- an opportunity for students to master the subject material independently and while studying;

Modern distance education uses the following basic elements:

- information-carrying media (e-mail, information and communication networks);
- the ways dependent on the information sharing engineering environment;

Figure 4. Here you can see the portal of NSU – the page is dedicated to the curriculum and academic material of this university.

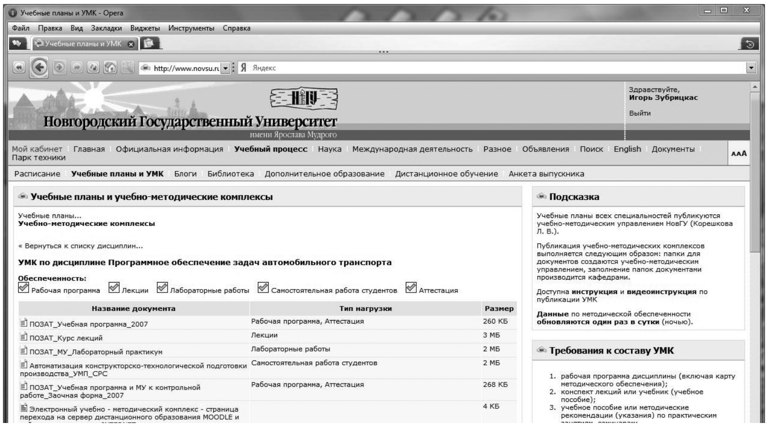


Figure 5. A welcome page of the portal.

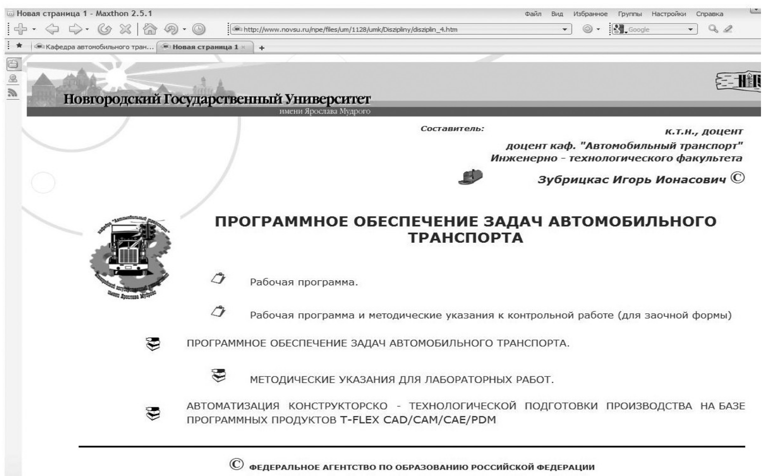
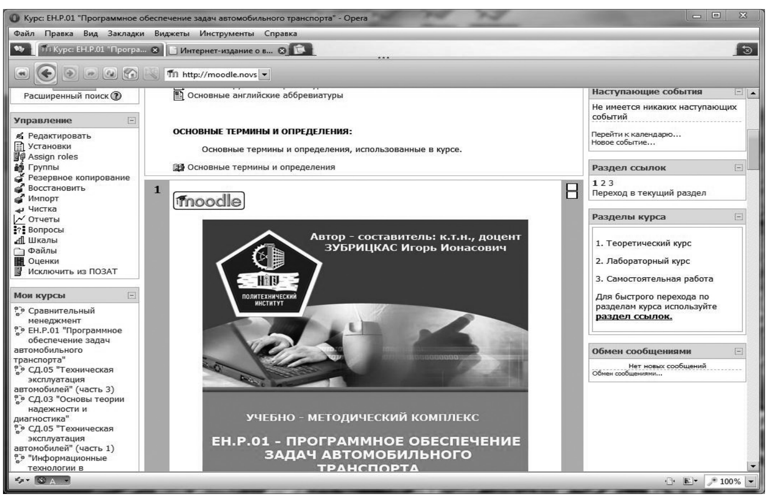


Figure 6. A welcome page of the distance education server.



Distance education technologies allow:

- to reduce education process costs (rent of premises, professors and students' commuting, etc. are not required);
- to teach a great number of students;
- to improve education quality by means of implementing modern resources, large electronic libraries, etc.;
- to create a universal educational framework.

There is one more argument for using such an informational and educational framework: according to the Order №137 by the Ministry of Education and Science of the Russian Federation dated 05/06/2005 "About implementation of distance education technologies", implementing distance education technologies while teaching we can give final tests both on-site and in absence. It allows us to monitor constantly students' knowledge level and syllabus time schedule; also such a system provides us with a number of communication means which ease significantly the dialogue "professor - student" during the education process.

REFERENCES (ALL TITLES IN RUSSIAN)

1. Afanasyev Y. A., Guzhov V.I., Kazanskaya O.V. Scientific, scientific-methodological, innovative and institutional university activities in terms of distance education// Open and distance education: experience analysis and prospects for further development: matters of international conference. – Barnaul: ASU Publishing house, 2002. – p. 27-29.
2. Afanasyev Y. A., Kazanskaya O.V. Elements of informational and educational framework at NSTU// Open and distance education. – 2001. - № 3. – p. 42-45.
3. Vostrikov A.S., Guzhov V.I., Kazanskaya O.V. Role of a technical university in the informational and educational framework development (issues, solutions, prospectives)// Open and distance education. – 2002. - № 3(7). – p. 20-24.
4. Vostrikov A.S., Kazanskaya O.V., Nikitina N. S. Resource regional center of open and distance education// ODE policy in EU and RF: commission of Russian and European experts, TACIS Services D61A, European Commission: work material – Moscow, 2001. – p. 104-109.
5. Didenko N.V., Isagarkova L.S. Design of a systematic innovative work at postsecondary institutions// Pedagogical journal of Bashkortostan. – 2010. - № 2. – p. 17-28.
6. Didenko N.V. Role of quality management system in specialists' education// Professional education. – 2009. - № 10. – p. 42-45.
7. Didenko N.V., Bahtiyarova V. F. Software-based design approach in innovative and educational framework development in engineering schools// Pedagogical journal of Bashkortostan. – 2010. - № 4, p. 2. – p. 219-242.

Tooling for Assessment and University Teachers' Self-assessment on the Basis of Competency Model

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The study analyzes the problem of implementing a competency profile as an alternative way of an assessment and university teachers' self-assessment system development. There the profile design procedure and the problems occurring within the process of its development and implementation are embodied in the study. The examples of a self-assessment procedure and a competency profile design are also given here.

Key words: *knowledge workers, university teachers, professional effectiveness, assessment, self-assessment, competency model, competency profile.*

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O.M. Vasilyeva

The university level mainly depends on its staff competence (competence of the university teachers (UT), or knowledge workers (KW)): the major factor of the university record is the UTs' operational efficiency. According to management guru P. Drucker, we know about the operational efficiency of knowledge workers as much as people knew about the operational efficiency of industrial classes in 1900 [1]. For the last century the operational efficiency has developed by 50 times. Our society faces the challenge of developing the operational efficiency of knowledge workers respectively. P. Drucker managed to formulate 6 determinative factors which specify any operational efficiency:

1. The question "What tasks have to be set?" is to stimulate the operational efficiency. The task clarification allows to focus on them only and to exclude influence of confounding factors as far as possible.
2. Knowledge workers have to be responsible for their operational efficiency, have to manage themselves and have to be independent when it is necessary.
3. Ceaseless innovations are to be an essential part of the workers' performance, goal setting and areas of responsibility.
4. Doing mental work an employee has to learn much, whereas an employer has to invest in workers' training willingly.
5. It is quality but not quantity which is important for the operational efficiency of knowledge workers; in addition, the quality should maintain not to minimum standards but to optimum or even maximum ones.
6. There is only one way to get a successful knowledge worker – if he is esteemed as an "asset" but not as an "expense". In such a case he is supposed to be loyal to the organization he works for, in spite of other job offers and opportunities.

To be successful workers has to know about their own weaknesses and fortes and to make it possible they should communicate. Self-assessment and a worker's assessment are significant for both employer and employee. Being self-assessed and assessed by the manager and colleagues allows an individual to feel recognition, self-esteem and right consciousness of self in the team. Self-assessment and assessment result in an employee's finding out his weaknesses and fortes which lead to efficient fortes implementation and working out a strategy of personal development. An employer should consider recurrent personnel assessment to be his official duty and basis for encouraging his employees develop, for their moral and economic reward, for the possibility to task them with doing something significant, etc.

All abovementioned is applied fully to university teachers. A range of a teacher's responsibilities is extremely wide which makes the procedure of self-assessment and adequate assessment by a head of a department an intractable problem. There is a very good point [2] that "there is no other profession which could have such a multidimensional, detailed job description as teaching. Learning of this trade demands not alone certain inborn aptitudes and ideally talent but lots of intellectual, physical, time and emotional-volitional efforts".

It's quite obvious and legitimate that any decision-maker attempts to assess adequately the performance of each UT, each department staff, each division staff and the whole university personnel. On the one hand, the university governing bodies have to form a clear view of certain teams and separate individuals' capabilities; on the other hand, there grounded decisions of the career system development are required. Moreover, it is essential to give the staff accurate information about what they are supposed to do. Finally, although the majority of teachers work with total efficiency, it is necessary to remind them (not only inexperienced teachers) about their roles and responsibilities. There is an idea [3] that "there are some professors who decipher mistakenly their title from the word "profit" instead of the Latin word "profiteri" which means "to tell the truth". Unfortunately, it is said, for recent 50 years there has been a significant reduction of honest professors' percentage. On the one hand, it is connected with pervasive changes in society with its longing for profit and unbridled corruption; on the other hand, it is connected with inflation of the title.

In spite of the fact that there are a great number of researches dedicated to the problem of operational efficiency assessment, their results hold out little hope in solving one. H. Shmidt's profound research [4] analyzes different approaches to scientific activity efficiency assessment of both large research teams (for example, in the sphere of research of fundamental particles) and individual scientists (the basis is bibliometrics, value of patents, macro- and micro-economical data). He believes that search for methods of R & D efficiency assessment is not pathetic but we do not have an opportunity to assess it sufficiently yet. In particular, assessment of result financial value faces some troubles and in the field of fundamental research is absolutely impossible. As for UT teaching activities, we can say that they are so multifarious that it is unlikely for them to be ever assessed sufficiently. It is possible to assess only certain (the simplest and numerically measurable) aspects of these activities. What is more, there is no scorecard which can characterize a teacher's diligence, citizenship and the interaction between a teacher and students. At the same time these factors no doubt influence graduates' gaining skills set. It is also hard to assess operational efficiency of some departments and the whole university because we can see and assess it only in several years after a student's graduation from the university.

Since numerous scorecards can show us just rough assessment of universities operational efficiency, their divisions and individual teachers, this brings up the question – is it worth paying so much time and attention to these scorecards? Of course, it is worth if we won't forget (when we make far-reaching decisions taking them into account) about the fact that the indicators being used are just proxy indicators: they can assess certain spheres of operational efficiency quite correctly and can be used by managers at all levels in order to identify specific problems and to make decisions, but only when proxy indicators represent real factors. For instance, when a teacher publishes a paper in not a peer-reviewed journal it does not mean that the paper is of bad quality. The causes would be the following: long publishing period, high publishing cost, inadequate command of language or the fact that a potential paper reader is a Russian.

One of the alternatives in assessment and UT self-assessment construction is a competency model implementation (a competency model represents ideally a full ranged set of competencies which describe core qualities, behavior, knowledge, skills and other characteristics necessary to maintain quality standards and professional effectiveness). Foreign L&D professionals (learning & development) have vast experience of using competency building approach which results in companies' competitive growth in the real economy. Over the last years interest in using competency models in Russian and foreign higher education systems has increased [5-8]. Their usage makes the "ideal teacher" model possible and thus it can be an ideal example for assessment and self-assessment processes.

Via decomposition of several core competencies the model can be detailed much. For example, the competency model for a school teacher created in Canada includes more than a thousand competencies. The decomposition of key competencies no doubt demands thorough familiarity with teaching activity aspects.

It is necessary to strike a balance of a detailed elaboration of all teaching activity aspects and a thorough detailed elaboration risk. The decomposition of a UT competency model into a thousand separate competencies would lead to "pulverizing" of professional competencies - that is why we need some filter in order to highlight the most relevant competencies (less that 100) which can be applicable. Such a pre-selection has been made based on standardized documents of different levels, jury of opinion and background paper [2, 9, 10, etc.].

Selected competencies were proposed to the panel of experts to be assessed. The panel consisted of 22 experts (17 professors and 5 associate professors) including the Heads of the Departments (17), managers of Master Studies, Post-graduate Studies and Post doctorate Studies divisions, the Information Expertise Center manager, the Elite Education Department manager, the Institute of Distance Learning lead manager. The panel of experts was approved by the University Rector.

The experts had to assess significance of each competency. For that reason a table of competency significance assessment was developed (you can see its fragment in Table 1). It was accompanied by competencies assessed nature of content.

The experts discussed the set of competencies given in terms of its completeness, redundancy or insufficiency.

As the result, the set of competencies has been completed, we turned back on an excessive detailed elaboration and came up with the optimal set of competencies including 8 divisions (groups) of UT competencies and 9 – of the Heads of the Departments (Figure 1). Each division consists of the indicators set which represents competencies nature. Significance and rank of each competency were defined by means of the paired-comparison method at the stage of selection and development of the competencies set.

One of the methodological problems is a choice of the rating scale. Having chosen initially a classical rating scale (5-score scale), we found out that in case of a UT's assessment/ self-assessment it would "depend" much on the school assessment of knowledge: 5 – excellent, 4 – good, etc.

It makes difficult the process of a competency skill level, as there is no spare room for the gradation: "high skill level", "intermediate skill level" and "low skill level". For instance, the intermediate skill level can correspond to the lower bound of the high skill level of a competency which seems to be impossible to represent in the 5-score scale – here we also need a balance. In our opinion, the ideal and the most practical is a 7-score scale: on the one hand, it is flexible and helps to assess a competency skill level reasonably; on the other hand, a competency skill level is not smeared within the level. In this case the low skill level corresponds to the interval 1-2, the intermediate skill level – 3-5, high skill level – 6-7. There are specifications for each skill level which provide a framework for carrying out self-assessment. There are specifications for the divisions either. You can see a specification fragment in Table 2.

Hence we output a ranged skill set which allows us to develop a personal competency profile in the process of assessment/ self-assessment (here "personal competency profile" means a complete set of competencies necessary for an individual employee to perform efficiently in his or her official capacity).

But there is a problem of the standard determining due to the fact that a mark is a result of comparison of the desirable and the real. In other words, first of all it is necessary to develop an "ideal employee's" competency profile. The manager is supposed to do it: he develops the ideal competency profile on the basis of aims and current tasks and chooses the most actual competencies from his viewpoint.

The one disadvantage of this approach is its high subjectivity. We might smear this problem if we developed a competency profile for departments which seems to be a more labor-intensive process. It would be necessary to gather the panel of experts – whether there would be all

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members of the department staff or not. There competency selections, definition of their significance and rank, their skill level would have to be carried out. After that the competency profile for the department would be developed and compared to the competency profile of each member of the department staff.

The assessment process includes several stages.

An employee analyzes his own competency profile. Having defined the skill level he has to explain the interference foundation, i.e. his self-assessment is to be well founded. The arguments can include certificates collected from refresher courses, mission reports, awards for research works or community involvement, students' achievements, etc. The next stage for the employee is to compare his profile with the ideal one. If there is a divarication, specifications and clarifications are significant. The interview with the employer is an abiding procedure because it appears to be both feed-back and an opportunity to discuss and to "round out rough corners" if such emerge.

Ideally the self-assessment procedure should be an annual process and its results should be recorded in the employees' personal files. It could give them an opportunity to trace the path of their professional and personal development upon the expiry of time.

There should be a strict list of people having access to the personal files. In our opinion, the employee and his or her employer are the people who can do it.

One of the criticisms the competency profile developers face is connected with the problem of inexactness of competency indicator formulations. For instance, what does the phrase "deep knowledge of the teaching" mean and how can we assess it? Let us remind you: this refers to self-assessment. Humans can equally underestimate and overestimate themselves. An "unbiased" assessment (by the employer or colleagues) and the interview can help to correct biased self-perception. But as a rule people know about their own weaknesses and fortes and can be fairly unbiased if they are sure in the fact that their self-assessment won't cause sanctions.

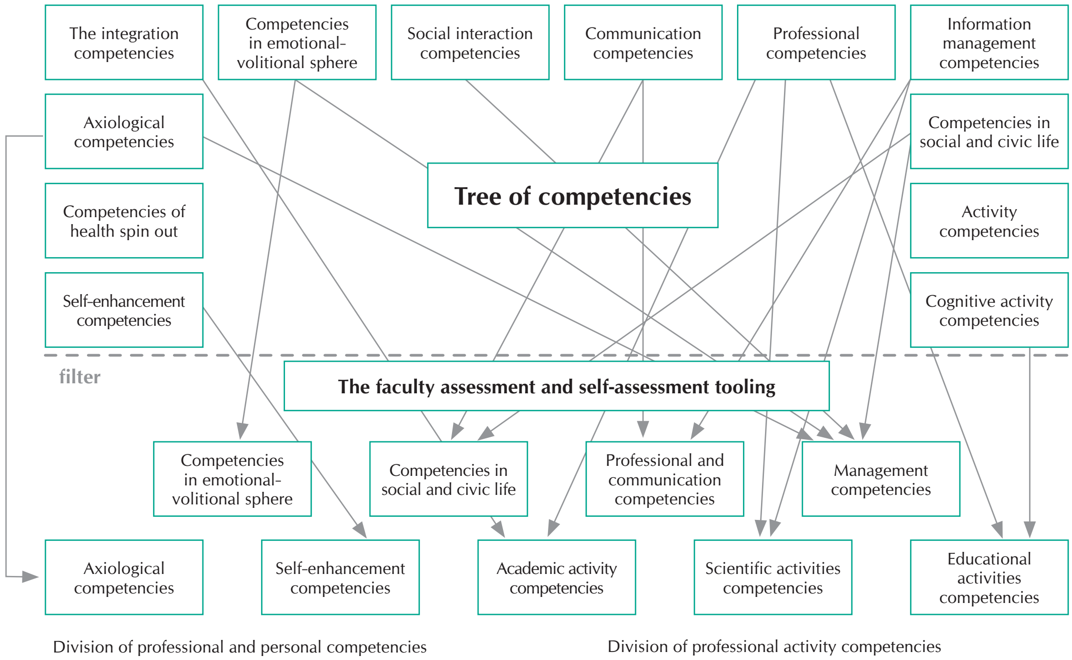
We can see it from the results given by the members of the courses dedicated to the competency model development and implementation within the TPU skill pool group (TPU – Tomsk Polytechnic University). They were instructed to develop a core competency individual profile based on the list accepted by the experts. After that with the consent of the members the heads of the divisions they work for were offered to assess their employees on the basis of their core competency grasp. But the heads did not get the employees' individual profiles. Then two profiles given were combined.

Table 1

1. Professional educational competencies		**1**	**2**	**3**	**4**
1.1	Deep knowledge of the teaching				
1.2	Knowledge of latest world advances in the teaching				
1.3	Command of project management				
1.4	Command of education science foundations				
1.5	Knowledge of psychology foundations				
1.6	Knowledge of instructional devices				
1.7	Command of instructional devices				
1.8	Ability to make full use of educational modes, methods, aids and devices in order to reach educational target				
1.9	Ability to find and implement new instructional devices				
1.10	Ability to encourage educational and cognitive activity of students				
1.11	Command of educational modes, methods and devices of personal educational abilities, specific features of the teaching and the contingent				

Scale: 1 - insignificant, 2 - nonessential, 3 - significant, 4 - essential

Picture 1. The scheme of the faculty assessment and self-assessment tooling build-up based on the competency model.



In some cases the difference between the assessment and self-assessment was insignificant (Table 3). Only once they had to fall back on the interview with the division head.

The self-assessment procedure is not an accreditation – it is of predictive nature – and its aim is to help a UT to:

- find directions for his career development;
- make refresher courses relevant to the employee's, the department and the university actual requirements;
- improve the dialogue "employer-employee".

The procedure might be an addition to the performance appraisal since it gives extra information about employees; it is significant because, since the performance appraisal procedure is regulated by a great number of legislative and statutory acts, its results can directly influence the employee's position and salary. The assessment and self-assessment procedures are carried out in view of prospects and help to distinguish the employee's potential, whereas the performance appraisal is just a "snapshot" capturing professional knowledge and skills level as of the time of its carrying.

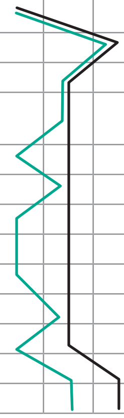
The set of competencies is to be up-to-date which gives rise to the necessity for specifying the frequency of its updating. As for TPU, we upgrade the University Development Integrated Program each 5 years; therefore we can also upgrade the set of competencies. The university divisions correct the set of competencies on the basis of current tasks. The university mission might be the basis for the reference model of core competencies development.

Table 2. Professional competencies.

3-5. A person has a general idea of the activity goals and objectives and finds methods of professional objective solution but needs guidance; as for serious matters, a person can be responsible for the results of work performed; is able to take the initiative if necessary; has a knowledge of professional activity in rich (invariable to other specialties) area to an adequate standard; has professional skills adequate to work effectively in the certain area and constantly develops them; is able to manage some information in the professional knowledge area; has elementary skills in business correspondence area and has a general idea of record management.

Table 3. Levels of core competencies – skill levels.

Core competencies	Significance	Rank	Skill levels – from optimal to ideal						
			1	2	3	4	5	6	7
Professional competencies	0,117	1							
Cognitive activity competencies	0,111	2							
Self-enhancement, figural and self-consciousness competencies	0,104	3							
Activity competencies	0,104	3							
Компетенции интеграции	0,103	4							
Information management competencies	0,084	5							
Axiological competencies	0,074	6							
Social interaction competencies	0,065	7							
Competencies of health spin out	0,062	8							
Competencies in emotional-volitional sphere	0,060	9							
Competencies in social and civic life	0,059	10							
Communication competencies	0,057	11							



The Department of Power Plants

Last, first and middle names **********

Date of filling out

Self-assessment profile

Assessment by the Head of the Department

REFERENCES (ALL TITLES IN RUSSIAN)

1. Drucker P.F. Management im 21.Jahrhundert – Muenchen: Econ, 1999. – 272 p.
2. Higher technical education: global track records of advancement, education programs, quality of specialist training, engineering education/ V.M. Prihod'ko [et al.]; under the editorship of V.M. Zhurakovskiy. – Moscow: Tehpoligraftsentr, 1998. – 304 p.
3. Kamenz U., Wehrle U. Professor Untat: Was faul ist hinter den Hochschulkulissen – Berlin : Ullstein Taschenbuch Verlag, 2008. – 282 p.
4. Schmied H. R&D-Management in Europe: Productivity, Performance, International Cooperation. – Wiesbaden: Gabler, 1995. – 180 p.
5. Ivanova S.V. Factors of effective international communication in the sphere of foreign affairs [Electronic resource]// Foreign language teaching: from professionalization to professionalism: matters of scientific and tutorial interacademic workshop dated November 11 2009. – Moscow, 2010. – p. 120-126. - URL: http://www.mgimo.ru/files/151731/151731.pdf (usage date: 10.03.2011).
6. The Ohio State University [Electronic resource]: the official site. – URL: http://extensionhr.osu.edu/compmodel.htm (usage date: 12.03.2011).
7. Core competencies [Electronic resource] // Human resources: the official site / Univ. of Calgary. – URL: http://www.ucalgary.ca/hr/staff/management_professional_staff/compensation_performance/core_competencies (usage date: 10.03.2011).
8. Johnson & Wales University Competency Model [Electronic resource] / Employee Development Inst. – Providence, [2010]. – 7 p. – URL: http://www.jwu.edu/uploadedFiles/Documents/Careers/JWUEmployeeDevCompetencyModel.pdf (usage date: 14.03.2011).
9. Stelzer-Rothe T. Kompetenzen in der Hochschullehre. Rüstzeug für gutes Lehren und Lernen an Hochschulen. – Rinteln: Merkur Verlag, 2005. – 400 p.
10. Pfaeffliy B. Lehren an Hochschulen: Eine Hochschuldidaktik fuer den Aufbau von Wissen und Kompetenzen. – Bern: Haupt. Roloff, 2005. – 287 p.

Engineering Economy - the Path to Entrepreneurship in Engineering

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The article describes the approaches to the development of entrepreneurship in engineering based on high technologies. It highlights the need to found engineering (engineering and economics centers) as the subjects of the modernization of engineering education and the gradual transition to innovative entrepreneurship in the technological modernization of the country. The article presents some methods of technological marketing as tools to create market-based approaches in engineering and improve regional innovation policies.

A. Putilov

Key words: *engineering education, technological marketing, innovative business, economics, modernization.*

INTRODUCTION

The meeting of the Commission for Modernization and Technological Development of the Russian economy on March 30, 2011 resulted in the list of orders of the President of Russia that included several provisions on the improvement of engineering education. In this article one can find a case study on engineering and economics education in the high-tech field which shows that the organizational forms may be different, but the content changes should be aimed at a comprehensive review of the engineering problems in general: each business initiative has two aspects - technical and economic. Therefore, the development of entrepreneurship in engineering is impossible without improving the human capital. And one of the tools can prove to be education in the field of engineering and economics, if it is raised to a new level - development of engineering centers where training, research and consulting services form an integrated educational complex. Such complex should include educational programs, graduate and degree-seeking, entry into a single network space of engineering and economic services through the teaching teams, focused on the outcome.

ECONOMIC KNOWLEDGE AND MARKET REALITIES OF TODAY'S GLOBALIZED MARKETSHA

In engineering economics knowledge management is a methodology aimed at improving competitiveness and security level of companies and other economic entities in the real sector through the use of a full set of instruments of protection, management and economics of intangible assets, use of human and other resources of a particular company. The engineering knowledge management system develops strategies aimed at providing the necessary knowledge just in time to those members of economic community (companies, structural units of economic entities, subdivision of corporations, etc.) who need this knowledge in order to improve the performance of this community. Since the beginning of this century engineering knowledge management system has been included in separate university courses that are read at Management Departments of leading universities. There are examples of application of this methodology for the development of engineering education by establishing a knowledge management system for large international organizations, such as the International Atomic Energy Agency (IAEA), the United Nations.

In the domain of engineering knowledge management there has developed a specific terminology, which should be adapted to the economic realities of the industry. It is quite difficult to make in general, so the attempt will be realized only on the example of the engineering problems in the energy sector, particularly in the field of nuclear energy / 1 /. Explicit knowledge includes all those areas of engineering knowledge that can be represented, we can save them, share with other or insert into a database (e.g. a description of the design, composition formulation of a particular material). The implicit engineering knowledge contains different know-how, secrets of excellence, experience, insight and intuition. Communities of practice in many engineering organizations could be considered as the most important, key component of knowledge management: it is a group of practitioners who are allied with a common interest in a particular area of expertise and seek to share with each other their experiences, for example, designers of specific technical and economic objects. Category of knowledge workers has the following main characteristics: a high level of mobility and ability to work virtually, a high level of education, a full set of skills required for the transformation of knowledge, etc.

Competencies of employees' mean abilities working for a particular organization. A spiral of knowledge is the model proposed by Ikudzhio Nonaka / 2 / to explain how the implicit and explicit knowledge interact in an organization to create (generate new) knowledge due to four processes of their transformation, or ways of behavior: socialization (implicit knowledge is converted into implicit), exteriorization (implicit into explicit), combination (explicit into explicit as well) and internalization (explicit into implicit). Engineering education has been developed within learning organizations (universities, engineering centers, specific corporations, etc.).The term learning organizations covers such organizations that as a part of everyday activity create, acquire, transfer and retain knowledge. It is flexible and changes adaptively in response to new knowledge and context of the situation. These are organizations where people continually expand their capacity to create the results they truly desire, where new and expansive patterns of thinking are nurtured, where collective aspiration is set free, and where people are continually learning to learn together. In modern Russia national research universities are classified as learning organizations.

Learning community is an informal group of people, without reference to the organizational structure, discussing together those best practices, various issues and skills that the team strives to acquire. And there are many other terminological features / 3,4 /. To extract more value from intellectual capital and engineering expertise organizations need to manage the flow of knowledge between different types of relationships - social capital, internal and external structure. There are three reasons for the need to develop engineering knowledge management systems:

- - Social: in most structures of the real sector of the economy material production becomes secondary compared to the intangible (information, knowledge, experience, etc.) in the conquest, retention and use of appropriate market segments;
- - Economic: The recent economic evaluation (study) of the implementation of any information systems shows that when counting economic return knowledge is taken into account as an economic factor, an information technology by itself is not profitable, profit is generated through transactions with the knowledge (data);

- - Technological: the evolutionary process of creating and using engineering knowledge and information technologies follows the vector of "Computing - Communication - Support for mental activity."

ENGINEERING-ECONOMIC OR ENGINEERING CENTERS AS HOLDERS OF INTELLECTUAL CAPITAL

The structure of intellectual capital in any field of engineering or scientific and industrial activity is conventionally divided into three blocks: human capital, organizational capital, customer capital (Figure 1). Personnel (human capital) involved in the domestic industry had been developed and educated for decades, but in the 90s of the last century the tradition of supporting engineering staff was broken and a "human failure" has formed. Today the main task is to educate and consolidate the youth. With the establishment of several public corporations (Rosatom, Russian Technologies, etc.) organizational capital was significantly strengthened. Nowadays this kind of capitals is being structured and developed. This article is mainly devoted to the third component - the consumer capital on the example of entrepreneurship in engineering.

The current stage of development of the real sector of the economy is characterized by competition in the completely new - both qualitatively and geographically - segments of the market in the context of globalization. With the advanced engineering developments (in-situ leaching technology and others), the Russian uranium production in 2010 compared with the previous period has increased by almost a quarter, 17% of the global nuclear fuel market is supplied by Russian gas. Russian manufacturers hold leading positions and a significant part in the world market of enriched uranium product thanks to good engineering practices in the field of a gas centrifuge uranium enrichment. Saving of market segments, improving the economic performance of mining, processing and mechanical engineering enterprises that are engaged in mining, processing and carrying to the commodity form of nuclear energy (nuclear fuel for a specific nuclear power), require development of the engineering knowledge management system. The transition from the network management in complex economic systems to the knowledge management can serve as a method of finding new business models is much more effective engineering and manufacturing activities in the post-crisis Russian economy. Organizational forms of engineering knowledge management can be engineering centers (as stated in the list of orders of the President of Russia accepted at the meeting of the Commission on modernization and technological development of Russia March 30, 2011) or engineering and economic centers, based on leading engineering universities, first of all - national research universities. These new business models for the establishment of engineering-economic centers have the following features:

1. When developing engineering knowledge management phase business structure should have its own system of generating innovations, system of sales technology development and production updating, quality control.

2. Possession of engineering assets, which form a complete set of technology, is not mandatory, although desirable. Economic competences should be considered separately in accordance with a potential of the global services market, a detailed analysis of the globalization processes and cooperation in a specific area of engineering and real economy.

3. Managing the economic system in the phase of knowledge management supposes scheduling placement of orders (including third-party contractors) and improving of material flows.

ENGINEERING CENTERS AS SUBJECTS OF IMPLEMENTATION FOR ENGINEERING AND ECONOMIC DECISIONS

Basic engineering knowledge management strategies (Figure 2) require adaptation to the realities of the world market, in particular, a specific

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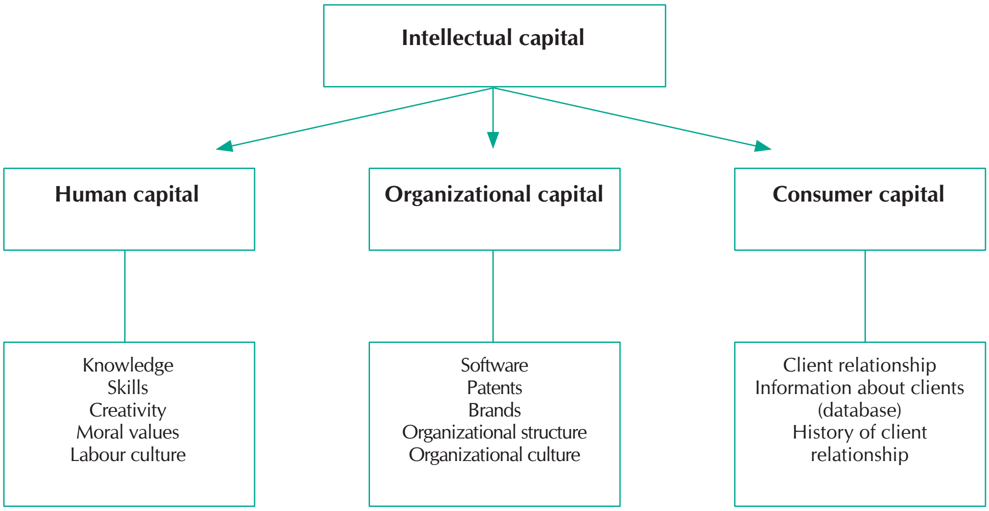
Figure 1. Structure of intellectual capital.

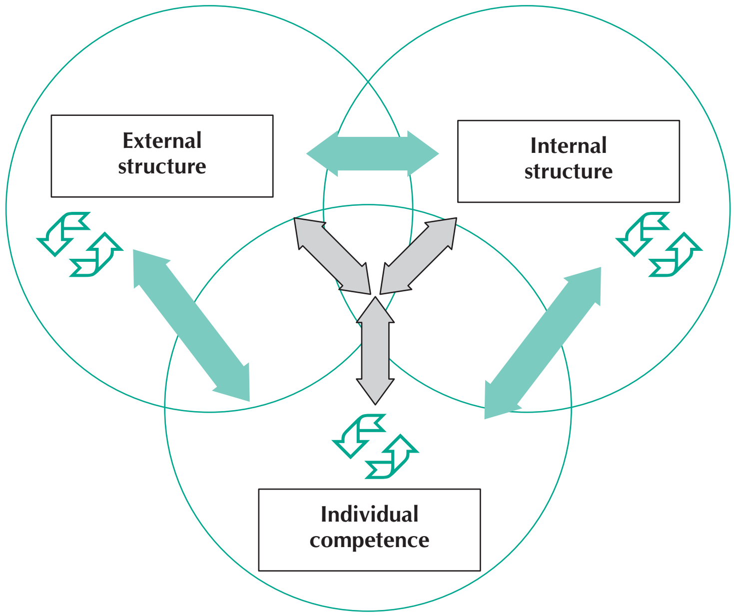


segment of the market associated with the procurement, processing and use of energy resources. Engineering knowledge management strategies are intended to create new value, realized in the products, people and processes with a rational formation and use of knowledge in organizations, particularly in engineering (engineering and economic) centers. The main objective of these strategies is to increase the efficiency of using all available resources of the organization, getting better and more rapid innovation, improved customer service, reducing the loss of unused intellectual assets. Engineering centers, whatever legal form is selected for their running, should be focused on the integrated use of engineering and engineering-economic skills of cooperative activity participants.

All possible strategies for the development and use of engineering knowledge in organizations can be represented as seven combinations of the basic strategies (Figure 2). Three of them are focused on efficient generation and use of knowledge in one of the types of intellectual capital (individual competence, internal structure and external structure). Three other strategies are supposed to achieve a positive effect on the interaction between two different types of intellectual capital (individual competence and internal structure, individual competence and external structure, internal and external structure). Finally, the last, seventh strategy is taking into account the simultaneous interaction of all three elements of intellectual capital (these strategies are conventionally shown in Figure 2 in the form of arrows of different shapes).

Thus, the basic strategy for the establishment of engineering centers should be directed either to the exchange of knowledge within a single type of intellectual capital in order to increase it, or the effective transfer of engineering knowledge from one form of intellectual capital to another. There is a clear correspondence between these two ways of determining the structure of intellectual capital and its substantive content. In engineering practice, especially related to energy problems, the effective transfer of knowledge can be considered as a major priority of engineering and economic centers.

Figure 2. Basic knowledge management strategies.



ENERGY PROBLEMS AS AN "EXPERIMENTAL FIELD" FOR IMPLEMENTATION OF ENGINEERING AND ECONOMIC DECISIONS

Organizational capital corresponds to internal structure; consumer capital corresponds to external structure, and human capital to staff competence. The specific content of these terms in the field of getting and using energy resources is as follows:

Staff competence (individual competence) – it is the ability to act in various situations, education, qualifications, skills, experience, energy and attitude to work, to clients, general level of culture.

Internal structure – it is the organizational basis of production, technologies background, patents, concepts, know-how, copyrights, computer and administrative systems, networking, organizational culture.

External structure - a relationship with customers, suppliers, competitors, social communities, brands, trademarks, image of an organization.

External structures are oriented to the market and the research methodology, besides, the development of market strategies are described in marketing terms. For the markets of engineering solutions aimed at improving the production structure, producing new goods and rendering landmark services, a new marketing direction called "Technology Marketing" has been formed / 12-15 /. It is important for the engineering center, which develops engineering-economic services in the areas of energy, to have a network structure to cover the maximum range of similar engineering problems, distributed over a vast territory. Local problems are quite rare in the energy sector, network structure of the modern energy tends toward globalization.

Spatial distribution of energy needs in Russia is a crucial factor when assessing energy efficiency of a technology platform. Energy transportation costs form an important part of the total costs. Study of the energy resources consumption over the past years has shown that in 2008 the total amount of consumed energy resources decreased almost in all Federal Districts of Russian Federation, which was obviously caused by negative consequences of the financial and economic instability (Table 1). However it was a very slight decrease, indicating a constant demand for energy as a basically required element for development.

Since 2009, simultaneously with efforts to overcome the crisis in the country, there has been an increase in energy consumption by an average of 6-7% compared to 2008. At the moment Central Federal District (CFD) has the smallest energy density of the gross regional product (GRP) among other districts. Its economy is characterized by a high proportion of service industries and industries with low energy consumption. Siberian Federal District is distinguished by the highest energy density, where more than 70% of industrial production is energy-intensive industries such as metallurgy, chemical, petrochemical and others. The energy density of Siberian Federal District is 2.4 times greater than that of Central Federal District. Other federal districts are ranked in relation to CFD in the following order: Urals - 1.4 times, the Far Eastern - 1.5 times, Northwestern - 1.8 times; Southern - 1.9 times; Volga - 2 times greater. It is important to note that in the past five years, energy density in CFA decreased by 8%, in Northwestern Federal District by 10.4%; in Urals Federal District - by 26.5%, in Far Eastern Federal District by 12.8%.Knowledge management in the field of regional energy needs will permit to predict such changes and prepare for them.

Present high power consumption rate of the domestic economy is caused, to a large extent, by a number of reasons:

- use of obsolete and energy intensive technologies in manufacturing, transport and processing of energy resources;
- special climate conditions in most regions of the country, which are characterized by low annual mean temperature;
- significant amount of technologically obsolete equipment with a high wear rate;
- existing structure of the economy, characterized by a high share of energy intensive industries (over 60% of industry) and a relatively small share in GDP of services and businesses that meet the requirements of the modern "knowledge based economy";
- lack of developed innovative infrastructure.

Engineering solutions, based on the economic estimates of expected results, can make a significant contribution to improving energy efficiency of the real sector of the economy and developing energy saving at large. Entrepreneurial approach to implementation of such decisions can be based on the establishment of engineering centers. Contribution of these centers in the individual components of intellectual capital can be inequivalent, although the overall effect of the centers' establishment obviously will be positive.

The ratio between intellectual capital components in the engineering center is shown in Figure 2, where one can notice that the boundaries between three main types of intellectual capital are vague (conditional). Some elements of intellectual capital can be equally attributed to its various types. At the same time there are elements that correspond only to one or another form of intellectual capital. Human capital is described in detail in the economics literature. Moreover, for the development of human capital issues Nobel Prizes in Economics have been awarded (Theodore Schultz in 1979 and Gary Becker in 1992). Under the human capital it is usually understood a set of knowledge, skills and motivation, which everyone has. Rising educational level, accumulation of professional experience, personal relationships, better health, mobility, acquisition of information and competence mastering could be regarded as an investment in human capital. Intellectual capital is not additive. It basically cannot be decomposed into components so that the sum of their estimates would be equal to the overall assessment of the organization's intellectual capital such as engineering center. The interaction between different components is highly nonlinear. So, for example, only human component is not always sufficient enough for the development of a strong

Table 1. Energy resources consumption by Federal Districts of Russian Federation, million tonnes of coal equivalent

Federal District	2006	2007	2008	2009
Central	181,4	187,3	190,1	176,0
Northwestern	95,7	97,3	98,0	97,4
Southern	91,4	95,8	96,3	95,6
Volga	179,2	185,5	191,1	189,0
Urals	199,1	207,9	205,2	202,7
Siberian	147,2	150,0	149,8	136,7
Far Eastern	42,6	42,6	46,2	44,8

**- according to Russian Federal State Statistics Service*

intellectual capital. This requires high competence of the engineering staff to complement the corresponding elements of structural capital such as organizational structure, information technology, administrative procedures, etc. A vital role plays the network structure of the engineering center itself. This network structure can be based on specific structural units of a high school, where an engineering center is established. For instance, National Research Nuclear University "MEPhI" (NRNU MEPhI) has more than twenty separate divisions (branches) in 12 federal subjects located in 5 federal districts. Thus, engineering solutions, developed for example in the organizations of Central Federal District, can be replicated in the organizations of other federal districts taking into account local features. Consideration of the local features (climate, etc.) should be carried out by engineering employees. These employees may be professors and graduate students of NRNU MEPhI separate divisions.

Information technologies make it possible to mobilize the potential of human capital and turn its development vector towards improving of the external structure: market interaction with customers, competitors, social structures. Entrepreneurship in engineering should be accompanied by the development of specific business education. Unlike traditional forms of business education (MBA, etc.) this kind of education should allow for acquiring a combination of engineering and economic skills within the training process. Engineering and economic education was developed in the former socialist form of economic activity, but over twenty years of transition it has virtually disappeared. Economic education in general is focused on non-productive structure: banking, stock transactions, insurance business, etc. Over the years pedagogical staff has also changed, engineering competence has disappeared from the teaching practice. Establishment of engineering (engineering and economic) centers, stated as a problem in the last president's orders, should be supported by the engineering community along with the government support provided by the federal bodies of executive power. Security issues in engineering practice / 18.19 / should also be reflected, when designing and implementing educational programs. In this case engineering will receive a new impulse for its development and the output effect will be seen in all segments of the real economy.

CONCLUSION

We are still to find and test mechanisms for creating organizational and legal form of the engineering centers. However, the competence content of such centers could be assessed today. Entrepreneurial potential in Russia is mainly concentrated in the financial, banking, insurance sector and other non-industrial capital investment spheres. In the real sector of economy except for the oil and gas sector, which gives an immediate quick return on invested intellectual capital, it is difficult to mention some remarkable engineering achievements that had a significant impact on business projects.

Efficient application of the described in the article knowledge management features and improvement of present situation is possible only with an intensive and conscious state support in training and retraining of engineering personnel with a focus on business implementation of engineering achievements. As a tool for assessing the prospects of any engineering design (i.e. engineering and economic center) we can use an approach for development of a knowledge management system, involving the methodology of technological marketing.

REFERENCES (ALL TITLES IN RUSSIAN)

1. A.A. Putilov, A.G. Vorobiev, A.V. Putilov. Economic Characteristics of raw uranium in prereactor technological redistribution of nuclear energy. / / "Non-ferrous metals", 2010, № 4.
2. Nonaka I., Takeuchi H. «The Knowledge-Creating Company : How Japanese Companies Create the Dynamics of Innovation», 1995.
3. Sveiby K.E. The New Organisational Wealth – Managing and measuring Knowledge-Based Assets. San-Francisco, 1997.
4. B.Z/ Milner. Knowledge management: evolution and revolution in the organization. - Moscow: INFRA-M, 2003. - 177 p.
5. A.A. Putilov, A.G. Vorobiev, A.V. Putilov, E.L. Goldman. Public corporations and development of high-tech sectors of the real sector of the economy: a historical perspective and global experience. / / "Economy in the industry», № 2, 2009, p. 2-13.
6. A.A. Putilov, A.G. Vorobiev, A.V. Putilov, E.L. Goldman. Public corporations and development of high-tech sectors of the real sector of the economy: the economic benefits and the role of industrial modernization. / / "Economy in the industry», № 3, 2009, p.13-21
7. A.A. Putilov, A.G. Vorobiev, E.L. Goldman. National innovation policy: problems of organizational design and evaluation methods. / / "Non-ferrous metals", 2009, № 4, p. 18-27.
8. S.A. Mikhailov, M.I. Dli, A.A. Balyabina. Types of regional energy saving strategies / / Integral, 2008, № 4 (42) - p. 76 - 78.
9. S.A. Mikhailov, A.A. Balyabina. Controlling energy processes at the regional level / / Controlling, 2010, № 2 (35). - p. 74 - 79.
10. S.A. Mikhailov, A.N. Kuzovkin, I.A. Gordukalov, N.A. Sizova. Comparative analysis of federal, regional and sectoral programs on energy saving and energy efficiency / / Microeconomics, 2007, № 1 - p. 35 - 55.
11. S.A. Mikhailov, V.P. Meshalkin, A.A. Balyabina. Place of energy saving strategies in the region strategy of socio-economic development / / Management in Russia and abroad, 2009, № 2. - p. 22 - 58.
12. A.V. Putilov. Introduction in scientific and technical marketing. / / Ore and Metals, 2003.
13. A.V. Putilov. Introduction in technological marketing for the needs of nuclear energy - Moscow: published by "Ore and Metals", 2005.
14. A.V. Putilov. Introduction in technological marketing of nanotechnology development. - Moscow: published by MISIS, 2008.
15. A.V. Putilov, I.P. Sokolov. Introduction in scientific and technical marketing of service technology. - M.: MGUS, 2004.
16. A.V. Putilov. Nanotechnology will give a serious impulse for the development of nuclear and other industries // Newsletter – nuclear energy, 2008, № 7, p. 4-11.
17. A.V. Putilov. Problems of sustainable energy development / / News in electrical power engineering, 2003, № 3, p. 3-6.
18. A.V. Putilov, N.N. Shemigon, Yu.L. Davydov, N.V. Dolgopalov. Nanotechnology in security industry / / Technopolis XXI, 2006, № 3, p. 4-6.
19. D.I. Shnaider. Technological Marketing. - M.: Published by "Janus-K," 2003.

Development of Personnel Specialized Training in the Field for High-tech Production Quality

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The article deals with some problems of personnel training for high-tech productions in relation to the implementation of the federal state standards. It justifies the need to vary the training in the frame of one specialty to take into account regional and professional peculiarities of personnel training in the field of quality.

Key words: *high production, quality education, training profile.*

M.V. Akulenok

N.M. Larionov

The information society is characterized by constant economy increasing on account of breakthrough high technology implementation. It makes new requirements for the professional education system and the process of personnel training.

The increase of national economy competitiveness under conditions of globalization and Russian entrance into the WTO depends directly on how successful we are in creating intellectual products, advanced scientific and engineering developments and their business implementation. It is impossible to do without qualified personnel. There is a need both in high technology personnel and in specialists in quality management field. These are the specialists who are capable of adaptation in a changing world, who are ready to self-study and self-improve, who can take a non-standard decision and promote a product to the world market.

It is generally known that the training level of a particular graduate rarely meets the demand of particular enterprises. Thus, there is a need to complete the education, to have tutors and even to retrain a fresh graduate [1].

This problem is the most obvious in the high-tech field because this field is being developed the most rapidly. For example, training of specialists in nanotechnology becomes difficult because of its interdisciplinary character and rapid information change. It needs making programs of "anticipating" training focused on particular tasks of enterprises [2].

Taking into account high rates of economic growth with increasing technology and equipment complexity, it is critical to develop such educational programs that allow training students whose knowledge and competence can meet the demands of enterprises. It can shorten the post educational adaptation period of a graduate.

Thus, it is necessary to include innovative content, to develop technologies and methods that challenge students' activity. Along all this, it is also important to do the following:

- to strengthen interdisciplinary components both inside the discipline and in specialty modules of educational programs (EP), to consolidate the contents of mathematic, natural, professional and special subjects;
- to ensure individual student training and diversification of educational direction by means of module variety of the specialty part of EP.

Application of the third-generation Federal State Educational Standard (FSES) is an important step in this direction. It gives much more freedom to universities ensuring the opportunity to have some curricula for one specialty to comply with particular customers' demand.

In comparison with the second-generation State Educational Standard (SES) the FSES is more structured and brief. The requirements to education results are termed as competences; there is no excessive specification in some subjects, variable elements of all subject blocks give more freedom for high schools to develop educational programs.

The basic peculiarities of FSES requirements are:

- Changes in labour input measurement of student's educational load and program acquisition,
- Possibility to organize a module studying process ,
- Education results are termed as competences, which have a wider notion than knowledge and skills.

Along with these basic changes it is necessary to note:

- There are requirements for the application of active and interactive forms and methods in education process,
- There are possibilities of constant development of education programs (item 8.1 has the requirement to reconsider the programs annually, to monitor and to review them).

Application of these requirements together with employers will allow matching the education level of graduates with the level of the employers' demands. This joint work should be implemented by joint education program development, creating of a "competence model" of a graduate taking into account professional standards, educational programs reviewing by specialists of enterprises, joint evaluation of education results(for example, in the frame of State Accreditation Committee) and participating of employers in education programs analyzing at least as a feedback on graduates.

The comparative data on education standards in specialty "Quality Management" in Table 1 testify the extension of possibilities of high schools to develop targeted education programs.

It is necessary to note that a very important factor influencing the education quality is the quality and topicality of the stated standards, requirements and targets (Fig. 1).

From this point of view, the passed edition of FSES has some drawbacks:

- The notion "module" is not clearly defined (for example, what is the difference between the completed subject section and the subject module). It can cause some difficulties while developing a module scheme of education programs;
- It seems that the definitions of kinds of activity and competences were done in a hurry, which makes the qualification "Master" an equivalent to the qualification "Specialist". In this case the bachelor is assumed (though not declared) to be half-taught specialist. The circumstances mentioned above can lead to education quality loss.

The implementation of the FSES in the Pilot education programs has the previous set of specialties. As a result, some specialties are too generalized. For example, a set of specialties for educational direction 22140 "Quality Management" includes the following:

1. Quality management in industrial-technologic systems
2. Quality management in socio-economic systems
3. Quality management in domestic and service sphere
4. Quality management in ecologic systems
5. Quality management in information systems
6. Quality management in logistics
7. Quality management in construction.

Training of graduates, specialty "Quality Management in Industrial-technologic Systems" for enterprises of the special economic zone "Zelenograd" can serve as an example. The professional

Table1. Comparative Characteristics of Educational Standards for Specialist, Bachelor and Master Degree in "Quality Management" Specialization

Second-generation SES	SES "657000" Order N686 in 02.03.2000	Third-generation FSES	FSES "221400" Order N 704 in 8.12.2009	FSES "221400"
qualification	specialist	qualification	bachelor	master
Special subject + General professional subject (high school components and electives), hours	2340	Profile component including variable components in all blocks	3888	3276
Percentage of theoretical course	50	Percentage of theoretical course	50-33	71-84
General professional subjects(GPS)(high school components and electives), hours	566	Only a profile block, hours	2052	1404
Percentage of GPS	10	Percentage of a profile block	48	78

activity sphere of the graduates can cover telecommunication, bioengineering, micro and nanoelectronics, etc. To meet all specific requirements, to take into account all peculiarities in one variant of educational program (EP) is impossible, because the degree of a graduate's competence in a particular industrial-technologic system is determined by peculiarities of the system, specific character of its faults and imbalance as well as measuring systems etc. As a result the period of graduate's adaptation is prolonged.

The development of some EP variants in the frame of one profile can be a solution of the problem. These programs should take into consideration regional production peculiarities and be based on a module principle with a wide range of modules focused on particular production sector. It will ensure the possibility for targeted personnel training in the field of quality.

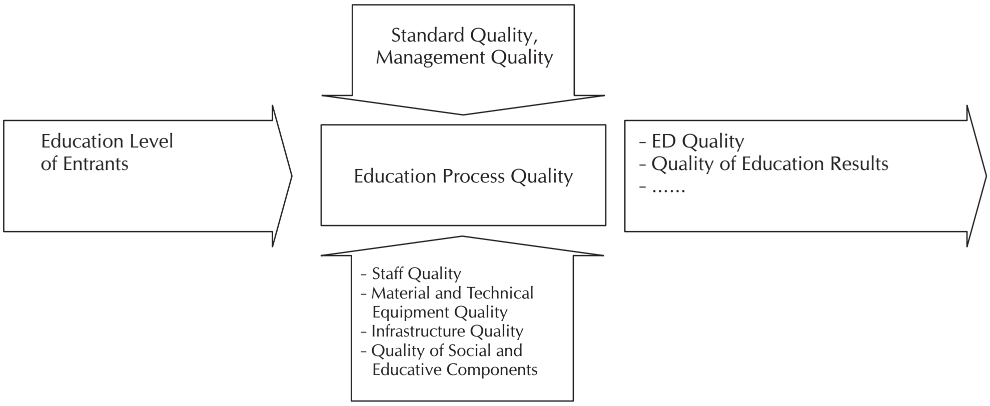
It is important for any specialist in the field of quality to master the following modules (without any reference to a specific economy sector):

- Connected with the development and implementation of quality management system (QMS) based on the All-Union State Standard (GOST) in Russia (ISO 9001:2008) and its further approval by authoritative international certification systems;
- Connected with mastering of special methods and means of control, management and quality provision including such subjects as " General Quality Management", "Statistical Methods in Quality Management", "Metrology", "System Reliability", "Quality Qualimetry", and "Measuring and Control Methods and Means";
- Connected with law and regulatory knowledge. This module consists of the subjects concerning European and Russian legislations. These are the subjects "Technical Market Regulation", "Quality System Certification", "Consumer Protection", "International Certification Sphere";
- Focused on mastering of information technology and computer process simulation (according to standards IDEF3), function simulation (IDEF0), data base simulation (IDEF×), data base management, net management, object oriented programming etc.

Together with these modules it is also necessary to include such modules as:

- Specialized (industry-specific) modules reflecting peculiarities of requirements to quality for example in telecommunication (TL-9000),

Figure 1. Basic Aspects of Education Quality



medicine and pharmacology (GMP), food processing industry, microelectronics (SEMI and ASTM), electrical engineering, automobile production (QS-9000/ISO 16949). These modules should provide the application of general approaches, requirements, and management methods to particular industry activities of enterprises.

- Specialization of basic courses (in the examples, issues and aspects) both in specialty subjects and in mathematical and natural blocks. Thus, to have good knowledge in nanotechnology it is necessary to study such sections of physics and chemistry as "Fundamentals of nanotechnology", "Certification and metrology of nanoscale objects ", "Measuring methods of nanoscale structures", "Defects of structures";
- Particular features of QMS, an enterprise or an employer can also influence the choice of special subjects. For example, courses devoted to integrated management systems, standards of computer-integrated productions, applied protocols of product information support (PIS/CALS), mastering of specialized application programs can be included in an individual training program of a particular graduate. Though it means an active collaboration of a high school and employers.

Laboratory and experimental facilities of high schools are the most important component of providing high quality education for a high-tech production section taking into account its characteristic features like searching and interdisciplinary character of the scientific and technology area. These facilities are made for creating a good combination of practical and theoretical skills, as well as for a well-functioning system of curricular practical trainings in modern enterprises that should be based on an active and constant interaction of a high school and enterprises.

The development of specialty training and extension of its possibilities will help to overcome the contradiction between high potential of high schools and low education quality and to balance the education level and labour market demand. As a result it would increase the educational system efficiency.

REFERENCES (ALL TITLES IN RUSSIAN)

1. Pesozkiy Y. Business as a consumer of HPE "product" //Accreditation in education. - 2008. - №22 - p. 24-25.
2. Gerasimenko N.N. How to train personnel for nanotechnology // Nanoindustry. - 2011. - №1 - p. 50-51.

Enhancement of Quality Education Models Through the Independent Professional Public Expertise

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The enhancement and dissemination of quality education models is to be ensured through the development of the independent professional public expertise in the sphere of education

Key words: *education quality, administration, monitoring, expertise, development, dissemination.*

R.E. Bulat

The necessity of a steady education quality enhancement is determined by the contemporary socioeconomic conditions, scientific achievements, regulatory requirements, as well as by the needs of educational institutions and their customers.

The review of scientific papers in the area of education system management has revealed that most quality education models are regulated by the accreditation and licensing requirements specified in the regulatory documentation. This can significantly contribute to the successful accreditation of educational programs. However, the main educational purpose, i.e. the readiness of graduates to the future professional activity, which demonstrates the real education results, could not be achieved.

It can be explained by the fact that in accordance with the state accreditation an educational institution should meet the state standard requirements for the quality of graduate training, i.e. to the definite minimum level. Therefore, the existing state accreditation system can hardly contribute to a steady development of educational institution, including a thorough elaboration of scientifically-grounded educational programs, improvement of teaching technologies and learning process, formation of innovative learning and scientific environments.

Alongside with that, due to the approved accreditation system coercion and fear have beneted Russian educational institutions, while the level of corruption in the Ministry of Education has significantly increased [1]. For better understanding the seriousness of the whole situation with the Russian education system sunk in bureaucratic routine, V.S. Avanesov holds the USA as an example [2], where there are no State Certification, Federal Internet-Exam in Professional Education, State Control of Education, and State Commission for Academic Degrees and Titles, as well as there are no universities operated under the Ministry of Education [3]. However, the list of world's top 100 universities includes 33 US universities and 15 UK universities. These countries are followed by Australia (7 universities) and France (5 universities). Altogether, the world's top 100 universities list comprises 19 countries [4], excluding Russia.

In foreign countries, education quality expertise is conducted openly by non-commercial, nongovernmental, independent regional or professional organizations which have assumed this responsibility or have been deliberately established for this purpose.

In the Russian Federation, the international experience in professional public expertise was primarily supported by the higher education community. That's why a cooperation agreement in development of national system of professional public accreditation of the educational programs in engineering was initiated between the Ministry of Education of the Russian Federation and Russian Association for Engineering Education (RAEE) in 2002. The latter has developed and approved the procedures and criteria of national public accreditation system and established Accreditation Center and Accreditation Board of RAEE.

The RAEE criteria which are used for professional public evaluation of the quality of educational programs in engineering and technology have been developed in accordance with the traditions of the Russian Higher Education System and the State Educational Standard of Higher Professional Education. At the same time they are based on the quality assurance experience of the following leading international accreditation organizations: Accreditation Board for Engineering and Technology (USA), the Institution of Engineers Australia, Japan Accreditation Board for Engineering Education, Engineering Council of South Africa (Republic of South Africa) [5].

The first 12 educational programs in 6 leading Russian Technical Universities were accredited in 2003 by RAEE Accreditation Center in accordance with the developed criteria. The commissions hired an array of experts, distinguished specialists of Russian Higher Education Institutions, scientists and manufactures have been formed. These experts and specialists have completed special training courses. The accreditation guidelines to assist experts in accreditation procedure have been developed. To participate in "pilot" professional public accreditation the representatives of accreditation organizations of Washington Accord member-countries (ABET) and the Ministry of Education of Russian Federation have been invited. In 2006 the RAEE Accreditation Center became an international organization, being authorized to award EUR-ACE label.

Based on the activity of the RAEE Accreditation Center, it has been proved that a true quality evaluation of educational programs and learning process can be ensured with the assistance of qualified experts who are the representatives not only of educational institutions but also of industrial enterprises, scientific communities and various professional organizations.

Being aware of the importance of professional expertise, the Federal Education and Science Supervision Agency analyses the possibilities of the application of professional public and expert evaluations in various state procedures and recognizes their viability due to the adequate illustration of the current state of education. On December 25, 2009 in the Year-End Press-Conference held in "Interfax" agency, Mrs Lubov N. Glebova, head of the Federal Education and Science Supervision Agency, commented that "audacity of the current education system lies in the fact that it supports the organizations which conduct independent evaluations. I hope that the number of such organizations will be constantly increasing" [6].

Herewith, according to the opinion of some employers, public education expertise must be obligatory. Deputy Director General of State corporation "Rosnanotekh" Andrei G. Svinarenko said that the Russian Corporation of Nanotechnologies (Rusnano) had proposed the amendments to the articles 77, 81 and 84 of the Education Act according to which professional public expertise of educational programs became an obligatory procedure [7].

In any cases while developing and applying the criteria for education quality evaluation, supervision agencies have to turn to the current achievements of the national science and apply for the help of the representatives of psychological, pedagogical communities, as well as industrial enterprises. The necessity of community involvement into the process of education quality assurance is proved by the modern trends of social development. True educational management cannot be achieved only on the basis of departmental arrangements excluding the role of public bodies.

The system of professional public expertise of educational institutions allows working out the path of their further development and thereby contribute to the education quality assurance. The independent professional public expertise in the sphere of education is a voluntary, self-regulating process aimed at improving of education and assuring its quality. It is proved to:

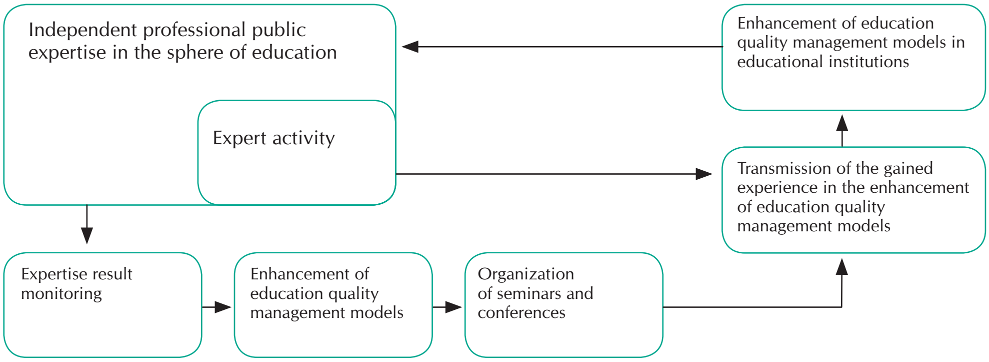
- inspire educational institutions for self-improvement and development;
- encourage educational institution responsibility for educational program quality;
- aim not only at the educational process itself (which provides knowledge) but also at the purpose of education, i.e. the readiness of graduates to the self-development (personal growth) based on the acquired knowledge;
- enhance educational system, including training and short courses for teachers and managers of educational institutions;
- increase competitive performance of educational institutions, which in its turn assures education quality;
- provide the public awareness, including the parties concerned and governmental bodies about learning process quality in educational institutions.

Above all, based on the experience of the RAEE Accreditation Center, independent professional public expertise in the area of education enables to accumulate, analyze and transmit the gained knowledge in the enhancement of education quality management (Figure1). This corresponds to the grants and activities enumerated in the Federal Special-Purpose Program on the Development of Education in 2011-2015, as well as "the dissemination of educational system models which can assure the quality of basic education all over the Russian Federation" [8].

Thus, a steady enhancement of educational system models which meet the quality requirements of modern education should be assured through the development of independent professional public expertise in the sphere of education, due to which it would be possible to:

- develop and implement extra expertise training courses intended to increase professional competence of teachers, managers of educational institutions and other people concerned;
- provide an effective training of experts in the sphere of education quality;
- transmit the gained experience, disseminate the current models of available and qualitative education through the activity of the experts of the independent professional public expertise in the sphere of education;
- hold seminars and conferences dedicated to the results of independent professional public expertise in the sphere of education. This contributes to the further development of the educational system models and modern education quality assurance.

Figure 1. Enhancement and Dissemination of Quality Education Models through Development of Independent Professional Public Expertise in the Sphere of Education



REFERENCES (ALL TITLES IN RUSSIAN)

1. 1. Avanesov V.S. Higher Education Bypasses // Independent Newspaper. – 2000. – 7 July. – p. 3.
2. Avanesov V.S. Strategic National Project «Education» as a method of transition to the public-state management in the sphere of education. [Electronic resource]. URL: http://testolog.narod.ru/Obrazov42.html (3.07.2011).
3. List of state universities in the United States. 22 June 2011 at 18:15 [Electronic resource]. – URL: http://en.wikipedia.org/wiki/List_of_American_state_universities (13.07.2011).
4. Russia is out of world university top list [Electronic resource]. – URL: http://5ballov.ru/articles/2007/12/05/44 (13.07.2011).
5. Pokholkov Yu.P. Engineering Education Quality // Quality of Higher Engineering Education and Specialist Training: proceedings of International symposium. – Tomsk: TPU, 2005. – p. 9–15.
6. Batanova M. A. The importance of independent education quality assessment for effective state quality control in the sphere of education and program accreditation in the Ulyanovsk Region [Electronic resource]. – URL: http://sinncom.ru/content/publ/info/batanova/index.htm (13.07.2011).
7. Interview with A.G. Svinarenko, Deputy Director General of State corporation "Rosnanotekh". 28.09.2010. [Electronic resource]. URL: http://www.nanonewsnet.ru/articles/2010/intervyu-sag-svinarenko-zamestitelem-generalnogo-direktora-gkrosnanotekh (13.07.2011).
8. Competitive selection of regional educational program development. [Electronic resource]. – URL: http://www.fcpro.ru/index.php?option=com_content&view=article&id=40&catid=11&Itemid=28 (13.07.2011).

The Competence Model for Experts of Accreditation Center of Association for Engineering Education of Russia

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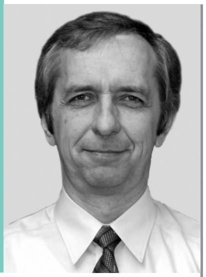
Indicators and characteristics of AC AEER experts' competencies are considered in the article

Key words: *competence, evaluation methods.*



S.I. Gerasimov

E. Yu.Yatkina

«Scientists investigate that which already is;
Engineers create that which has never been.»
Albert Einstein

Globalization and internationalization as the major trends in society development have increased the requirements for recognition and acknowledgement of content and outcomes of higher engineering education of all countries involved in the integration process.

It has become apparent that a purely external integration, achieved by previously signed conventions, is not sufficient to make dramatic improvements in education quality. Not only results recognition (diploma, degree, qualification) is needed but also trust (credo) to the process (training, practice, internship, design). It is important to influence and interfere in the internal processes of universities - the main teaching triad of teaching "what is taught, how is taught and by whom is taught" [1]. One of the ways for multilateral assessment of university activities aimed at improving quality of education is public and professional accreditation of educational programs. Association for Engineering Education of Russia was among the first organizations which have carried out a professional survey of this problem. [2]. AEER structural unit - Accreditation Centre - provides primary assessment of educational programs and university self-study materials, organizes on-site visit of experts to the university, prepares an evaluation report of the examined programs for the AEER Accreditation Board [3].

Experts of the Accreditation Centre of the Association for Engineering Education of Russia (AC AEER) form an integral part of AC working capacity and the image of modern engineering education in Russia. More than 150 certified professionals - deans, heads of administrative divisions, heads of departments, professors, associate professors, industry and governments representatives – annually benefit their professions dedicating time and efforts to AEER activities.

Most AC AEER experts start out by working as a member of the evaluation team during on-site visits to universities.

MINIMUM QUALIFICATION REQUIREMENTS

Potential AC AEER experts should meet the following requirements:

1. be interested in improving of engineering education.

2. be AEER member or express a desire to become AEER member before starting any activities as AEER expert.

3. have higher education and recognition in a particular field of activities.

4. have a degree in a relevant field.

5. have computer skills: be able to use the Internet, electronic mail, word processing programs (Microsoft Word) and PDF files.

Talking about a particular area of activity, it should be kept in mind that experts in their work have to deal with a variety of educational programs in engineering and technology. Currently, in accordance with the All-Russian classification of professional education, there are 29 enlarged groups of professions and areas of training in Russia; 17 of them belong to the engineering groups [4]. As of mid-2011 13 of 17 groups were accredited by AEER (see Table 1).

When we talk about the need for evaluation of expert activities efficiency first, of all we are interested in two characteristics: whether the level of his professionalism (education, skills, experience) contributes to the activities efficiency and what kind of person he is - intelligent, purposeful, responsible, committed, etc. (so-called personal and business qualities). The practice shows that high qualification, solid experience and high intelligence are not enough to guarantee effective work of expert within the audit of educational program.

Table 1. List of Specialties and Qualifications of Post-Secondary Education in Russia

Code	Name of the enlarged groups of professions and area of training	Engineering programs	Accredited by AEER programs
010000	PHYSICAL AND MATHEMATICAL SCIENCES		
020000	NATURAL SCIENCES		
030000	HUMANITIES		
040000	SOCIAL SCIENCES		
050000	EDUCATION AND PEDAGOGICS		
060000	PUBLIC HEALTH SERVICE		
070000	CULTURE AND ART		
080000	ECONOMICS AND MANAGEMENT		
090000	INFORMATION SECURITY		
100000	SERVICE INDUSTRY		
110000	AGRICULTURE AND FISHING INDUSTRY		
120000	GEODESY AND LAND MANAGEMENT	*	*
130000	GEOLOGY, EXPLORING AND MINING	*	*
140000	POWER ENGINEERING, POWER ENGINEERING INDUSTRY AND ELECTRICAL ENGINEERING	*	*
150000	METALLURGY, MECHANICAL ENGINEERING AND MATERIAL PROCESSING	*	*
160000	AVIATION AND ROCKET AND SPACE MACHINERY	*	*
170000	WEAPON AND WEAPON SYSTEMS	*	
180000	MARINE MACHINERY	*	
190000	TRANSPORT FACILITIES	*	*
200000	INSTRUMENT MAKING AND OPTICAL EQUIPMENT	*	*
210000	ELECTRONIC ENGINEERING, RADIO ENGINEERING AND COMMUNICATION	*	*
220000	AUTOMATIC DEVICES AND MANAGEMENT	*	*
230000	COMPUTER SCIENCE AND COMPUTER ENGINEERING	*	*
240000	CHEMICAL TECHNOLOGY AND BIOTECHNOLOGY	*	*
250000	REPRODUCTION AND PROCESSING OF FOREST RESOURCES	*	
260000	FOOD AND CONSUMER GOODS TECHNOLOGY	*	
270000	ARCHITECTURE AND CIVIL ENGINEERING	*	*
280000	PERSONAL AND SOCIAL SAFETY, ENVIRONMENTAL ENGINEERING AND PROTECTION	*	*
290000	MILITARY EDUCATION		

In the evaluation and selection of expert auditors European and American accrediting agencies use the term "competence" [5,6]. There are many definitions of competence, because different organizations and experts prefer their own interpretations of this concept. But finally most of the definitions actually mean a variation of two competency approaches - English and American. English approach interprets competence as performance standard or expected outcomes according to which employee's ability to act is measured. American competence approach describes the behavior required to work effectively. Within this approach the assessment correlates actual employee behavior with the description.

AEER ACCREDITATION CRITERIA

The first step in AEER public professional accreditation is a self-study process carried out by applicant university in accordance with AEER criteria. Nine criterions are approved by all international accreditation agencies - ENAEE members [7]. Only when all nine criterions are met, the program is awarded the EUR-ACE ® quality label (accredited engineer). In fact, before the on-site visit to the university and during the audit of the university, an expert gives a reasoned response to the questions listed in the right column of Table 2.

Usually an on-site visit to the university takes 3-5 days. During this time meetings with faculty, students, graduates of the educational program and employers are held. Within the visit it is important that the behavior of experts and the expected results correspond with the competence model; its key indicators are listed in Table. 3.

COMPETENCE MODEL FOR AC AEER EXPERTS

AC AEER expert community has identified a number of requirements for a competence model, which should be met to make its implementation practical and effective.

THE COMPETENCE MEASURING SCALES

There are many opportunities to assess the achievement of competencies by experts:

1. Binary scale
   - satisfactory
   - unsatisfactory
2. Three-level scale
   - Below Expectations
   - Meets Expectations
   - Exceeds Expectations

Table 2. AEER criteria outline

Criterion	Outline
1. Program objectives	Do the educational program objectives correspond with the university mission and the needs of potential constituencies?
2. Program content	Do the program outcomes meet the required criteria and correspond with the educational program objectives?
3. Students and study process	Does study process ensure learning outcomes achievement? Are students enrolled to educational program aware of planned learning outcomes and ways of their achievement in given time?
4. Faculty	Does the faculty meet the requirements needed to achieve learning outcomes?
5. Professional qualifications	
6. Facilities	Do classrooms, laboratory facilities, equipment meet the requirements needed to achieve learning outcomes?
7. Information infrastructures	Do computer classes, library, available information resources meet the requirements needed to achieve learning outcomes?
8. Finance and management	Do financial resources , organizational structure and university management processes meet the requirements needed to achieve learning outcomes?
9. Graduates	Are program graduates employed in accordance with their qualifications?

3. Four-level scale
   - O competence is not developed and expert does not seek to develop it
   - A need and possible to develop competence
   - B competence meets standard requirements
   - C expert demonstrates higher level than it is set by standard

Below there is Table 4 with a four-level competence scale. A chairman of the expert team can evaluate expert's work using this scale. This kind of information is important for AC AEER analytics. In case expert gets a significant number of A scores, he/she is invited to undergo additional training in AC AEER seminars. Figure 1 demonstrates a model diagram of an expert competencies assessment. Similarity of such diagrams of various experts allows forming groups of experts for advanced professional training and select an appropriate methodological support.

Table 3. AC AEER experts' competencies

Competence	Desired skills	Application during on-site visit to the university
1.Ad-hoc expert background	• Demonstrates awareness as an expert in accordance with the position held • Interested in lifelong learning in his/her professional field	• Able to apply expert knowledge to define how the educational program meet accreditation requirements • Aware of all updates of accreditation procedure and criteria
2. Effective communication	• Easily holds face to face interviews • Writes reports clearly and concisely • Holds focused briefings	• Interviews university staff to evaluate program efficiency • Writes short, criteria-based reports on the strengths and weaknesses of the program • Provides a thesis for the final interview hold by evaluation team • Inform the Chairman of all unavailable for evaluation team information (including from a self-study report),the prior and within the on-site visit
3. Interpersonal communication skills	• Friendly and naturally interacts with others • Listens actively and is interested in the topic • Unbiased and avoids personal prejudices • Decisive, not restrained his opinion out aloud • An expert in highlighting strengths and weaknesses of the educational program in a non-confrontational manner	• During interview have a strong willing to accept information from staff, administration, industry representatives and students • Evaluates the program in accordance with the accreditation criteria within a particular institution • Evaluates and expresses constructive opinion about strengths and weaknesses of the program
4. Teamwork oriented	• The willingness to accept information from members of the experts' team • Works with team members to reach consensus • Evaluates the success of the team higher than of an individual	• Compares his data with information collected by other team members for better understanding • Catches and listens carefully in order to achieve general result on the program • If necessary helps other team members within on-site visit
5.Professionalism	• Observes professional behavior and has proper appearance • Improves the process of program evaluation • Evaluates people honestly, and in accordance with the ethical standards	• Represents AEER and his engineering profession as a practicing professional • Tries to make suggestions on how to stimulate innovation and other efforts for continuous educational program improvement • Demonstrates respect to the university and its employees • always observes the code of ethics of AEER expert
6.Self-discipline	• Keeps within the meeting time limit • Focuses on the major critical issues and avoids details • Ready to take the initiative • Responsible at work with minimal supervision	• Formulates preliminary strengths and weaknesses of the educational program on the basis of the review materials provided prior to the visit • Focuses on the important results, effectively attracts additional data relevant to the used criteria and offers possible solutions • His distinctive feature is timely and high quality reporting to the experts team chairman • Makes critical recommendations where necessary

Table 4. Assessment of experts' competencies by the chairman

1. Ad-hoc expert background				
	Requires improvement A	Satisfactory B	Exceeds expectations C	Impossible to assess O
1.1. Knowledge of applying accreditation criteria	Demonstrated wrong understanding of accreditation criteria	Demonstrated awareness of accreditation criteria	Demonstrated an exceptional ability to explain accreditation criteria to others	
1.2. Knowledge of accreditation procedure	Demonstrated wrong understanding of accreditation procedure	Demonstrated awareness of accreditation procedure	Demonstrated an exceptional ability to explain accreditation procedure to others	
1.3. Leadership	Failed to provide adequate leadership	Provided the team with additional resources by managing within the on-site visit	Demonstrated a high level of team management, that provided good results of the visit	
2. Effective communication				
2.1. Information transfer	Chairman of the experts' team is not informed about the activities and contacts with university representatives	Provided the chairman with the new information in accordance with the new data	Was an active supporter of the chairman informing	
2.2. Final report	Written final report required significant editing	Written final report was effective. Key points were highlighted	Outstanding written report. Slight editing by the chairman was /was not required	
2.3. Interview	The interview was not conducted carefully enough and did not provide suggestions for program improvement	Effective interview allowed to determine the key points	Demonstrated exceptional personal qualities when conducting the interview in a confidential manner	
2.4. Suggestions	Made suggestions were too biased	Made suggestions for continuous improvement of educational programs and promotion of innovations	Was creative when making suggestions for continuous improvement of educational programs and promotion of innovations	
3. Interpersonal communication skills				
3.1. Communication	Not demonstrated effective communication	Was effective in communication with the program, students, teachers	Demonstrated an exceptional ability to prevent actual or potential conflict when discussing strengths and weaknesses of the program	
3.2. Prejudice	Was biased when evaluating the program	Demonstrated an unbiased approach when evaluating the program	Demonstrated an unbiased approach when evaluating the program	
3.3. Diplomacy	Was rude and aggressive towards team members or university representatives	Demonstrated ability to articulate in a diplomatic manner in difficult cases	Was decisive and spirited when making final conclusions	

4. Teamwork oriented				
	Requires improvement A	Satisfactory B	Exceeds expectations C	Impossible to assess O
4.1. Willingness to listen	Interrupt others, and tended to monopolize the conversation	Demonstrated a willingness to listen to other points of view during a meeting of the expert team	Encouraged others to express their point of view	
4.2. Willingness to help	Was focused only on his/her own tasks without voluntary will for assistance	Demonstrated a willingness to help other team members during the visit	If necessary, consistently offered assistance to other team members	
4.3. Cooperation	Demonstrated a limited ability to see different perspectives, or to seek a common point of view	Worked in collaboration with other experts to reach consensus	Demonstrated an exceptional ability to help the experts to find a common point of view and resolve the conflict, reaching a general consensus	
5. Self-discipline				
5.1. Prior to the visit	Was not prepared when he arrived in the university	Demonstrated timely performance of all tasks before visit to the university	Demonstrated performance of tasks prior to the visit and actively interacted with the expert's team chairman and / or team members	
5.2. Ability to "keep track of time"	Did not provide program enough time to prepare for additional requests	Demonstrated effective time management at university	Demonstrated an exceptional self-discipline and efficiency during on-site visit to the university	
5.3. Ability to respond	Delayed materials and did not respond to the comments of the expert's team chairman	Timely reported to the experts team chairman	Documentation was submitted ahead of time	
5.4. Self-discipline	Was disorganized in all aspects of the accreditation process	Demonstrated an effective organization in the evaluation process from first contact to final report	Was extremely effective, completed all tasks timely	
6. Professionalism				
6.1. Respect	Showed little respect in relation to the university	Showed respect for the university	Demonstrated a high level of respect for the representatives of the university during the meetings with them	
6.2. Behavior	Did not represent AC AEER in a proper manner within expert's team activities and final meeting	Showed respect for the university within expert's team activities and final meeting	Demonstrated superior ability to express respect for the university within expert's team activities and final meeting at uncomplimentary conclusion	
6.3. Ethics	Demonstrated misplaced arrogance in respect of other experts	Constantly observed the Code of Ethics of AEER expert	Set an example to other experts in the application of the Code of Ethics	
6.4. Decision making	When evaluating the program, based on his/her own opinion and not on the AEER criteria	Demonstrated expertise in making decisions when evaluating the program	Showed a brilliant professional decision making in the interpretation of criteria and characteristics of the program	

Note: Your choice should be explained when estimating competence with A score

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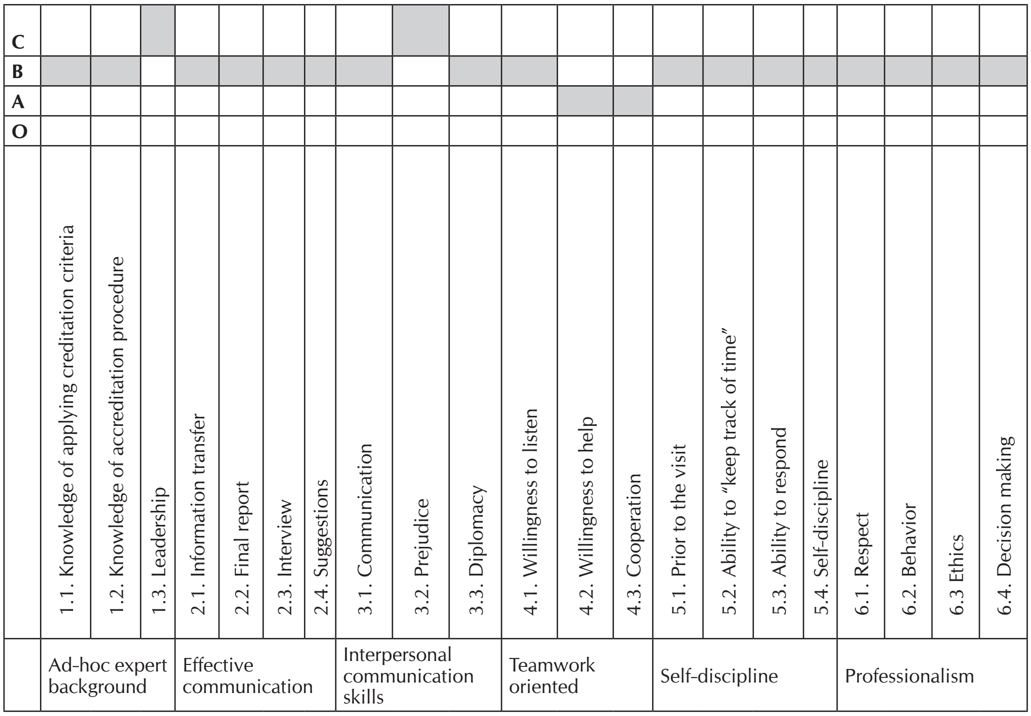
Figure 1.Expert's competence evaluation example.



CONCLUSION

Today, the process of accreditation of educational programs is widely recognized as the most efficient factor to improve the quality of education. It is crucial to develop at universities systems of continuous programs improvement through an independent external accreditation of programs by national and international professional community. The formal outcome of an external examination is regarded as the credibility to the program from graduates' consumers, and the main result is a real quality improvement of educational programs.

REFERENCES (ALL TITLES IN RUSSIAN)

1. A.E Belyaev, V.I. Livshits EDUCATIONAL GAP: Technological Education at the threshold of the XXI century. - Tomsk: STT, 2003. - 504 p.
2. Association for Engineering Education of Russia [electronic resource] :official website. Moscow, 2003-2011. URL: http://www.aeer.ru/ (date assessed: 15.05.2011).
3. Accreditation Center of the Association for Engineering Education of Russia [electronic resource]: official website. Moscow, 2003-2011. URL: www.ac-raee.ru (date accessed: 15/05/2011).
4. Russian education. Federal portal [electronic resource]: official website. Moscow, 2002-2010. URL: http://www.edu.ru (date accessed: 11.05.2011).
5. Accreditation Board for Engineering and Technology (ABET) [electronic resource] : official website. Baltimore, 1998-2010. URL:http://www.abet.org (date accessed: 12.05.2011).
6. Engineering Council of the UK [electronic resource]: official website London, 2011. URL: http://www.engc.org.uk (date accessed: 11.05.2011).
7. European Network for Accreditation of Engineering Education [electronic resource]: official website. Brussels, 2011. URL: http://www.enaee.eu (date accessed: 10.05.2011).

Compliance of Bachelor and Master Competencies with the Professional Standard Requirements

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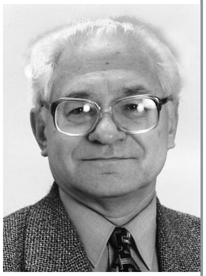
The paper discusses the issues concerning the development of scientific-methodological basis for the process of Bachelor and Master competencies approval in accordance with the requirements of their possible professional activities.

Key words: *the competence, bachelors, masters, the basic educational program, professional standards.*

O.A. Gorlenko



V.V. Miroshnikov

In the context of the transition to the two-level system of higher education much is being done now on developing basic educational programs (BEP) for Bachelor and Master training. Specifically, new curricula are being developed in accordance with the newly approved Federal State Educational Standards of Higher Professional Education (FSES HPE). As a natural result this process faces a number of challenges.

The most critical problems concern the questions of business and higher education system interaction, as well as the correlation of the two-level education pattern with the existing labor system [1]. It can be easily explained by the absence of regulatory support. Because of this, for example, it is not clear what positions the graduates with Bachelor's and Master's Degrees can apply for and how much they should be paid. What are their responsibilities? Today, not only the professors of Higher Educational Institution, but also industrial enterprise representatives express a great concern about the questions they have not received the answers yet.

The implementation of professional standards [2] could be effective in solving these problems. Unfortunately, the development of the professional standards is rather slow if compared to the state educational standards. Therefore, there are some troubles in correlation of graduate competencies, approved by FSES HPE with the future position requirements.

The next challenge concerns the development of the so-called variative component of the basic educational program [3]. One of the peculiarities of the newly approved FSES HPE is the division of the basic educational program into basic and variative components, its proportion depending on the specialty and program type. On the one hand, the presence of the variative component provides Higher Educational Institution with the possibility to vary its educational program in accordance with employer's requirements. However, on the other hand, the methodological basis for variative component implementation has not been completely developed yet. That's why each Higher Educational Institution solves the problem in its own way. Thus, it is required to develop scientifically-grounded technology for effective application of the newly-developed educational programs.

In the circumstances concerned, a group of experts of Bryansk State Technical University has started the project aimed at the development of methods and technologies for matching Bachelor's and Master's competencies, approved by the FSES HPE with the professional standard requirements. The project is realized on the basis of two specialties: 221700 "Standardization and Metrology" and 221400 "Quality Management". Above all, the following objectives are achieved:

- development of methodological basis for variative component integration in Bachelor's and Master's basic educational programs;
- generation of curriculum development technology, paying attention to those subjects which are aimed at competence training and enumerated in the variative component of the Bachelor's and Master's basic educational programs;
- development of Bachelor and Master competence model on the basis of such specialties as "Standardization and Metrology", "Quality Management" where graduates can face various professional requirements set by an employer;
- development of the procedure for the correlation of the Federal State Educational Standards of HPE with professional ones.

To our opinion, professional standards, being an essential part of any professional activity, must be integrated into the educational standards forming the basis for professional educational program development. Due to the implementation of the professional standards, employers, the representatives of industrial enterprises and educational institutions would gain the following advantages:

- enterprise representatives will receive the opportunity to evaluate their professional level, define the needs and possibilities of their professional training;
- employers will be able to control the professional level of their employees in order to reveal the necessity of advanced training courses;
- there also will be the possibility to renew educational standards (variative component) including curriculum and teaching material development in the system of Higher Professional Education.

The project consists of several stages. The first stage includes the development of methodological basis for the integration of the variative component into Bachelor's and Master's basic educational programs, which is complied with employer's requirements. The flow chart of the first stage realized on the basis of quality function deployment (QFD) [4] is provided in Fig. 1. In this regard, curriculum development technology is being worked out with special attention being paid to those subjects which are aimed at competence training and skill development and enumerated in the variative component of the Bachelor's and Master's basic educational programs. Above all, a corrective semantic-structural model of educational subject is applied. It allows to correct the content of basic educational program variative component in order to broaden or deepen knowledge, develop student skills and competencies [5].

Today, the first stage of the project in question has been realized in Bryansk State Technical University on the basis of the specialty: 221700 "Standardization and Metrology". In order to obtain the data concerning additional competencies of basic educational program variative component within the above-mentioned specialty, the following technologies were applied:

1. Survey of employers and graduates of Higher Educational Institution (10 enterprises of Bryansk region and 22 graduates of Bryansk State Technical University).
2. Expert analysis of academic community data (including research results obtained due to the TUNING project realized in European universities and also due to the research work conducted in Perm State University and Voronezh State University).
3. Expert survey of professors and teachers of Bryansk State Technical Univer-

sity (2 professors, 10 associate professors, 2 senior teachers and 2 assistants)

The obtained data were analyzed based on QFD process including two subsequently applied matrix diagrams [4]. The analysis has revealed:

a) for Bachelor training in the specialty 221700, basic educational program includes:

- 13 additional competencies (with regard to FSES) for variative component of humanitarian, social and economic blocks of basic educational program;
- 12 additional competencies (with regard to FSES) for variative component of mathematics and natural science blocks of basic educational program;
- 22 additional competencies (with regard to FSES) for variative component of basic educational program professional block;

b) for Master training in the specialty 221700, basic educational program includes:

- 10 additional competencies (with regard to FSES) for variative component of general science block of basic educational program;
- 14 additional competencies (with regard to FSES) for variative component of basic educational program professional block.

In order to make the obtained results more vivid, structural-hierarchical model of Bachelor's and Master's competencies within the specialty 221700 has been developed. Eventually, based on the results obtained through the realization of the first project stage, a pilot curriculum was developed in Bryansk State Technical University for the 2011-enrollment, specialty 221700.

The second stage includes the development of Bachelor's and Master's competence models with regard to employers' requirements and professional standards. The flow chart of the second stage is provided in Figure 2. Besides, the second stage includes the analysis of Bachelor's and Master's competencies, i.e. their compliance with the requirements provided in the skills guide for positions of managers, specialists and other non-manual workers; with regard to the national qualification framework [6] and professional standard projects within the given specialty [2]. Thereupon, it is essential to develop technology for Bachelor and Master certification in order to check whether they meet the professional standard requirements set by organizations – employers.

The second stage realization began with the development of the following formalized competence model M_{BB} relating to a graduate of Higher Educational Institution:

$$MBB = (Sp, PEL, ACC, APA, APT, APC),$$

where Sp – specialty of a graduate; PEL – professional educational level (qualification (degree)) of a graduate (Bachelor, Specialist, Master); ACC_k – abundance of k cultural competencies a graduate must have, k = (1,2,...,h),

$$ACC_k = (ACC_1, ACC_2,..., ACC_h);$$

APA_q – abundance of q professional activity of a graduate, q = (1,2, ..., t),

$$APA_q = (APA_1, APA_2,..., APA_3);$$

$APT_{q.i}$ – abundance of i professional tasks, corresponding to the type q of professional activity, i=(1,2,...,n),

$$APT_{q.i} = (APT_{q.1}, APT_{q.2},..., APT_{q.n}, APT_{q.1})$$

$APC_{q.i.j.}$ – abundance of j professional competencies required for solving different types q of professional activity, j = (1,2,...,m):

$$APC_{q.i.j} = (APC_{q.i.1}, APC_{q.i.2}, ..., APC_{q.i.m}).$$

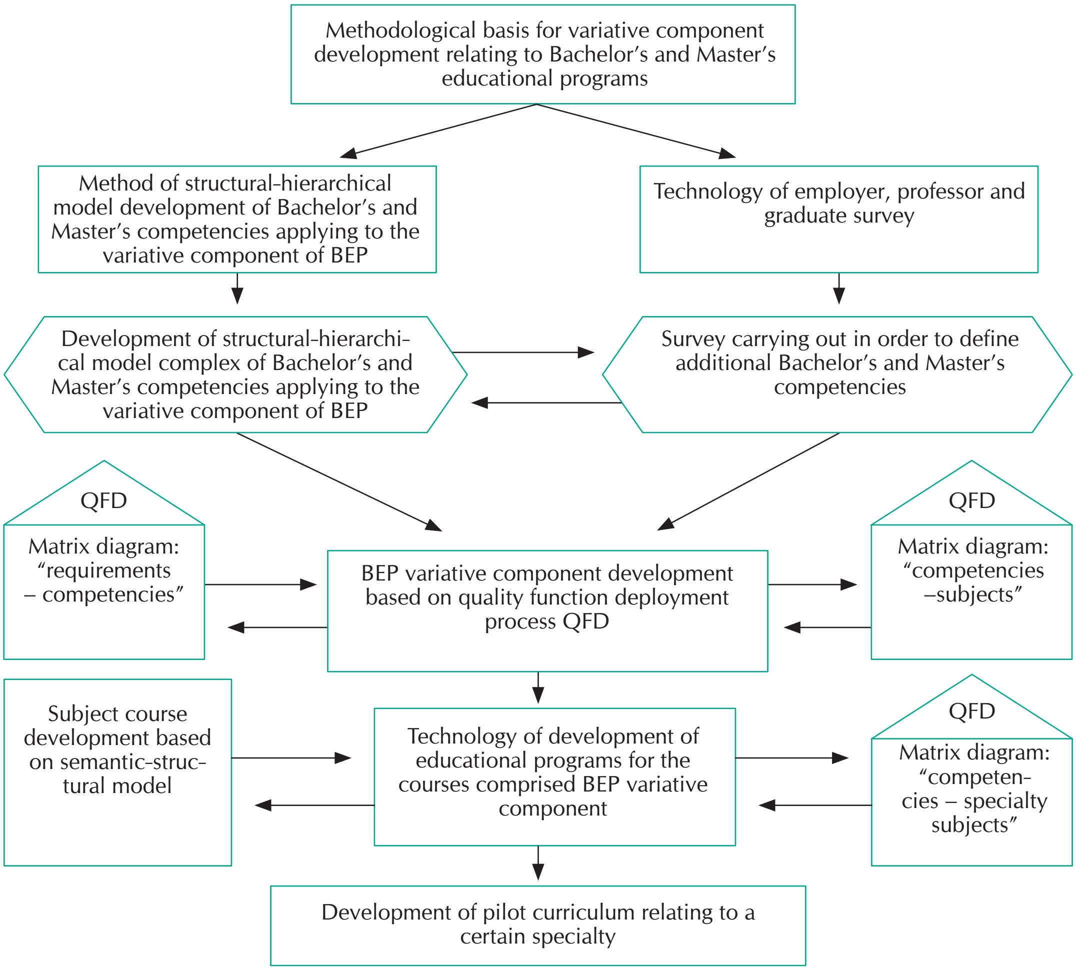
The competencies are presented as a sum of:

knowledge (K_x, x = (1,2,...,X)),
skills (S_y, y = (1,2,...,Y)),
experience (E_z, z = (1,2,...,Z)):

$$APC_{q.i.j} = (K_x, S_y, E_z).$$

The application of the proposed graduate competence model allows to regulate professional competencies by their differentiation in accordance with the solved professional tasks, i.e. each professional task requires a definite set

Figure 1. Variative Component Development Technology Relating to Bachelor's and Master's Educational Programs in the Given Specialty

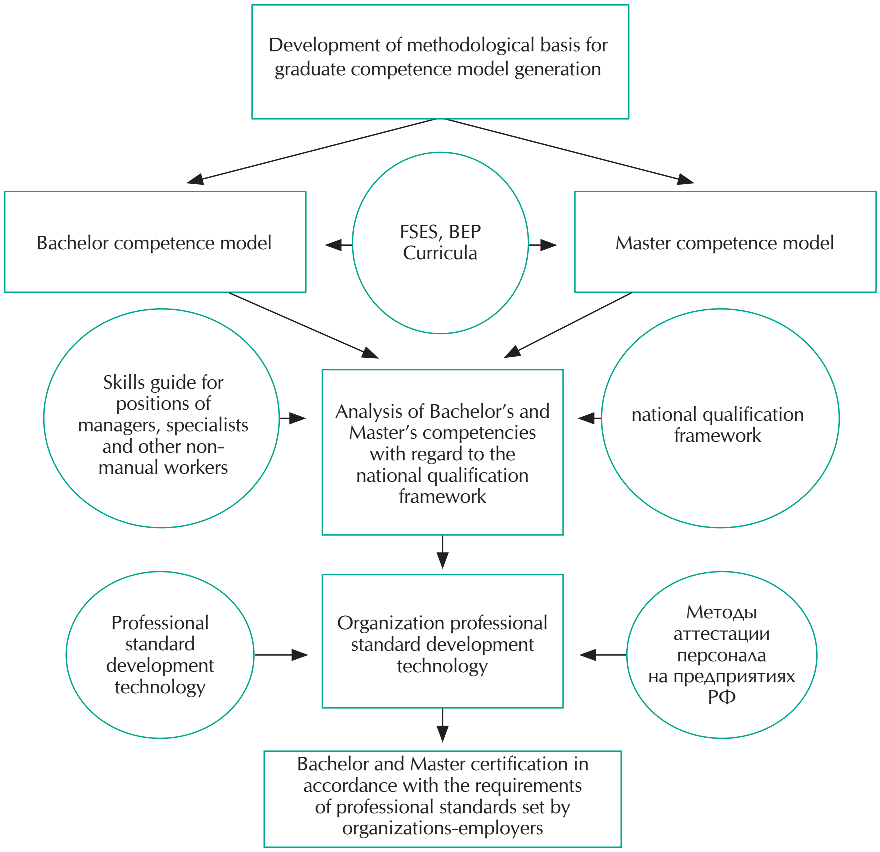


of professional competencies. Besides, this model establishes the correlation between competencies and their constituents: knowledge, skills, and experience. The model is proved to be universal and it can be applied in teaching result assessment relating to any graduate of Higher Educational Institution.

Applying this formalized model, the experts of Bryansk State Technical University developed complete Bachelor's and Master's competence models within the specialty 221700. These models could be used as the basis for professional standard development. To do this, it is necessary to modify the models in the following ways: include the requirements relating to professional experience; types of professional activities should be replaced by working activities; professional tasks should be changed to working functions (units of professional standard); professional competencies should become working actions [2].

The final stage of the project discussed is the development of the recommendations on specialized Bachelors and Masters professional training within technical specialties. It can be explained by the fact that in the context of the transition to the two-level system of higher education,

Figure 2. Development of Mechanism of Bachelor and Master Competencies and Possible Professional Activities Correlation



it is Higher Technical (Engineering) Education that has been heavily modified in the Russian Federation. Not only the definite specialties, but also educational programs were united. It was necessary to find a radically new approach towards educational program and curriculum development. A lot of subjects were integrated, their content being significantly changed.

Such critical changes can broaden the sphere of technical training making it closer to the general professional basis which corresponds to the officially approved American and European Bachelor's programs. However, it should be considered that in developed countries the special professional training is usually provided by the companies which are interested in employee education continuation [7]. As a rule, this kind of education includes the system of short-term or refresher courses in organizations, innovative centers and etc. There is no such an experience in the Russian Federation.

At the same time, Russian enterprises are becoming more and more interested in the engineers who have deep knowledge in a definite professional sphere. However, even large-scale enterprises are not ready to invest into the development of further bachelor education system. As for mid-sized and small businesses, they have no such possibilities at all. Thus, it can be stated that it is essential to develop the system of further bachelor education, so-called "finishing-up" [7], in the Russian Federation. This problem becomes particularly critical in connection with the orientation of the political leaders to the speed up modernization of Russia's economy.

Based on the proposed approach, we believe that it is possible to develop essential scientific-methodological basis for the structure improvement and content enhancement of Higher Professional Education that can be achieved by means of correlation of Bachelor's and Master's competencies approved by FSES of HPE and the requirements of industrial professional standards. It would contribute to the creation of favorable conditions for matching the existing labor system and the two-level educational system.

REFERENCES: (ALL TITLES IN RUSSIAN)

1. Borshch V.V., Abramova E.G. Mechanisms of Independent Education Quality Assessment based on the Demand Analysis of Higher Educational Institutions Graduates. Recommendations on Mechanism Application // Engineering Education. – 2010. - № 6. – p. 4-9.
2. Gorlenko O.A., Miroshnikov V.V., Kukarenko A.N. Development of Professional Standards in sphere of education quality besed on competence models // Vestnik BSTU. -2010. - № 3 (27). – p. 91-98.
3. Matushkin N.N., Stolbova I.D. Development of Graduate Professional Competence List // Present Higher Education (Vysshee Obrasovanie Secodnya). – 2077. - № 11. – p. 28-30.
4. Gorlenko O.A., Miroshnikov V.V., Barbats N.M. Quality Management in Industrial-Technological Systems. – Bryansk: BSTU, 2009. – 312 p.
5. Mozhaeva T.P. Quality Management in Lecturing // Quality Management Technologies. – 2004. - № 3. – p. 37-40.
6. Blinov V.N., Sazonov A.B., Batrova O.F. About the project of National Qualification Framework in the Russian Federation, which is correlated with European Qualification Frame. – M.: FIRO, 2007. – 58 p.
7. Gazaliev A.M., Egorov V.V., Breido I.V. Bachelor Training within Technical Specialties // Higher Education in Russia. – 2010. - № 3. – p. 138-142.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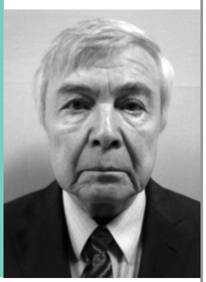
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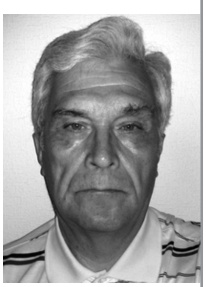
A.E. Novozhilov


V.M. Rizhkov

Modernization of Teaching Materials for the Curriculum "Electric Circuit" National Research Nuclear University (NRNU), Moscow Engineering Physics Institute (MEPHI)

National Research Nuclear University «MEPHI»
V.I. Koroteev, N.N. Nechaev, A.E. Novozhilov, V.M. Ryzhkov

Due to the introduction of IT a new situation has emerged in the sphere of electric engineering, which, in its turn, defined the demand in re-designing the core curriculum "Electric Circuit". The following factors are discussed in this article: modernization (up-dating) paradigm, definition of forms and methods under new conditions, development of technical and material resources, including IT, and filling up the Education Gap.

Key words: *electrical engineering, teaching activities, educational space.*

The advanced achievements in electronics, once a branch of electric engineering, resulted in the development of a new situation- its (electronics) fusion with electric power engineering. Due to a rather sophisticated intellectual management of the electromagnetic (EM) energy flux, there was the possibility of a wide-range non-linear load connection and expansion of old application spheres. For example, the synthesis of electric (power) semiconductor switches with MPU (microcontrollers) supported the induction motor flexibility, which according to many textbooks was considered to be uncontrollable. The introduction of multiwatt pulse technology made it possible to work at a power level of 1015W, and thus, electronics could register stop-actions. Figuratively speaking, modern electric engineering is experiencing a reversible transition from Nikola Tesla AC current to Alexandro Volta DC current.

At the same time, computerization and electronic communication development introduced new elements into project activities and close-related academic activities. Modern program systems completely computerized such processes as design engineering, simulation (modeling), and, in some cases, production of electrical appliances. Designers of electric appliances only see what is before them- computer display or ready-made products.

Critically, considering the teaching process in different electric engineering courses in this context, it has become obvious that this process must be up-dated. First and foremost, it was necessary to select the teaching process paradigm as a quality "Ariadne's thread".

Modern pedagogical approaches in teaching process organization in higher education institutions include the competence concept, i.e. "competence is implemented knowledge"[1]. However, if we state "electric current is implemented voltage", then how could the Ohm Law have been comprised. In both cases there are two different understandings for one and the same notion "medium": the first one that through which the current flows, and second one that where competence is formed and implemented. L.S.Vigotski suggested the notion "environment". He considered the social situation development as "particular and specific for a given age, an exceptional, exclusive and unique relationship between a child and his\her reality, i.e. social reality" [2]. This trend in pedagogy and psychology developed into the so-called pragmatic which was furthered by G.P. Schedrovitski and his colleagues [3].

Thus, in our case, the paradigm can be considered to be the notion "education activities", based on the trainee-engineering environment interaction. An excellent example could be the teaching process organization and development in A.S. Makarenko communities, i. e. from carpenter workshop to the modern optomechanical enterprise [4].

In other words, the student education activities should be organized in the same way as those of the production activities. But there is one distinct difference – the results of student education activities may not have any commercial value and must be maximally disburdened of production routine. Therefore, the basis for the teaching process organization should be independent quasi-production problem-solving by applying sophisticated production tools and facilities. The volume and content of such problems should be maximally versatile and subdivided into minimum, average and successful progress results. But, it is only in the army that the company's test time is determined by the last run-in soldier.

The above-mentioned paradigm deemphasizes the traditional forms of the teaching process: lectures, seminars, labs and autonomous tasks. The first and outmost form is autonomous tasks in modeling (project engineering) and analysis (testing) of electric engineering facilities. Its execution location- at home or lab- is determined only by the technique operation complexity. The workplace for a student or engineer can be organized out-of university through Internet and WEB-devices. Lectures and seminars function as comprehensive tutorials in search of primary information (problem statement, know-how analysis, etc) and secondary information (service instructions, technical regulations and specifications, etc.).

The overwhelming amount of information in electric engineering furthered the development of new electronic slide review lectures with Internet access. As they say in Oxford "please read around the subject and find the explanation \ description that is best for you. Go to the Library!" [5].

The problem discrepancy involves the difference in content volume to given curriculum hours and is easily solved by dividing the topics into basic and secondary ones. If these lectures are review ones then this problem will not exist, because the number of lecture curriculum hours determines whether the lecturer is present or not, but does not affect the lecture content itself. Now the curriculum defines the education activities. The initial 16-hour student course was redesigned into a 40-hour advanced training course. However, in both cases, there was\is no student autonomous module, which, in its turn, has become a challenging task.

First of all, a precise organization mechanism for the education activities was developed involving such characteristics as continuous process and feedback. The 150-student stream is a serious working community and providing relevant tasks is not a simple thing to do. The solution to this problem was the existing university system MEPhIST, widely known as "moodle" (ru.wikipedia.org\wiki\Moodle).

Student autonomous tasks were approximately divided into a 2-week period, involving one single topic and concluding test. The credit is a successfully completed series of tests. The above-mentioned system makes it possible to put these tests in the Internet as learning and controlling ones [6].The following fact should be highlighted that although the computer is the go-between the student and instructor, at the same time, it only ensures the forwarding of well-defined tasks. This is a serious disadvantage which could be solved in the near future; however, one should remember such a factor as personal human communication. In this case, seminars and after-tutorials are planned where non-traditional problems are discussed and analyzed.

Content of each topic (segment) involves a differential approach, providing minimum, average and successful progress results. This does not hamper successful students, but allows every student to determine his\her own progress trajectory.

The structure of every topic includes a package of tasks- homework (mathematical problem textbook), calculation lab task (mathematical modeling), lab diagnostic tester for analog modeling and description, workbook for recording modeling and analog modeling results, tests for programmed survey.

The first structure element is homework, including the following four chapters: (1) easy-type tasks: for those "who can't, but want to"; (2) university-level tasks: "Erudite and eruditress"; (3) advanced-type tasks (designed by the university department): "Talented and gifted" [7], and (4) preliminary-test-tasks: for test-based tasks. These tests include task-problems which have been developed for programmed survey and involve elementary mathematical tasks with easy answers. In the learning regime most students spend from 10-60 minutes for 5 test tasks

The second structure element is calculation lab task in mathematical modeling of electric circuits, which are further studied on the lab diagnostic tester. This task is based on the element values described on this unit which includes both compulsory and supplementary tasks. One calculation task result is an approximate oscillograph which a student obtains during analog modeling. This is based on the fact that a signal in modern electric engineering is an impulse and it's this impulse mode that determines the task solution. For example, the first topic devoted to elementary circuit with sine-waves includes the study of its phase deviation.

Complex signal form and non-linearity of applied elements results in the necessity of modeling computer programs. For above-mentioned tasks the MicroCAP program was selected (www.spectrum-soft.com) because the producer markets a free-load student version with a calculated grid volume of up to 50 nodes. This is sufficient. The Multisim program (www.ni.com\multisim) can be used as an alternative as it includes a distinct graphic interface and is in-built into a large program system LabView, used in many departments of NRNU. As the license cost (45US$-student version) is rather high for a student, it has a limited home application. Basically, all these programs are similar and are based on the basic electric circuit calculation program Spice. Students easily cope with these programs, and, besides this, there is a vast amount of references devoted to these programs. The application of these programs furthered the introduction of supplementary tasks, which are rather difficult to implement into the learning labs, for example, induction (eddy-current) heating.

Technically, the most complex element is the lab diagnostic tester, designed for scheme analysis (analog modeling) where perfect elements are substituted by factual elements. The principle of the diagnostic tester "ELUS" (which has been used for over 30 years) was used in this case. Its operation is simple- it is practically an automated workplace for an electronic engineer. This tester includes a computer plus program package and Internet, sophisticated digital oscillographTDS-2002B, involving not only the study of analog signals but also their transformation into a digital form; further processing as well as DC current source and generator for specific signals (harmonic and impulse). There is a digital multimeter to measure these values. Later this tester can be changed for an ordinary tester. This device is widely used and a student should be able to operate it.

The basic diagnostic tester element is a base-plate (card board) with elements and leads. In the course of time, a circuit of 3-4 basic elements was used. Although, in this case, there were some difficulties in the calculation of mathematical models, this did not hinder the possibility of using it for many years and considering it to be more than enough for the students. With respect to different views, the most appropriate basic circuit is 3 rows of separate elements, R, L, C, the ratings, of which is selected in accordance to the rows E24, E12, and E6, respectively. Thus, there are 24 element series RLC or 24 task variants. Adding one variable resistor and in-phase filter made it possible to design elements for four basic topics on a 150x100mm base-plate (cardboard): ″Linear electric circuits with harmonic signals", "Resonance in linear electric circuits", "Magnetic-coupled coils", "Transient processes in linear electric circuits". To increase the performance reliability simple 2.8mm knife switches were used, as circular plug-in connection proved to be unreliable during their application in the long-performance of the tester base-plate "ELUS". The cost of one base-plate ranges within 1000 roubles.

We turned down the proposal of buying the teaching material package of Multisim due to one rather important reason. Let's examine the structure of the program package in the design of the electronic base-plate PCAD. So, it is developed in accordance to the following principle: introduction of elements which further tracing of tracks. In the real-life production, the element is primary, while the track is secondary. However, in the teaching material package of Multisim, visa versa: track is primary and the element is inserted. This stands in stark contrast to the previous stated paradigm of education activities and can be compared to kindergarten blocks rather than to work in an enterprise.

The remaining topics, such as "Three-phase circuit", "Transformers", ″Long-distance transmission lines", "Non-linear elements" are similarly designed as the previous ones on separate base-plates. In the future it is planned to arrange the major training tasks of the course "Power semiconductor technology" on such base-plates.

Above-mentioned principles in the organization of the teaching process in an electric engineering lab can be easily implemented into the system of professional education in accordance with each individual instructor and his\her methodology.

However, in the higher education system, all lab tasks are integrated into the student timetable. Based on this fact, 13 diagnostic testing lab tasks were designed in accordance with one lab task for two students at standard number per student group. A projector can be used during seminar discussions, and, in the near future, an interactive board will also be installed.

It is obvious that the student timetable itself cannot regulate the execution of student autonomous tasks (as well as library attendance and homework). In this case five additional diagnostic testing were designed in a free access regime. If there comes the time when university "people" would understand all the absurdity of class-labs, then it would be easy to shift them into the "library-lab" regime. In this case we would only benefit from it, i.e. changing to new teaching technology- tutorials.

Such an organization approach of the student autonomous could make it possible to shift it (student autonomous) out of the teaching laboratory. In this case, analog modeling could include WEB-oscillographs and WEB-generators. The student would receive a set of base-plates with conductors, tester and WEB-device AKIP-4107 PV65 as well as a task package. Whereas, lectures, tasks, workbook with a record of completed tasks, test tasks can be found in Internet through the MEPhIST system. Naturally, one can agree that there is no personal communication in this case; however, it can exist in a more free way as tutorials or seminars.

The first experimental results showed the basic disadvantage of today's education –low student task orientation, resulting in no professional motivation. According to data results, only 1\3 of students are somehow interested in the teaching process. The remaining students are "ballast" who would need further training at the enterprise itself. The statement that "a student is not a vessel which must be filled in, but a flare that must be kindled" is not only still the issue of the day in our education system but also requires a new versatile approach in its implementation. However, this question is beyond the scope of this article.

The major problem in our case is to provide a balanced teaching process for the students. The absence of any professional motivation resulted in the internal quality control of the student's everyday work, while external monitoring is governed by the term – quality control principle of the teaching process itself. Earlier there was no free information access which today's IT provides, and in those days, the professor was the "pivotal figure" who posed only eternities. Everyday control was based on the professor's assertions, but not on the student activities. This fact still exists and has become an administrative regulation, including rudiments from past-century massive training of engineers, i.e. engineers of the 30's.

Excluding all above-mentioned factors, it can be stated that the introduction of sophisticated IT into the teaching process contradicts existing organization principles.

In conclusion, the selected approach in modernizing the teaching materials for the curriculum "Electric Circuit" not only updates the requirements to student autonomous activity but also opens up new vistas for further teaching and studies. As A.S. Makarenko said:" forty "40-rouble" teachers could completely degrade not only a homeless community , but also any community".

REFERENCES (ALL TITLES IN RUSSIAN)

1. Tatur Ya.G. Competence approach in describing the results and designing of higher professional education standards – materials from the second methodology seminar M.: Research center in quality training of engineers, 2004. - 18 p.
2. Vigotskiy L.S. Psychology of human development M.: Publishing House «Smisl», Esmo, 2005. – 1136 p.
3. Schedrovtskiy G.P. Psychology and methodology. Situation and conditions of concept origin of stage-to-stage development of mental powers. M.: Put, 2004 pp. 367 (from archives of Schedrovtskiy, G.P. Vol 1. Issue 1).
4. Makarenko A.S. Pedagogical poem. Compiled with remarks by Nevskaya, S.– M.: ITRK, 2003. - 736 p.
5. Will Moore, Circuit analysis 1(p2a1), DC Circuits (2009). Oxford University
6. Information-education portal MEPhIST NRNU ed. Guseva A.I., Kireev V.S., Tikhomirova A.N., et al. 2009. - №3. – P. 19.
8. Theory of electric circuits Workbook of tasks. ed. Varlamov, N.N., et al M.: NRNU MEPhI, 2010. – 58 p.

The Development of Academic Master (student) Competence in "Design Engineering and Technology of Electronic Aids"

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This article describes the development of academic master (student) competence in design engineering and technology of electronic aids. One effective variant in organizing the academic training of Master students in a technical university is suggested.

Key words: *the scientific-pedagogical competences, preparation of magisters in technical college, scientific-pedagogical preparation of magisters.*

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Only an advanced instructor (teacher) could solve the contemporary problem of today- training a new generation of engineers, research personnel and academic staff, who would implement a stable and dynamic competitive promotion (advancement) of the country's economy. Such an instructor (teacher) should have the following skills and knowledge: competence proficiency in his\her content area, methodological and project management approach, research and innovation –based experience, innovative educational technology strategies, moral and ethic principles, professional communication skills, good command of IT skills, and continuous improvement of one's professional level.

Based on the analysis and compilation of information [2, 3, 4] in training the academic staff for higher professional technical education, the following requirements were defined:

- high professional competence including in-depth and versatile knowledge in one's research-academic content area, unconventional creative mentality, innovation strategy and technique skills, creative problem-solving methods;
- pedagogical competence including basic knowledge of pedagogy and psychology and medic-biological intelligence aspects, command of contemporary learning forms, methods, tools and technology;
- social-economic competence including knowledge of the global civilization process development and modern society mechanism as well as a basic knowledge of sociology, economics, management and jurisprudence;
- communicative competence including academic and written communication skills, foreign language proficiency and IT skills, substantial knowledge of the approaches and methods in interpersonal communication;
- high professional and personal culture, i. e. scientific ideology, stable intellectual, moral, cultural and other values, not only as national but also as human ones.

Today's acute issue is the problem of training technical institution academic staff in accordance with up-to-date requirements, whereas classical universities and pedagogical universities do not train such instructors (teachers) in areas of basic professional and specific content. At the same time, these high requirements to the professional competence of the new generation academic staff and changed socio-economic conditions elaborate and expand future problems within the training frame of technical institution teaching staff.

The introduction of multi-level higher education system (Bachelor's-Master's programs) involves the possibility of training the academic staff within the framework of the technical universities. According to the new education concept, master students should be qualified for high-performance research and pedagogical activities in different areas. In view of these factors, the effective organization of the pedagogical training of master students in a technical university to implement professional-pedagogical activities furthers the solution of above-mentioned problems.

The academic activity tasks of the master students in design engineering and technology of electronic aids, stated in the project third-generation document "Federal State Education Standard of Higher Professional Education" are the following:

- conducting labs and tutorial classes with students;
- supervising term projects and Bachelor graduate papers;
- designing student teaching materials in different courses.

Federal State Education Standard for Master's degree in "Design engineering and technology of electronic aids" does not involve a core psychologic-pedagogical curriculum [4], and, in some cases, the training of master students as instructors (teachers) in technical disciplines includes only teaching internship.

S.I. Dvoretski, E.I. Muratova, et al [1] considered several approaches in the organization of the academic training of master students in engineering and technology (Figure 1).

It is considered that the implementation of in-depth psychologic-pedagogical training of master students in a technical university influences not only the development of all training factors for their future teaching activities but also is a pedagogical requirement in developing the academic competence of master students in a technical university.

An organization model of academic training of master students in "Design engineering and technology of electronic aids" is depicted in Figure 2.

It is presumed that the academic training organization of master students in a technical university involves a systematic approach and special teaching process management:

- orientated development strategy in accordance to HR policy to develop an innovative training system for instructors (teachers);
- pedagogical training target towards a functional pedagogical model for technical university instructors (teachers) and developing basic principles of project management and teaching;
- organization of academic training as an integrated part of the professional pedagogical training of technical university instructors (teachers), based on those problem-solving tasks specific for this or that engineering university;
- performance of master students in the teaching process should be considered only as academic-research, being systematic and continuous within the master degree program framework and is the first bridging stage in the continuous structure of technical university instructor (teacher) education.

Thus, the academic competence development of master students in "Design engineering and technology of electronic aids" is implemented within the orientated professional academic training, including an integrated (theoretical and training) part and involving not only physico-pedagogical but also socio-humanitarian programs (modules).

Figure 1. Different approaches in the organization of the academic training of master students in engineering and technology

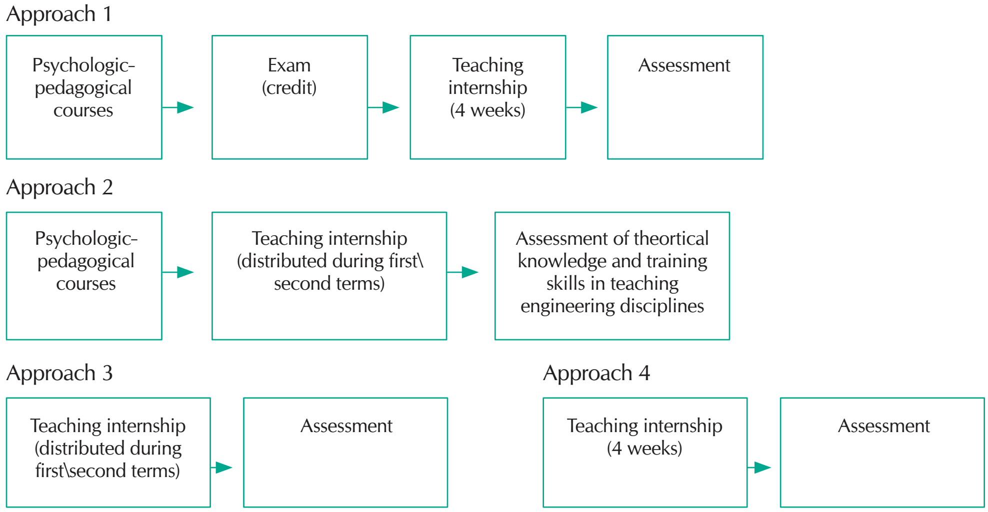
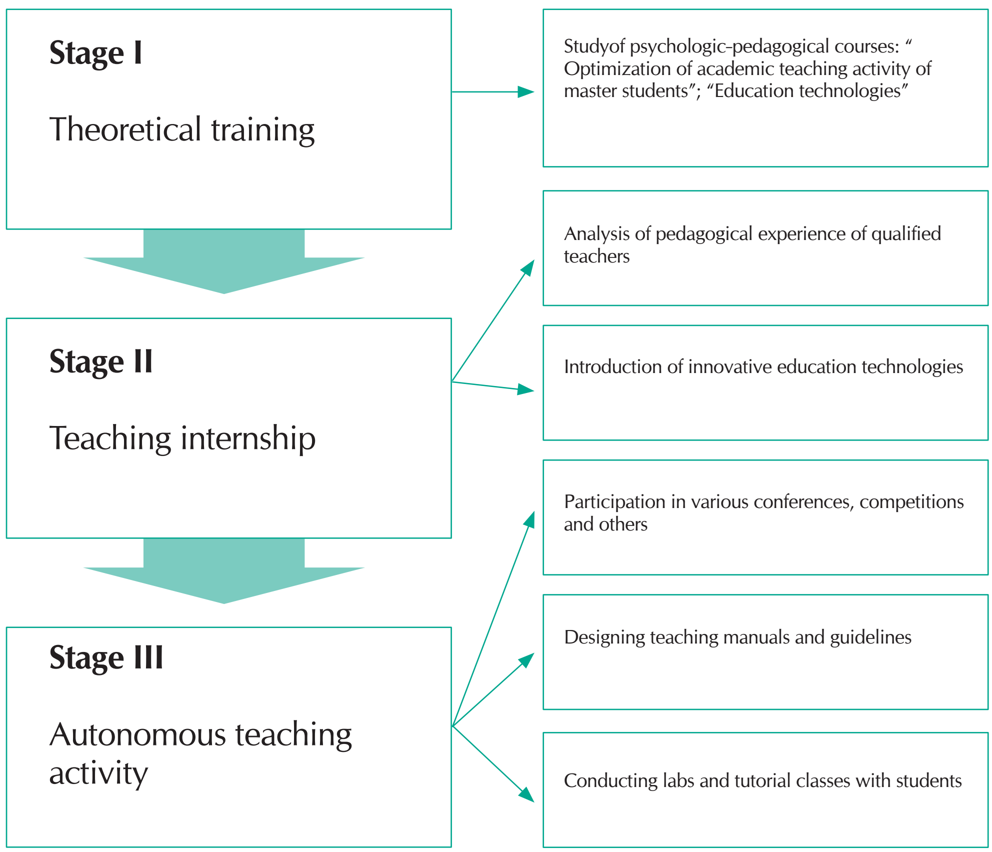


Figure 2. Organization of the academic training of master students in "Design engineering and technology of electronic aids"



REFERENCES (ALL TITLES IN RUSSIAN)

1. Dvoretskiy S.I., Muratova E.I., Fedorov I.V. Innovative-orientated training of engineers, research and academic staff: monograph. - Tambov: Tambov State Technical University Publishing House, 2009 – 308 p.
2. Federal target program "Research and academic HR of innovative Russia in 2009-2013"- URL: http:// www.sci-innov.ru
3. Training system and advanced training course and program resources for instructors (teachers) in technical universities ed. Fedorov I.V., Prikhodko V.M., Zhurakovskiy V.M., Vrazhnova M.N. et. M: PMK IGIP, - 2007. – 409 p.
4. Zhurakovskiy V.M. Development and practical application of teaching materials and education resources in training instructors (teachers) of technical universities, and further international certification. - M: MADI GTU, 2009. – 85 p.

Engineering Education Educology: Basic Postulates of Systems Engineering

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At the beginning of the 21st century, the novelty of the situation in the global system of engineering education (EE) is determined by the legislative introduction of the international EE Standards. These regulations should become a universal tool in the intensifying attack on the well-known phenomenon – Education Gap. To achieve the target- EE modernization, it is necessary to develop a general theory- EE educology. The basic postulates of this theory are discussed in the following article.

B.I. Livshits

Key words: *systems engineering, adequacy, homoeostasis, feedback.*

Problem situation. At the beginning of the 21st century, the global Engineering Education (i.e. EE) system began to operate within a principally new situation. International Standards of EE were legislatively implemented. These Standards were grouped into three clusters [1],[2],[3],[4] for different global regions. The basic principle – competence approach incorporates all these three clusters. Competence approach is an explicit primacy requirement of any employer to the quality of EE "product" and every individual "item"-EE graduate. These requirements are included in the parameters of "professional competence (PC) of an EE graduate" and relevant professional competence package (PCP).

Within the Fours "PC, knowledge, abilities, skills" (PCKAS), characterizing the EE results, the last three factors are inferior to the PC parameter, being exclusively intermediate registering indicators.

The adoption of a consensus on the basic principle of IC EE was a concluding solution to the long-term conflict of interests between "employer: producer – engineer" to overcome the EG-Education Gap. This phenomenon is typical for most EE structures, systems and elements and shows the developmental EE lagging from today's reality and yesterday's innovations, such as hi-tech, infor-tech, and science-tech in the technosphere. Thus, the novelty of the situation in EE involves the fact that the universal tool IS EE is developed and imposed to activate an attack on such a well-known phenomenon EG.

The existing EG is the real continuous long-term state of EE. However, there is no objective and principal justification of this existing EG and it is only the cause and effect of a well-known triad postulate: new technology and knowledge, abilities and skills in the technosphere should be accompanied by simultaneous and alternative updating technology- hardware, software, strategies and didactics in EE. Today, the consequences of the scientific-engineering revolution are the phenomenal increase of complex objects, elements and segments in the technosphere; thus, executing the triad requirement is a consuming and non-trival problem. However, the triad postulate has been cancelled, and today, enough experience has been accumulated to solve this problem, which in its turn, is discussed in many publications about engineering education [5].

Nevertheless, it should be highlighted that EG has deeply penetrated into the EE universities, where EG "stagnations" are permanent and never-ending ones. Important factors of this "stagnation" are such university establishment fetish as campus freedom, pluralism in understanding the EE targets and others. Under such conditions the execution of new IS EE requirements is often farmed out by the professorship that are not really ready to modernize the interminable university "life" structure.

EE top-staff personnel cannot counteract the professorship "opposition" theoretical-based viewpoint, because there is no existing EE theory. Numerous theoretical publications concerning particular EE issues and areas have still not been merged into one basic theory- EE educology. The implementation of the IS EE strikingly shadowed out the necessity to close this gap up, as the absence of EE educology theory encourages the top-staff personnel to only the administration application of the EE strategies and tactics as a voluntary policy, which in its turn, hinders the possible target solution- EE optimization.

EE systems engineering It is obvious that the problem of EE modernization is intrinsically imperative. If the basic EE structure model is considered as a graduate department model –structure, then it should be emphasized that the above-mentioned problem is multidimensional and significantly depends on a number of internal and external factors. In other words, it is a complex problem which could be considered as a complex system. Systems Engineering is the design of a complex interrelation of many elements (a system) to maximize an agreed-upon measure of system performance.

EE Systems Engineering includes the following modules:

- general theoretical methodology and tool aspects, optimal for system targets, i. e. system model, defining and characterizing such systems, modeling, simulation, optimization, decision making;
- technological methodology of the major system process - acquisition, education, assignment of knowledge, abilities and skills and their transmission into professional competence; i.e. planning and designing Curricula and Syllabi, sub-systems, assessment indicators, and other factors;
- engineering i. e. education engineering;
- organization of engineer's activities, i.e. social psychology, planning, management.

Selected EE structure model is termed as academic-organization system (AOS). AOS components include human resources, technology, process engineering, methodology, information, finances, which should develop an effective functional system. This is rather a complex task under the conditions of increasing sophistication of all the components in the outer world. Nevertheless, this task is feasible. An excellent example can be the leaders in university and department rating in the development of EE. Hence, the problem of process technification, occurring within the domain of these EE leaders, emerges (excluding the supposition that all these processes are exclusively heuristic and can be neither analyzed nor reproduced). Technification is the first stage in transferring the performance from the heuristic to the operational plane. The following stages include: formalization and algorithmization for analysis, problem-solving optimization, simulation. The tool, in this case, is systems engineering.

Up to the present day, many EE top-managers are convinced that it is sufficient enough to only design the AOS as a concise operating mechanism, and then all stated problems will be solved. However, the complexity and dynamics of the 21st – century world, in particular, enforces on AOS a high-level capability to adaptation, execution ability of its functions in a wide range of changing internal and external conditions, and, even within the framework of a conflict. Accordingly, the transformation from a mechanism to an organism or from a machine to a system is necessary for AOS with a rather high degree of adaptation potential.

Leading systemologists, for example, John van Gigch [6], consider the education system to be a soft system (SS). Such systems depending on the environmental constraints, especially, given super-system commands, could produce various types of results under one and the same initial conditions. Assessment of activity results of the education system is very difficult due to a number of reasons [6].

Different (including negative) AOS activity result effects on the ecosphere, inform-sphere, techno-sphere, socio-sphere should be taken into consideration at the performance and development stage of EE AOS. Designers and administrators of today's AOS should "keep abreast" of their structure-designs and receive all necessary evaluation from employer-consumers and graduates. This information is an important feedback during the updating of the input and inner AOS processes.

Feedback outline is technically included in the AOS design. However, at the AOS performance and development stages, there are a number of objective and subjective factors that reduce the significance of this feedback; or it is used only as watered information, completely losing its correcting functions.

For example, campus freedom is the "shield and buckler" playing the negative role in this collision. It may result in possible dualism when adopting management decisions within the AOS. Frequently, in these cases, monitoring and feedback in the AOS is pushed back into the marginal position or even, sometimes, this obtained information is completely annulled. There is an obvious reason for this- monitoring (feedback) is always an external intervention for AOS factors, i.e. employers, administrators, their experts, etc. In this case, the professorship considers that this intervention, spoken or unspoken, is an invasion of campus freedom. Thus, quite often the real results of AOS activities significantly differ from those in the stated AOS target of the project. Many employers, experts and auditors characterize this situation as EE crisis.

This statement is based on evident standards – the target of the state EE system should meet the country's demand in professionals. However, all this evidence proves the fact that this target has not been included in the priorities of the current module performance and EE system structure. As objective and subjective factors have dramatically corroded and deformed the essence of this target, the above-mentioned problem- demand in professionals- is not even considered as a specific target of the EE system. It is regarded as the problem of the labour market, but not of the EE system.

Above-mentioned indicates that the role of the feedback is extremely minimized because the feedback outline is practically annulled. Nevertheless, one basic axiom of systems engineering states: soft systems with any feedback are inclined to deform the targets and "outputs" of this system and with further inevitable degradation. Such a scenario can be cured by on-time treatment of the "diseased" system.

Feedback is not the only stimulation tool in the AOS. All EE system modules-people, or organizations- are open systems which cannot be controlled exclusively by feedback as in the case of inanimate systems. According to the monitoring results, a self-control component should be included, i.e. simulators and motivation elements, triggering an infallible performance of the system target. It is unacceptable to be indifferent to the fact that enormous resource expenses are used without results.

Management concept in complex systems is based on the solution of two associated problems: providing a stable performance of the system and increasing an effective introduction of innovation. It is obvious that these two problems are in close confrontation. The aim of this optimal management retains these two system features- stability and variability- in a dialectic unity.

The principle of divergence is involved in any complex system, i.e. the target of individual system elements is more progressive than the major target of the system itself. This is characteristic of complex systems with human resources; its "elements" pretend to assume an advantageous or convenient position for itself and frequently at neighbor's or resource's expense, which in its turn, are intended for the achievement of system performance target. This situation is termed as "travellers in a boat", where besides personal aims all of them have one common aim "not to sink the boat".

The term homeostasis can be technically applied to these systems. Let's consider x-space as y1.....yn, where yi- input of every system "element" in achieving the common target. The homeostasis boundary area within this space is termed as surface F (y1...yn) = F0, designating the area of all existing individuals, i.e. area of stability, homeostasis of this system.

To preserve its existence within H surface, the system includes the following possibilities:

1) to change its position relevant to the surface H;

2) to change its internal characteristics to some degree which affects the contour of surface H (threshold property);

3) to temporary change the environment parameters temporary.

To implement these possibilities, the system should have two potentials: non-response and resistance to external disturbance; and tracing internal disturbances caused by the parameter disharmony within the system.

The general system theory is a warning indication against the trivial understanding of H due to the unjustified comparison of it to well-known categories from natural sciences. For example, in biology, H is defined in a simple way; however, such simplicity is not typical for complex systems connected with people. There is also a formal description of H, identifying it with its stability in simple systems, while, in the case of complex systems, it is impossible to find a clear-cut connection between complexity and stability [7].

Homeostatis as a development trend resulted in the generation of self-controlling systems aimed to confine its parameters within definite boundaries.

Homeostats operate within system-like communities, invoking an information exchange between them. AOS can be termed as an artificial homeostat with a certain level of self-control to achieve a given target and self-programming when the target of the system changes. The term AOS involves such an important non-trivial property as an organismic one. Organism is a system having one's own aims, resources to achieve these aims and task-oriented performance (behavior). The super-target of the organism is H post-storage. In the organisms with people (communities), there is a distinctive complication- a response to any innovation is not reflexive (syntactic), but semantic, involving an indirect complex behavior.

Homeostatis is basically relevant to such a phenomenon as "progress", i.e. the efficiency growth of performance through the implementation of innovations. However, the behavior of this organism (organization) suffocates this tendency in order to exploit other development strategies. Frequently, the hypertrophy of H results in stagnation and negative professional and social results. This is the result of stagnation, long-term application of worn-out, but "reliable" technologies and performance methodology, blockage of the innovations within the system, etc.

Such tactics results in relatively significant system stability against the system relevance prior to super-system, downstream management system and actual environment. In other words, one H category is insufficient to effectively manage AOS as H only characterizes one side of the system stability. Variability and stability in the system is in a complex dialectic collision with unity; and there is no doubt that both of these categories should be included in the system management concept. The growth of complexity and the dynamics of modern systems produced such a new system analysis category as adequacy (A) - the ability of the system to accept and implement innovations, adequate outward and super-system influences, remaining, at the same time, an effective performance to achieve the given system target.

Because of various reasons, not only the objective but also the subjective ones, AOS is often shielded from direct outward influences and operates in an artificial favorable performance area. However, environmental dynamics constantly increases, and, consequently, furthers the interruption of AOS development in these conditions signifying the following facts: the regression of this system, dramatic abruption, and violation of the AOS adequacy principle through sophisticated innovations in the techno-sphere and inform-sphere- i.e. Educational Gap (EG).

Thus, there are two performance strategies for EE model:

(1) model-machine: stated final target, algorithm and resources to achieve all objectives. After this, AOS begins to work according to a rigid scheme, whatever the external conditions are;

(2) model-system: stated final target and a number of operation trends to achieve this target. After this, AOS begins to work tending to achieve this final target and, at the same time, preserving the given trend under changing external conditions.

This organization is often formed in a hierarchic structure. The delegation of authority and resources downward reduces these subsystems into independent organisms with individual aims and further results in the collision between the authority center and downstream subsystems. This collision is often based on the fact that H overemphasizes itself and becomes the super-target of the organism. Within such hierarchic EE systems A is quite often sacrificed for H, therefore, AOS management strategies should be directed towards the preservation of category A at a required level.

Major target of AOS Discussed EE model structure-AOS is designed and developed when there is a problem-solving situation, i.e. collision between new society demands and the low EE performance efficiency in satisfying these requirements. What are the challenges of the 21st century? A very simple and decisive answer: the every-day growing sophistication of such spheres as techno-, inform-, and socio- .The tool to grasp all this is high professionalism "heavily armed" with a contemporary system approach in the spheres of technology and inform-knowledge, where the role of empirical knowledge and heuristic, creative and conceptual problem-solving solutions drastically redouble. The traditional problem-solving approach, based on natural science, physicalism, model-designing and analytics "takes second billing".

The problem-solving situation models the AOS target. Based on the above-mentioned, the major target of AOS is formed as following: the relevant development tendency of the civilization and a specific society, in particular, the growth of professional competence dimension and quality of a defined student community, which in its turn, is achieved by constant monitoring of mentioned trends and, at the same time, the reconstruction of the structure, element behavior and the system itself.

This statement reflects such items as the final products of AOS and the ideal management object situation in accordance with how AOS should operate. The quality-quantity combination of an effective process is a compulsory integrated brand of today's successful AOS. Both of these features should not be in a cause-effect relationship, as each of them characterizes an important independent aspect of AOS performance.

The alignment space is generally 4-dimensional: AOS co-operates with managing system (super-systems), managed systems and present-day environment. Besides, AOS, itself, forms targets for its own stable operation. Therefore, four sub-targets should be determined at the second decomposition stage, in accordance to the 4-dimensional alignment space.

AOS model performance is based on A and H criteria. The following stages are included in designing this model:

1. selection of input and output model parameters;
2. selection of criteria to conform the input and output model parameters; these parameters can be calculated or assigned in respect to H and A;
3. selection of major criterion for AOS operation;
4. technical determination of AOS performance result, i.e. output parameters through input ones, through the AOS operation function;
5. definition of the optimization target due to the major criterion for AOS operation, limitations and interrelation between input and output AOS parameters.

The operation function defines the operation systems, which includes the basic performance process for the designed system. In the monograph "Education Gap: engineering education on the threshold of the XXI century" [5] the authors suggested the Cobb-Douglas production function in designing the AOS operation function, as it is a classical solution for similar problems in economic cybernetics [8].

The processing technique of AOS operation function as well as the definition of the optimization target for AOS and the algorithms to solve specific suboptimization problems are discussed in the monograph "Education Gap: engineering education on the threshold of the XXI century" [5].

REFERENCES (ALL TITLES IN RUSSIAN)

1. International Engineering Alliance [Electronic resource]: the official site. – URL: http://www.washingtonaccord.org.
2. ABET [Electronic resource] : the official site. – Baltimore: ABET, Inc., 1998–2010.– URL: http:www.abet.org (usage date: 14.05.2011).
3. ENAEE EUR-ACE European Accreditation Engineering programmes [Electronic resource]: the official site. – Brussels: ENAEE, Inc., 1998–2010. – URL: http://www.enaee.eu/the-eur-ace-system/eur-ace-framework-standards/ (usage date: 14.05.2011).
4. The APEC Engineer Manual: the identification of substantial equivalence [Electronic resource] / Asia-Pacific Economic Cooperation, Human resources development working group, [2009]. – 48 p. – URL: http://www.washingtonaccord.org/APEC/Documents/APECEngineerManual.pdf (usage date: 14.05.2011).
5. Beljaev A., Livschits V. Educational Gap: Engineering education on the threshold of the XXI century – Tomsk: STT, 2003. – 503 p.
6. Gigch John P. van. Metadecision: Rehabilitating Epistemology (Contemporary Systems Thinking). – New York: Springer Publ., 2003. – 363 p.
7. Moiseev N.N. Mathematical Problems of System Analysis M.: Nauka, 1981. – 488 p.
8. Economic Kybernetics - Manual for universities, ed. Kobrinskiy N. E., Maiminas E.Z., Smirnov A.D. M.: Economics, 1982 – 408 p.

Sherlock Holmes and Third – Generation Education Standards

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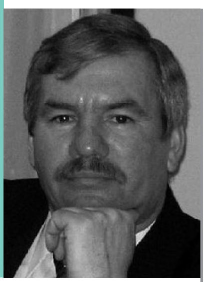
Training modern competent engineers with relatively in-depth "economic" and "cultural" competence, which is based on the third-generation State Education Standard (SES) without changing the structure and content of existing programs is rather problematic. The solution of this problem is to design such a competence model to further unit-module curriculum for task-oriented competence development.

Key words: *competences, educational standard, study block, competence module, study plan, purposeful formation.*



V.V. El'tsov

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What is it all about? The matter in question is not an investigation of some intricate crime within the walls of the Ministry of Education, and, moreover, it is not about the deductive method which could be applied in designing the State Education Standards for engineering training, the so-called "third-generation" Standard. As far as is concerned, it is professionalism, which was a distinct characteristic feature of Sherlock Holmes, together with his determination and in-depth knowledge in one single area. And this is undeniable what an engineer-graduate should obtain through this or that engineer training programs.

Here is a citation from one famous A. Conan Doyle novel which is controversial even today:"..... But I am not everyone! Watson, do not misunderstand me: the human brain is like an empty attic- attics are catch-alls. A fool stows this attic full of everything and the kitchen sink. And then comes the time when the must-have cannot be rammed into this attic. Or it is tucked away and you cannot get it. I do it in another way. In my attic there are only necessary things for me. They are many, but in perfect order and at my fingertips.

Needless bits and pieces I don't need.

- *Is Copernican theory rubbish, says you ?!*

- *All right. The Earth rotates around the Sun.*

- *It is...what is it....WHAT should we suppose???*

- *The Earth rotates around the Sun. But for me, it is useless in my affairs!.."*

Now, let's turn to more serious items, i.e. modern engineering education. Besides the fact that the Earth rotates around the Sun, there is an abundance of information, which according to existing conceptions (for example, SES requirements) a person should assimilate, elaborate and accumulate to have the reputation of being not only an "educated" man but also a high-qualified professional. One cannot reject the authenticity of a fact that a person should be an "erudite". Hence we infer that a professional in the engineering sphere should develop "humanitarian and economic" competence to successfully communicate (without an "interpreter") within that "cultural" area and understand those requirements and demands when designing this or that engineering project. However, the human brain capability and capacity (only in that well-studied hemisphere) is fairly limited for the assimilation, retention and application of all the necessary information for a specific activity, i.e. that "attic" in which all imaginable and unimaginable "stuff" (information) is rapidly and randomly stowed. Additional information content expansion and its simultaneously high assimilation result in the degeneration of these intensive knowledge acquirements and application level in a professional sphere, involving further professional "non-competence".

What are the basic requirements in the third-generation SES of higher professional engineering education and what is the principal difference from the first- and- second –generation State Education Standards? Based on the analysis of above-mentioned documents, it can be underlined that there is no principal difference between them. However, one must mention the following facts- technically, the higher professional education system was changed (introduction of 2-level system of education) and, revolutionarily, there was an expansion of accessible information content (computerization and Internet), but, at the same time, the information acquisition time period remained unaffected. The structure and content of third-generation SES, concerning the Bachelor training degree, principally, did not change in any item, except in the following fact- the term "class hours" was changed to "hour-credit", while "learning skills" to "competence". Structure requirements to the basic education programs remain the same, i.e. it includes not only, all the following subject-cycles: humanitarian and socio-economic, mathematic-natural science, scientific and professional [1, pg. 9-16], but also compulsory and optional subjects for each discipline cycle. In other words, the situation is as follows: the economic society parameters have sharply changed; the volume of different processing information has drastically increased; and the requirements to the education end-process have also changed, while the higher professional education model for future graduates is still the same within the previous framework.

It's important to underline the fact that within the framework of the SES, any education institution has the right to design its own basic Bachelor or Master Degree training program. Thus, the institution community has the possibility for creativity. However, unfortunately, a significant number in this community are rather conservative to any innovation in the education sphere, especially if this or that innovation is not documented by the federal or regional administration, for example, SES. In this case, most Bachelor or Master Degree programs are either previously ready-to-use ones (for example, the Education Program from Education and Methodics Association [EMA]) or designed (by the universities) with minimum possible alterations within earlier existing education programs. Both variants of designing education programs principally make it impossible to change the education process itself, as they do not include those characteristics relevant to contemporary development demands in science, technology, engineering and society, necessary for future graduates. This relative "impossibility" is based on the fact that the new education content is "squeezed into" the previously old existing forms and methods so as to enforce it.

Although it may not be a revolutionary one, the way-out plan in this case could be some definite changes in the education process and within the structure of the Higher Professional Education program itself. What processes and forms are to be improved in the engineering education?

Firstly, it is the design of a competence graduate model for each education program with its further updating. As there are already adopted existing Standards, the so-called designed graduate model should, in one way or another, formally consider these requirements without contradicting them.
For example, in the SES section "Requirements to the assessment of basic Bachelor degree education program "an

unspecified competence list is defined in accordance to some characteristic feature, i. e. "cultural or personal-social" competence, "engineering or technology", "professional" and so on. One can use the above-mentioned terminology in the project graduate model, however, the informative content of these competences should be tailored in compliance with the potential employer demands, global or European criteria, and at the same time, envisage the future development of this or that engineering sphere and, respectively, include perspective professional competences. Competent graduate model should be designed in such a way that within each group of competence there are two-three dominants, which in its turn, are developed through different disciplines (modules, courses, programs). The designed competent education graduate model should involve an assessment mechanism to control the compliance of this model to the obtained results and an updating mechanism as well.

Secondly, the main item is to change the graduate curriculum structure. Existing Bachelor and Master Degree curricula are simply a revision of an engineer curriculum, i.e. a cut-down version. A curriculum should be designed on the basis of a developed competent graduate model, but, at the same time, excluding the requirements stated in the SES – because a variety of disciplines for each particular cycle are not integrated by one definite target which would further develop this or that specific competence. (Table 1).

This discipline cycle is compiled in an optional sequence from natural sciences to professional courses throughout the curriculum itself; and such factors as the teaching succession of these disciplines, their content and scope are frequently employed unreasonably or may even involve a subjective interpretation, for example, using such words as "always" or "it's convenient" to avoid further misunderstanding. To design a curriculum promoting the development of this or that competence, it is necessary to provide a task-oriented classification and time distribution in teaching the different subjects, courses, modules and practical training (session). Instead of a discipline cycle integrated into "humanitarian", "engineering", "professional" categories, academic modules should be designed, each of which would stimulate the development of specific competencies or competence groups, initiated into the graduate model. No matter whether these individual academic modules could include all disciplines or only a part of them (humanitarian and socio-economic, natural sciences, general professional disciplines, and professional disciplines), all of them are oriented in developing an assigned competence, i.e. each academic module "is responsible" for the development of this or that competence. Furthermore, it would be advisable if a supervisor could head one of these modules and be responsible for it, which in its turn, would be more effective (Table 2).

The successive implementation of such academic modules could be based

Table 1. Extract from a section of «Basic Professional Training Structure» SES for Bachelor Degree in discipline 190600 "Operation of industrial-transport vehicles and systems"

B.3	**Professional cycle** **Compulsory** **(basic professional)** After studying this cycle, a student should know: definition of a dot, line, plane and polyhedron on a plot; metric and positional equations; curves; surface of rotation.	105-115 55-60	Descriptive geometry and engineering graphics Theory of strength of materials Theory of Machines and Mechanisms Principles of machinery elements	OC-1 OC-3 OC-4 OC-5 OC-6 OC-8 OC-9 OC-10 OC-15 RC-1 RC-2 RC-3

Table 2. One structure element (of an academic module) and its content from the new curriculum for a Bachelor Degree in one of the engineering disciplines

Competence	Learning module	Courses, practical training, trainings, modules, term papers, graduate papers and projects	Supervisor of the module
Target (socio-personal)	academic module №1.1 «Socio-communication and culture"	Personality psychology - modules №1, 2, 3 History of Russia – complete course History of World Culture - module №1 Foreign language - Module №1 «speaking» Philosophy - modules №1, 2 Russian language and culture- modules №1, 2 Department of public communications- trainings №1, 2, 3	V.V. Nurenberg, director of public communications department
Capability: be communicative in social interrelations, including speaking a foreign language and appropriate behavior in a definite social environment			
Capability: to understand and analyze world outlook, important social and personal philosophic problems; the dynamics and mechanism of the historical process			
Skills: intellectual culture, generalization, analysis and perception of information			

on the same competence model which underlines the following requirement for any graduate- from simple to complex. Besides this, each module, except the first one, should include essential pre-details from the previous module. According to the developed competence-based academic modules, it is not difficult to plot the learning trajectory of the students, comparing it to a LEGO, where these blocks can be replaced or inserted. At the same time, the coefficient output of such a module is easy to evaluate in credits, as the number of developed modules, total content of the education program and expert determined significance degree of each module to further the education process results are known.

However, such a curriculum structure requires that the executives of these education programs, professor-teaching staff and university administration apply every effort in order to change not only the content and volume of the academic courses, but also to develop a new education process schedule. Such problems could arise: absence of necessary personnel and the necessity to introduce additional courses. There is no doubt that the designing and application of such block-module programs has a positive effect, i.e. in the "attic" of a graduate there will be only necessary and adequate implements for the future professional activity and "cultural" communication, and this all will be in perfect order and at one's fingertips.

REFERENCES (ALL TITLES IN RUSSIAN)

1. Federal State Education Standard of Higher Professional Education in discipline 190600 "Operation of industrial-transport vehicles and systems" (electronic version): official document approved by Ministry of Education and Science, Russian Federation, dated December 8, 2009: № 706

The First Electrotechnical Institute on the Threshold of its 125-th Anniversary

Saint Petersburg State ElectroTechnical University
"LETI" n.a. V.I. Ulyanov (Lenin)
V.M. Kutuzov, D.V. Puzankov, L.I. Zolotinkina

This article describes the history and development of the oldest electrotechnical institution in Russia and one of the leading technical universities in our country-Saint Petersburg State Electrotechnical University "LETI" n.a. V.I. Ulyanov (Lenin). Many outstanding Russian scientists have worked and are working in this University, who furthered research development of global and Russian priority meaning.

Key words: *electrical engineering education, the oldest in europe, electrotechnical university, teaching and scientific research, recognized academic and research schools, electrical engineering and electronics.*

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D.V. Puzankov

L.I. Zolotinkina

June 15, 2011 marks the 125-th anniversary of the foundation of Saint Petersburg State Electrotechnical University "LETI" n.a. V.I. Ulyanov (Lenin) – one of the largest institutions in HR training, basic and research studies in electric engineering, radio engineering, telecommunications, electronics, management, computer engineering and IT, control processes, instrumentation engineering and others.

The forthcoming XXI century is defined as an IT century, while the past XX century - century of electricity, where research, inventions and projects were connected with electricity in one way or another. This, in its turn, changed the world, dramatically changed the life of mankind and became the development basis for numerous new research trends.

Whatever the name of the oldest electrotechnical institute in Russia was-Engineering College of the Department of Post and Telegraph of Russia (1886), Electrotechnical Institute, Imperial Institute of Electrical Engineering, Electrical Engineering n.a. V.I. Ulyanov (Lenin), Leningrad Electrical Engineering n.a. V.I. Ulyanov (Lenin), Saint Petersburg State Electrotechnical University "LETI" n.a. V.I. Ulyanov (Lenin) - the notion "the first" is present throughout the history-record of the institute's development and within the titles and names of all research and technical disciplines, associated with electric engineering, radio engineering and electronics.

Electric engineering had to pave its way throughout Russia. The introduction of electricity began during the last decades of the XIX century. The development of electrical communication means gave the onset to a country-wide network of telegraphs and telephone lines. This resulted in a high demand of HR personnel and engineers. However, practically all electrical equipment and installation were produced in foreign companies or, in some cases, in a few Russian enterprises, where the employed engineers and technicians were also foreigners.

Working as an inspector of Postal & Telegraph Services in 1868-1886, the outstanding engineer in electrical communication means and public figure Nikolai Grigoreevich Pisarevskiy (1821-1895), justified the demand in the foundation of a special electrotechnical

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Building of ETL, 1903
(Photo by K. Bulla)

N.G. Pisarevskiy

education institution - Post and Telegraph Institute of Russia [1]. Although such an education institution – electrotechnical – did exist in the world, the new concepts in electric engineering, such as fundamental principles of physics, mathematical complexity in research problem-solving, determined the necessity of engineering training.

June 3 (15) 1886 – Emperor Alexander III adopted the Provisional Statute on the establishment of Engineering College of the Department of Post and Telegraph of Russia. This Status defined a 3-year training course and degree in engineering only after a 2-year internship [2].

September 4(16) 1886 the Engineering College of the Department of Post and Telegraph of Russia was inaugurated to be the first civil electrotechnical education institution in "training professional engineers for post and telegraph service".

The first five year results showed the essential demand in increasing the teaching period and expanding the curriculum and, thus, in June 11 (23), 1891 Emperor Alexander III adopted the Decree on the reformation of the Engineering College into the Electrotechnical Institute with a 4-year academic course and degree in electrical engineer after a 1-year internship.

At the end of the XIX century there was a progressive development in electric engineering, i.e. not only in telegraphy but also in telephone services. There was a further development of such spheres in Russia as electrical illumination, electrometallurgy, electric operation (traction), power distribution, electrical engineering. And in June 4 (16), 1899 the ETI was granted the status of higher education institution, including a 5-year academic course in training professionals of all electrical engineering [2].

In August 12 (24)1899 the institute was renamed into Imperial (Alexander III) Institute of Electrical Engineering, and in 1900 the graduates received the qualification of electrical engineer.

Graduates of St. Petersburg University - M.A. Shatelen and V.V. Skobeltsin as well as the first graduates of the Engineering College – P.S. Osadchiy and P.D. Voinarovskiy were the first professors in electrical engineering of ETI. Professor of St. Petersburg University I.I. Borgmann established the first Russian Department of Fundamental Principles in Electrical Engineering at ETI in 1891.

Library

A.S. Popov's telephone receiver

Study hall (2011)

To solve the problem of the development of new professional spheres and satisfy the high demand in such professionals, the State Council allocated resources and facilities, in view of contemporary requirements and the achievements in electrical engineering to construct new buildings for ETL on the Aptekarskiy Isle. The construction was based on the architecture project by A.N. Vekshinskiy, an instructor in architecture and construction course in ETI.

At the turn of the XIX and XX centuries ETI became the acknowledged center of electrical engineering and education in Russia. The most outstanding pioneers in electrical engineering and those who contributed to the establishment of the institute itself and furthered its future development as well as distinguished inventers from 1899 to 1903 were awarded the honorary title "electrical engineer". This title was awarded by the Academic Council of ETI and approved by the Secretary of State for Home Affairs in Russia. The following honored electrical engineers were awarded: N.N. Kachalov, I.A. Evnevich, D.A. Lachinov, I.I. Borgmann, N.G. Egorov, N.L. Kirpichev, N.N. Kormilev, A.A. Krakaya, A.I. Smirnov,E.P. Tveritinov, E.П. V.J. Florensov, N.N. Benardos, A. N. Lodigin, A.S. Popov, A.A. Voronov, K.F. Simens, M.O. Dolivo-Dobrovolskiy [2].

The director\rector in the face of a leading scientist and administrator played and plays an important role in the development and effective organization of this institute. The most striking pages in the history of the institute are connected with the first director of Engineering College and ETI - N.G. Pisarevskiy (1886 – 1895), N.N. Kachalov (1895 – 1905), first elected director Prof. A.S. Popov (1905), prof. P.D. Voynarocskiy (1906-1912), prof. N.A. Bikov (1912 – 1918), prof. P.S. Osadchiy (1918 – 1924), academician of Academy of Science, USSR G. O. Graftio (1924 – 1925), prof. A.A. Cmurov (1925 – 1929), prof. N.P. Bogoroditskiy (1954 – 1967), correspondent member of Academy of Science, USSR A.A. Vavilov (1968 – 1983), prof. O.V. Alekseev (1984– 1998), prof. D.V. Puzankov (1998– 2009).

And even during the difficult prewar – war - post-war period of our country's development (1929-1953), the institute staff toiled to solve the major problems of the country, mainly military defense. The Institute directors of this period were N.O. Shmuilovich (1929 – 1932), A.S. Aleksandrov (1932 – 1934), A.F. Shingarev (1934 – 1937), P.I. Skotnikov (1937 – 1954).

Students and the teaching staff of ETI always actively participated in the social and political life of Russia. This can be marked by the following facts: during the years of the first Russian revolution (1905) ETI became active Russian Social Democratic Labor Party nucleus; in 1918 the students of this institute appealed to the Government to award the Institute the name "Lenin", thus in November, 1918 in accordance with the Decree of People's Commissariat of Postal & Telegraph Services (P&TS) awarded ETI the name "V.I. Ulyanov (Lenin)".

At the beginning of the XX century the three basic application spheres of electricity – ELV electrical engineering (communication), high current electrical engineering (industrial electrical engineering and electrical energy) and electrochemistry were introduced as courses in ETI [3].

Head Department of Postal & Telegraph Services (HD P&TS) designed a policy in the development of electrical communication and postal services in Russia. The first domestic professionals in wire electrical communication were trained in ETI. At that time there was not another state institution in electrical engineering. During 1900-1918 the department heads and members of the ET committee of HD P&TS were mainly graduates and teaching staff of ETI. From 1904 to 1915 the assistant Director of HD P&TS was prof. Petr Semenovich Osadchi, head of the Telecommunication Department.

During these years HD P&TS put into operation thousands and thousands of kilometers of electrical telegraph and telephone communication lines, constructed powerful wireless telegraphy

A.S. Popov

stations, organized training courses for radiotelegraph professionals. ETI graduates, prof. V.I. Kovalenkov and P.A. Azbukin and their students established the fundamental principles of line telecommunications and solved the problem of multiplex telephony.

The fundamentals of radio engineering education were established by A.S. Popov and his predecessors' prof. A.A. Petrovskiy and N.A. Ckritskiy. Based on the ETI Academic Council decision, dated 24 October, 1916, a new curriculum "Radio-telegraph stations" was first introduced in Russia, i.e. it became the starting point in the training of radio technology engineers. In 1917 the supervisor of this school was the ETI graduate I.G. Freeman [4]. The transition from "spark and arc" to electrical bulbs as communication means for the navy was performed under the supervision of I.G. Freeman as well as projects in hydro-acoustic and underwater radio communication. His followers who developed their own scientific schools, were academicians A.I. Begr, A.N. Shukin, A.A. Kharkevich; correspondent members of the Academy of Science USSR S.Ja. Sokolov, V.I. Siforov, prof. B.V. Aseev, M.P. Dolukhanov,M.I. Kontorovich, G.A. K'jandskiy, V.N. Lepeshinskaya, S.I. Panfilov,E. G. Mo-

mot, E. Ja. Schegolev, A. F. Shorin and many others [3].

The development and initiation of power energy (energetics) in Russia is connected with the basis and development of the energetic trend in ETI. Here new scientific schools were organized by the professors: P.D. Voyanarovskiy, V.V. Dmitriev, G.O. Graftio, Ja. M. Gakkelja, I.V. Egiazarov, A.A. Smurov and others.

In 1904 the first Russian high-voltage (200000V) lab in a new building was equipped by prof. P.D. Voynarocskiy [5]. In 1910 the Volkhovskiy HPP (Hydro Power Plant) project was designed by G.O. Graftio. A significant contribution in the construction of the first thermal-hydroelectric power stations was made by the graduates of the above-mentioned schools. The electrical engineering school of ETI played an important role in the development of the methods and means of energy transmission, different power station projects and electric operation (railway and city transport).

Many professors and teaching staff, scientists and graduates of ETI participated in the electrification development plan of Russia (State Committee in Electrification of Russia). At the beginning of the XX century they developed a series of pioneer projects, becoming the foundations of HPP projects, which, in its turn, provided the possible development plan of State Committee in Electrification of Russia.

The electro-economic basis of the electricity-energy power supply of large industrial centers and electrification of industrial enterprises was developed by the ETI graduates- professors V.V. Dmitriev, S.A. Rinkevich, V.A. Timofeev and their students. Prof. A.A. Voronov and the ETI graduate prof. F.Ja. Kholujanov were the founders of the domestic school in electric machine engineering. Today's executives of "Electrosila" Plant, professors R.A. Luter, V.K. Goreleichenko, A.E. Alekseev, V.T. Kasjanov, M.I. Moskovskiy and others have developed powerful hydro-turbine generators for electrical stations, electrical machinery and motors for bloomers for gigantic metallurgical plants.

The development of domestic electrochemistry industry is connected with the names of such teachers and graduates of ETI as: academician N.S. Kurnakov, I.V. Grebenshikov, professors A.A. Krakay, N.A. Pushin, M.S. Maximenko. With in the four walls of the institute, the following engineering projects were developed: industrial methods in processing aluminum and manganese from domestic ore fields (1915) and optical glass.

The works and research of the 20's and 30's in the XX century was furthered in the works of above-mentioned scientists and reflected in different scientific school [3].

ETI graduate A.A. Smurov established a scientific school in high-voltage engineering and electric power transmission (1919) [6]. From 1932 one of the major research topic of this school was development of protection projects for overvoltage power systems Donenergo, Centrenergo, Uralenergo. A.A. Smurov followers- prof. G.T. Tretjak, V.I. Ivanov and their colleagues furthered the development of gigantic electrosystems with quick-response protection generators, transformers and power transmission lines.

The first department of electric operation, as a new trend in electrical engineering, (1922) was organized by prof. S.A. Rinkevich. On the basis of this department, other departments were established to solve electrification problems in different industrial areas. In 1927-1929 he founded the first Russian research laboratory in electric operation. On the basis of this, other labs were organized in LPI (1931), MEI (1934) and LIERT (1936). Prof. S.A. Rinkevich followers – A.V. Fadeev, G.V. Odintsov, A.V. Berendeev, B.I. Nornevskiy, A.V. Basharin founded their own scientific schools.

A new domestic scientific school- electric welding- arose within the four walls of the institute in the 20's. The most outstanding representatives of this

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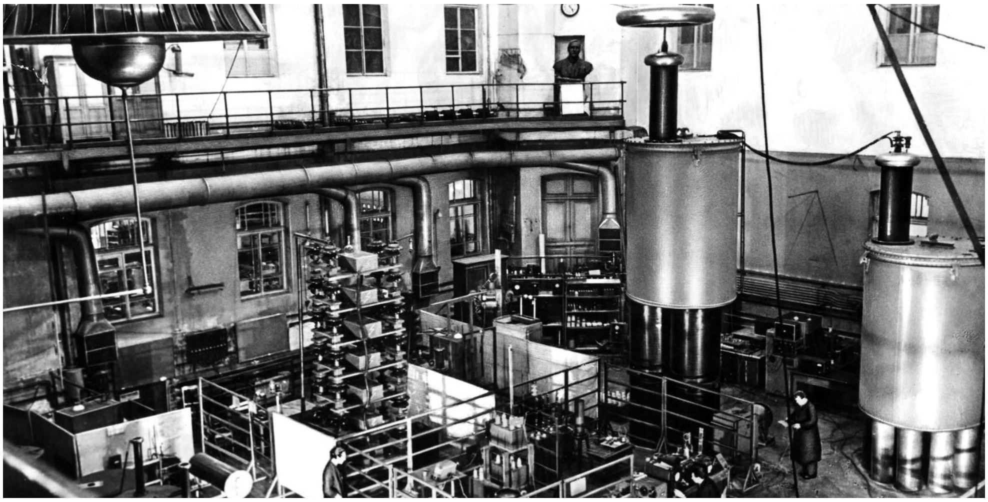


Largest high-voltage lab in Europe (prof. A.A. Smurov)

school were academicians AS USSR K.K. Khrenov and A.A. Alekseev.

Other examples of the first new profession in LETI were engineering acoustics and high-frequency electrothermics. Two trends in electric acoustics of the 20's and early 30's were established in LETI: broadcasting acoustic developed by prof. A.F. Shorin and ultrasonic vision, the Father who was the outstanding scientist, correspondent member of AS USSR S.Ja. Sokolov. In 1931 he established the Department of Electric Acoustics, which was a part of radio engineering. During these years the first ultrasonic defectoscope was designed at this department.

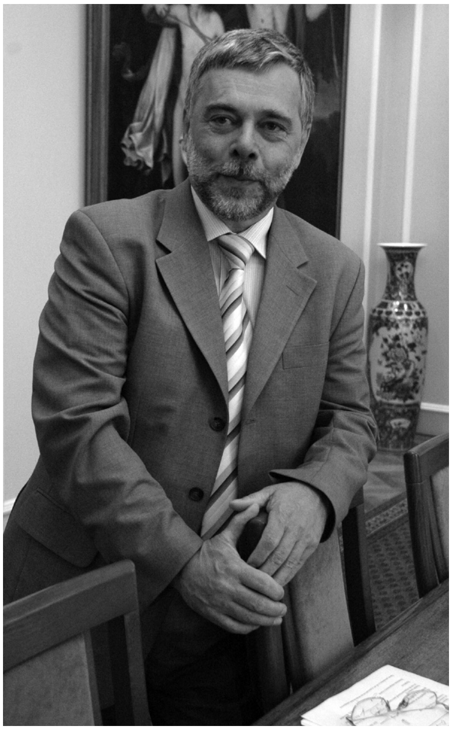
The development of electrothermics in LETI is connected with correspondent member of AS USSR V.P. Vologdin who had worked at this Institute from 1924. In 1935 he established a lab in high-frequency electro-engineering, which in 1947 was reorganized into Research Institute of High-Frequency Circuits, which, in its turn, furthered the development of a new profession – "High-Frequency Technology" under the supervision of V.P. Vologdin.

Development of radio engineering, technology and electrical energy involved the onrush of technology in a new industrial sphere-electrovaccum technology. The fundamental principles of this topic were described in the works of professors V.I. Kovalenko, S.I. Pokrovskiy and N.A. Skritskiy in 1913–1917. The supervisor of the first training electrovaccum lab was prof. in Physics M.M. Glagolev (1923). The facilitator of the Department of Electrovaccum Technology became prof. A.A. Shposhnikov in 1931. It is important to underline the fact that the engineer-technician personnel at the "Svetlana" Plant are graduates of LETI.

In the early 20's the first research in electrical insulating materials was conducted under the supervision of A.A. Smurov in the high-frequency lab at LETI. In the 30's the research was continued by N.P. Bogoroditskiy in the pilot projects of ceramic materials for radio technical devices. The establishment of the Department of Dielectric and Semi-Conductor Materials in 1946 by N.P. Borogoditskiy triggered as a powerful stimulus in the research development and significant organization stimulus in the academic process in radio material engineering and later, in microelectronics.

In 1930 the new specialty "Telecommunications" was introduced in LETI by professors V.I. Kovalenko and A.A. Skritskiy, and later another

Prof. S.A. Rinkevich in the lab of the first Department of electric operation in the world



Rector (2009) , Prof. V.M. Kutuzov

specialty "Automation and telecommunications" came into existence. In 1935 the Department of Automation and Telecommunications was organized and headed by prof. V.A. Timofeev. The major research spheres were automation of industrial processes, telecontrol of distant and complex objects, which, in its turn, furthered the development of several departments. Correspondent member of AS USSR A.A. Vavilov supervised this research area for many years.

In the early 30's the problem of the day was to equip and supply the army, navy and aviation with high-quality guidance computer artillery device systems, torpedo launchers and bombing sight. The first in the USSR department to train engineer-electricians in computer device systems was organized in February, 1931 in LETI – Department of Fire Control System Devices [4]. The first Head of this department was the navy engineer, graduate of this Institute, V.G. Naumov. Later similar departments were organized in such universities and institutes as LI TMO (1938) and MHTU n.a. N.E. Bauman (1939). This department was headed by engineer S.A. Izenbek, authority in mathematical instrument engineering. The Computing Technology Department which included from electrical engineering to electronics, from analog and digital-analog computer devices, machines and systems became the leading one in this sphere.

During 125-year history of ETI the following departments were established: telegraph, telecommunication, electric machinery, radio-technology, high-voltage technology, electro-welding, X-ray and electron-optical devices, hydro- and thermal electrical stations, hydroacoustics, ultrasonic defectoscope, automation, telecommunications, high-frequency electrothermics, computer engineering, electro-vacuum engineering, remote control systems, synchronous-tracking system and biomedical devices.

The first departments in the world were the Departments of Electric Operation (1922 – founder S.A. Rinkevich), Electro-Acoustic (1931 – founder S.Ja. Sokolov), High-Frequency Electro-thermics (1935 – founder V.P. Vologdin). Research in the spheres of ultrasonic defectoscope, ultrasonic imaging (1931- S. Ja. Sokolov), methods of induction heat treatment of metals and high-frequency electrothermics (1936- V.P. Vologdin) today have global priority.

A particular page in the history of the institute was the years of the Great Patriotic War. Practically 2000 students and teachers enrolled in the army and navy. Most of them defended Leningrad and many were toilers in many war cities, constructed defense lines, cleared debris, extinguished fires after bombardments [3].

In 1942 the Research People's Commissariat Bureau in Shipbuilding Construction was organized at LETI. The teaching staff under the supervisor of prof. S.A. Rinkevich, director of LETI, remained in the blockade city and participated in the blockade, executed all tasks of the Baltic Fleet command in the reinforcement of the air defense system, developed new materials and devices which could be used in different industries, military units, and hospitals. During the war years the headquarters and politic administration of the Baltic Fleet was located in LETI. Throughout the Blockade Days (from December 1941 to 1944) the director of the Institute P.I. Skotnikov was the Chairman of Petrograd District Executive Committee of Leningrad. Evacuated Research Labs under the supervision of V.P. Vologdin and S.Ja. Sokolov performed important tasks in improving armament. They were awarded wirh Stalin rewards for their contributions in science: prof. V.P. Vologdin for the development of high-frequency tank armor heat treatment technology; prof. S.Ja. Sokolov for methods and devices of non-destructive testing of military equipment by ultrasonics. Prof. N.P. Bogoroditski was also awarded with the Stalin Reward for his contribution in the development of high-frequency ultraporcelain radioceramics, which was used in military transmit-receive radio equipment.

More thousands of LETI-personnel were awarded medals and orders for their bravery, courageous labor and sacrificial contribution in the victory at Fascism.

During the first post-war years the Institute personnel reconstructed the buildings and different objects of the city. Students worked at different construction sites of agricultural structures, including Krasnobor Electrical Station.

At the same time the teaching and research processes were reorganized in accordance with the achievements in science-technology progress in different spheres-electronics, automation, computer engineering, instrument engineering, and atom energy. The creative atmosphere within LETI promoted not only furthered perspective research areas but also the development of new spheres as radio-electronics and cybernetics, electrification and industrial automation, high-frequency electrothermics, electrical technical materials, automatics and telecommunications, computer engineering, optical electronics and others. The birth of the atom industry involved an urgent demand in relevant engineers and the development of a modern system in training these engineers in several USSR institutes. In the first decades of 1947 the Department of Physics and Power Engineering was organized in LETI (dean- S.Ja. Sokolov), and existed up to 1951. This department showed a high training level in physics-mathematics. About 200 electrophysics engineers and electrical engineers graduated from this department. A number of executives in the atom industry finished this department (L.I. Nadporozhskiy, A.I. Il'in and others) [8].

In the early 1960s the scientists in LETI elaborated the following aspects: basic principles in nuclear spectrometry, development of devices for space research, and construction of a unique zero-gravity space station training facility. In the 1970s LETI was the first institution in the country to develop problem-solving industrial research labs, to establish a network of basic departments in large research enterprises, in a number of organizations AS USSR and research-and-production complexes. Graduates of LETI headed such major enterprises as: RPA "Altair", RPA "Svetlana", RPA "Pozitron", CRI "Avrora",CRI "Granit", Elektron, Russian Research Institute of Radio Design, Ltd. Co. "Plant n.a. Kozitski", RPA "Vector" and others [9].

In 1986 interacademic department of microelectronic technology of Ministry of Higher Education (from 1961 - Center of Microtechnology and Diagnostics) was established in LETI. Further it became a fundamental base for research projects and training of highly-qualified professionals in microelectronics. There was a gigantic development leap in the spheres of electronic, plasma, high-frequency and laser technology. Large-scale works in the spheres of flexible computerized manufacturing systems, robot technology, APS, automation, microprocessor technology and IT was executed at this Institute. The Institute participated in the sphere of high-thermal hyper-conductivity research [10].

LETI was awarded with Lenin Order (1966) and October Revolution Order (1986) for its contribution in the training of highly-qualified professionals and in RD (Research Development).

LETI, as the foremost institute in Russia, participated in the organization, establishment and development of daughter institutes (St. Petersburg State University of Telecommunications n.a. Prof. M.A. Bonch-Bruevich, Rjazan Radio Engineering Academy, Novgorod State University n.a. Jaroslav Mudriy, Penzen Polytechnic University, Vladimir Polytechnic University) and tens of departments in many cities of Russia.

The Institute's authority was acknowledged in the following facts: participation in the development of new engineering profile professions and the establishment of Institute Education and Methodics Association of the USSR in automation, electronics, micro-electronics and radio engineering on the base of LETI in 1987. Council chief of EMA was Rector of LETI, prof. O.V. Alekseev [10].

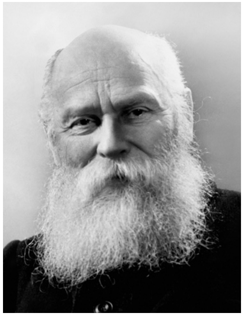
At the end of the 80s and the beginning of the 90s, not only engineering but also natural science, economic and humanitarian academic disciplines were introduced. In 1992 the Institute acquired the status of technical university and renamed St. Petersburg State Technical University "LETI n.a. V.I. Ulyanov (Lenin)" (SPSETU).

The crisis of the 90s turned over a new page in the understanding of reality. Administrations of institutes and other public organizations, establishments and departments began to see this reality in a new light, pragmatically evaluate all research results and, at the same time, were forced to search and find non-budgetary funding. An important funding source became different programs and grants, international scholarships, cooperative innovations. LETI reorganized its work to maximal use all possible new opportunities in solving the problems of HR training and RD.

Based on the agreement with Belgian partners – Catholic University Leuven, Catholic University de Louvain and Association "Universities-Industries" in 1990 the International Management School "LETI-Lovanium" was established in LETI (supervisor prof. A.E. Janchevski). This School promotes 1-year program : "Expert in business administration". Owing to the experience of the leading foreign professionals, the Scholl gained great reputation and established itself in the dominating rating among the Russian education institutions.

In 1991 the first Russian university Research Park (Technopark) was established in SPSETU, while in 1998- the first Russian innovative technological center, promoting the development of small enterprises and innovative university infrastructure complex. Technopark united 25 small and medium innovative


N.P. Bogoroditskiy


V.P. Vologdin


S.Ja. Sokolov

enterprises, producing high technology products. This Park also participates in European innovative projects and cooperates with foreign partners [10].

The University is one of the initiators and participants in the transfer of Russian institutions to a level-education system: in 1996 the graduates with Bachelor Degree; in 1998 Master Degree in Engineering and Technology. Tens of SPSETU personnel participated in the development project of higher professional education standards of the 1st, 2nd and 3rd generations.

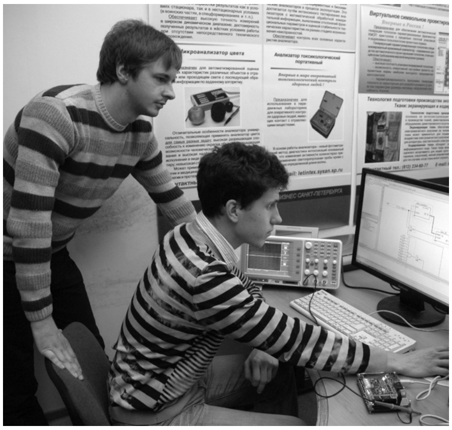
In 1999 there were 14 disciplines at 7 departments (full-time education): radio engineering and telecommunications, electronics, IT and informatics, electrical engineering and automation, measuring-information and biotechnological systems, management, humanitarian, as well as, open curriculum and further training and professional departments established in the Institute.

In 1998 SPSETU in cooperation with Ugorsk (Khanty-Mansi Autonomous Territory) administration and core company "Tumentransgas" opened a new affiliated institution with a 2-year uniform higher education professional program (director- A.G. Klikov). Due to the two-sided cooperative efforts of the partners, this institution has become not only well-known all over the country but also the best education center in Western Siberia with an excellent material and technical base. At the same time our Institute has a constant inflow of 3-year students from different department of this institution.

At the turn of the 21st century the hard days of the crisis were left behind. This can be highlighted in the following three major factors- increase in funding, growth demand in professionals for high-technological enterprises and research project institutes, volume increase in research contracts and pilot design and experimental projects. A significant contribution in the development of above-mentioned factors was Microtechnology and Diagnostics Center (director- prof. V.V. Luchinin), establishment of Research Lab in radio systems and Signal Processing (2002) and reorganization of RI Radio Engineering and Telecommunications (2010: executive- prof. V.N. Ushakov).

In 2001 the University in cooperation with more than 40 St. Petersburg organizations designed target-oriented program "Strategic partnership", including mutual profitable and integrated partnership in the spheres of science, research, innovation and education [11].

The strategic partners are: LtD. "Avangard", FSUE RRI "Vector", LtD. "Svetlana", LtD. "Inteltech", LtD. "Concern CRI Electropribor", LtD. RRI "Radar mms", LtD. "Russian Institute of Radio Design", FSUE "Research Institute of Transport", CJSC "Roseelectroprom Holding", LtD. "Power Machines", LtD. "Concern RPA Avrora", LLC "Simens", CJSC "St Petersburg Motorola", CJSC "EleSi", FSUE "RRI Control Devices", FSUE Production Engineering Design Office "Biophispribor", FSUE "RRI of HFC", LtD. "Chemical Enterprise Leninets", LtD. "LOMC", Ioffe Physi-



System-on-chip Lab

Microprocessor System Lab

Nanotechnology center

cal-Technical Institute of the Russian Academy of Sciences, St.Petersburg Institute of Informatics and Automation of RAS and others.

During the last 10 years the successful development and dynamic progress of above-mentioned program was determined by the widely-distributed experience of SPSETU in the system of higher professional education in Russia. The growing integration between universities, enterprises and other education institutions resulted in the organization of a research-education syndicate of higher and technical professional education, hi-technology enterprises, research and project organizations in St. Petersburg (2009) - “Corporate Institute of Research and Continuous Education in radio-electronics, instrument engineering, communication tools, inform-telecommunications”.

The problem-solving dimension and complexity, including teamwork of university-enterprise-organization, increasing resources and temporary solution parameters, predetermined the necessity to use strategy planning methods within the management system of SPSETU.

University development strategy plan 2001-2005 was based on an innovation development model, which in its turn, furthered the development of an innovative university complex, uniting all research institutes, technoparks, innovation-technology centers and small innovation enterprises.

University development strategy plan 2006-2010 involved the development of the institute as a research entrepreneurial university, providing practical contribution in the economic development of the region and core enterprises. All this is based on priority development of fundamental and applied sciences, systematic integration with research organizations and core enterprises and international partnership in education and RD.

During the period the university personnel and staff performed a series of large system projects “Federal Target Program of Education Development”

(FTPED), target programs: "Development of Nanoindustry Infrastrcuture RF: 2008-2010", "Training of Scientific and Pedagogical HR in Innovative Russia: 2009-2013".

Twenty large-scale research-methodological projects were conducted in accordance with Ministry of Education RF mission: concept project of organization-methodological base for multi-level higher professional education system and development of state education standards of HPE of the first, second and third generation. In SPSETU the implementation of these projects included the transition of the University to the multi-level education system oriented on large-scale professional oriented training of Master degree students together with the strategies of partners and major employers.

SPSEU is one of the base universities - executors of the target-oriented program "Training and retraining of HR for hi-technology enterprises in St. Petersburg: 2007-2009". During these years the University trained more than 150 students from special purpose entity and retrained more than 300 employers from enterprises.

The University significantly contributed to the development of the Quality Management System in training professionals for Russian institutes, which included the design and implementation of standard model of QMS in RF education establishments. In accordance with the decision of the Federal Supervision Agency for Education and Science the Interacademic Center headquarters to implement standard model of QMS in RF education establishments on the base of SPSEU.

Within the framework of the FTPED "Infrastructure Development of RF Nano-industry: 2008-2010" several projects were implemented and within the national nano-technology network, the research center "Nano-technology in Security System" was developed.

During the first decade of the XXI century the systematic and complex progress of SPSEU forwarded it to be one of the leading scientific-education and innovative centers in Russia. This is endorsed in the fact that the University was the winner in the competition of innovative education programs –Priority national project "Education" (2007-2008). The implementation of this project resulted in principal innovative changes in the teaching process and research development, accelerated intelligent potential progress and expansion of university material and technical base. The results of this project included the following: 30 new academic programs for Master Degree, and 15 for post-graduates, more than 50 sophisticated equipped research labs, centers and specialized rooms, modernization of corporate information computer network, reconstruction of library, establishment of room-base videoconferencing, design of all standards, methodological and information facilities, and more than 1000 University instructors and personnel improved their qualifications in large education and research centers in Russia and other countries. SPSEU stepped towards the transformation of the university into a modern competitive university within the framework of the Russian and global market of research and education activities.

J.I. Alferov

St. Petersburg Technical Trade Fair Laureates O.I. Bureneva and N.M. Safjannikov

Control Unit for landing runway Engineering project of department ACS

Lab of Marine Control Systems

Today more than 1600 students graduate from this University annually. There are about 10 000 students, post-graduates and trainees, among which, approximately 1000 Master students. Professorship – instructor staff include 1100 teachers, among which 8 members of the Russian Academy of Science, 20 laureates of national and international rewards, more than 200 professors and PhD in Science and about 600 candidates.

Personnel professional training is conducted in 42 areas: 27 engineering, 6 natural sciences and 9 humanitarian. Annually, 80 students finish the post-grad- uate studentship. In the university there are 9 Dissertation Council in 24 research areas.

SPSEU is active in the global market of education services: foreign partners from 44 universities of Europe, Asia and USA. From 1952 to 2010 the University trains about 4000 engineers, candidates and professors for 95 world countries and there are about 400 foreign students studying in this University.

Nowadays the University trains Bachelor and Master Degree students and engineers in 100 education programs within the framework of 14 education areas.

There is Institute of RD in education, 4 research institutes: Research, Design and Technology Institute in Biotechnological systems, Research, Design and Technology Institute in Modeling and Intellectualization of Complex Networks, Research, Design and Technology Institute in Radio-electronic Systems Forecasting Emergency Situations and Research, Design and Technology Institute in radio-engineering and Telecommunications.

During the 125 years of the existence of SPSEU, "LETI" about 100 000 students graduated from this University, including 4000 graduates from 95 foreign countries. How different was the fate of either! Most of them became highly-qualified professionals making considerable contributions in the development of Russia and other countries. We are proud of the outstanding graduate Zh. I. Alferov, Nobel laureate in physics 2000 as well as many other significant scientists, executives of different enterprises and research institutes, chief design engineers. We also acknowledge those graduates for their professionalism in different spheres of economy, defense potential, and science.

REFERENCES (ALL TITLES IN RUSSIAN)

1. Zolotinkina L.I. Nikolai Grigorevich Pisarevskiy – organizer and first director of ElectroTechnical Institute. Izvestiya SPSEU "LETI", series "History of science, education and technology", №1, 2003. – 28-33 p.
2. 25 years of the Imperial Electrotechnical Institute 1886 – 1911// N.I. Evstifev Typolithography, 1914. – 582 p.
3. Leningrad Electrotechnical Institute n.a. V.I. Ulyanov (Lenin) 1886 - 1961// Izvestiya LETI, Publishing House Leningrad University, 1963. – 412 p.
4. Zolotinkin L.I., Shoshkov E.N. Imant Geogrievich Freemann / L. Nauka. 1989. – 144 p.
5. Bocharova M.D. Outstanding Public Figure in electro-engineering education P.D. Voynarovskiy - Works in Technology History. Articles of the First Conference in History of Technology. – Publishing House AS USSR. 1953. Vol. 6. – 85-97 p.
6. Davidova L.G. Aleksandr Antonovich Smurov. - M. Nauka.1974. – 135 p.
7. Puzankov D.V., Smolov V.B. Department of computer technology on the threshold of 70s. Department of computer technology// Pub. House SPSEU "LETI". 1999. – 33 p.
8. Vinokurov V.I. Training Engineers in LETI in atom energy // Pub.House SPSEU "LETI". Series: History of science, education and technology. 2000. Vol. 1. – p. 7
9. Vinokurov V.I., Puzankov D.V. Academy of Science - 275 Anniversary // Pub.House SPSEU "LETI". Series: History of science, education and technology. 1999. – p. 101
10. Development of University Complex: Traditions and Innovations// Ed. by prof. D.V. Puzankov of SPU: Pub. House SPSEU "LETI". 2004. – 304 p.
11. Strategies in partnership between universities and enterprises.// Ed. by prof. D.V. Puzankov. CJSC «Insanta». SPU, 2008. – 192 p.

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Summary

AXIOLOGY OF ENGINEERING, OR WHY WE HAVE THE CRISIS OF ENGINEER EDUCATION.

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The paper is devoted to finding out the causes of the crisis in engineer's education. According to the authors opinion these causes are of the «world-system» character and are determined by the being essence of the moral human autonomy. The authors see overcoming in the modeling of praxis of social justice in the education process. We have specially noted the meaning of creating an interdisciplinary modul, the main goal of which is humanitarization of engineer's education.

NEGATIVE INFLUENCE OF THE FORMALISM OF KNOWLEDGE OF STUDENTS AT FORMATION OF ENGINEERING THINKING

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In article signs which should possess modern successful the engineer are considered. Problems of formation of engineering thinking of students are allocated, the reasons of occurrence of a formalism of knowledge of students are established, the basic ways of integration fundamental and professional knowledge for the purpose of overcoming of a formalism of knowledge and a problem of its formation are considered.

A LEARNING ORGANIZATION THEORY BASED VIEW AT THE TRANSITION OF THE RUSSIAN ENGINEERING UNIVERSITIES TO THE «BACHELOR- MASTER» SYSTEM OF EDUCATION

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Transition of the Russian engineering universities to the «Bachelor- Master» system of education is analyzed in this paper. Specific approach based on the learning organization theory was used for the analysis. It is shown that many challenges arising by this transition are caused by singularity of new system for employers and by their reluctance to change existing opinion regarding quality of the university graduates rather than by changing the real quality of the engineering education. Some ways for coping with those challenges are proposed.

FORMATION OF INNOVATIVE INFORMATION - DUCATIONAL ENVIRONMENT FOR STUDYING TECHNICAL SUBJECTS

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The article deals with creating and implementing the educational process of higher education institution of information - an educational environment that would use not only of modern information technology such as electronic textbooks, educational portals, but also innovative methods of distance education, organizational - methodical means of a set of technical and software for storing, processing, transmission of information, providing quick access to educationally relevant information and create an opportunity for communication of students and teachers.

THE TOOL FOR ASSESSMENT AND SELF-ASSESSMENT OF UNIVERSITY TEACHERS ON THE BASE OF COMPETENCY MODEL

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Using the competency model as an alternative way of assessment and self-assessment of university teachers is suggested. The methodology of model's construction is given and the problems of the model's development and using are indicated. Example of self-assessment and competency-profile construction is presented.

ENGINEERING ECONOMY – A WAY TO BUSINESS DEVELOPMENT IN ENGINEERING

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In article approaches to business development in engineering on the basis of high technologies are described. Necessity of formation engineering-economic centers as subjects of modernization of engineering education and gradual transition to innovative business are described. Methods of technological marketing as toolkit to formation of market approaches in engineering and to perfection of a regional innovative policy are described.

SPECIALIZING QUALITY MANAGEMENT EDUCATIONAL PROGRAMS DEVELOPMENT FOR HIGH TECHNOLOGY INDUSTRIES

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Some problems of training for science-intensive industries due to the introduction of the federal state educational standards. Justifies the need to prepare variability within one profile to take into account regional and professional characteristics of staff in the field of quality.

IMPROVEMENT OF EDUCATION QUALITY MODELS ON THE BASIS OF INDEPENDENT PUBLIC AND PROFESSIONAL EXPERTISE

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Improvement and dissemination of education quality models is more appropriate on the basis of independent public and professional expertise development in educational field.

THE ACCREDITATION CENTRE OF THE ASSOCIATION FOR ENGINEERING EDUCATION OF RUSSIA EXPERTS' COMPETENCES MODEL

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Indicators and characteristics of the AEER AC experts' competences were regarded in the article.

THE COMPETENCES OF BACHELORS AND MASTERS WITH THE REQUIREMENTS OF PROFESSIONAL STANDARDS

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In article are considered questions of development of scientific-methodical provision of the approval processes competences of bachelors and masters with the requirements of possible forms of their professional activity.

MODERNIZATION OF EDUCTIONAL COMPLEX «ELECTRICAL CIRCUITS» AT NRNU MEPHI

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A new situation has emerged in electrical engineering that is related to modern informational technology applications. In turn, the necessity of changing the «Electrical Circuits» discipline arose. A modernization paradigm was suggested. The forms and techniques of operation in new conditions were determined. The technical base, which included informational technologies, was developed and the fulfillment of the educational space was started.

FORMATION SCIENTIFIC AND PEDAGOGICAL MAGISTER'S COMPETENSE DIRECTIONS «DESIGNING AND TECHNOLOGY OF ELECTRONIC MEANS»

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Formation scientific and pedagogical magister's competense in the field of designing and technology of electronic means is considered. One of variants of the effective organisation of pedagogical preparation magister's technical college to performance of is professional-pedagogical functions is offered.

EDUCOLOGY OF ENGINEERING EDUCATION: BASICS POSTULATES OF SYSTEMS ENGINEERING

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The Newness of situation with world system of Engineering Education (EE) in the beginning of XXI century is determined by legislative introducing in practice of international standards EE. These standards have to be universal tools for intensification of attack on well – known phenomena – Educational Gap. In order to get successfully the goals of modernization EE there is a need to accomplish international standards EE by general theory – educology EE. Basic postulates of Educology EE are introduced in following article.

SHERLOCK HOMES AND THIRD GENERATION EDUCATIONAL STANDARDS

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In order to provide training of modern engineers with sufficient economical and cultural competences according to state standards of the third generation without changing the structure and content of the study plans is quite problematic. The development of the competence-based model of a graduate which will serve as a basis for block-module study plan for the purposeful competences formation is one of the solutions.

THE FIRST ELECTROTECHNICAL INSTITUTE ON THE EVE OF ITS 125 ANNIVERSARY

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The paper presents the history of foundation and development of St. Petersburg State Electrotechnical University "LETI", the oldest in Europe school of higher learning in the field of Electrical Engineering and one of the leading technical universities in the country which celebrates its 125th anniversary this year. The role of outstanding academicians and researchers who worked or are working now for the University in developing new scientific areas and achieving the world and national priority is shown.

List of AEER Accredited Programmes

Non-commercial Association for Engineering Education of Russia (AEER) has been actively involved in the development and improvement of the professional accreditation system for more than 10 years. Since 2007 it has conducted national professional accreditation of educational programs in accordance with both the accreditation standards for engineering programs applied in European higher education establishments and the criteria approved by the member-countries of the Washington Accord.

Seven national agencies which have introduced their own accreditation criteria in accordance with the existing standards possess the right to assign European quality mark EUR-ACE Label (European Accredited Engineer) to the educational programs. These are the agencies ASIIN (Germany), CTI (France), IEI (Ireland), OE (Portugal), ECUK (Great Britain), RAEE (AEER, Russia) and MUDEK (Turkey).

In 2009, AEER entered the international market and first educational programs of higher educational establishments in the Republic of Kazakhstan were accredited.

147 educational programs of Russian and Kazakh higher educational establishments, with 66 educational programs being awarded EUR-ACE Label have been accredited by 01.11.2010.

The list of the accredited programs approved by AEER is given below.

List of Accredited Programmes, Russian Federation (as of 01.06.2011)

	Program Code	Qualification	Program Name	Certificate	Accreditation Period
Altai State Technical University named after I.I. Polzunov					
1.	100400	INT	Electrical Supply	AEER	1997-2002
2.	120100	INT	Mechanical Engineering Technology	AEER	1997-2002
3.	120500	INT	Welding Equipment and Technology	AEER	1997-2002
4.	150900	FCD	Technology, Equipment and Automation of Mechanical Engineering Productions	AEER	2003-2008
Ivanovo State Power University					
1.	140404	INT	Nuclear Power Plants and Installations	AEER EUR-ACE®	2009-2014
2.	210106	INT	Industrial Electronics	AEER EUR-ACE®	2009-2014
Irkutsk State Technical University					
1.	130100	INT	Aircraft and Helicopter Construction	AEER	2004-2009
2.	250400	INT	Chemical Engineering of Natural Power Supplies and Carbon-base Materials	AEER	2004-2009
Kazan State Technical University named after A.N. Tupolev					
1.	150600	FCD	Science and technology of new materials	AEER EUR-ACE®	2011-2016
2.	160100	FCD	Aircraft construction and rocket production	AEER EUR-ACE®	2011-2016
3.	230100	FCD	Computer science	AEER EUR-ACE®	2011-2016
Kazan National Research Technological University					
1.	240100	FCD	Chemical Technology and Biotechnology	AEER	2004-2009
Krasnoyarsk State Technical University					
1.	200700	INT	Radio Engineering	AEER	1997-2002
2.	220100	INT	Computers, Systems and Networks	AEER	1997-2002
3.	210302	INT	Radio Engineering	AEER	2003-2008
Komsomolsk-on-Amur State Technical University					
1.	140600	FCD	Electrical Engineering, Electromechanics and Electrical Technology	AEER	2005-2010
2.	140601	INT	Electromechanics	AEER	2005-2010
3.	140604	INT	Electrical Drives and Automated Industrial Sets and Engineering Systems	AEER	2005-2010
Moscow State Technological University "Stankin"					
1.	120100	INT	Mechanical Engineering Technology	AEER	1993-1998
2.	120200	INT	Metal-cutting Machines and Tools	AEER	1993-1998
3.	120400	INT	Machines and Metal Forming Technology	AEER	1993-1998
4.	210200	INT	Automation of Technological Processes and Manufacturing	AEER	1993-1998
5.	210300	INT	Robots and Robotic Systems	AEER	1993-1998
6.	220300	INT	Automated Production Systems	AEER	1993-1998

Moscow State Mining University					
1.	090400	INT	Mine and Underground Construction	AEER	1996-2001
2.	090500	INT	Open-pit Mining	AEER	1996-2001
3.	130408	INT	Mine and Underground Construction	AEER EUR-ACE®	2010-2015
Moscow State University of Applied Biotechnology					
1.	070200	INT	Low Temperature Physics and Technology	AEER	1996-2001
2.	170600	INT	Food Production Machines and Devices	AEER	1996-2001
3.	210200	INT	Automation of Technological Processes and Manufacturing	AEER	1996-2001
4.	250600	INT	Plastic and Elastoplastic Processing Technology	AEER	1996-2001
5.	270900	INT	Meat and Meat Products Technology	AEER	1996-2001
6.	271100	INT	Milk and Dairy Products Technology	AEER	1996-2001
Moscow State Institute of Radio Engineering, Electronics and Automation (Technical University)					
1.	210302	INT	Radio Engineering	AEER	2004 -2009
2.	220402	INT	Robots and Robotic Systems	AEER	2005-2010
3.	200203	INT	Optoelectronic Devices and Systems	AEER	2005-2010
4.	220401	INT	Mechatronics	AEER	2005-2010
5.	210104	INT	Microelectronics and Solid State Electronics	AEER EUR-ACE®	2005-2015 *
6.	230105	INT	Computer Technology and Automated Systems Software	AEER	2005-2010
7.	230201	INT	Information Systems and Technologies	AEER	2005-2010
8.	230101	INT	Computers, Systems and Networks	AEER EUR-ACE®	2008-2013
9.	200200	FCD	Optical Engineering	AEER EUR-ACE®	2010-2015
10.	210300	FCD	Radio Engineering	AEER EUR-ACE®	2010-2015
Moscow Institute of Electronic Technology (Technical University)					
1.	210100	FCD	Electronics and Microelectronics	AEER	2003-2008
2.	230100	FCD	Computer Science	AEER	2003-2008
Moscow Power Engineering Institute (Technical University)					
1.	140600	FCD	Electrical Engineering, Electromechanics and Electrical Technology	AEER	2005-2010
2.	140602	INT	Electrical and Electronic Machines	AEER EUR-ACE®	2007-2012
3.	140604	INT	Electrical Drives and Automated Industrial Sets and Engineering Systems	AEER EUR-ACE®	2007-2012
4.	140609	INT	Electrical Equipment for Aircraft	AEER EUR-ACE®	2007-2012
5.	140611	INT	Insulators, Cables and Capacitors	AEER EUR-ACE®	2007-2012
6.	140403	INT	Technical Physics of Thermonuclear Reactors and Plasma Installations	AEER EUR-ACE®	2010-2015
“MATI” -Russian State Technological University					
1.	190300	INT	Aircraft instruments, Measuring and Computing complexes	AEER	1996-2001

2.	110400	INT	Foundry of Ferrous and Non-ferrous Metals	AEER	1996-2001
3.	110500	INT	Metal Science and Thermal Treatment of Metals	AEER	1996-2001
4.	110700	INT	Welding Metallurgy	AEER	1996-2001
National University of Science and Technology «MISIS»					
1.	150101	INT	Metallurgy of Ferrous Metals	AEER	2004-2009
2.	150105	INT	Metal Science and Thermal Treatment of Metals	AEER	2004-2009
3.	150601	INT	Science and Technology of New Materials	AEER	2004-2009
4.	150400	FCD	Metallurgy of Ferrous Metals	AEER EUR-ACE®	2011-2016
Samara State Aerospace University					
1.	160301	INT	Aircraft Engines and Power Plants	AEER EUR-ACE®	2008-2013
2.	160802	INT	Spasecraft and Rocket Boosters	AEER EUR-ACE®	2008-2013
Saint Petersburg Electrotechnical University "LETI"					
1.	220200	FCD	Automation and Control	AEER	2003-2008
2.	210100	FCD	Electronics and Microelectronics	AEER	2003-2008
3.	230100	FCD	Computer Science	AEER	2003-2008
4.	200300	FCD	Biomedical Engineering	AEER	2003-2008
Siberian Federal University					
1.	210200	SCD	Microwave Equipment and Antennas	AEER EUR-ACE®	2010-2015
2.	230100	SCD	High-Performance Computing Systems	AEER EUR-ACE®	2010-2015
Taganrog Institute of Technology of Southern Federal University					
1.	210100	FCD	Electronics and Microelectronics	AEER	2003-2008
2.	230100	FCD	Computer Science	AEER	2003-2008
3.	230100	FCD	Computer Science	AEER EUR-ACE®	2010-2015
4.	220200	FCD	Automation and Control	AEER EUR-ACE®	2010-2015
Tambov State Technical University					
1.	210201	INT	Design and Technology of Radioelectronic Devices	AEER	2006-2011
2.	140211	INT	Electrical Supply	AEER	2006-2011
Togliatty State University					
1.	140211	INT	Electrical Supply	AEER EUR-ACE®	2009-2014
2.	150202	INT	Industrial Welding Technology and Equipment	AEER EUR-ACE®	2009-2014
3.	151002	INT	Mechanical Engineering Technology	AEER EUR-ACE®	2009-2014
Tomsk Polytechnic University					
1.	071600	INT	High Voltage Engineering and Physics	AEER	1996-2001
2.	080200	INT	Geology and Prospecting of Mineral Resources	AEER	1996-2001

3.	180100	INT	Electromechanics	AEER	1996-2001
4.	200400	INT	Industrial Electronics	AEER	1996-2001
5.	210400	INT	Applied Mathematics	AEER	1996-2001
6.	250900	INT	Chemical Engineering of Modern Energetic Materials	AEER	1999-2004
7.	250800	INT	Chemical Engineering of Refractory Non-Metal and Silicate Materials	AEER	2000-2005
8.	070500	INT	Nuclear Reactors and Power Plants	AEER	2000-2005
9.	220100	INT	Computer Science	AEER	2000-2005
10.	100500	INT	Thermal Power Plants	AEER	2000-2005
11.	101300	INT	Boiler and Reactor Engineering	AEER	2000-2005
12.	230100	FCD	Computer Science	AEER	2003-2008
13.	140600	FCD	Electrical Engineering, Electromechanics and Electrical Technology	AEER	2003-2008
14.	140601	INT	Electromechanics	AEER	2004-2009
15.	140604	INT	Electrical Drives and Automated Industrial Sets and Engineering Systems	AEER	2004-2009
16.	230101	INT	Computers, Systems and Networks	AEER	2004-2009
17.	020804	INT	Geoecology	AEER	2004-2009
18.	130100	FCD	Geology and Prospecting of Mineral Resources	AEER	2005-2010
19.	200106	INT	Measurement Devices and Technologies	AEER EUR-ACE®	2007-2012
20.	200203	INT	Opto-Electronic Equipment and Systems	AEER EUR-ACE®	2007-2012
21.	240304	INT	Chemical Engineering of Refractory Non-Metal and Silicate Materials	AEER EUR-ACE®	2007-2012
22.	240901	INT	Biotechnology	AEER EUR-ACE®	2008-2011
23.	140200	FCD	Electrical Power Engineering	AEER EUR-ACE®	2008-2013
24.	150917	SCD	High-technology Physics in Mechanical Engineering	AEER EUR-ACE®	2008-2013
25.	230100	FCD	Computer Science	AEER EUR-ACE®	2008-2013
26.	140600	FCD	Electrical Engineering, Electromechanics and Electrical Technology	AEER EUR-ACE®	2008-2013
27.	140200	SCD	High Voltage Engineering and Physics	AEER EUR-ACE®	2010-2015
28.	130100	SCD	Groundwater Resources Formation and Composition	AEER EUR-ACE®	2010-2015
29.	150900	FCD	Technology, Equipment and Automation of Mechanical Engineering Productions	AEER EUR-ACE®	2011-2016
30.	220301	INT	Automation of Technological Processes and Manufacturing (Gas and Oil field)	AEER EUR-ACE®	2011-2016
31.	210100	SCD	Physical Electronics	AEER EUR-ACE®	2011-2016
32.	140200	SCD	Mode Control of Electric Power Systems	AEER EUR-ACE®	2011-2016
33.	140400	SCD	Electrical Drives and Electrical Drive Control Systems	AEER EUR-ACE®	2011-2016

34.	200100	SCD	Stabilization and Navigation Systems	AEER EUR-ACE®	2011-2016
35.	130500	FCD	Petroleum Engineering	AEER EUR-ACE®	2011-2016
36.	130500	SCD	Geologic-geophysical Problems of Oil and Gas Field Development	AEER EUR-ACE®	2011-2016
Trekhgorny Technological Institute					
1.	230101	INT	Computers, Systems and Networks	AEER	2004-2007
Tyumen State Oil and Gas University					
1.	130501	INT	Design, Construction and Operation of Gas and Oil Pipelines and Storage Facilities	AEER	2006-2011
2.	130503	INT	Development and Exploitation of Oil and Gas Fields	AEER	2006-2011
3.	130504	INT	Oil and Gas Drilling	AEER	2006-2011
4.	190601	INT	Automobiles and Transportation Facilities	AEER	2007-2012
5.	190603	INT	Transport and Technological Machinery and Equipment Service (oil and gas production)	AEER	2007-2012
6.	190701	INT	Transportation Organization and Transport Management (automobile transport)	AEER	2007-2012
7.	130602	INT	Oil and Gas Fields Machinery and Equipment	AEER EUR-ACE®	2008-2013
8.	150202	INT	Industrial Welding Technology and Equipment	AEER EUR-ACE®	2008-2011
9.	190205	INT	Lifting, Transportation Means and Road Machines	AEER EUR-ACE®	2008-2013
10.	240401	INT	Chemical Technology of Organic Substances	AEER EUR-ACE®	2009-2014
11.	240403	INT	Chemical Engineering of Natural Power Supplies and Carbon-base Materials	AEER EUR-ACE®	2009-2014
12.	240801	INT	Machines and Apparatus of Chemical Production	AEER EUR-ACE®	2009-2014
13.	280201	INT	Environmental Control and Rational Use of Natural Resources	AEER EUR-ACE®	2010-2015
14.	280102	INT	Safety of Technological Processes and Productions	AEER EUR-ACE®	2010-2015
15.	120302	INT	Land cadastre	AEER EUR-ACE®	2010-2015
Ural State Forest Engineering University					
1.	270205	INT	Automobile Roads and Aerodromes	AEER	2006-2011
Ural State Technical University					
1.	240302	INT	Technology of Electrochemical Productions	AEER EUR-ACE®	2008-2013
Ufa State Aviation Technical University					
1.	280200	FCD	Environment Protection	AEER	2005-2010
2.	230100	FCD	Computer Science	AEER	2005-2010
3.	150501	INT	Material Science in Mechanical Engineering	AEER	2005-2010

4.	280200	SCD	Environment Protection	AEER EUR-ACE®	2008-2013
Ufa State Petroleum Technological University					
1.	130504	INT	Oil and Gas Drilling	AEER EUR-ACE®	2007-2012
2.	130603	INT	Oil and Gas Processing Equipment	AEER EUR-ACE®	2007-2012
3.	150400	FCD	Processing Machinery and Equipment	AEER EUR-ACE®	2007-2012
4.	240100	FCD	Chemical Engineering and Biotechnology	AEER EUR-ACE®	2008-2013
5.	240403	INT	Chemical Engineering of Natural Power Supplies and Carbon-base Materials	AEER EUR-ACE®	2008-2013
6.	130602	INT	Oil and Gas Fields Machinery and Equipment	AEER EUR-ACE®	2008-2013
7.	130501	INT	Design, Construction and Operation of Gas and Oil Pipelines and Storage Facilities	AEER EUR-ACE®	2009-2014
8.	551830	SCD	Equipment Design Theory for Oil and Gas Processing, Petrochemical and Chemical Production	AEER EUR-ACE®	2010-2015
9.	551831	SCD	Technological Systems and Equipment Reliability	AEER EUR-ACE®	2010-2015
10.	550809	SCD	Chemical Engineering of Fuel and Gas	AEER EUR-ACE®	2010-2015

List of Accredited Programs, Republic of Kazakhstan (as of 01.06.2011)

D. Serikbayev East Kazakhstan State Technical University (Ust-Kamenogorsk, Republic of Kazakhstan)					
1.	050703	FCD	Information Systems	AEER EUR-ACE®	2011-2016
2.	050713	FCD	Transport, Transport Facilities and Technology	AEER EUR-ACE®	2011-2016
L.N. Gumilyov Eurasian National University (Astana, Republic of Kazakhstan)					
1.	050702	FCD	Automation and Control	AEER EUR-ACE®	2011-2016
2.	050732	FCD	Standardization, Metrology and Certification	AEER EUR-ACE®	2011-2016
3.	050901	FCD	Organization of Transportation, Traffic and Operation	AEER EUR-ACE®	2011-2016
4.	6N0702	SCD	Automation and Control	AEER EUR-ACE®	2011-2016
5.	6N0732	SCD	Standardization, Metrology and Certification	AEER EUR-ACE®	2011-2016
6.	6N0901	SCD	Organization of Transportation, Traffic and Operation	AEER EUR-ACE®	2011-2016
Innovative University of Eurasia (Pavlodar, Republic of Kazakhstan)					
1.	050701	FCD	Biotechnology	AEER EUR-ACE®	2010-2015
2.	050718	FCD	Electrical Power Engineering	AEER EUR-ACE®	2010-2015

Kazakh National Technical University named after K.I. Satpaev (Almaty, Republic of Kazakhstan)					
1.	050704	FCD	Computer Science and Software	AEER EUR-ACE®	2010-2015
2.	050711	FCD	Geodesy and Cartography	AEER EUR-ACE®	2010-2015
3.	050712	FCD	Mechanical Engineering	AEER EUR-ACE®	2010-2015
4.	050718	FCD	Electrical Power Engineering	AEER EUR-ACE®	2010-2015
5.	050723	FCD	Technical Physics	AEER EUR-ACE®	2010-2013
6.	050713	FCD	Transport, Transport Facilities and Technology	AEER EUR-ACE®	2011-2016
7.	050716	FCD	Instrumentation Engineering	AEER EUR-ACE®	2011-2016
8.	050719	FCD	Radio Engineering, Electronics and Telecommunications	AEER EUR-ACE®	2011-2016
9.	050720	FCD	Chemical Technology of Inorganic Substances	AEER EUR-ACE®	2011-2016
10.	050721	FCD	Chemical Technology of Organic Substances	AEER EUR-ACE®	2011-2016
11.	050722	FCD	Printing	AEER EUR-ACE®	2011-2016
12.	050724	FCD	Processing Machinery and Equipment	AEER EUR-ACE®	2011-2016
13.	050729	FCD	Construction	AEER EUR-ACE®	2011-2016
14.	050731	FCD	Life Safety and Environmental Protection	AEER EUR-ACE®	2011-2016
15.	050732	FCD	Standardization, Metrology and Certification	AEER EUR-ACE®	2011-2016
Karaganda state technical university (Karaganda, Republic of Kazakhstan)					
1.	050702	FCD	Automation and Control	AEER EUR-ACE®	2010-2015
2.	050707	FCD	Mining Engineering	AEER EUR-ACE®	2010-2015
3.	050709	FCD	Metallurgy	AEER EUR-ACE®	2010-2015
4.	050712	FCD	Mechanical Engineering	AEER EUR-ACE®	2010-2015
5.	050713	FCD	Transport, Transport Facilities and Technology	AEER EUR-ACE®	2010-2015
Semey State University named after Shakarim (Semey, Republic of Kazakhstan)					
1.	050727	FCD	Food Technology	AEER EUR-ACE®	2010-2015
2.	050724	FCD	Processing Machinery and Equipment	AEER EUR-ACE®	2010-2015

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SCD – Second Cycle Degree Programme
INT – Integrated Programme

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