N.I. Sidnyaev

UDC 37.378.14

Contemporary Day Discussions on the Concept of Elite Engineering Education

Bauman Moscow Higher Technical School
N.I. Sidnyaev

Article is devoted to modernization of domestic system of engineering education. According to the innovative development in higher technical education there exist contradictory problems which have been studied. The role of technical universities in preparation of professional elite – scientifically-engineering and state-administrative is considered. Analysis of transformation processes in a domestic education system is presented. Considerable attention is paid to the methods of shaping a modern engineering outlook.

Key words: engineer, modernisation, higher education, the industry, innovations, professional elite, methodology, formation, the concept, reform.

Introduction

In modern society the educational market is quite diversified, and Russia has to step in more actively, become more competitive and constantly work on raising its competitiveness that can be, first of all, supported by the modern education. Modern fundamental education is one of the powerful instruments for quality advancement of state management. It should be noted that elite education is always the innovative education. For the development of Russia, for its shoot forward, the core strategic objective is to take a shift towards innovation development path. Modern high-level education is a valuable tool for introduction of innovative approaches to all spheres of economics, production, science, culture, as well as the educational system itself.

In a society that relies on a solid knowledge base, higher education attains a top-priority role in development of countries and the global society overall. As a result, the key roles in such societies are played by people, those who obtain this knowledge, are capable of applying it on practice, and create new knowledge; people, who build up the society's intellectual elite [1, c. 47-51]. Among these society's educational institutions a distinctive place is assigned to the elite education, the main goal of which is the development of deep up-to-date knowledge.

Thus, for instance, Russia has always been known for its engineers; this profession has been a respectable one both in the pre-revolutionary Russia and in the Soviet times. Within the past few years there have been a number of actions implemented in order to support national engineering schools [2, c. 102-104]. National research universities that focus on training nuclear modern technical specialists have been created. Starting from 2006 over 54 billion rubles have been invested targetedly in the development of facilities and resources of engineering departments. The quality of specialists training has been successfully advanced, including training in such critically important specialties as aviation, atomic, automobile industries, metallurgy, power engineering [3, c. 88-91]. It is gratifying that social prestige of the profession is also rising; a career of an engineer is becoming more attractive from the point of its status and material wealth. Large industrial projects that are genuinely interesting for engineers to work in are launched in the country. And it is natural that more and more school students

are keen on mathematics, physics, and chemistry. Leading universities report that a specific tendency for these professions' prestige rising is getting stronger and the number of enrollees is growing. Nowadays, natural sciences are in favor and the selection competition for hard sciences is rising [4, c. 12-14].

Besides, there is a fair-minded demand for changes in the system of engineers' training. It is not only the technological, but rather the overall lifestyle that is changing in the modern conditions; perception of engineering is altering, and the requirements for this profession are growing. Modern engineer is a high level professional worker, who does not only operate complex machinery or design up-to-date equipment and machines, but, as a matter of fact, forms the social realm [5, c. 106-108].

Fundamental basis for elite engineering HEIs

With an aim to train an intelligent and sophisticated engineer it is necessary to construct the curriculum in a way to have no less than 30% of the total number of hours for the fundamental sciences. Unfortunately, we have a completely opposite tendency. It originates from the fact that number of natural science subjects is, unfortunately, decreasing rapidly both at schools and in universities [6, c.10-12]. Thus, for instance, physics is not a mandatory subject for the Unified State Exam, and even mathematics may be excluded. Our goal is to enlarge the fundamental component of education. And we have good opportunities for this, including engagement of the Russian Academy of Science potential. It is possible today, but it needs to be fortified; and the leading scientists, who work at the Russian Academy of Science, need to work at universities.

The normal workload of faculty members in foreign universities usually does not exceed 300 hours, and the great majority of all teachers is actively involved in research. If we really intend to come to the level of the world leading universities, we need to limit the overall workload of the teachers to the level of 400-450 hours including around 150 hours of lecture time for professors and associate professors [7, c. 171-172]. This is approximately the level of workload that leading universities imply.

It should be noted, the global tendency for humanitarization of education approves itself in Russia as well, where the trend for development of higher education system – reduction of number of technical universities – was accompanied by increase of human science majors, especially those of law and economics (notably even with overlap: in recent years an excess "production" of specialists in these majors took place). Other more general indicators of Russian educational system are in an even worse state. The cutdown of budget allocations for education is accompanied by the brain drain, insufficient quality of mass (non-elite) education, stagnation of such an important development indicator of education as the number of students per thousand people. It is a known fact that budget allocations for education are the investment in the country's future, and the reduction of these allocations is a train wreck waiting to happen. The revival of Russia as a superpower is only possible if education truly becomes one of the key priorities of its social development [8, c. 75-76]. It can be revitalized not by selling its natural gas, oil and other natural resources (which means stealing from our future generations and taking the straight root to transformation into the third world countries), but only by developing those traditions of the great culture, that made invaluable contribution to the development of modern civilization.

Unfortunately, the world-wide tendency for fast growth of HEIs' number and quality of higher education is contrary to the Russian policy for education that has resulted in rough reduction of budget allocations in the 90s. Consequently a vast number of countries have drawn ahead of Russia in this sphere. Back in 60-70s Russia had a

ENGINEERING EDUCATION
17'2015

leading position in number of students to overall population ratio. Today Russia has been outdriven in this indicator not only by USA, Japan and many European countries, but also by such East Asian countries as South Korea and Taiwan. Reference to the economic difficulties (especially in the context of high prices for energy resources) cannot justify such a shortfall policy for education that lowers the chances of Russia for its economic upturn, for the recovery in the post-crisis period of the XXI century [9, c. 32-34].

As of the moment, undoubtedly, it is not enough to have engineers, who obtain good professional skills in a specific field. It is essential for people, who get employed by enterprises, to understand methods of project management, to know principles of lean production, to comprehend cost management on all stages of the product's lifecycle.

It should be noted that the balance between practical and theoretical knowledge should be 70 to 30 percent. So far worldwide there has not been found a better way to solidify theoretical knowledge than the individual practical activities (for instance, course thesis and course design work) and the internships with mandatory presentation of the work. All these activities contribute to the development of students' system thinking and ability to analyze numerous facts and make proper conclusions.

When comparing the educational systems of the USA and Russia, first of all from the point of the development of the elite education within them, it is worth noting the deep differences of these systems that are connected with historical traditions, mentality, economic and political structures of the countries. It is no doubt that these systems differed the most during the period, when our country was led by the soviet government. American educational system has always been built according to the pluralistic development path, where different educational models have been competing, and where the key role in line with the state educational programs was played by publicly developed programs. Besides, the federal programs had a rather advisory, than prescriptive nature (that seems natural in the context of the private educational institutions' existence), where education was greatly influenced by state and local bodies. In other words, this is a system with high degree of decentralization. An opposite educational system was represented by the soviet system of education, i.e. the unification, ideologization of educational process, dominance of egalitarian approach to the organization of the educational system.

During the post-Soviet era the educational system of Russia has been rapidly moving towards its deideologization: total governmental control is dissolving, educational programs and educational institutes are becoming more diversified, individual and group public interests are being taken into account. Frankly speaking, this is an obvious step towards pluralistic educational model. Thus, we can acknowledge a certain convergence of educational systems of Russia and countries of Western Europe and North America in line with the paradigm of pluralistic educational system [8, c. 74-76]. This is even more noticeable in the context of Russia accepting the Bologna Declaration.

There can be seen a certain shift of Russian models for recruiting the elite – from nomenclative to the pluralistic one (although, as it has been mentioned, there are contra tendencies existing), towards recruiting of elite through different channels, basically, towards a more transparent system of recruiting, that draws it closer to the American and Eastern European systems of elite recruitment. Thus, we can underline the overall shift of different socio-political structures towards pluralistic models reflecting democratic processes in the modern society. These changes can be addressed as a part of the global transition towards the growing role of an individual as a part of social process that reflects the humanization and democratization of the global socio-political development.

However, the existing underrun of the Russian educational system, including the elite education, is intimidating. As has been stated above, the majority of experts in economics and sociology of education justifiably believe that for the sake of accelerated development of the country the most efficient actions are the investment in the "human capital assets", in the fields of education and science (some economists believe that each dollar put into the development of science and education in short term period will turn out to bring in at least 10 dollars). Therefore, it is possible to speak of the poor judgement of those governments that do not enlarge (or even decrease) the expenses on science and education when planning the budget.

Unfortunately, the drastic cutdown of the budget allocations for education and science as part of the "reforms", such as those that took place during the 90s in Russia, led to the catastrophic decrease of the level of education. And in the XXI century, despite the announced priority of the educational system development, its financing is still being far behind from the leading educational systems funding, especially of such in USA, Great Britain, Scandinavian countries, Japan, where education expenditures overrun Russian budgeting not only in the absolute numbers (which can be understood), but in its proportion within country's GDP. This becomes a precondition for future underrun of Russia in this field that may consequently lead to future degradation of our education and science (and this will further result in the degradation of economy and culture). While Russia still has HEIs and scientific school, that have high ratings in the global system of education and science, it is essential to develop a system of education and science in Russia with the advanced growth rate leaning on these schools (and especially on the leading and academic universities).

It is necessary to optimize the number of higher engineering education institutions, excluding the possibility to blur the majors and specialties of the national technical higher education establishments. This optimization process should be in line with the development paths of the regions and the complex integrated structures: the Ministry of Education and Science of the Russian Federation together with the Ministry of Industry and Trade of the Russian Federation and other state executive authorities, corporations. A list of high-tech production and scientific organizations should be created and approved; those organizations that will be obliged to officially employ and pay students for comprehensive annual industrial internships. These measures should correlate to the development tracks of innovative territorial clusters in the regions. The number of individual laboratory and practical activities in HEI should be enlarged; these activities should be conducted on a "simple-to-complex" basis. It is necessary to organize comprehensive annual industrial internships: during the first year – one internship a year; during the latter years – two internships a year (at the beginning and at the end of the year). HEIs, especially the engineering ones, should have in possession up-to-date analytical and technological equipment, since it is the basis for scientific schools' foundation.

It should be pointed out that in the information society knowledge is, first of all, used for the production of the knowledge itself. The optimum management of such society should be based on the effective knowledge use for creation of new knowledge, including the most general knowledge that is focused not on any applied goal, but on the production of new knowledge. That means that it is not a direct answer to the subject's demand, but a solution to a more general problem: how to solve a specific class of problems, where the solution for an applied problem is just a special case of a general theory. At the same time a relative independence of science from the applied goals of the subject, its self-reproduction is noted. Knowledge is

the intellectual capital that is distinguished from natural, human, financial resources also by the fact that while transferring it (or selling for a very high price) the creator does not lose this information, he/she fosters and enhances this intellectual capital. Whereas by selling material assets, especially natural resources (they are always limited, usually non-renewable, and very often in deficit) the seller always makes his/her country poorer. The key good in the postindustrial world is the intellectual capital, thus, its creators play the key role as well.

At the present time, a concept of mathematics education is accepted [9, c.23-36], it will allow the development of the basis for mathematics to become the force for other natural science disciplines. However, this may take some time, so, first of all, special attention should be paid to physics and informatics, not with the use of a top-down approach, as, for example, to announce a mandatory Unified State Exam on physics, but by creating a special environment, where the school and the students will be interested in teaching, learning and passing these subjects.

Year by year the number of school graduates, who take the final exam on physics and informatics is growing. Currently this indicator is estimated to be 30%. From the one side, this means that the prestige of engineering profession among school students is growing, from the other side, their self-confidence is rising, and, therefore, the quality of physics and informatics training at schools is advancing [10, c. 34-36]. Currently the laws and regulations allow the foundation of basic university departments at partner enterprises and not just at scientific organizations, as it has been before. These basic departments (their network is already growing) are to become the basis for the internships and realization of new educational programs. Besides the knowledge consumption and skills development, special attention is paid to the formation of soft skills, general and professional competences.

The statement about the connection between science, practice and engineering education is highly important, it is essential for any type of education. And here both types of mechanisms are acceptable: the ones that have been mentioned before and the ones that are provided by the current legislation. No one stands against putting these standards and these educational programs through filters of the employers. This is how it is done in many universities. As well as no one stands against attracting employers to be a part of educational and methodological expert teams, HEI's scientific commissions and state examination boards. This is the right of an HEI, and it should be exercised.

Conclusion

When discussing the problem of the enhancement of engineering professional training level and the compliance of the acquired knowledge and skills with the requirements from potential employers and the demand from the real economy, it is essential to advance the whole structure of the educational process. It is necessary to head on towards continuous increase of investment into the field of education; this is the main track for the revival of Russia with its great cultural and scientific traditions. There needs to be a selective support of skilled and talented youth that includes the processes of searching and selecting gifted kids, talented girls and boys. These activities will mainly include the already tested competitions – regional and all-Russian olimpiads, awarding grants to the winners and runner-ups for them to be able to enroll at country's technical universities (it especially concerns the support given to the gifted kids, talented youth, who live in outland, in cities and countryside far from cultural centers). This is a vital element of the state policy on elite engineering education. The knowledge-based economy should be the prevailing one in Russia. A specific, if not the central role should be given to the education and science, first of all to the engineering education that has close ties with the knowledge development and training of specialists, who can manage high technologies, apply methodology of information analysis – specialists of very high level of qualification, innovators, who broaden the horizons of the mankind, whose lifestyle is a continuous and rapid development in the context of fast obsolescence of old knowledge, the need for its constant renewal and rethinking, and the need for new approaches, new ideas, new unifying theories. Russian system of education should have a flexible system of process management, where there is no strict centralization, where there should be a strive for balance between state educational programs and regional, local ones. National programs for the development of education should include the control of the academic level of education, level of educational management, pedagogical control focused on the art of teaching, professional control – analysis of HEIs' graduates from the point of the "consumers" requirements, encouragement of different educational forms and methods.

The contents of this article can be useful for a wide range of faculty members and students, the system of vocational professional training, the system of HEI staff development programs, engineering and scientific workers.

This article has been written during the realization of a Contract with a non-profit organization "Association of Moscow universities" on social services for Moscow citizens in terms of educational services delivery.

ENGINEERING EDUCATION
17'2015

REFERENCES

1. Scientific Schools of Bauman Moscow State Technical University. The History of Development / Ed. I.B. Fedorov, K.S. Kolesnikov. – 2nd ed. – M.: Bauman Moscow State Technical University, 2005. – P. 404.
2. Fedorov I.B. Keeping and Developing Traditions Moving Forward. Public Speeches 1991-2010 / I.B. Fedorov. – M.: Bauman Moscow State Technical University, 2010. – P. 567.
3. Sidnyaev, N.I. Methodological Aspects of Teaching Advanced Mathematics in the Context of Modernization of School Mathematics Education // Alma Mater – 2014. – № 5. – P. 33–40.
4. Mitin, B.S. Engineering Education on the Edge of XXI century / B.S. Mitin, V.F. Mainulov. – M.: Rusanov Publishing House, 1996. – P. 224.
5. Danilaev, D.P. Mechanisms for Adaptive Correction of the Training Process of Highly Qualified Technical Specialists / D.P. Danilaev, N.N. Malivanov, Yu. Ye. Polskikh // Infocommunicational Technologies. – 2013. – № 1. – P. 105–111.
6. Romanov, Ye.V. Contradictions as a Source of Innovative Development of the Higher Professional Education System / Alma Mater. – 2014. – № 5. – P. 9–13.
7. Masalimova, R.G. Foreign Technics of Corporate Training: Essence and Its Significance for the National Tutorial Activities // Kaz. Ped. Journal – 2012. – № 4. – P. 171–178.
8. Grigorash, O.V. On Advancement of the Students Training Quality // Alma Mater. – 2013. – № 3. – P. 71–75.
9. Evgenev, G.B. Systemology of the Engineering Knowledge / G.B. Evgenev. – M.: Bauman Moscow State Technical University, 2001. – P. 376.
10. Zimnaya, I.A. Key Competences – New Paradigm of Learning Outcomes // Higher Education Today. – 2003. – № 5. – P. 34–42.

УДК 378.1:004

Model of Students' Practical Training Processes in Institutions of Higher Professional Education

State University – Education-Science-Production Complex
M.A. Tarasova

The article deals with the model of students' practical training processes, its unit-by-unit description of processes and relationship between them. It forms the basis for subsequent development of a monitoring model.

Key words: process management, resource technological base, the quality and efficiency of education, the rate of rationality, information-analytical system.

Problem statement. One of the most relevant trends in the improvement of contemporary education is the development of information and analytical resources (IAR) that reflect its actual status and can be used in management system design [1. p.7-9]. Adequate solutions, management objects and algorithms, for example, quality of student's practical training, allow effective management in the educational process, the major constituent of which is academic-research-production base and, as a consequence, answer the question: "Whether expenditures for practical training justify high quality education of a highly -qualified and competitive engineer?"

IAR are developed on the basis of integrated monitoring. At the preparatory stage it is reasonable to design a model of students' practical training processes to consider in detail the sequence and integrity of the processes in which the problem of IAR development is solved, to evaluate the quality and effectiveness of students' practical training at all learning stages and set management functions [2, p. 10-13; 3, p. 22-25].

Results analysis. High quality of professional education is profound fundamental training based on the latest scientific achievements. These two principles have become academic-research-production base, which defines the resource potential of a university and conditions the opportunities of training sessions, research, and development, their results and quality of students' practical training. At present, the development of academic-research-production base is performed through the implementation of high-tech, modern equipment and development of new technologies and forms of training. Both trends form a complex: innovative education system grounded on academic-research-production base, which is appropriate to term a resource technological base (RTB) of education. It is clear that RTB, its state and development, is a crucial factor of HPE quality [4, p. 31-35].

Competence approach is taken as a basis for HPE FSES. Defining the competence functions in training supports the main essence of competence approach – to enhance the practice-oriented training. Therefore, a distinctive feature of the modern HPE development stage is the significant increase of students' practical training. This peculiarity promoted the formation of innovative training systems based on RTB, for instance, resource centers academic-research centers, research-academic clusters, etc. The design of such innovative systems provides a guarantee for high quality learners' practical training [5, p. 114-116].

At the moment, the quality management system (QMS) in universities has been established and certified, which is based

M.A. Tarasova