

## Editorial board

**Editor-in-chief:** Prof. Yu. P. Pokholkov, President of Association for Engineering Education of Russia, Head of Organization and Technology of Higher Professional Education Department, National Research Tomsk Polytechnic University.

**Managing Secretary:** Prof. B.L. Agranovich, Director, West-Siberian Regional Center of Social and Information Technology.

### Editorial Board:

Prof. M.P. Fedorov Rector, St. Petersburg State Engineering University G.A. Mesjats, Vice-President, Russian Academy of Science (RAS) Director, Physical Institute n.a. P.N. Lebedeva Member, RAS (Moscow)

G.A. Mesyac Vice-President of the Russian Academy of Science, Director of RAS Lebedev Physical Institute (Moscow), RAS Full Member

Prof. S.A. Podlesni Vice-Rector, Siberian Federal University

V.M. Prikhod'ko Rector, Moscow Automobile -Road State Engineering University (MARU) Corresponding Member, RAS

Prof. D.V. Puzankov Department Head, St. Petersburg State Electro-Engineering University

A.S. Sigov Rector, Moscow State University in Radio Engineering, Electronics and Automatics (Engineering University) Member, RAS

Prof. U.S. Karabasov President, Moscow State Institute of Steel and Alloys (Engineering University) Deputy, Committee in Education, State Council of Federal Assembly RF

Prof. N.V. Pustovoy Rector, Novosibirsk State Engineering University

I.B. Fedorov President, Moscow State Engineering University n.a. N.E. Bayman President, Engineering University Association Academician, RAS

Prof. P.S. Chubik Rector, National Research Tomsk Polytechnic University Member, Public Chamber RF

Prof. A.L. Shestakov Rector, South-Uralsk State University



## DEAR READERS,

Russian engineering education has a glorious more than 300 years history and rich traditions. Since the establishment of the School of Mathematical and Navigational Sciences by Peter the Great, traditions of Russian engineering education have developed and strengthened. These traditions are based not only on the mentality of the Russian people (curiosity, quick wit, commitment to results, desire and ability to bring the efforts to a successful conclusion), but also on the governmental support of the engineering education system. There is a great variety of evidence since Peter the Great, who sent Russian youth to study shipbuilding in Europe and opened the above mentioned school, in fact the first engineering school in Russia.

Another example is the first engineering school founded by Catherine II in 1773 in St. Petersburg (Mining Institute). It is worth noting that four years later she issued a decree to establish the Mining Museum in this university. Russian industrial and mining enterprises were bound to supply the museum with the latest technological developments. This chain could be continued by establishing of the Moscow Higher Technical School named after N.E. Bauman, that later became Moscow State Technical University n.a. N.E. Bauman (MSTU) - Russian Engineering University of educational excellence always supported by any government. We could also talk about a legendary foundation of Tomsk Technological Institute of practical engineers in 1896, when count S.Yu. Witte, being at that time the Minister of finance of Russia, made a historical record in his diary, "Today, March 5, 1896, I struck out provision for armadillo and transferred these funds to establish the Tomsk Technological Institute." the race of armadillos, built at the time, finished long time ago and the Tomsk Technological Institute - the first technical higher educational institution in the Asian part of Russia, and now the National Research Tomsk Polytechnic University, has been living, developing and benefiting motherland for more than 110 years.

Impact of engineering education on the country's economic development,

the level of technical and technological culture among the population, ensuring its economic and technological security is crucial. In support of this thesis there are vivid evidence only in the last 100-150 years. Development of domestic aviation, exploration and development of mineral resources (especially in Siberia), electric power and hydro engineering, nuclear and chemical technologies, nuclear power engineering, space exploration, etc. These achievements became real thanks to gifted, talented people, graduates of local technical higher educational institutions: N.E. Zhukovsky, S.P. Korolev, N.A. Dolezhal, M.K. Korovin, I.V. Kurchatov, M.L. Mil, A.P. Tupolev, N.I. Kamov, V.N. Schukin, N.V. Nikitin and millions of "ordinary" engineers without whom it is impossible to imagine any design, production or exploitation the variety of engineering technics and technology, equipment, that concentrated brilliant engineering solutions.

Unfortunately, in modern Russian history there is a trend pointing out how professional community and authorities break with the glorious traditions of the Russian engineering education. The reasons for this are explained by inadequate response to the challenges sent by environment to the government and academic community.

Russian engineering education in recent years has faced a number of global and national challenges, the most severe are the following:

- transition on a multilevel system of education in accordance with the basic principles of the Bologna Declaration;
- Russian WTO Accession, competition in the global engineering market;
- sharp decline of the image and status of the engineering;
- lack of common requirements for the qualification of specialists in the field of engineering and technology, professional standards taking into account the transition to two-tiered training system;
- market-based employment relationship;
- the contradiction between the previous system of engineers

- training and new requirements from employers;
- getting out of date facilities and aging human resources of universities;
- a small number of enterprises with modern equipment to provide good quality of practice training for future engineers and university professors.

Failure to adequately and promptly respond to these challenges has resulted in critical state of engineering education in Russia. To some extent, this failure has also become a reason of crisis in engineering - products resulting from engineering activities: projects, technologies, facilities, machinery, instruments, equipment, operation and maintenance.

One of the causes of the crisis in engineering education and engineering is the contradiction between the quality of engineers' training and employers' requirements.

Employers look for such professionals who:

- are able to think independently, systematically and efficiently solve production problems using competencies developed in university;
- know business processes and features of the Russian business environment
- know the laws and methods of creative thinking to find solutions of engineering problems;
- know methods of nonlinear physics and nonlinear dynamics of complex systems (synergy), fractal concepts;
- are able to use the elements of the Applied Systems Analysis;
- are able to use high-performance integrated computer network design tools (CALS-technologies);
- are focused on the professional development and career growth;
- have business communication and negotiation skills;
- are able to present themselves and the results of their work in a professional environment;
- have teamworking skills;
- have high foreign language proficiency level.

As a rule, the content of engineering curricula and educational technologies

used today, do not allow to develop such qualities while training future specialists.

Universities organize the training process in such a way that the graduates primarily should have knowledge in the disciplines studied at university. In this case, each teacher believes that the more hours he would have to teach their discipline, the better he will prepare a specialist. As a consequence, the criteria for assessing the quality of training of future engineers in higher educational institutions are shifted to the assessment of their knowledge.

Finding answers to these challenges requires a meaningful and systematic approach to analyze current situation and to choose appropriate responses to these challenges. One of the main tools for this could be the development of a fundamental document the "National Doctrine of Engineering Education of Russia". Its preparation and implementation should assure strengthening and development of the best traditions of Russian engineering education as the basis for successful economic and cultural development of the nation.

In general terms the doctrine is "a collection of officially accepted views on any issue and the nature of its solution" \*.

In any case, the doctrine is an important strategic document based on a specific philosophy that helps to state the objective and describes how to achieve it in a certain field of activity for a long period of time. The importance of developing the "National Doctrine of Engineering Education of Russia" at the present stage of economic development is obvious.

The "National Doctrine of Engineering Education of Russia" based on objective and adequate assessment of the situation prevailing in the field of engineering education in Russia and in the world, should include the definition of the strategic goal of national engineering education and its role in the development of the Russian economy, the tools and means of improving the methodology, key principles of the

Doctrine. Of course, the objectives of the development of engineering education, applied methodology, tools and techniques may be different. Their selection and implementation of their principles should be carefully analyzed and discussed by specialists and society at large.

On December, 4-6, 2012 All-Russian Scientific and Practical Conference "Approaches to Development of the National Doctrine of Engineering Education in the New Industrialization" will be held in Tomsk.

The Conference is organized by the Association for Engineering Education of Russia, the Association of Technical Universities of Russia, the Association of Innovative Regions of Russia, National Research Tomsk Polytechnic University, Administration of Tomsk Oblast, Administration of Novosibirsk Oblast, Foundation for Assistance to Small Innovative Enterprises in Science and Technology. The Conference will be held with the support of the State Duma Committee on Education, Council of the Federation Committee on Science, Education, Culture and Information Policy, Bauman Moscow State Technical University, RF Chamber of Commerce and Industry.

The publication of this special issue of the journal "Engineering Education" is dictated by the need to give an opportunity

for representatives of business, science and engineering education community in Russia to get acquainted with the opinion of the country's leading experts on how to develop the Russian engineering education.

The first part of the journal contains articles about the experience of the organization of national higher engineering education and the problems we face in this field today. The second part of the journal presents articles of the authors who share their ideas on how to improve engineering education in Russia and discuss approaches to the development of the National Doctrine of Engineering Education.

The Editorial Board hopes that the publication of this issue will initiate more discussions on how to develop and improve engineering education. And the forthcoming conference will become a good platform for further discussion and recommendations on the development of the "National Doctrine of Engineering Education of Russia." Implementation of the National Doctrine will ensure solution of human resources problems of the Russian economy on the basis of the new industrialization.

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

# Contents

*Editor's letter* 2

---

## ENGINEERING EDUCATION: CHALLENGES AND SOLUTIONS

---

The Bauman Mstu: experience, traditions  
and innovations in engineering  
and scientific staff training  
**A.A. Alexandrov** 6

Problem situations in Engineering education  
**A.P. Karpik** 12

Enhancing engineering education  
in the post-crisis period of economical  
development in Russia  
**V.M. Kutuzov, N.V. Lysenko,  
S.O. Shaposhnikov** 16

Education Problems within Marketing  
in Technical Universities  
**B.Ch. Meskhi, T.P. Lubanova,  
N.N. Shumskaya** 22

Experience in Staff Training  
and Development for Solving  
Design and Engineering Problems in  
Petroleum Industry  
**I.N. Koshovkin,  
A.S. Latyshev, A.G. Chernov** 28

Integration of Engineering Education  
with High-Technology Business  
(by the of ISTU)  
**I.M. Golovnikh** 38

---

## NATIONAL DOCTRINE OF ENGINEERING EDUCATION: STRATEGY AND TACTICS

---

National Doctrine of Advanced  
Engineering Education of Russia  
in the Condition of New Industrialization:  
Approaches to Development,  
Objectives, and Principles  
**Yu.P. Pokholkov** 46

Industrialization as a major driver  
of engineering education transformation.  
Engineering education:  
a course for new industrialization  
**P.S. Chubik, M.P. Chubik** 60

Approaches in Designing the National  
Engineering Education Doctrine  
**S.A. Podlesni** 68

Requirements applied to engineers  
in view of Modern Industrialization  
and the ways of their fulfillment  
**Sigov A.S., Sidorin V.V.** 72

Designing National Engineering  
Certification System Based  
on International Standards  
**P.S. Chubik, A.I. Chuchalin,  
A.V. Zamyatin** 82

**OUR AUTHORS** 88

**Summary** 91

---