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Approaches in Designing the National Engineering Education Doctrine

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Aspects in designing the national doctrine of advanced continuous engineering education under conditions of today's Russian industrialization and globalization within the economy sector and education space have been considered in this paper.

Key words: *engineering education, national doctrine, postindustrial society, public policy, private and state partnership.*

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The development and implementation of the national engineering education doctrine (herein referred to as "Doctrine") is a crucial problem determined by numerous factors. One factor embraces the role of the engineering education in procuring stable civilization development, XXI-century global problem-solving aspects (world-wide natural resources depletion, environmental degradation due to increasingly large-scale human activity impact, energy crisis, etc.), implementing adopted Government Strategies of Innovation Development in RF (2012-2020) and multi-national security problem-solving aspects. Another factor involves the circumstances and problems associated with engineering education and engineering itself in Russia. According to various estimates, the system of human resources (HR) training in technology and engineering has been facing critical and serious problems [1].

A national-level perspective document, explicitly stating the major challenging objectives and tasks and functions of the state, business, higher education institutions and R&D institutes, should be adopted to reflect those integral views of the existing research-and-technology community, society, government, businesses and individuals, which, in its turn, would further the development of the national-technological base, innovative economy and engineering education [2]. Such a document should incorporate a system model of the multi-level advanced continuous engineering education within the post-industrial -information community, as well as, interrelate the national and market mechanism regulations. This Doctrine should include the best of domestic and foreign experience and knowledge. The implementation of the Doctrine shapes the background to provide a stable country development, to update the industrialized and national security sectors and to rate up the global market competitiveness of Russia in high-technology and education services.

The Doctrine is the key national document emplacing the engineering education into state politics, determining its strategies and basic development areas during the transition period to the stable development and shaping of the post-industrial community and globalization

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of economy and private-public partnership. The following document should determine the long-term strategic objectives and tasks of engineering education, their performance model, necessary resources, stages, implementation mechanisms and expected results.

The development of domestic engineering education and its global quality improvement is a rather challenging systematic problem, involving political, legislative, economic and management activities, as well as, supporting research-technology activities, precise public and business strategies and tactics. Doctrine design is based on the systematic analysis of modern day-to-day realities in the research-technologic and socio-economic spheres of the post-industrial community and Foresight-technology within the forecoming 15-30 years. The following issues are highlighted within the framework of the Doctrine itself: integration of Russian engineering education system into the global education space; conditions providing its promotion, continuity, integrity and fundamentality; future-oriented requirements to engineers; training content; educational technology and high-quality engineering training.

Outlining the different approaches in developing the Doctrine, the positive and negative factors revealed during the implementation of the adopted Government resolution" RF National Education Doctrine" in 2000 should be considered.

Engineering education dominates the leading positions in the system of higher professional education and includes the following characteristic features:

- far-reaching sub-system of higher professional education;
- high-technology education sphere;
- direct influence on the country's technological development, its dynamic innovation progress and global competitiveness;
- multi-aspect curriculum disciplines requiring prompt content updating;
- significant academic improvement relevant to the engineering status, research and R&D project financing and effective professional engagement and interaction with strategic partners;
- significant financial costs in developing research university laboratories and physical infrastructure;
- requiring exclusive physico-mathematical competence of school graduates and their profession orientation.

Major problem-solving aspects in engineering education:

- no clear-cut long-term development- strategy of the engineering education system itself, undefined ideological basis and interested partners;
- no integrated system of forecasting and framing requirements for engineers, based on labour market analysis and technological development [3];
- no industrial policy;
- significant severance of close-up ties between science, education, industry and business affecting the motivated content and quality-level of specialist training;
- no uniform professional standards in most industrial sectors; in many cases a mismatch between the university infrastructure itself and existing accepted requirements, distressed equipment in student learning and shortage of hardware and software packages;
- underdeveloped institutional science and inadequate development of innovative-oriented intellectual marketable products (patents, licenses, etc.) for real economy;
- deep-in problems in organizing on-the-job training (internship);

- inadequate promotion of academic mobility (student exchange) programs;
- financial budgeting of Russian higher education institutions significantly lower than that of universities in highly-developed countries;
- low export provision of educational services abroad;
- imperfection of the legislative framework, discentives and no preferences leading to disinterested businesses in co-financing engineering education;
- ageing of faculty, low salary level inconsistent to faculty qualification and experience input resulting in low-rate recruitment of young professionals;
- unappealing scholarships for engineer-students;
- lowly- occupations such as engineers, instructors and research associates due to existing realities within Russia;
- physico-mathematical competence of school graduates significantly decreasing;
- system failure of professional orientation (career guidance) education of school graduates in technology and engineering.

Basic priorities and socio-economic characteristics of the post-industrial community are quite different from those of the industrial community. One difference is the principle of sustainable development and the shaping of a new behaviour model, both of which, embrace the education sphere. The predominate new economic industry type is the production of customer-order goods and services. The production management principles are changing- multi-national corporations and virtual enterprises have emerged, which have no fixed functional and territorial structure, while resources pooling distributed among enterprise-partners are monitored through computer network integration. The major revenue source is secured by means of rapid innovation promotion, which, in its turn, is enforced by high-tech production. Such products are becoming more and more intellectual involving a high-tech production potential increase. Thus, the intellectual potential has emerged into the production primary factor. Socio-economic mode is based on the global economic principles, high "living standards" and self-actualization [4]. The transition to the sixth step of the technological mode is performed where nano- and bio- information - communicative technology clusters are base-types.

Significant fundamental changes have also proceeded within the higher professional education system involving the development of an innovative university and further modeling and re-shaping of existing curriculum. In this case, the basic principles are: training trajectory tailoring; personal orientation; autonomous management; global training level quality; integration of education, research, innovation and production activities; shaping innovative mentality and training students for future innovative teamwork (including, global teamwork) within the framework of sustainable development; high personal cultural level. The learning process itself has changed through its content and applied technology. Previous lecture-seminar model in the education process has been substituted by the so-called "e-learning" model, which, in its turn, is transforming into "smart education". Integrated grading systems are becoming prevalent in the universities.

Based on the in-depth analysis of existing alterations in the post-industrial community within the framework of engineering education and national technological development, the priorities in developing Russian competitive and functionally effective engineering education systems could be defined to further the innovative sustainability of the country and to establish its leading position in the global space. The key issue- financing

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budget and effective appropriation of financial resources. To be a world leader, the financing of engineering education and science should be consistent with that predicted by the global analogous indicators.

The effective implementation of the Doctrine, as a benchmark for the state, business and higher professional education systems, could be achieved only in two cases: (1) if there are answers to the following questions- what to do and how to do it and (2) if there is an explicitly stated implementation mechanism.

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