



PROFESSIONAL GROWTH OF ENGINEERS IN GLOBAL MULTICULTURAL ENVIRONMENT

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The modern world is rapidly becoming globalized. The world's top engineering companies employ best specialists from all over the world. The "binding force" for such specialists is their engineering education background: they form so-called "engineering elite" without boundaries and cross-country barriers. Different cultural background of engineers in a global world may, however, form unpredictable barriers to their cooperation within a transnational company or a university. On the other hand, cultural differences as a set of various "points of view" and approaches can make a fruitful contribution to the development of engineering community [1].

Professional growth of engineers is closely linked to the global challenges mankind faces today. In the XXI century, the mankind is facing a number of new challenges; their solution will determine the future progress and even survival. The "global agenda" today includes the following issues: corruption, poverty, environmental pollution, human rights, terrorism, armed conflicts, climate change, epidemics, unemployment, world economy globalization, religion-based conflicts, human migration. Scientists, politicians and social activists are actively discussing the so called "global challenges" on the daily agenda of the United Nations, the clubs. All the road mapping documents of G20 member states design the future projects with a strong emphasis on the global risks and instabilities. The world scale problems are also reflected at the regional scale. Almost all the major challenges can be grouped into the following categories:

- Healthcare and quality of life – human lifespan, environment deterioration, especially in the cities, early mortality, poverty and corruption;
- Safety – a threat of war, ecological disasters and climate change, religious and ethnic conflicts, terrorism, economic safety related to modernization of the Russian resource based economy, corruption, globalization of the world economy, migration of population;
- Resources and their scarcity – demand for new types of energy and energy efficient materials, pure drinking water, food problems, intensification of the housing and road construction.

The world leading engineering universities aim at solving the most urgent global challenges through R&D projects and education declared in their missions [2].

Within the research, education and project activities of the universities, engineering is often considered as a decisive factor in the roadmap of the XXI century. For example, the annual report of the Institute of Chemical Engineers (IChemE) places an emphasis on engineering as one of the most effective instruments for solving global problems through providing high-tech solutions for healthcare, development of new materials, safety and the problems of energy and resource scarcity. Engineering in the constantly renovating appearance will always be of particular importance for the modern civilization.

The "Building Blocks" of the modern civilization based on Engineering are:

- Process safety. Modern engineering processes are based on operational and industrial safety.
- Education, knowledge and professional skills.
- Research and development. Engineering faces the complex challenges of the modern science.
- Energy. Engineering develops key energy solutions for the forthcoming decades.
- Water. Engineering provides renewable water resources;
- Food. Engineering can find solutions for sustainable food generation and distribution.
- Health and welfare. Engineering has been the basic instrument for producing commodities since the early XX century.
- Economic impact. Engineering contributes over USD 3,000 bln to the global economy, thus serving as the major economic leverage.
- Social impact. Engineering improves the quality of life all over the world.

The major contribution to the high level of new universities is made by the engineering activities, which fill the commercialization “gap” resulting in the lack of large national companies able to carry out modernization projects and design innovative production lines.

Graduates of top engineering universities often seek employment by international corporations and if employed can be sent to Europe, Asia or Africa. Their further professional growth and promotions are often related to changing regions and even countries within their employing company [3].

There is a number of gaps for engineers to be bridged to ensure their sustainable professional development:

- the gap between the social demand of the global world for internationally competitive engineers capable of international scale professional activities and the engineering university graduates and faculty who are not ready for intercultural communication;
- the gap between the demand for international recognition of activities done at national universities and the low presence of regional engineers in the international databases of grants, publications and conferences;
- the gap between the demand for development and implementation of international programs in engineering education to enhance the competitiveness of the engineering universities and a number of barriers faced by the faculty (insufficient interdisciplinary links, little experience of work in professional multilingual environment, low efficiency of personal international contacts, psychological problems in intercultural communication);

- the gap between the demand for expanding the international presence of an engineering university, social order to the universities to get into the top positions in the international university rankings and the real positions of engineering universities in the global education market;
- the gap between the demand for international integration of engineering education, research and industry, the existing successful international experience of engineering entrepreneurship development and commercialization of research results and the absence of efficient mechanisms for adapting and implementing this experience;
- the gap between the demand for studying and adapting the international rules and regulations for engineering education internationalization and the absence of mechanisms for efficient implementation of this experience in engineering universities;
- the gap between the demand for analyzing the historical background of engineering education internationalization and the need for comprehensive analysis of this problem;
- the gap between the existing conceptual approaches to engineering education internationalization in the developed countries, empirical experience of internationalization in engineering universities, and the absence of critical description, explanation and analysis of these approaches with a further developed engineering education model.

These gaps formulate the problem at the heart of the presented project: what is the structural functional model for the professional growth of engineers in global multicultural environment? The problem discussed in this study is that lifelong learning process, accompanying professional growth of a modern engineer, can often be a continuous impact of different cultures.

An important aspect of analysis is that the contribution of a multicultural environment to the development of engineers can appear at any stage of their lifelong education pathway: Bachelors', Master's or PhD studies, as well as professional training courses offered by an employing company. Linguistic, cultural and religious differences exert certain influence on the learning process, an ability to sustain working and learning stresses, and the process of decision making. It is important to consider, however, that engineers get multicultural experience today at earlier stages of their lifelong learning process due to globalization: students can change several universities located in different parts of the world to get advanced engineering education degrees. Another key point for discussion is that on the other hand, many engineers gain all their degrees in home countries. In this case, multicultural component becomes predominant in their continued professional growth when they first face multicultural environment as a part of their career in a transnational company.

A promising approach offered to reveal the influence of multicultural environment on continued professional growth of engineers is to select regions with strong multiculturalism and intensive engineering infrastructure as the points for analysis. One of such regions in Russia is the Republic of Tatarstan, incorporating two major nations of Russia – Russians and Tatars. They have different historical, cultural and religious background. At the same time, this part of Russia is strongly industrialized by many national and global companies and has a cluster of engineering

universities. Thus, it is perfect place to reveal best practices in professional growth of engineers in a multicultural environment.

Kazan National Research Technological University is the only Russian National Research University which focuses on research and academic programs in Chemical Engineering and trains skilled professionals demanded in both the Russian and global markets. KNRTU implemented a whole set of degree programs: “Chemical Engineering of Polymer and Composite Materials”, “Chemical Engineering of Energy Intensive Materials”, “Chemical Engineering of Integrated Processing of Hydrocarbon Resources”, “Chemical Engineering of Nanotechnologies and Nanomaterials” and “Chemical Engineering of Energy and Resource Efficiency in the Production of Advanced Materials”.

KNRTU is a part of the innovative infrastructure of the Republic of Tatarstan that is a unique Russian region for innovations. KNRTU can be a gateway for its global partners in reaching such large complexes as Special Economic Zone “Alabuga” (a special place for foreign residents with zero or reduced taxes), “Innopolis” Innovative City (a new-town-from-scratch project, supported by Carnegie-Mellon University, USA, to integrate the best IT-specialists in Russia in one place), and the “SMART City” Kazan (the new investment ground for business, education and innovations).

The mission of KNRTU aimed at becoming an internationally competitive institution is to solve the global challenges of the mankind in the 21st century through research, education and engineering activities based on the significant role of chemical engineering for contemporary stage of human civilization, because chemical engineering will be at the forefront of tackling many of the world’s tough challenges in coming decades.

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