

## Engineering Background: Modern Formats and Challenges of Conceptual Engineering

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**Abstract.** This paper describes the analysis of problems and development perspectives of engineering education in our and other countries. Special attention is given to modern formats of education that motivate creative efforts of engineers-to-be as well as issues of conceptual engineering taking the challenges of modernity into account.

As the global economy has been declining over last 10-20 years, which overcoming requires complete economic conversion worldwide and escalates the competition between the key players, this dramatically changes the policy of a country related to engineering shape and skilled personnel training. Recent years have focused the national education policy of the Russian Federation on the mainstream development of engineering education. The reference figures stating the number of enrolments to study engineering sciences in higher educational institutions grew steadily and exceeded 50% of the total reference amount by 2015. The RF Ministry of Education and Science records demonstrate that the issue related to the deficiency in the number of engineers has been solved by that time, while the issue of their skills is acute until now.

In general, the issue of education quality is typical of both the human and engineering fields while training new generation of specialists for national industry and applied science. The engineering field is going to be exactly that breakthrough that will be able to push the country out of the slump, bring our industry to a new technological level and reliably protect from any aggressive attempts from outside through introduction of new types of equipment.

It should be stressed that lack of highly skilled engineers is true not only for Russia. In late 1990<sup>th</sup>, 'brain drain' has started meaning emigration of gifted specialists in economically developed countries of Europe and America. Inadequate attention to such a complicated process as training of engineering personnel and efforts to allocate the productions in the areas with low labour cost, required to move first the training centres behind the technologies while this, in turn, resulted in such a situation that the young people has less and less interest to do these jobs. The resulting shortage has been covering by attraction of foreign specialists.

Within a long period of time, we, in Russia, faced a phenomenon called bleeding of our science as the young professionals did not want to commit the works they have been trained to while the teachers at universities and institutes became aged. Our young specialists went abroad or did other, more challenging businesses – trade, commerce etc. This was encouraged by a drastic shortfall of backing higher institutions followed by drop in creditability of academicians. Growth in backing observed for



the last 10-15 years could not make it possible to completely recover the losses for the time being; however, at least it is noticeable that the situation started to improve.

According to increased number of publications by immigrants of Indian, Chinese and other Asian and Middle East descents, building up new global engineering and scientific centres is another worldwide trend. This may be considered because of the above described processes brought to a fundamentally new level from the quality point of view, which cannot be ignored any more.

Therefore, Russia is currently facing two challenges: short-term (extremely aggressive) – the western countries losing their benefit and searching for a possibility to find a way out of the protracted downfall for the account of others, and long-term, which is associated with the growth of new centres of economical and technological influence.

Not to fall behind the others, our country should have an integral philosophy of engineering education as a system of training qualified human resources in demand who can contribute to a new round of development.

This appears to happen only based on a method of conceptual engineering and strategic planning [1]. Particularly, [2] demonstrates that "...conceptual engineering of the systems is specifically actual in terms of their innovation-driven growth". In other words, conceptual engineering makes conditions for creation of qualitative transitions between the systems (including the system of engineering education) resulting in modification of structural organization of these systems.

The purpose of conceptual engineering is extremely complicated and requires a comprehensive approach [3], study of philosophy components and their degree of contribution to achieve the goal. As is written in the papers of those who studied this problem, one of the basic components of the engineering education philosophy is the development of an enduring interest to be shown by young specialists in choosing this domain of interest, that is of engineering. This is important to be done in time as the creativity, artistic skills, inventive thinking are mostly formed by 15 years of age [3]. And then we have to do with what we have and make efforts not to lose, but to improve and realize.

Popularization of engineering achievements and applied science plays a valuable role in this matter. Not for nothing is this sphere observed to actively look for non-conventional forms and non-trivial solutions. This includes up-to-date technology parks, exhibitions where the people can be directly engaged in the creative process, contests, and studio performances. The movements of stand-up interactions in groups of likeminded persons becoming more popular where the speakers have live communication with the audience at regular club meetings, on which only 5-10 minutes are given for discussion of a single topic to activate thinking process, concentrate the people on it and prevent from feeling bored.

One of the active players is the Ingenium, a studio of technically creative young people at the Institute of Engineering of the Kazan Federal University, which successfully apply new formats of popularization of creative engineering and grow high potential staff for national industry, science and pedagogics.

The studio has been established by a group of enthusiasts namely students, postgraduates and lecturers of the Institute who are inspired to engineering innovations and popularization of applied researches.

However, the matter of subject the Studio is specializing on has demanded not only the active intellectual and publication activity, but also involvement of significant means to collect material resources to implement and test research and engineering ideas. These ideas may include effective and ineffective ones, which is normal practice when searching for new solutions. Even in case of failure, realization of an engineering idea cannot be considered useless as it gives invaluable practical experience and feeling of possibility to improve and optimize someone's ideas and plans.

In 2015, a project developed by Ingenium Studio was granted by PAO Lukoil and OAO RITEK. There were three groups of targets to be addressed:

- 1 . Material support
- 2 . Organisational issues
- 3 . Creative tasks

The first group of targets covered the issues related to the procurement of modern equipment and consumables for individual projects of the Ingenium Studio members.

The second group dealt with how the Ingenium Studio is organized as the number of members has noticeably increased over the last period; the range of its interests and capabilities has extended, however, the matter of how to employ emerging technology and get skilled in using the sophisticated technological means was not gone.

The third group relates to the creative endeavor aimed to popularize technical achievements of the Ingenium Studio and involve new participants and partners as the studio's members focus on how to arrange for networking to distribute and popularize the best successful experience and provide guidelines of how to arrange alike studios in the Republic of Tatarstan.

To support Ingenium Studio in finding solutions to the organizational problems, skilled lecturers and employees of the Institute of Engineering at Kazan Federal University trained the studio's participants, advised them in terms of how to draft a design of training and laboratory trials and explained the sequence, targets, purpose and methods of engineering and design works. From creative process point of view, the implementation of the Ingenium Studio's design encouraged the aspiring designers to have a technologically sophisticated way of thinking, commitment to results, decision-making discretion as well as innovations, inventiveness, skills required not only for an individual, but also for teamwork.

### References

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