The paper presents the TUSUR University case study in implementing CDIO Standards. The authors describe how TUSUR University manages to apply CDIO principles at different levels, from one discipline to the whole educational program.

Key words: Worldwide CDIO initiative, CDIO standards implementation, project-based learning, curriculum modernization, distance learning technologies.

According to the remark of President Vladimir Putin, that has been made during his speech at the extended session of the State Council on February 08, 2013, "the main problem of today's Russian economy is its uttermost ineffectiveness. Workforce productivity in Russia stays unacceptably low...". In our opinion one of the reasons for such ineffectiveness is an outdated system of future engineers' training. It is natural that with the transition from industrialized national economy to a knowledge economy new economic fields and professions emerge, requiring miscellaneous training of specialists.

Unfortunately, due to a variety of causes many classical universities get involved in the process of adaptation with a stitch in time. Despite the active evolution of innovative infrastructure and development of new research trends racing to create the most effective educational approaches, it is evident that educational curriculum as well as teaching methods is not undergoing a reformation: the solution to the problem is the multidisciplinary projects and project-based learning, close cooperation with corresponding industry on early stages of curriculum development, and more flexible approach to modern competence formation.

In context of slow-speed advancement of national economy and with the aim of its stimulation it is necessary to change the attitude for engineers' training. Liberal creative engineering requires specialists who have fundamental knowledge are able to set and solve problems, see the whole picture and promote development of scientific and technical fields not only nationally, but on an international level as well. Let alone the fact that such education would raise considerably the competitive ability and attractiveness of project areas for students and therefore creates a solid base for project-based learning.

According to the curriculum, Bachelors’ project-based group learning starts at the fourth semester. In case it is related to the interns or thesis project such learning proceeds until graduation, i.e. slightly over 2 years. During this limited period a set of actions has to be carried out, i.e. set a problem, conduct research and development actions as well as trial experiments, document the results. This implies that students will get into action right away. However students are not ready for the project activity yet [2, pp. 44-46].

According to the CDIO initiative university association, students have made their wrong choice. A unified curriculum during the first semester provides students with an overview of all disciplines creation, leading to a one-to-one training. Secondly, students have an opportunity for extra career guidance.

In TUSUR the state of education on the first stage. This provides an answer to the challenge a concept of project-based learning. It may be quite complicated to make a change once students realized they have made a wrong choice. A unified curriculum during the first semester provides students with an overview of all disciplines creation, leading to a one-to-one training. Secondly, students have an opportunity for extra career guidance.

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Integrated course “Introduction to Engineering” carried out in the third semester is designed to prepare students for the project-based group learning. Background for the course is provided by three courses of the integrated curriculum: “Innovative Projects Management”, “Basics of Mechatronics and Robotics” and “Basics of Quality Management”. The first two are the courses of federal component for “Innovation” and “Mechatronics and Robotics” programs and therefore are the extension of a first-year course “Introduction to Profession”. “Basics of Quality Management” is a part of the University educational programs component and serves for the same purpose for the “Quality Management” program. Implementation of the Worldwide CDIO Initiative Standards and execution of an own Project-Based Group Learning fully corresponds to the modern trends in international engineering education development, where knowledge paradigm of education is replaced by the active-learning approach, putting TUSUR on one level with world educational leaders, such as Massachusetts University of Technology (USA), Chalmers University of Technology (Sweden) and others. However, it is essential to keep in mind that world of engineering thinking does not have territorial boundaries, and international aspects of project-oriented learning should not be left out. At the moment a complex challenge is set for universities of the world, which is to train technically competent entrepreneurs, scientists and engineers, who focus their activities on global development and understand interdisciplinary and cross-cultural connections, as well as know at least one foreign language. TUSUR’s answer to this challenge is presented in the Net Project-based Learning Concept. The aim of the project is to stimulate development of international creative teams within a framework of specific projects. The project implies existence of four key components: increase of practice study hours within specific projects; constantly enriching data base and methods of self-education; close ties between university and industry; development of a project within an international team.

TUSUR has already been conducting such projects for several years. A successful example of the Net Project-based Learning Concept realization is a joint educational course «Global Software Engineering» organized together with Ritsumeikan Asia Pacific University (APU) and dedicated to software development. In 2012, the project leader, developer and main lector, Professor Victor Kryissanov from Ritsumeikan University invited his colleagues from TUSUR to participate in the project with the aim to broaden course’s content and make it more practice-oriented.

Aiming to carry out this educational project teams of Russian and Japanese students are formed each fall semester. Moderators define project theme for current semester collaboratively. The theme is given in a generalized manner, normally only the basic technologies are discussed, for example “neural interface” or “humanoid robot”. Specific content of the projects will be formed by student teams during educational process.

Major part of the course consists of online courses on both distributed software...
development and specific technologies proposed for the semester. Lectures on technologies are led by guest specialists. Thus in fall semester of 2012-2013 lectures on social networking analyses were delivered by professor Uwe Serdült from the University of Zurich, in fall semester of 2013-2014 professor Tomasz Rutkowski from University of Tsukuba gave a speech on neural interfaces and Eugene Shandarov from TUSUR discussed NAO humanoid robot. However the core elements of the course are not the lectures, but rather collaborative student work on projects. Project execution is provided by two virtual teams; each of them consists of equal number of students from Kyoto and Tomsk. These teams have to accomplish the following tasks on a competitive basis:

- Prepare CVs for each participant.
- Outline roles in the team (programmer, designer, team leader, presenter, etc.)
- Choose subgroup leaders (Japan, Russia) for effective cooperation.
- Select communication channels (as a rule, the main communication channel is e-mail, however it could be Skype for collaborative software and hardware trials).
- Specify project’s theme based on the proposed wider themes.
- Prepare project’s presentation for midpoint project defense.
- Ensure collaborative project execution (software code writing, hardware preparation, detailing of each module’s specifications, etc.)
- Conduct collaborative trial experiments.
- Prepare and make presentation and demonstration for project defense.

Thus attendees of the Global Software Engineering educational course not only get theoretically acquainted with distributed software development methodology, but conduct projects using this method by themselves. Owing to the roles outline within teams each student has an opportunity to actively and efficiently participate in the project. It is also essential that communication within teams as well as the education process is conducted in English language, which is a foreign language for both Russian and Japanese students. Real practical results that have to be shown at the final presentation of the project serve as an extra incentive for a more thorough work within the project.

During the 2013-2014 semester two projects on NAO humanoid robot management through neural interface have been conducted. One was designed for development of an application that provides aid for kids with “attention deficit disorder”, the other one was aimed at development of robots’ remote control system. One of the projects’ unique features was that all work concerning neural interface has been done in Kyoto and the one with NAO robot has been conducted in Tomsk. All the trial experiments and developments presentations have been made via free access Internet channels in real-time mode. Projects results have been presented in three conference reports and one thesis paper.

Opportunity for participation in international projects is a strong motivation that leads students to their knowledge enhancement and, besides teamwork skills, provides students with such an important quality as a habit of self-education. It is insufficient to simply download information from the Internet and listen to a course of video lectures from a distinguished professor. It is necessary to have the ability to see aspects of practical knowledge implementation and understand which of the variety of courses will be useful within a specific project.

Owing to the existing educational system and educational methods of the TUSUR Distance-learning Institute students are able to obtain access to the University educational resources not depending on their location. This allows students to constantly improve their professional skills and broaden their professional horizons. Thus Net Project-based Learning leads to student’s transformation from a listener to a man of action. Educational process is retargeted; emphasis is shifted from theory to practice. And most significantly the process of knowledge and skill assumption is deliberate and directly related to execution of real-life tasks [4, pp. 19-23].

Summarizing all of the above we can conclude that an intensive and effective modernization of educational curriculum in accordance with the Worldwide CDIO Initiative Standards takes place in TUSUR. The success of this experience is mainly based on historical prerequisites and both moral and infrastructural readiness to accept the changes: longstanding experience of Project-based Group Learning, distance learning technologies, equipped laboratories, innovative infrastructure, including student business incubator and center for engineering creativity. All of these ensure a more balanced pass to a new evolution level of University’s educational practice and raises chances for TUSUR graduates’ employment. Young engineers trained within this ideology will not be a burden for the enterprises during the adaptation period, but will rather be able to introduce a new vision and take part in optimization and modernization of the production process.

REFERENCES