Theme: Universities as interactive partners

INNOVATIVE EDUCATIONAL STRATEGIES AND APPROACHES FOR BETTER INTEGRATION OF GRADUATES INTO MODERN BUSSINESS ENVIRONMENT

(CASE STUDY OF TUSUR UNIVERSITY, RUSSIA)

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Introduction

University is a constantly evolving entity. Designed for transfer of knowledge between generations, it has to adapt constantly to meet all the new demands of society in the field of specialists' training. The transition from an industrial society to a knowledge society leads to creation of new jobs, and many of these new professions require highly specialized and up-to date training.

Today the ones choosing the profession of engineer come to the university in order to get trained to face real engineering challenges and to be ready to solve sophisticated problems. The

new generation of students wants to have an immediate use of all this knowledge acquired in the university and to become successful and qualified experts right after obtaining their degree.

Unfortunately, due to a number of reasons, classical universities take too long to get involved in the adaptation process. In this never-ending race, universities develop their innovative infrastructure and create new research areas, but it is clear that curriculum, as well as methods of teaching do not undergo significant changes. In Russia, as well in many other countries, it is often the case that university majors, created during the industrial era, fail to keep pace with the development of their associated industry, thus dooming their students in advance to difficult job hunting after graduating. In this case, education contradicts the socio-economic context and needs to be reformed. One of the solutions for this contradiction could be multi-disciplinary research and a more flexible approach to the development of modern skills.

Historically, the higher engineering education is largely focused on the acquisition of theoretical knowledge in various scientific fields rather than on the educational process, considering the last one being already well-shaped and organized. The emphasis in favor of theoretical knowledge and the lack of its integration to practical experiences leads to situation when only 16-17% of classes in the curriculum aim at obtaining design-build experience, the most important part of training for an engineer. In these conditions, the assimilated knowledge through out of the remaining 84% represents only 10%.

It becomes evident that if a university wants to increase the chances of its graduates for further employment, it calls for a careful analysis followed by reform of educational programs. This approach will give to university graduates the opportunity to gain the expertise in different areas of knowledge, will teach them to adapt to the ongoing globalization and have the mindset focused on professional self-development.

State-of-the-art

Historically, TUSUR University always stood out among other Russian universities by virtue of its innovative spirit; it is particularly expressed in its openness and willingness to adopt advanced approaches from leading universities abroad. Thus, in 2006, TUSUR University started to embed in its classical education process a novel approach called "Project-based group learning", that relies on introduction of practice experiences used to reinforce knowledge, research and managerial skills by developing innovative projects. As a rule, these projects aim to create devices, systems or software products with a prospect of commercialization.

As of September 1, 2012, TUSUR had 255 student projects registered, employing 914 undergraduate and graduate students following different curricula. In order to have a holistic approach to the challenges of each project, project teams are formed so as to include members with complementing areas of expertise.

If a student project evolves into a business idea, the group participates in tenders for placement in the TUSUR University business incubator, where the participants will benefit from University business support services: free advice on economic and financial issues, intellectual property office, commercialization unit etc.

In Fig.1, the author describes the way from a student project to successful company, and it can be seen that approximately 4 out of 150 companies per year become real start-ups creating new jobs.

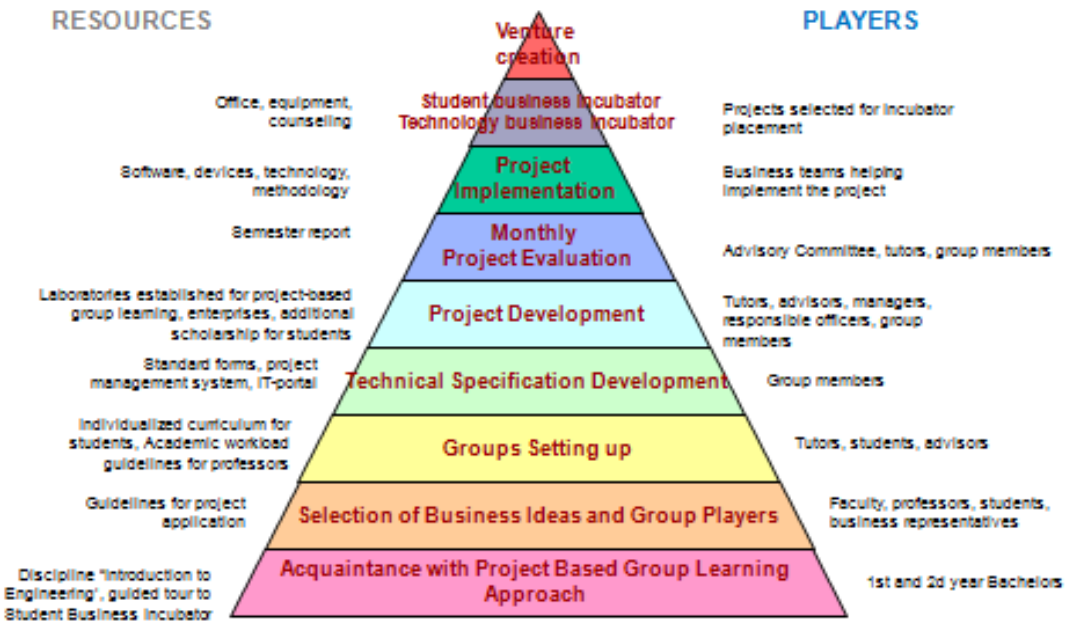

Fig. 1 The way from a student project to an independent successful company in TUSUR University[1]

Project-oriented learning in TUSUR University was partially inspired by the principles of *CDIO Initiative (Conceive-Design-Implement-Operate)*[2], a major international project on the reform of engineering education, developed in 2000 at the Massachusetts Institute of Technology (USA), by Prof. Edward Crowley and his colleagues. CDIO appeal is bidirectional: from one side it is facing the students explaining to them the entire lifecycle of a product and showing the way from idea to its full implementation, on the other hand – it is a commitment that University takes over, saying that it will teach its students to go through all this fascinating experience.

In accordance with the above Initiative, during the training of engineers, University should constantly interact with industry to provide, along with disciplinary theoretical knowledge, advanced practical skills and competencies. Business experience should become a primary criterion for recruitment of University professors, alongside with practice and constant learning process a real design activity will become an integral part of the education process,

[1] The structure is kindly developed and provided by Prof. L. Bokov, Vice rector for Education in TUSUR University, in order to illustrate the structure of project-based group learning in TUSUR University.
[2] http://www.cdio.org/

providing students with the opportunity to apply the acquired knowledge and better preparing them for further job practice.

At the same time, MIT has noticed that teaching specialized subjects only significantly restricts the career opportunities of their graduates, and, ultimately, they will be led by the people who have received a broader education including humanities. To change the situation, it was decided to enhance the share of humanities within engineering education[3].

Professor Henry Etzkovitz and his colleagues analyzed the experience of MIT and other leading universities, and elaborated the concept of *Novum Trivium*, which aims to train "tech-savvy" entrepreneurs, scientists and engineers, focusing their activities on global development, and conscious of interdisciplinary and cross-cultural communication, on speaking at least one foreign language[4].

The last concept does not contradict the first one, as according to CDIO, one of the most important University tasks is to give the student, along with professional experience and skills, the opportunity for developing his or her personal and interpersonal skills that come from communication and team work. This statement is clearly described in Standard # 7[5] (Integrated Learning Experiences) of CDIO Concept.

Another interesting point that is covered in these two concepts is the appeal to the Universities to be closer to the industry, not only for students' training, but also for faculty skills up-grading[6]. It's a very common situation worldwide that most of University faculty settles for teaching only, without having a regular engineering practice. This situation enlarges the gap between the knowledge given to students and the real engineering challenges. The self-evidence nowadays is that the educational process should be led by professors of practice in order to reduce the existing gap. Moreover, the partner-enterprises should also participate in curriculum

[3] Etzkowitz H. (2002) 'MIT and the Rise of Entrepreneurial Science' London Routledge.
[4] Etzkowitz, H., M. Ranga and J. Dzisah (2012), 'Wither the University? The *Novum Trivium* and the Transition from Industrial to Knowledge Society', *Social Science Information* 51 (2) (in press).
[5] http://www.cdio.org/implementing-cdio-your-institution/standards
[6] http://www.cdio.org/implementing-cdio/standards/12-cdio-standards#standard9

development to ensure the relevant and targeted training adjusted to their particular needs and to avoid the loss of time caused by integration of graduates[7].

Analysis made, the management of TUSUR University has resumed that these two cutting edge concepts are highly complementary and are entirely up to the University mission. The University infrastructure for innovation development which includes design offices, shared use centers, student business incubator, technology park, technology business incubator, was extremely helpful in meeting the demands of the companies growing from student projects and better implementing the reform.

Methodology

In this article, the author comments on results of analysis carried out for TUSUR Institute for Innovation. This analysis consisted in comparing the similar curricula in Innovation management in Russian Universities in order to determine the average percentage of hours dedicated to practical activities in the curriculum.

In TUSUR University this major strives to prepare engineers who will contribute to the global scientific development but also will be capable of promoting hi-tech products and commercializing them on the global market. That's why the "weight" of the practical activities in training such specialists is of a particular importance.

In order to verify this hypothesis and prove that project-based group learning promotes successful integration of graduates into the business environment, a survey is carried out regularly among the TUSUR University graduates to identify the conformity of their education with their expectations and business realities. Since 2011 every year 50-70 graduates take part in this on-line survey. 90% of them confirm that "learning by doing" gave them a competitive advantage in job hunting, and as a result they got their positions in hi-tech enterprises right after

[7] CDIO Standard # 3 Integrated Curriculum: http://www.cdio.org/implementing-cdio/standards/12-cdio-standards#standard3

graduating. 60% of these graduates started their own ventures during the first or second year following their graduation. Today TUSUR University has a network of 125 spin-out companies.

Following this study, and based on the University already existing achievements, a new approach called 'International project based learning' was proposed and introduced in TUSUR University by its work group for reorganizing of educational process.

Findings and interpretation

During the study, the curricula of six Russian universities[8] were examined and it was found out that the number of hours for practical experiences for the major 'Innovation management' lies within the range of 13-22%[9]. According to its mission, every University can modify the set of disciplines and priorities of the Program. While some of them are pushing forward the managerial topics and economics, the others are paying more attention to engineering skills. There is no any unified solution for curriculum development all of them should be unique and this is what will influence the prospective students' choice during his career planning. In this context, the project-based group learning implemented at TUSUR University remain a unique phenomenon in Russia (65% of hours dedicated to practical work in the curriculum).

Thus, as mentioned above, most of the educational programs in TUSUR are elaborated in accordance with the concepts of *CDIO Initiative* and *Novum Trivium*, the synergistic effect of this interaction allows us today to state an active participation in project activity during training, the growth of students' interest and early development of their professional skills. In recent years this educational approach led to a significant "proliferation" of small high-tech enterprises initiated by students and graduates of TUSUR University in Russia and beyond.

[8] Tomsk State University; Saint-Petersburg State Polytechnic University; Novosibirsk State Polytechnic University; Kuban State University; Moscow State University of Economics, Statistics and Informatics; Saratov State Technical University

[9] Under the terms of the oral agreement made when the plans were provided to the author, the exact data relating to each particular University may not be mentioned in the article, as it represents the information of a limited use and belongs to University.

The transformation of the entire educational process was made to ensure the transition from the system where University gives students a well-defined set of knowledge (mostly theoretical) to the system where students, in the course their own practice, consciously obtain the necessary knowledge and skills.

Another challenge that Universities face today is the ongoing globalization that pushes Universities all over the world to be more international and introduce international experiences (mobility, international projects etc.)

This tendency made TUSUR University develop the brand new approach called "International Project-Based Learning", and was bases on *CDIO Standards* and *Novum Trivium*. The concept has four basic components:

- *close interaction between University and the future employers,*
- *increasing number of hours dedicated to design-build experiences and to work on group projects,*
- *constantly updated knowledge base and methodology for efficient work,*
- *professors-tutors guiding students through the educational process,*
- *international scale of projects (involving numerous countries*).

To trial this new concept, during the fall semester 2012 a group of TUSUR students followed the online conferences given by professors of Ritsumeikan University (Japan) and University of Zurich (Switzerland). During this course Russian students worked with their Japanese peers on two parallel projects. At the end of the semester students demonstrated their developments on NAO robot. The first project was about creating software for android robot that would go shopping for his owner, socio-oriented technology for people in loss of autonomy. Equipped with a web cam, this robot could be controlled remotely and pick the necessary

products in the supermarket, but also can advise/disadvise on some products based on the information found on the Internet, including social networks, product reviews.

The second project focused on improving the quality of webinars (online seminars) - the robot in this case acts as a lecturer; it can repeat the movement and express emotions, thus creating an illusion of a life communication.

This experience has shown that involvement in such projects is a powerful motivating stimulus that encourages students to replenish their knowledge. The opportunity to work with interesting and challenging projects instills the student, in addition to the ability to work in a team, an important quality as self-education.

Thus, it becomes apparent that a young engineer in order to update this professional competence needs: relevant knowledge base - continuously expanding and well structured data bank, methods of working with such information i.e. assistance of a qualified tutor in shaping his individual learning paths. It is certainly not enough to download courses from Internet or follow an online video lecture by distinguished professor, one must also be able to see all the aspects of the practical application of this new knowledge and to understand which of the huge amount of courses available on Internet will be really useful regarding a particular project.

In TUSUR University this knowledge base was developed by the Faculty of Distance Learning. Due to the distance technologies based on the use of global and local computer networks, the Faculty provides student with access to University educational resources, regardless of the location of the student, thus giving the opportunity to both students and engineers to continuously improve their qualification.

No matter how convenient and project-oriented the distance education is, but still students need real well-equipped workplaces to practice and to make their project experiments. Moreover, it happens that some enterprises are reluctant allow the interns to production lines, explaining that students do not have enough experience of working on their equipment, but also

they will have to invest their time and personnel to "re-train" the interns, because their lack of professionalism may affect the quality of the products and hence the image of the company. In order to solve this problem, joint laboratories should be created between universities and prospective employers, thus providing students with a chance to get the necessary skills intra muros.

Conclusions

The combination of the existing information technologies with modern educational techniques allows TUSUR University effectively develop and implement the new concept of the International project-based learning, which ultimately leads to the transformation of the student role from a ‘passive receiver’ to ‘main actor’ of his own education. Reorientation of the educational process by shifting from theory to practice takes place, and to this extent the most important issue is the acquiring of new knowledge and skills, is henceforth deliberately and directly linked to the practical problem solving.

Industrial enterprises are more likely to employ the students that received a relevant and target education. Since the XIX century university – industry are working closely, making this cooperation more and more beneficial for both sides. Nowadays, the role of the industry is about to change from ‘consumer’ of engineers and technologies to ‘ordering party’. In this context, University should leave behind its role of ‘ivory tower’ and turn to an interactive partner who will benefit from this interaction by having new specialized facilities and equipment, faculty with relevant and up-to-date training, and guaranteed employment for its graduates worldwide.

Directions for further research

The new layer of research, which was discovered in the course of the study, consists in investigating the effectiveness of remote interaction of students and teachers from different countries. To make this cooperation fruitful, it is necessary to take into account all the parameters: jet lag, language difficulties, and psychological aspects.

The work group is also planning to continue reshaping the educational process in the University, trying to approach the project-oriented model of education, described in the International project-based learning concept. As for its efficiency, the authors of the concept consider possible that very soon industries and multinational companies could be interested to join these activities, and become the direct clients or future employers for such international project teams.

References

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3. http://www.cdio.org/