BUILDING SOFT SKILLS OF STUDENTS AT A TECHNICAL UNIVERSITY

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Abstract
Taking into account a rapidly changing environment and the development priorities of National Research Tomsk Polytechnic University ("TPU") building post-professional competencies of students can be viewed as an essential tool for their successful integration into the global job market.

Scientists from a variety of fields claim that the 21st century is a century of knowledge-based economy and drastic changes. All these changes inevitably result in the emergence of a variety of new jobs. The Atlas of Emerging Jobs compiled by Skolkovo is a vision of changes that may happen in the job market in the coming decades. The emergence of new jobs requires the building of new competencies. Soft skills are highly essential due to the fact that their development can increase the work performance significantly.

This paper introduces the concept of soft skills in the context of higher education. Soft skills are defined as an entirety of post-professional competencies and personal attributes that provide an opportunity to achieve the set goals through effective collaboration with others in the rapidly changing environment.

The paper proves the increasing importance of development of soft skills in the context of knowledge-based economy. The paper discusses the experience of the School of Engineering Entrepreneurship at TPU in implementing an educational program aimed at development of soft skills in students from various training programs. The educational program consists of three different modules: 1. Entrepreneurship education. 2. Extracurricular activity related to implementation of social and business projects. 3. Development of entrepreneurial environment at university.

The authors state that the presented educational program supports development of soft-skills in engineering students and that these skills are universal and highly demanded in the present job market as well as hard skills.

Keywords: Post-professional competencies, hard skills, soft skills, entrepreneurial behavior, engineering entrepreneurship, atlas of emerging jobs.

1 INTRODUCTION
More than 30 years ago, a great scientist and the founder of the three laws of robotics, Isaac Asimov, said: "Now is the time when the present turns into the future right before our eyes" [1]. These words are especially relevant today. At the present stage of societal development, we can observe significant changes in all spheres of professional activity. Quality and productivity standards are evolving due to the use of new materials and innovative technologies.

Taking this fact into account, it is reasonable to suppose that the role of educational institutions and training programs is subject to change. The list of core professional competences of university graduates needs some adjustment as well.

This paper attempts to answer the following questions: How should the current educational system be transformed? What and how to teach today's and tomorrow's students?

A great number of articles on soft skills have been published over the recent years. Most scientific articles published in Russian are related to development of soft skills in humanities majors: philologists, linguists, teachers and sociologists [2, 3]. International scientists, however, focus their attention on soft skills development in IT specialists, freelancers, and engineers [4, 5, 6, 7].

Today, we are facing a challenge of forming a conceptual categorical apparatus in this field. Some researchers regard soft skills as a kind of superstructure over professional skills. Possessing equal professional skills, specialists with advanced soft skills improve their work performance significantly [8, 9]. On the other hand, some scientists believe that the concept of "soft skills" is an enormously
versatile and large-scale phenomenon [10]. They suggest that soft skills include attitudinal, behavioral and cognitive components that comprise such interpersonal skills as the ability to communicate, resolve conflicts, negotiate, show leadership, as well as personal effectiveness, active listening, creative problem solving, strategic thinking, decision making, teamwork, etc.

Russian scientists Batalova and Galyuk consider soft skills as a significant factor in increasing the success of solving professional tasks and describe four groups of soft skills: communication skills, managerial skills, effective thinking skills and self-management skills [11]. Shilova considers soft skills to be a set of social and communication skills that enable specialists to communicate and work more effectively in groups and teams [12].

Summing up all the above mentioned, the concept of soft skills attracts attention of many international and Russian scientists. In the present paper, soft skills are defined as an entirety of post-professional competencies and personal attributes that provide an opportunity to achieve the set goals through effective collaboration with others in a rapidly changing environment.

In 2014, the Agency for Strategic Initiatives ("ASI") and the Moscow School of Management SKOLKOVO issued the Atlas of Emerging Jobs [13]. The Atlas of Emerging Jobs was created through a unique to Russia large-scale study Competence Foresight 2030. Over 2500 Russian and international experts took part in the research and analyzed technological, social and economic changes in order to draft "roadmaps" for various industries. As a result of this research 57 professions were considered to be obsolete and decreasing by 2030. The authors also listed 186 new professions that would appear in the near future and tried to predict skills and competencies that will be necessary for future specialists. The experts claim that soft skills are supposed to play a key role in the training of future specialists due to the fact that they allow to increase professional efficiency significantly. Soft skills include creative thinking, teamwork, intersectoral communication, ability to work with artificial intelligence, multiculturalism and multilingualism, lean manufacturing, client-centeredness, ability to handle uncertainty, artistic ability and environmental thinking. In a world that is rapidly changing, it is crucial for an employee to be able to deal effectively with uncertain situations – to make decisions quickly, to respond to fast-changing working conditions, to allocate and redistribute resources, as well as to manage time effectively in a constantly evolving workflow. Development of soft skills is aimed at solving the problems listed above.

In connection with the above-mentioned issues, the following question is arising: How should the current educational system be transformed to develop both hard and soft skills of future specialists?

2 METHODOLOGY

Methods and approaches used in this research include self-assessment interview, self-assessment feedback as well as general scientific methods that enabled an analysis of the present studies in the sphere under consideration, choose the best techniques in teaching soft skills and apply them in the Entrepreneurial Behavior and Engineering Entrepreneurship courses including analysis, synthesis, induction, deduction, descriptive and comparative methods, etc.

3 RESULTS

3.1 Building soft skills in students of the same major

Over the past twenty years, TPU has been implementing a wide range of educational courses that contribute to development of soft skills within the curriculum of engineering university students. In the 1990s this work was carried out at the premises of the Russian - American Center ("RAC") at Tomsk Polytechnic University later reorganized into the Institute of International Management ("IIM") [14, 15]. In addition to basic training, engineering students learnt foreign languages in-depth (English, French and German as a second language), as well as information technology, system analysis, economics, management, and personal psychology. They had an opportunity to participate in foreign language and professional internship programs. It undoubtedly contributed to the building of such essential student competences as ability to work in a team, to manage intercultural communication etc. As a result, graduates became more competitive on the international job market. Currently, they are working all around the globe: in banks in the USA and in the UK; in trading companies in France, Germany and Switzerland; in travel industry in Vietnam, Spain, Slovenia, in the UAE; in oil and gas companies in Denmark, Holland, in the USA etc. Many have started their own businesses in Russia or
work as managers in big Russian companies. Extensive experience in training specialists who are
equipped with soft skills has shown that they became highly valued on the international job market
[16].

3.2 Elite engineering education program at TPU

In 2004, National Research Tomsk Polytechnic University launched a system of elite engineering
training. Each year, promising students majoring in physics, chemistry, mathematics and informatics
are selected for training in the elite engineering education program ("EEE"). The goal of EEE is to train
professionals on a brand new level that are capable of making a complex combination of research,
project, and entrepreneurial activities, and who possess deep fundamental knowledge, have a good
grip of engineering creativity, and are able to work in a team [17].

<table>
<thead>
<tr>
<th>Table 1. Program learning outcomes</th>
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<tr>
<td>In-depth fundamental knowledge (physics, mathematics, economics)</td>
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<tr>
<td>Leadership and teamwork skills</td>
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<tr>
<td>Foreign language communicative competence</td>
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<tr>
<td>Holistic worldview</td>
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<tr>
<td>Competencies in engineering entrepreneurship</td>
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<tr>
<td>Project work, inventive engineering, innovation theory, market knowledge</td>
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Only about 5% of all graduate students at TPU are EEE students. Therefore, the university managers
decided to include the soft skills development program into the curriculum of all engineering students.
The School of Engineering Entrepreneurship founded in TPU in 2018 is aimed to accomplish this
objective.

3.3 Building soft skills in students of different majors

The School of Engineering Entrepreneurship runs various educational programs aimed at developing
entrepreneurial culture and implements educational modules on Engineering creativity, Entrepreneurial Behavior and Innovations for TPU students of different majors. Having studied the Atlas of Emerging Jobs, the teaching staff of the School have developed a soft skills training program for engineering students.

The mastery of these competencies as a result of training was included in the curriculum of the
Entrepreneurial Behavior and Engineering Entrepreneurship courses. TPU students from various
training programs are provided with the opportunity to deepen their knowledge of soft skills by
studying the "Business technology" and "Intra-firm entrepreneurship" minor subjects. The Business
Technology minor subject familiarizes future engineers with the theory of solving inventive problems,
innovative marketing and project management. The Intra-firm Entrepreneurship minor subject
introduces students to the basics of lean manufacturing, logistics, and quality management.

The structure of the Entrepreneurial Behavior course is based on four main principles:

- the ability to set achievable goals;
- the ability to enter the flow state;
- the ability to show flexibility in thinking and behavior;
- the ability to perceive (sensory perceptivity).

In Module 1, using such tools as SMART goals, 5W, Life balance wheel as well as target evaluation
method, students learn to identify the problem, set goals according to their values, evaluate the set
goals, create a goal tree and achieve goals. All this leads to the development of systems thinking
skills.

The next outcome of the course is the development of the ability to find and allocate resources that
contribute to the goal achievement. In Module 2, students explore various forms of personal
resources, determine what prevents them from being in a flow state, examine various types of laziness
and stress, and analyze the “flow state” as described by Mihaly Csikszentmihalyi [18].

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Modules 3 and 4 are aimed at developing flexible thinking and behavior. Business games, case studies and brainstorming techniques are used in class to enhance flexible thinking skills. Students learn to make fast decisions under uncertainty.

The authors believe that students must have the ability to effectively present themselves and the results of their activities to others. Hence, as the final assignment, students deliver a presentation on how they developed the above skills and abilities during their training. 98% of the students who have completed the Entrepreneurial Behavior course note its importance for the training system of future specialists. Some students underline the relevance of soft skills and claim that, before starting this course, they only found it important to develop hard skills. Other students have always felt that soft skills and hard skills both matter and this course enabled them to create their own path of mastering these skills.

In the Engineering Entrepreneurship course, students master various methods of generating inventive ideas. They are introduced to the fundamentals of commercialization of R&D, engineering design activities, risk assessment, statistical methods, etc. As a result, students are able to develop a commercially viable product based on R&D ideas and to work on the resulting project as a team. Over the past year, the students implemented 100 projects and launched 50 startups as part of the course.

Different specialists are involved in the educational process aimed at development of soft skills in TPU students: teaching staff of the School of Engineering Entrepreneurship at TPU, entrepreneurs of Tomsk region, as well as graduates of the School who became project managers.

Extracurricular activities play a major role in development of soft skills of students. Participation in these out-of-the-classroom activities helps students to understand the importance of critical thinking skills, communication skills, project management, time management etc. [19]. Thus, main efforts in building technology entrepreneurship of students are focused on extracurricular activities. For this purpose, a system engaging students in entrepreneurial and innovative activities is being actively developed. Each year over 1,500 students participate in these out-of-the-classroom activities, and 20 of them register new companies.

The implementation of the 3-tier system includes 18 events annually. In the recent years, an integrated system of activities was developed, which includes both commercial and social projects. The TPU team won two years in a row the competition of the Preactum program established by “Rybakov Foundation” - a non-profit organization providing support to young talents in the area of economics and innovations [20]. TPU students presented their developments at the competition and won the main prize – 1 million rubles.

Currently, the development of entrepreneurial ecosystem at the university level plays a significant role in building soft skills in engineering students [21]. We find it impossible to educate all university students as entrepreneurs. According to sociologists and psychologists, only 7 - 20% of the total population are likely to become entrepreneurs [22]. However, we suppose that soft skills development is essential for all graduate students [23].

4 CONCLUSIONS

We conclude that the development of soft skills is an essential component in training of future competitive engineering specialists. As longstanding professional experience of the School of Engineering Entrepreneurship has shown, it needs the fulfillment of various conditions. The key condition is the awareness of university teaching staff of the importance of soft skills in the educational process. The commitment of teaching staff to self-improvement and to transferring knowledge to students using both traditional and interactive learning methods contribute to building of the competencies listed above. Another important factor is the involvement in the educational process of graduates who can share their experience in both commercial and social projects with students. As mentioned above, extracurricular activities play a major role in development of soft skills in students. Hence, an appropriate entrepreneurial environment should be created for the implementation of extracurricular project activities. Multiculturalism and multilingualism of the university environment is another crucial condition. Currently, over 3 600 international students from across 40 countries study at TPU, which makes up to 28.8% of the total number of students at TPU [24]. Cross-cultural communication provides Russian students with an invaluable experience of interaction with representatives of other cultures. Thus, soft skills should be an integral part of student training, as they will help future specialists to succeed in the global job market.
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REFERENCES


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