Practically Oriented Training of Engineers

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Abstract. The paper presents some elements of training engineers in the integrated system “higher educational institution-plant” which is one of the mechanisms allowing the graduates to achieve competitiveness and to be in demand in the present day Russian industrial environment. A special feature of the integrated educational system in Yurga Institute of Technology, Tomsk Polytechnic University affiliate is maximum degree of the training process, production activity and research work integration.

Keywords: Practically oriented training, Professional competency, Industrial practice, Bachelor of Applied Sciences.

1 Introduction

At the present moment it is widely recognized that research and technology, high-tech solutions, science-intensive products and educational potential of the work force are the main driving powers of sustainable growth for every region and for the country as a whole. That’s why technical universities educating selected professionals and establishing engineering potential are to teach their graduates innovative culture, innovative thinking and the basic principles of innovative activity.

Satisfying the demand for qualified specialists for high technology production where the works are completed with the application of welding technologies for constructing, assembling, repairing and reconstructing of technical equipment of hazardous facilities controlled by the Russian Technical Supervisory Authority, is one of the hardest problems to solve for the company managers. At the present moment the labor market is badly in need for qualified specialists. At the same time the qualification of university graduates who obtained classical engineering education does not meet the employers’ needs as the training programs do not keep up with the fast development of production technologies. The gap between the theoretical knowledge of university graduates and the skills and practical knowledge to be mastered in the field of welding production necessary to complete production functions is becoming more and more noticeable every year [1].
2 Innovations in Modern Education

According to new European concepts in the field of technical harmonization and standardization and the Bologna process goals for the time until 2020 [2] improving the professional education quality is to be realized on the base of competency building approach and close cooperation with employers, that’s why personnel training for the social-economic system of the Russian Federation is a mutually rewarding process, both for higher educational institutions and for production. The companies are not only able to provide work places for young specialists but also to assist in the process of young specialist’s training during the whole period of education. Integration of separate elements of the working process into the training system allows forming educational environment satisfying all the modernized economy criteria. Besides, it allows striking the quantitative balance, i.e., providing the amount of specialists which is really demanded by the regional labor market.

3 Training Engineers in Yurga Institute of Technology

The structural subdivision of National Research Tomsk Polytechnic University—Yurga Institute of Technology—uses the integrated model of bachelor training (since 2011) for “Engineering” program, profiles “Welding production equipment and technology” and “Technology, equipment and automation of engineering production”. The given model is based on engineering in-plant training, which represents a special form, and an integral part of the training process based on the personal involvement of students into the production process of Russian companies. The training process combines the following forms: three years of full-time instruction and one (the fourth) year of evening classes.

The integrated model of bachelor training is based upon the integrated training system, which has been tested in Russia for many years in various companies and educational institutions. The integrated training system supposes bringing the educational process closer to production. The educational process is characterized by the iteration of usual terms when the students have full-time training and work terms when the students combine evening classes with the work in the base company. The graduate of this kind of educational institution possesses competencies allowing more successful adaptation in the company and accelerating career growth [3].

It should be noted that the developed countries have always solved the problem of engineering skills training in close cooperation with production. For example, in 1903 Great Britain widely practiced the so-called sandwich courses (alteration of training and working for a company), in the USA a kind of sandwich courses was cooperative education which first appeared in 1906.

In our opinion, the closest model to the integrated education system is the dual system of professional education traditional for Federal Republic of Germany, German-speaking Switzerland, Austria and partly implemented in Denmark [4].

The dual system of professional education in Germany is an educational process combining practical training with part-time employment and studying in a traditional educational institution. Duality means “two-in-one, doubleness”, “integral
organizational whole”. The given form of professional education appeared as a result of social partnership between the employers and the government. Within the framework of the dual form (in a company and at a vocational school) the young people are educated by vocational school teachers and foremen of vocational training who solve different but complementary problems. Cooperation is understood as horizontal coordination of vocational training when the teachers and the foremen of vocational training coordinate their activities at all stages.

The dual professional education system organizationally includes training in a company together with attending a corresponding vocational school in Germany or a college in Denmark one or two days a week and conceptually supposes that theory and practice merge into integral whole, professional skills are trained under the real production conditions, which, finally, leads to high qualification of graduates encouraging their career stability [4].

In Russia engineering in-plant training is becoming especially important due to the changes in the educational standards of Russia and, after completion of the course, the graduate who passes the State Final Examination successfully is awarded the Bachelor’s degree together with the degree of Bachelor in Engineering.

The goal of engineering in-plant training is mastering the professional competencies in the process of training, acquiring practical work experience. The engineering in-plant training supposes studying certain general engineering and special subdisciplines during class hours (lectures, practices, laboratory practicum, seminars, master-classes and so on).

The third generation State Educational Standards for higher professional education aimed at the realization of the basic principles of Bologna process list the general cultural and professional competencies to be demonstrated by the graduates after completing corresponding courses.

The special competencies in most cases are formed by each university independently according to its ideas about the employers’ requirements concerning the graduates. The authors [5] have compared and analyzed the special competencies of the profile “Welding production equipment and technology”, for the training program “Engineering” formulated in the educational programs of various technical universities of Russia. The study showed that the lists of special competences vary to a significant extent and in many cases they are weakly related to production requirements. The developed uniform special competencies for the profile “Welding production equipment and technology” emphasize the importance of practical training. It is the engineering in-plant training that forms production competencies and solves the following problems:

- Consolidates and deepens the theoretical knowledge essential for the technical students to work efficiently under the modern industrial conditions;
- Imparts skills of practical realization of theoretical knowledge in the field of organizing production processes and personnel control;
- Ensures employing the graduates at production according to their business and personal qualities and the company’s needs.

The system of integrated relations between Yurga Institute of Technology and Russian companies and plants supposes the organizational and methodological cooperation of the companies and the institute to be many-component and continuous. Its efficiency is proven in the process of training the students of “Welding production
equipment and technology” profile [6], [7]; that’s why the graduates of the welding production department of Yurga Institute of Technology are popular with large enterprises and companies of oil and gas or engineering industries of Kemerovo and other regions of Russia. The specific character of bachelor training for “Welding production equipment and technology” profile involves preparing a universal specialist able to work in various companies.

To organize the educational process and to implement new federal educational standards we have developed:

- Curricula with a flexible professional training system;
- Work programs of the academic disciplines for engineering in-plant training;
- Study guides and manuals concerning the contents of engineering work and specific features of engineering in-plant training;
- Textbooks, study guides and lectures for the engineering disciplines;
- Programs for engineering in-plant practice.

According to the chosen specifics of training the students of the first and second years have their introduction practical training in the companies of various economic branches which have agreements with the Institute including engineering companies of the region. During their introduction practical training the students receive individual assignments including creative ones.

The theoretical basis of in-plant training is studied in the course of such disciplines as “The basis of engineering in-plant training”, “Construction materials technology”, “Introduction into engineering technologies” and other. One of the positive moments is that the students are certified for the trade of an arc welder or of a controller-NDT inspector of the 2nd or 3rd level. The curricula of bachelor training for “Engineering” program include such discipline as “Engineering in-plant training” (in the 7th and 8th terms), the classes during this period are held at the Institute in the evenings and at the industrial enterprises according to the chosen branch of the company the students travel their way from arc welders, controllers to foremen, technician/technologist, assistant technologist to design engineer, industrial engineer, departmental manager and shop superintendent assistants.

It should be noted that it is very important for technical institute graduates to be able to work under time, competition, market conditions pressure factors and those of new product development costs. Completing purposeful and systematic class and extracurricular cognitive activity within the integrated system “higher educational institution-plant”, allowing wide independence to the students, encouraging their initiative we can achieve positive dynamics in the process of formation of students’ professional competencies.

4 Summary

The presented system of practically-oriented bachelors training does not claim to be the complete solution for the given problem; it can be the basis for further development of efficient approaches to formation of integrated training of “Applied Sciences Bachelors”. Further study of the problem requires continuing work aimed at developing methodological basis, developing academic courses orientated at...
preparing specialists meeting the requirements for the 21st century engineers, technologies implementation and searching new relations with social partners – local companies and educational institutions.

References