Using Modern Technologies in Research Complexes and Laboratories of Saint-Petersburg Mining University for Improving the Preparation Efficiency of Specialists in the Mining Industry

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Abstract. The modern level of development of science, production, equipment and technology ensures a high level of training of specialists, which requires an increase in the pace of social development and an increase in the level of professional education, which involves the search for new forms and methods of teaching. Improving the quality of training students in universities is determined by the use new learning technologies in the educational process, where it is necessary to take into account the peculiarities of the professional competence formation of specialists to work in various industries.

1. Introduction
At the present stage of higher education development proceeding in the new socio-economic, political, cultural and informational conditions more and more high demands are placed on the content of the educational process. Among the most important priorities for improving the training of technical specialties students is the task of introducing new research complexes and laboratories into the academic activity. This factor is due to the ever-increasing need of industrial enterprises and design institutes for highly qualified specialists in the field of design, implementation and maintenance of management systems. The training of such specialists is the main task of higher educational institutions.

World practice has shown that the organization and effective management of production is largely based on information systems of various classes. The enterprises of mineral resources sector need specialists engaged in research, development and practical implementation of information-modelling systems for managing complex energy-intensive objects and their complexes in metallurgy, mining, oil and gas processing.

Thus, the following requirements are raised to higher technical educational institutions: equipping modern computers, expanding the list of special disciplines in the study of which it is necessary to use various types of computer technologies.

2. Introduction Specialists training in the field of automation of technological processes and production in the Mining University
So, in 2006, with the aim of expanding the activities of the Mining University in the direction of training highly qualified specialists in the field of automation of production processes and equipment, the
University Academic Council decided to establish the Department of Automation of Technological Processes and Production (ATPP) at the Faculty of Mineral Processing (former metallurgical faculty).

Employees of the department have knowledge of modern microprocessor technology, in particular, the device of microcontrollers, programming languages; know how to competently use hardware and software for building automated process control systems in various industries; create models of technological processes and industrial enterprise management systems; in the field of scientific studies, they carry out contract-based research with enterprises, issue educational and methodical and scientific literature.

The department was headed by Doctor of Technical Sciences, Professor, Academician of the International Academy of Informatization of the New York Academy of Sciences, Russian Academy of Metrology, International Academy of Ecology and Life Safety, International Academy of Sciences of Higher Education, Corresponding Member of the Russian Academy of Natural Sciences, Ilya Nikitich Beloglazov (1950-2011), whose scientific and pedagogical activities were directly connected with the problems of metallurgy, as well as with the development of modern methods for calculating and modeling chemical engineering techniques.

For many years Beloglazov I.N. was the head of a research area on the study of patterns of chemical and metallurgical processes, the development of new complex technological schemes for processing complex polymetallic raw materials and industrial products, taking into account the solution of environmental issues, as well as methods of modeling and automating chemical and metallurgical processes and devices.

3. Introduction Specialists training in the field of automation of technological processes and production in the Mining University

The laboratories are equipped with the latest technology for automating the production of leading Russian and foreign companies such as Schneider Electric, Matsushita, National Instruments, JUMO, GE Fanuc, programmable logic controllers Zelio, TSX Premium, TSX Quantum, Magelis liquid crystal panels, models of technological objects Festo and et al.

Several training and research complexes with the latest technical means of automation and software from leading Russian and foreign companies have been developed and put into operation. Laboratory complexes are equipped with appropriate methodological support – methodological instructive regulations and study guides.

One of the research complexes used also in the process of teaching students is the Center-Laboratory of Intelligent Measuring and Control Systems (Fig. 1).

![Figure 1. The Center-Laboratory of Intelligent Measuring and Control Systems.](image-url)
The center-laboratory is based on National Instruments controllers and LabView application development tools to develop and promote «virtual instruments» technology for measuring, control and automation, as well as to study a wide range of high-tech monitoring equipment.

At present a graphical programming environment of software LabView is a standard for the development of «virtual devices» and is widely used to create automated test and measurement systems in industry, research centers, design institutes and educational institutions.

In addition to scientific research, the Center-Laboratory provides training for students as part of the curriculum. Students who have disciplines in the curriculum related to the study of modern methods and technical means of automating processes and production, listen to lectures and perform a number of laboratories works aimed at studying modern microprocessor and transforming equipment, network technologies, top-level software for an automated process control system (SCADA-systems) and production management systems.

For teaching students of Oil and Gas Engineering at the Department of Automation of Technological Processes and Production, an educational and scientific stand «Intellectual Information Management System in the Oil and Gas Industry» (Fig. 2) was designed and implemented to study the processes of primary oil refining, hydro- and aeromechanics and heat exchange, detection and construction of control loops by technological parameters.

The stand provides an opportunity to students to simulate various technological processes in the laboratory and work out various schemes for managing industrial facilities, allows to study and develop technical measurement tools, software, visualization tools and data networks. As part of research projects, talented students, under the guidance of teachers, develop and synthesize SCADA-systems to provide automated process control.

The «Explosion-proof automated control system of conveyor transport and loading and un-loading machines in mines» installation (Fig. 3) is designed to simulate the operation of conveyor transport and loading and unloading machines used in mines.
4. Competence Center of the Mining University
The Mining University has established long-standing and mutually beneficial ties with one of the world’s leading companies in the field of energy systems and process automation «Schneider Electric». The equipment of the Schneider Electric company is effectively used at the departments of the university for more than 10 years in the educational process and research work, the staff and students of the university did an internship at the enterprises of the company. One of the forms of mutual cooperation is the creation of the Competence Center «The Mining University – Schneider Electric» (Fig. 4).

![Figure 4. The Competence Center Modules.](image)

For the first time in Russia in June 2016, Schneider Electric and The Mining University organized and created the Competence Center in a 3-modular scheme:
- Module 1. Scientific researches.
  Conducting Research Activity and Research and Advanced Development on state scientific projects and programs, grants, fiscal, contract-based and initiative topics. Development of stands, devices and automated systems for branches of the Mining University, departments and other units of the Mining University and outside organizations. Conducting scientific and technical conferences and seminars in areas related to the automation of technological processes and production, reliability and quality of electric power supply based on industrial hardware and software automation «Schneider Electric».
- Module 2. Supplementary vocational education center.
  Professional retraining and advanced training of specialists in the oil and gas, mining and metallurgical industries of Russia in the areas of ensuring reliable electric power supply of enterprises and automation of technological processes and production based on industrial hardware and software of «Schneider Electric» automation software.
- Module 3. The academic activity.
  Training of students, post-graduate students, staff of the Mining University and its branches, as well as representatives of outside organizations in areas and specialties related to the automation of technological processes and production, improving the reliability of power supply and quality of electrical energy, as well as protecting the main electrical equipment of electrical networks on the basis of industrial technical and software automation «Schneider Electric».

5. The main scientific-research directions of the Department of automation of technological processes and production of the Mining University
The scientific-research directions of the Department of Automation of Technological Processes and Production in the Mining University are quite diverse and are aimed mainly at developing modern technologies and process control systems that provide comprehensive mineral processing based on «Industry 4.0» technologies and Big Data. Among the main areas of the scientific-research directions are the following: the development of technology for the integrated gasification of coal in the conditions of the Far North; development of technology for complex processing of solid, liquid and gaseous
wastes of steelmaking; development of advanced digital intelligent and robotic mineral processing technologies; conducting analytical studies; creation of training stands and simulators for enterprises.

6. Conclusion

It is obvious that the use of the scientific-research complexes in the educational process has a positive effect on improving the efficiency of the educational process, since the quality of education received by a student is determined both by the level of theoretical training and the ability to use the knowledge gained in practice.

The student acquires practical skills through laboratory work on various stands and installations, which presuppose physical modeling of the technological process in a simplified form, specially envisaged in the curriculum. Students acquire skills in working with models of technological processes, and also have the opportunity to equip it with sensors, effectors, and to provide interfacing with a computer through input-output modules.

Students are given the opportunity to back up their theoretical knowledge with practical laboratory skills in solving typical problems in the field of industrial automation in view of studying programming languages focused on the creation of control algorithms, while working in laboratory settings.

As the result, the use of the scientific-research complexes in the educational process provides an opportunity to form the socio-professional competence of university graduates, thereby improving the quality of education.

7. References

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