

# Professional Standard as an Incentive for the Development of Polytechnic Education

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**Abstract.** Innovative processes in production require updating the skills of staff. Modernization of the construction industry is based on the introduction of information modeling technologies of construction projects. One of the tasks of modernization of the construction industry and improving the quality of construction is the training of specialists in the field of building information modeling (BIM). The study of the basics of information modeling should be an integral part of the polytechnic education of all specialists in the construction industry. It is necessary to reform professional construction education and develop both educational programs for students of colleges and universities, and programs of advanced training courses for already working specialists. In Russia professional educational programs should be developed taking into account the requirements of professional standards. The project of a new professional standard of a specialist in information modeling in the field of construction is proposed. The generalized labor functions, requirements to education of specialists of different level of qualification are described. The international experience of the description of specialists qualifications is used. The draft professional standard is under discussion within the construction professional community of Russia.

## 1. Introduction

The modern labor market imposes strict requirements to the competitiveness of specialists. It should be noted that the strengthening of innovative processes in the field of modern production requires the acceleration of the process of updating the knowledge of staff. Most workers will need to change their specialty and/or qualification at least 4-5 times during their working life in order to keep up with the changes that occur in production.

Rapid obsolescence of knowledge is observed in various fields. For example, in the chemical industry knowledge becomes obsolete every 4.8 years; in advertising – 5 years; in business – 2 years, in metallurgy - 3.9 years; in engineering — 5.2 years [1].

In the field of construction technology has changed little over the past 50 years and labor productivity in the industry has not increased [2]. The construction sector of the economy has not been transformed and does not use the achievements of technology. Low expenses for R&D (Research and Development) and information technology are marked. It is necessary to introduce digital technologies, new materials and automation. Changes in the construction sector cannot be achieved without investment in re-equipping and changing the composition of the ageing workforce.

Construction companies and workers must constantly change their skills and learn to use the latest equipment and digital tools [3].

Russia is preparing to approve the "Strategy of innovative development of the construction industry of the Russian Federation for the period up to 2030". The main objectives for the modernization of the construction industry and improvement of the quality of construction are identified, among which:

- transition to the life cycle management system of capital construction projects through the introduction of information modeling technologies;
- training of specialists in the field of building information modeling (BIM) [4].

The ways of training specialists in the field of information modeling in construction were discussed at the world economic forum (WEF) in February 2018. The proposed approach was the following. "Education must be reformed to provide prospective employees with necessary BIM skills as well as the interdisciplinary skills required for BIM collaboration. Courses should teach students tangible, applicable BIM knowledge through practical, hands-on training. Universities, vocational and professional training providers should integrate BIM into general design and engineering classes rather than offer courses as electives or add-on. Upskilling the existing workforce can be done on the job or in the classroom. In either case, IU companies and industry associations should work with professional providers and academia to develop upskilling courses" [5].

The study of information modeling technologies of construction objects can be considered as an element of polytechnic education in the field of construction. Regardless of the future specialization (developer, designer, builder, etc.) the student must have an understanding of the principles of BIM and the ability to use digital tools for collaboration.

One of the ways to create a sustainable and effective interaction between the sphere of labor and education is the development of a professional standard. Professional standard provides guidance to professional organizations in the selection of employees and guidance to educational organizations in determining the goals and content of educational programs.

This study discusses the development of the professional standard of specialist in the field of BIM in order to develop polytechnic education for the construction industry in Russia.

## **2. Materials and methods**

The tasks and content of polytechnic education, principles of BIM and peculiarities of Russian professional standards were considered in the course of the research.

### *2.1. Polytechnic education*

Polytechnic education is the method of organizing the content and teaching of subjects and courses. It involves familiarization with the basic principles of modern production and the underlying laws of nature and society. Polytechnic education acts as a foundation for further education. The main tasks of polytechnic education at the present stage are:

- to show the technological application of the laws of physics, chemistry, biology, computer science and other Sciences;
- to provide knowledge on the basics of modern engineering, technology, economy and organization of production;
- to form students' skills and abilities to use modern tools, means of mechanization and automation, methods of process control;
- to form the general labor qualities of the person, and the ability to work collectively.

The content of polytechnic education is the system of knowledge about modern production and human activity. Polytechnic knowledge is a simplified model of typical production and technical problems that professionals have to solve in practice [6]. Higher polytechnic education is often called engineering education.

Trends in the development of polytechnic education are described in article [7]. They are related to the development of worldwide achievements in science, technology and culture. The content of engineering education is also influenced by the territorial factor, which, in turn, is determined by the

needs of economic development of the country or region. In article [8] it is shown that the basis of modern technologies are interdisciplinary studies that determine the need to teach engineers to use innovations.

Polytechnic principle requires to build educational process in such a way that students could form knowledge of the scientific foundations of modern production and they could acquire generalized skills used in many types of industrial and technical activities. Modern polytechnic education is closely connected with information and communication technologies.

### *2.2. Building information modeling*

Building information modeling is digital representation of information about the construction project.

The main features of BIM are:

- formation of a 3D model of a construction object;
- object-oriented approach to modeling;
- parametric modeling and establishment of associative dependencies;
- storage of geometric, physical and any other information about the construction object;
- collaborative work of specialists on the basis of a single information model;
- use of BIM throughout the life cycle of the construction project.

BIM data is formed, processed, transmitted and stored to solve various construction tasks. Management decisions are made on the basis of the information model data analysis. A variety of technical documentation and expertise is also formed on the basis of BIM data. The information model allows to simulate processes and to predict situations [9].

The study of the basics of information modeling technologies can be part of the course of Informatics for higher construction education. The use of information modeling technologies for solving specialized problems can be considered in the course or diploma project. It is possible to develop a special educational program for in-depth study of information flow management in collaborative processes of information modeling. In article [10] questions of creation double programs of magistracy education are considered. Similarly to the proposed model of education, it is possible to master dual education programs, for example, the program on construction technologies and the program on information modeling technologies. Specialists which is already working in the field of construction can learn the basics of information modeling technologies through the development of education programs.

### *2.3. Professional standards*

In Russia, professional educational programs should be formed taking into account professional standards. Professional standards set requirements for knowledge, skills, competencies, experience, value system and personal qualities necessary to perform a particular job or professional duties. These requirements to qualification of workers are caused by the applied technologies and the accepted organization of production and work. Accordingly, if production technologies change, new skills and even professions are required. The article [11] analyzes the prospects of Russian higher education in the field of education in the conditions of growing technological innovations. The article discusses the problem of the future of Russian education in connection with the emergence of new competencies and changes in the classifier of professions. In article [12] the various educational models for the conjugation of higher education and the labor market are analyzed and the lack of connection between educational models and the requirements of employers is concluded.

The structure of the professional standard in Russia includes the description of labor functions, labor actions, requirements to education, and also knowledge and skills which the expert has to possess. The levels of qualification and the corresponding levels of education of specialists are determined. Qualification level 5 corresponds to secondary professional education. Qualification level 6 corresponds to the level of bachelor's degree. Level 7 corresponds to the level of the magistracy. Thus, the professional standard is an invaluable source of information in the formation of educational

programs for different levels of education. The professional standard helps to describe the planned results of education, to develop the content of practical tasks and to form appropriate evaluation tools.

What if there are no professional standards for new production technologies and labor organization? Professional organizations and organizations for the assessment of qualifications should fill this gap. If the professional community is not ready to understand the new trends, educational organizations can take the initiative to develop the necessary professional standard.

In the course of this study, a draft professional standard "Specialist in information modeling in the field of construction" was developed.

### **3. Results**

The international experience of describing the qualification of experts participating in processes of information modeling of construction objects has been analyzed [13]. Many countries already have extensive experience in applying information modelling at different stages of the life cycle of capital construction projects. International and national instruments [14, 15, 16, 17], which define the roles, functions and basic knowledge of specialists involved in the collaborative work on the creation and use of the information model of the object were developed. In many countries that do not have their own qualification requirements the basic knowledge is based on the qualification requirements of the international organization buildingSMART.

As a result of the research, a draft professional standard was developed. The main purpose of the new type of professional activity was declared as "creation, use and maintenance of information model of construction object at all stages of its life cycle". It suggested the following generic job descriptions and the corresponding skill levels:

- Technical support of information modeling of construction projects (5 level of qualification);
- Creation and use of disciplinary information models of construction object at different stages of its life cycle (6 level of qualification);
- Organization of creation and use of disciplinary information models of construction projects (6 level of qualification);
- Management of processes of information modeling of construction object (7 level of qualification);
- Management of the implementation, support and development of information modeling technologies at the organizational level (7 level of qualification).

In conditions of acute shortage of staff the draft professional standard requirements for specialized education are described widely enough. The described works can be performed not only by specialists with constructive education but also by specialists with education close to construction or to applied information technologies. Taking into account that information technologies and, accordingly, information modeling technologies are developing with great speed, it is recommended to carry out advanced training of all specialists at least once every three years. Requirements for basic knowledge in the development of educational programs should not be lower than similar international requirements.

The Russian organization "BIM Association" has taken the task to develop a professional standard "Specialist in information modeling in the field of construction". The proposed draft professional standard is taken as a basis. Currently, this draft is being discussed in the construction professional community.

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