FORMAÇÃO DE COMPETÊNCIAS DE LIDERANÇA DO ENGENHEIRO CIVIL RUSSO MODERNO NO PROCESSO EDUCACIONAL

FORMATION OF LEADERSHIP COMPETENCIES OF MODERN RUSSIAN CIVIL ENGINEER IN THE EDUCATIONAL PROCESS

ФОРМИРОВАНИЕ ЛИДЕРСКИХ КОМПЕТЕНЦИЙ СОВРЕМЕННОГО РОССИЙСКОГО ИНЖЕНЕРА-СТРОИТЕЛЯ В ОБРАЗОВАТЕЛЬНОМ ПРОЦЕССЕ

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Received 21 November 2018; received in revised form 30 December 2018; accepted 07 January 2019

RESUMO

O artigo apresenta a visão do autor sobre o novo curso de formação "Gestão de Pessoal" para os formadores de mestrado, com o objetivo de formar competências de liderança. É necessário mudar o paradigma de formação de um engenheiro e incluir no processo de formação os temas que visam formar suas competências organizacionais, liderança, responsabilidade de tomar decisões no campo da gestão de equipes. Como parte da nova abordagem de treinamento, propõe-se construir as habilidades de liderança com a ajuda de métodos de ensino ativos: jogos de negócios, equipes de projeto, estudos de caso, treinamento. Baseando-se na experiência de trabalho e desenvolvimento curricular, sabe-se que a principal dificuldade para os compiladores de currículos é uma seleção dos assuntos que ajudarão a implementar essas competências. Por isso, propomos o tema (módulo) "Gestão de pessoas", que tem a base profunda do conhecimento de muitas questões pessoais e é composto por um conjunto de temas interdisciplinares com um conjunto de novas ferramentas de atividades. A condição para a formação de engenheiros civis é aumentar o componente de atividade: aplicação de gerenciamento de projetos, trabalho em pequenos grupos (equipes), iniciativa CDIO, abordagens interdisciplinares, treinamento orientado para a prática.

Palavras-chave: *liderança, equipe de projeto, competências gerenciais, educação em engenharia, formas e tecnologias de trabalho gerencial.*

ABSTRACT

The article presents the author's view on the new training course "Personnel Management" for master-degree builders aimed at forming leadership competencies. It is necessary to change the paradigm of training an engineer and include in the process of the formation such subjects that are aimed at forming his or her organizational competencies, leadership, responsibility for making decisions in the field of team management. As a part of the new training approach, it is proposed to build the leadership skills with the help of active teaching methods: business games, project teams, case studies, training. Basing on work experience and curriculum development, it is known that the main difficulty for compilers of curricula is a selection of those subjects that will help to implement these competencies. Therefore, we propose the subject (module) "Personnel management" that has the deep basis of knowledge of many personal issues and is made up of a set of interdisciplinary themes with a set of new activity tools. The condition for the training of civil engineers is to increase the activity component: application of project management, work in small groups (teams), CDIO initiative, interdisciplinary approaches, practice-oriented training.

Keywords: *leadership, project team, managerial competencies, engineering education, forms and technologies of managerial work.*

АННОТАЦИЯ

В статье представлен авторский взгляд на новый учебный курс «Управление персоналом» для магистров-строителей, направленный на формирование лидерских компетенций. Необходимо изменить парадигму подготовки инженера и включить в процесс формирования такие предметы, которые направлены на формирование его или ее организационных компетенций, лидерства, ответственности за принятие решений в области управления командой. В рамках нового подхода к обучению предлагается развивать лидерские качества с помощью активных методов обучения: деловых игр, проектных команд, тематических исследований, обучения. Основываясь на опыте работы и разработке учебных программ, известно, что основной трудностью для составителей учебных программ является выбор тех предметов, которые помогут реализовать эти компетенции. Поэтому мы предлагаем предмет (модуль) «Управление персоналом», который имеет глубокие знания многих личных вопросов и состоит из набора междисциплинарных тем с набором новых инструментов деятельности. Условием подготовки инженеров-строителей является увеличение компонента деятельности: применение управления проектами, работа в малых группах (командах), инициатива CDIO, междисциплинарные подходы, практико-ориентированное обучение.

Ключевые слова: *лидерство, проектная команда, управленческие компетенции, инженерное образование, формы и технологии управленческой работы.*

INTRODUCTION

In terms of integration of Russian economy into the world economic space and creation of a modern economy of innovative type, where high-tech branches are breakthrough, the preparation of highly professional engineering personnel is an important and successful component of the transition to a new economy. Therefore, modernization of higher education and transition to professional standards of activities implies the introduction of innovative approaches to the formation of competencies of master's degree graduates of engineering specialties (Froli and Laconne, 2018; Gravit *et al.*, 2018b; Kalinina and Valebnikova, 2018).

As known, a young, competent engineer-builder can quickly move up the career ladder, and become a leader of the lower and middle level already in the age of 25-30 years. Such managers often do not meet important requirements, which leads to frustration in themselves, their work and their competence. Technocratic management style, so common in the Soviet period, has become popular again, although it is absolutely not suitable for all production situations. For effective leadership in a new management environment, in the era of globalization, project management, it is extremely necessary to acquire management skills, situational leadership, teamwork, project

management skills (Nagymzhanova, 2013; Amirova *et al.*, 2016; Rogach *et al.*, 2016). However, it is still problematic to obtain such skills at the university due to poor understanding of their need, so today this is possible only by visiting various costly seminars and training (Stritch and Christensen, 2016; Ilin *et al.*, 2016; Larsson *et al.*, 2015).

An important change in the training system was the transition to the training of specialists with a set of necessary competencies set forth in the Federal state educational standard, as well as professional standards. However, despite positive developments, a number of traditional contradictions still operate in the training of engineering personnel, in particular, the principle of interdisciplinarity has not been sufficiently implemented (Rottmann *et al.*, 2015; Itani and Srouf, 2015; Hartmann and Jähren, 2015; Kirillov, 2015; Akhmetshin *et al.*, 2018).

Among the scientists who covered this problem, we can distinguish the following: Yu. Poholkov, R. Martínez-López, M. Reznichenko, C. Yot, C. Marcelo, F.T. Shageeva, V.G. Ivanov, A.A. Dulzon and others. All of them are discovering the problems of forming a modern, innovative leader on the basis of an interdisciplinary approach to education. However, this approach is not fully realized in the educational environment (Gravit *et al.*, 2018a; Zotkina *et al.*, 2018; Tepe,

2016).

In the authors' opinion, the main contradiction is the traditional approach to the formation of educational programs, a functional look at a set of subjects (modules). The world is becoming more dynamic, and the results of the training of civil engineers in the master's degree require that they must be prepared not only for technical issues, but also able to competently conduct a dialogue with resource providers, personnel, clients, be able to build relationships in project teams, be responsible, establish communications, in other words, apply necessary strategies and technologies in field of human resource management (Buley *et al.*, 2016). There is a need for training and development of these skills in training programs for engineers. The socio-humanitarian component of knowledge, which is implemented in a classical manner, is not able to satisfy all the needs of an engineer, since the young specialist needs knowledge of practical (behavioral) instruments of influence on subordinates, knowledge of interpersonal communications, and the ability to see the consequences of their social actions (Kopytova, 2016; Kopytova, 2017; Zotkina *et al.*, 2017; Pykhtin *et al.*, 2017).

The main task of training masters, in authors' opinion, should be a paradigm of quality, rather than the number of subjects in training, as well as the orientation towards modern requirements for the leaders of organizations set out in the Professional Standards. The tasks to be solved during the training are to form a unique, modern, understandable and course based on active forms of training in the field of human management in the context of globalization and internationalization of business; to indicate the need to form this course on the basis of knowledge of human management, based on a more practical basis, rather than the classical disciplines (Vetrova, 2016).

As noted at the session on the project "People-X", which took place on September 10, 2016, in the Russian Presidential Academy of National Economy and Public Administration (RANEPA), "Education should be taught to work with knowledge on practical examples."

METHODS

The benchmark analysis of the best practices of implementing a competence

approach in leading technical universities in Russia, as well as some foreign universities and similar comparative analysis in universities implementing training programs for builders, was used as methods for investigating the problem.

The concept of CDIO was adopted as a basis for modernization of engineering education in Russia. It sets the principle of preparing graduates for integrated engineering activities at all stages of the life cycle of products, processes, and systems (Zotkina, 2011; Lezier *et al.*, 2017a; Kazannik, 2012; Lezier *et al.*, 2017b).

In this connection, the training plans for engineers based on the CDIO criteria were studied on the basis of the analysis of university websites and scientific literature in order to identify a list of subjects that include implementation of necessary competencies: General cultural competence (GCC)-2 – willingness to act in unusual situations, carry social and ethical responsibility for decisions;

General professional competence (GPC)-2 – readiness to lead the team in sphere of professional activity, tolerantly perceiving social, ethnic, confessional and cultural differences; GPC-3 – ability to use in practice skills in organization of research and scientific and production work, in the team management, influence the formation of the team's goals, influence the socio-psychological climate in the direction necessary to achieve the goals, assess the quality of activity results, ability to active social mobility.

Review of modern educational practices, based on a study of experience in solving similar problems in engineering master programs of Russian and foreign universities according to the websites of universities and other publications, showed the following (Table 1). Analysis of foreign experience shows that advanced and some developing countries have already created (create) conditions for full implementation of CDIO initiative. There are necessary subjects and modules in the curricula (Makushkin, 2016).

Analysis of Russian practice of implementing Master's programs in the direction of "Civil Engineering" (more than 60) in 8 national research technical universities and four civil engineering universities showed that most often subjects of humanitarian profile are aimed at formation of above-mentioned competencies, for example, "Basics of Pedagogy and Andragogy" are realized in 50 programs, on the second place

are "Psychology and ethics of business communication", "Social, psychological, legal communications", "Basics of scientific research", "Basics of professional activity", as well as pedagogical practice (the practice of obtaining primary skills and competencies), the state final attestation. Less common are "Philosophical Problems of Science and Technology", "Organization of Planning and Construction Management", "Quality Management", "Methods for Solving Scientific and Technical Problems in Construction", etc., where obtaining the above-defined skills is not always the subject of this discipline.

It can be said that universities, implementing modern principles of education, go from the possible, not focusing on the development of more adequate disciplines, modules. And only in one program "Value Engineering" of the Don State Technical University, there is the subject "Human Resource Management", which in its name and content is the closest to the formation of the above competencies.

RESULTS AND DISCUSSION:

At the Tyumen Industrial University, methodical approach to the development of assigned by FSES competencies was formed thanks to the successfully implemented for more than 10 years higher education program "Human Resource Management". Therefore, the subject "Personnel Management" in the second semester as a basic discipline of cycle B1 in all master's programs is taught on the basis of the high quality of training, experience in teaching subjects of managerial nature. In addition, other subjects and practices are directed to the formation of competencies, which can be seen in Table 2.

In the subject "Human Resource Management", all the required competencies are implemented at a high level in the format of modern pedagogical technologies containing practice-oriented training. This is a complex interdisciplinary, quite labor-intensive course, which includes the following structure (Table 3, on the example of master program "Management of the construction organization" of the direction 08.04.01 Civil Engineering, in the context of obtained competencies).

All the topics of lectures are supported by practical classes, which are implemented in the

format of business games, training, case studies. The method of teaching is based on the principles of HR-engineering and project management. HR-engineering is the methodology of system organization of human resources management, integrating human, corporate architecture and information technology. The methodological basis of HR-engineering is the system approach (basic methodology), business-engineering and socio-psychological approaches.

As a result of work on the course and an attempt to make it meaningful and useful, authors have formed such a list of topics that are maximally focused on the work of the leader in the team. It is obvious that nowadays only leading universities of the country (national research technical universities) are set for the training of new engineers-leaders: curricula have all the necessary modules and subjects for the formation of managerial competencies.

The analysis of curriculum of civil engineers showed that almost all specialized universities lag behind the leading ones in the formation of actual educational programs for the training of engineers, and most curricula do not include subjects aimed at developing managerial competencies. Despite the existing training and seminars, which are now very popular, it is important for a young specialist to gain primary skills in personnel management in the university, in the familiar environment, and to work with the team, having already acquired necessary knowledge and skills.

Due to the preservation of tradition in training of civil engineers, it is very difficult to find a master's program in which approach to the formation of managerial competencies has been competently implemented. The main choice of compilers of curricula for civil engineers falls on the subject "Fundamentals of Pedagogy and Andragogy", as well as "Psychology and Ethics of Business Communication", "Social, Psychological, Legal Communications", "Fundamentals of Scientific Research". For example, according to the site of the Moscow State University of Civil Engineering in the curriculum "Fundamentals of Pedagogy and Andragogy" for students of the direction 08.04.01 "Civil Engineering" there are sections "Pedagogy as theory and practice", "Teaching and methodical work of the teacher of higher education School". Apparently, the main emphasis in the program is on the formation of methodological competences of the civil

engineers for work in the education system. There is a traditional approach to teaching, following the old approaches to the formation of curricula based on didactics. Nevertheless, it wasn't found a connection between the subject of lectures and the competencies indicated in the curriculum.

However, in order not to violate the established approach, but to approach formation of leadership skills of engineers in an expanded format and make them relevant, some universities offer a proposal in the form of additional professional education programs. For example, an extensive list of such programs was announced on the website of the St. Petersburg Polytechnic University. There were developed and presented additional educational programs "Head of the construction organization" and others to receive economic and managerial competencies, including Module 10 "Personnel Management" in the program "Industrial and Civil Construction", Module 2. Management of the project team in the program "Economics and Organization of Construction", Module 9 "Business Communications and Personnel Management" in the program "Head of the construction organization." In our opinion, the content of the federal educational standard is missed, and the formation of relevant competencies is being offered by the university on a commercial basis, not only to practitioners but also to students. In this university in the master's program for the formation of these competencies, the disciplines "Teamwork and business communications", "Project management" are offered.

The subject "Psychology and ethics of business communication" also does not cope with the formation of leadership competencies, since, it often presents to the students more tools for interaction in isolation from the practice of their application in a professional environment. On the basis of the conducted research, it becomes obvious that our system of training of civil engineers is still far from penetrating into it the principle of interdisciplinarity and team approach, which is incorporated in authors' training course.

CONCLUSIONS:

A solution of the task of preparing a modern civil engineer is now in front of all technical and civil engineering universities. For

authors of this article, it is important to develop and implement a training discipline that covers the full range of managerial competencies. Therefore, the discipline "Personnel management" with necessary competencies is taken as a basis. The course is aimed at the formation of practical skills of construction engineer in the team so that he can be an active leader of any team: from the master to the head of the construction site, from the head of the project team to the chief engineer of the project.

Proposed discipline "Personnel management" is a kind of "response" to the request for practice in the formation of a modern leader in the knowledge economy. It differs from many disciplines because it includes the development of not only communication skills but also teamwork. Undoubtedly, this is a necessary cross-section of competencies in the horizontal direction but also aims at developing leadership skills – team management, distribution of functions, management of the cross-cultural environment, which makes the study of discipline voluminous, and covers vertical development of leadership.

ACKNOWLEDGMENTS:

The research was performed in the framework of the project Smart-City, IoT/IloT, and Big Data.

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Table 1. *Analysis of the best educational practices*

University/educational standard	Practice	Main trends
Foreign experience		
International standards CDIO – (Conceive, Design, Implement, Operate).	MIT (Massachusetts Institute of Technology). The basis for modernization of engineering education in accordance with the concept of CDIO is the preparation of graduates to integrated engineering activities at all stages of life cycle of products, processes, and systems.	The standards provide for the systematic training of engineers who can generate ideas, design, produce, operate and dispose of engineering products – perform all 4 stages of engineer training. Managerial competencies are provided in the second stage Syllabus: 2. Professional and personal qualities: 2.5. Ethics, justice and other kinds of responsibility. 3. Universal competencies: teamwork and communication. 3.1. Teamwork. 3.2. Communications.
RMUTT Rajamangala University of Technology Thanyaburi	The program of industrial engineering – beginning of implementation in 2015.	It places emphasis on the formation and development of work skills in the project team communication, personal skills. The subject "Human Resource Management" is taught in the second semester of the 1st year
Singapore Polytechnic	Adapted secondary vocational education programs have been developed, based on the planned results of CDIO training	The list of knowledge and skills, apart from the fundamental ones, includes additional competencies: ability to solve problems, ability to manage human resources, ability to work in team and build communication, and ability to rely on professional ethics and values in work activity
University of Debrecen, Hungary	Solving the problem of "low level of professional and universal skills of graduates of engineering specialties"	Humanities and economics account for 16% of the labor intensity, various interdisciplinary programs are being created
Russian National Universities		
National Research University "Tomsk Polytechnic University"	In 2012, a new version of "Standards and guidelines for quality assurance of the main educational programs for the training of bachelors, masters, and specialists in the priority areas of development of the National Research Polytechnic University of Tomsk" was put in place	Basing on the low results of assessing leadership in engineering activities by employers, an additional supplement to the basic vocational education program was developed, alongside the program "Elite Technical Education", which includes the module "Innovative Leadership"
Siberian University	Federal Development of training technology and formation of professional competencies as a result of training in educational programs of the project "Special engineering education" using network interaction	In the curriculum in the subject "Basics of projecting" the module "Project Management" is proposed, within which framework the subject "Organization and Personnel Management" is implemented, and also the subject "Leadership Program" offers the topic "Leader and Teamwork (Trainings)"
Kazan National Research Technological	Training of personnel for the "economy of new knowledge"	The main emphasis is on the development of leadership qualities,

University (KNRTU)		development of individual intellectual resources in the implementation of the psychological module
Northern (Arctic) Federal University named after MV Lomonosov.	Modernization program of engineering training areas based on international standards CDIO	Strategic planning, scientific research practice, industrial and technological practice, organizational and administrative practice
Russian State University of Oil and Gas named after IM Gubkin	Implementation of the principle of interdisciplinarity in the system of innovative projects of the XXI century University on the development of competencies of young specialists and industry workers	The project "Virtual environment of professional activity as a learning environment" is of the greatest interest, as well as joint virtual training for students in various training areas. The disadvantage is methodical complexity in preparation of cases
St. Petersburg Mining University	Subjects and Practices: Fundamentals of pedagogy and andragogy Research Practice Pedagogics Project and technological practice State final attestation	The programs are based on traditions of the didactic approach, separate topics of courses (practical programs) include study or testing of presented competences. An integral system for formation of managerial competencies doesn't exist
St. Petersburg Polytechnic University	Subjects and Practices The subject "Teamwork and business communications", as well as additional educational programs "Head of the construction organization" and so on for obtaining economic and managerial competencies	Module No. 10 "Personnel management" Module 2. Management of the project team in the program "Economics and Organization of Construction" Module 9 "Business Communications and Personnel Management" in the program "Head of Construction Organization"
Irkutsk National Research Technical University Direction 08.04.01 "Construction"	Subjects and Practices: Fundamentals of pedagogy and andragogy Psychology and ethics of business communication All types of practices and state final certification	The programs are based on traditions of the didactic approach, separate topics of courses (practical programs) include study or testing of presented competences. An integral system for formation of managerial competencies doesn't exist
Mordovian State University named after Ogaryov	Subjects and Practices: Philosophical problems of science and technology Social, psychological, legal communication Basics of professional activity Educational practice (practice for obtaining primary professional skills and pedagogical skills) State final attestation	The programs are based on traditions of the didactic approach, separate topics of courses (practical programs) include study or testing of presented competences. An integral system for formation of managerial competencies doesn't exist
Universities of Civil Engineering (according to site monitoring)		
Moscow State University of Civil Engineering	Subjects and Practices: Philosophical problems of science and technology Social, psychological, legal communication Basics of professional activity Educational practice (practice for obtaining primary professional skills and pedagogical skills)	The programs are based on traditions of the didactic approach, separate topics of courses (practical programs) include study or testing of presented competences. An integral system for formation of managerial competencies doesn't exist

		State final attestation	
St. Petersburg University of Architecture and Civil Engineering		Subjects and Practices: Organization of planning and management of construction of transport facilities Pedagogical practice Fundamentals of pedagogy and andragogy Production practice Research Practice	The programs are based on traditions of the didactic approach, separate topics of courses (practical programs) include study or testing of presented competences. An integral system for formation of managerial competencies doesn't exist
Novosibirsk University of Architecture and Civil Engineering		Subject: Fundamentals of pedagogy and andragogy	The analysis of curriculum of the subject showed a traditional set of topics, which does not reveal the possibility to realize the full range of necessary skills
Rostov University of Architecture and Civil Engineering		Subjects and Practices: Basics of pedagogy and andragogy Quality management of road products Basics of management in the road sector The methodology of scientific research, Math modeling Methods of solving scientific and technical problems in civil engineering Quality management of road products New composite road-building materials, Research Practice The practice of obtaining professional skills Pre-diploma practice, State final attestation	The programs are based on traditions of the didactic approach, separate topics of courses (practical programs) include study or testing of presented competences. An integral system for formation of managerial competencies doesn't exist. There are quite "exotic" subjects from the point of view of management science

Table 2. *The content of training in management competencies in the "Tyumen Industrial University"*

Tyumen Industrial University		
General competence -2,	Subjects and Practices:	In general, programs are based on traditions of the didactic approach, separate topics of the courses (practical programs) include study or testing of competences presented, an integral system of forming managerial competencies is formed thanks to inclusion of a larger proportion of management disciplines in individual programs, including personnel, organization, and project management.
General professional competence -2,	Psychology and Ethics of Professional Activities	
General professional competence -3	Personnel Management Research Practice	
	The practice of obtaining professional skills Pre-diploma practice, State final attestation	

Table 3. *Design of the discipline "Human Resource Management"*

Competencies	Topics of lectures
GC-2 – a willingness to act in unusual situations, bear the social and ethical responsibility for decisions	Introduction to the theory of HR-engineering
	Forms and technologies of managerial activity of the leader. Motivation and performance evaluation.
GPC-2 – readiness to lead the team in the sphere of professional activity, tolerantly perceiving social, ethnic, confessional and cultural differences	Organizational culture as a managerial resource of the leader
	Forms and technologies of managerial activity of the leader. Motivation and performance evaluation
	Team leadership basics
	Basics of professional communication
	Engineering of manager's personal work. Basics of Time Management
GPC-3 – ability to use in practical skills in organization of research and scientific and production work, in the team management, influence the formation of team's goals, influence the socio-psychological climate in the direction necessary to achieve the goals, assess the quality of activity results, ability to active social mobility	Introduction to the theory of HR-engineering
	Team leadership basics
	Forms and technologies of managerial activity of the leader. Motivation and performance evaluation
	Designing professional teams
	Basics of professional communication