COMPETENCIES OF FUTURE ENGINEERS AND ASPECTS OF THE DEVELOPMENT OF ENGINEERING EDUCATION

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Annotation: The article provides instructions on the development of professional competencies of students of a higher educational institution and their aspects

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Many developed countries around the world have a two-tier system to meet the requirements for the quality of training future engineers and the recognition (recognition) of engineering qualifications. The first stage is the assessment of the quality of bachelor's education programs in the field of engineering and technology as a result of the accreditation procedure. The second stage is the recognition of professional qualifications of engineers through their certification and registration.

The quality of educational programs and international recognition of engineering qualifications (Professional Engineer) is ensured in a two-stage manner: national criteria of educational programs and mutual recognition of accreditation. This structure is called the Washington Accord (Washington Accord, WA, 1989), according to which the signatories of the agreement: qualifications accredited or recognized by other signatories are recognized equally by each signatory to the level of qualifications within its jurisdiction[1].

In particular, the following countries of the world have become members of this agreement in recent years:

India - Represented by National Board of Accreditation (2014);

Korea - Represented by Accreditation Board for Engineering Education of Korea (2007);

Malaysia - Represented by Board of Engineers Malaysia (2009);

Russia - Represented by Association for Engineering Education of Russia (2012);

Sri Lanka - Represented by Institution of Engineers Sri Lanka (2014); Turkey - Represented by MUDEK (2011);

The American model of engineering education and training of specialists in the field of engineering and technology is very influential and popular in the world today. This includes at least four years of university study with an accredited engineering program after 12 years of high school, and then obtaining a "bachelor's" academic degree with licensing, registration (certification) and the granting of a "professional engineer" status after successful work in a specific specialty.

This model of training engineers is implemented in many countries, primarily in countries participating in the Washington Accord and the Engineers Mobility Forum (EMF): USA, Canada, Japan, South Korea, Australia, etc. The title "Professional Engineer" (Professional Engineer) means that its holder has the ability to perform professional activities independently and has licenses from one or more state bodies to provide professional engineering services as an independent practitioner. To register as a professional engineer:

1. graduated from an accredited higher education institution with an engineering program;
2. to have a license to carry out professional activities;
3. having practical experience of engineering activities (from 3 to 7 years depending on the country);
4. pass professional exams (usually);
5. improve their skills through continuous professional development;
6. compliance with the code of professional ethics.

The Bologna Declaration is a unified educational space of the leading European countries formed in 1998 by the initiative of the education ministers of Germany, Italy, France and England. This initiative was supported by other countries and in 1999 the Bologna Declaration was signed by 29 countries and the feasibility of creating a unified system of higher education was recognized. Other countries are gradually joining the treaty on the unification of the educational process, as the declaration is open to all. Today, the Bologna process has united 48 countries, but at the same time, new participants continue to join.

Thanks to the unified educational space, national programs were able to collect the best and best practices related to higher education by partners.

Continental Europe, which is part of the Bologna process, is currently introducing a two-level higher education system, changing the model of training engineers. After completing a first-class 3-year university program in engineering and technology, a graduate with a bachelor's degree is expected to be ready to begin a career in applied engineering. As a rule, the Federation of European National Associations of Engineers (Federation Europeenne d'Associations Nationales d'Ingenieurs (FEANI)) does not conflict with the system of certification (registration) of engineers in Europe[2]. After four years of positive practical work experience, a specialist with a "bachelor" academic degree obtained as a result of mastering a 3-year program at the university can apply for the title of "European engineer". However, unlike the EMF system, in the FEANI system, the two-year practical work of a specialist with a bachelor's degree can be replaced by studies with a "master's" academic degree in a 2-year second-degree program of the university [3].

We present the requirements of the world's leading countries to their engineers in the table below. [SOURCE. Asia-Pacific Economic Cooperation Center for Certification and Registration of Professional Engineers was created in 2010 in partnership with one of the leading engineering universities].

ABET, USA	CEAB, Canada	JABEE, Japan	FEANI, Europan Union
Accreditation Board for Engineering and Technology, ABET, USA. Accreditation Council in the field of engineering and technology	Canadian Engineering Accreditation Board CEAB, Canada. Canadian Council for Accreditation in Engineering and Technology	Japan Accreditation Board Engineering Education, JABEE, Japan.	Federation Europeenne d'Associations Nationales d'Ingtnieurs FEANI,
What the graduates should be able to do or acquire as a result of education			
Being able to put into practice the acquired knowledge of natural-scientific, mathematical and engineering	Ability to use appropriate knowledge for the purpose of reshaping, using, and optimally managing resources through effective data analysis and interpretation.	A global perspective on various aspects of engineering problems	To protect the environment by understanding the nature of the engineering profession and its obligation to serve the community, the profession and adhere to the FEANI Code of Professional Conduct
Experiment planning and implementation, data analysis and interpretation	Жамиятда юз берадиган ўзгаришларга, муҳандислик касби технологиялар и ва талабларига тезда мослаша оладиган, ижодкор, ихтирочи, сезгир бўлиш	To be able to understand the results of influence and impact of technologies on society and environment, as well as the responsibilities and obligations of the engineer in accordance with the rules of professional ethics Acquiring knowledge of mathematics, natural sciences and information technology, as well as having the ability to apply this knowledge	Advanced understanding of engineering principles based on mathematics and other science related disciplines
Be able to design	Профессионал	Acquiring knowledge of	Have a general

systems, their components or processes in accordance with the given tasks	муҳандиснинг жамиятдаги роли ва мажбуриятлари ни идрок этиш, муҳандислик фаолияти барча турларининг атроф-муҳит ва жамиятга таъсирини тушуна билиш	mathematics, natural sciences and information technology, as well as having the ability to apply this knowledge	knowledge of the characteristics of modern manufacturing, taking into account the use of materials, components and software of the field of expertise, engineering activities
Teamwork on interdisciplinary topics	Жамоада самарали ишлай олиш, касб доирасида ҳам, умуман жамиятда ҳам самарали мулоқот қила олиш	To acquire knowledge related to the professional field and to have the ability to use this knowledge in solving professional problems	To be able to use appropriate theoretical and practical methods in the process of finding engineering solutions and analysis, to be able to use appropriate theoretical and practical methods in the process of finding solutions to engineering problems and analysis,
Formulating and solving engineering problems		Creation and implementation of engineering projects in order to meet the demands and needs of society using various fields of science, as well as various forms of technologies and information	Implementation of existing promising technologies related to the specialty
Perception of obligations from a professional and ethical point of view		Possess communication skills including written and oral communication skills, conversational skills in the mother tongue and	Knowledge of engineering economics, quality assurance methods, and the use of technical information

		basic skills for effective communication in a foreign language	and statistics
Ability to communicate effectively		Continuous independent education	Leadership, i.e. having leadership qualities, covering administrative, technical, financial and personal aspects
Demonstrate the broad range of erudition necessary to understand the global and societal implications of engineering solutions		Organization and implementation of activities in accordance with established or applicable restrictions	Maintaining the necessary level of competence through acquisition of communicative skills and continuous professional development
Realize the need to constantly learn and constantly work on yourself			Knowledge of standards and regulations appropriate to the field of expertise
Demonstrate knowledge of contemporary issues and passion for solving them			To study technical changes in constant development, to carry out creative research within the profession
Ability to apply modern engineering methods and skills necessary for engineering activities			To be able to communicate freely in foreign languages, to know enough languages to work in the world

Certification and registration of engineers. The certification and registration system for professional engineers proposed by the Asia-Pacific Economic Cooperation (APEC) has been formalized by the Asia-Pacific Economic Cooperation International Coordinating Committee. In particular, the Asia-Pacific Economic Cooperation Standard for Engineers stipulates that the following universal and professional competencies are available:

- being able to consciously apply universal knowledge;
- being able to consciously apply local knowledge;
- able to analyze engineering problems;

- ability to design engineering solutions;
- social responsibility; compliance with legislation and legal norms;
- ethics of engineering;
- organization and management of engineering activities;
- communication;
- not to stop learning during his life;
- ability to make engineering decisions in appropriate places;
- the presence of a sense of responsibility for engineering decisions.

At this point, we will briefly dwell on the work being organized in Uzbekistan. By the Decision of the President of the Republic of Uzbekistan dated November 9, 2018 No. PQ-3939 "On measures to organize the rapid implementation of entrepreneurial initiatives and projects in the regions", the Association of Engineers-Consultants of Uzbekistan (hereinafter UzAIK) was established.

Among the tasks specified in this decision of the President of the Republic of Uzbekistan, the main goal of UzAIK is to gradually implement import substitution based on large, complex and strategically important investment projects, including the formation of consortia with foreign engineering companies, based on the organization of engineering and consulting services.

UzAIC is a non-governmental and non-profit organization (NGO) that unites legal entities and individuals voluntarily engaged in the implementation of design, engineering and consulting services in the field of construction in the Republic of Uzbekistan. [4].

The dynamics of changes in engineering education based on current requirements [Sources: Current Trends Engineering Education. Frank P. Incropera. College of Engineering University of Notre Dame. Notre Dame, Indiana, USA. University of Bonn Federal Republic of Germany. March 11, 2002; I.A. Borovkov. Materials of lectures and performances 2007 - 2012]

Engineering education Late 1980s	Engineering education Early 2000s	Engineering education From 2010 to the present
Knowledge is from the past "school of memory”	knowledge - for the future ("school of thought")	Competencies – “knowledge in action”
Increasing importance of computers and information technologies (modeling, visualization, design)	The growing importance of biological sciences	The introduction of modern new technologies (for example, nano-bio-info-cogno, NBIK)
The growing importance of information technologies for all disciplines, the formation of interdisciplinary education	Increasing tradition of overcoming traditional academic (scientific) interdisciplinary and multidisciplinary boundaries (increasing flexibility of curricula, distance education,	The trend of unification and integration of disciplines, interdisciplinary/multidisciplinary/transdisciplinary educational-scientific-innovative programs

	virtual university, etc.)	
The learner is the object of pedagogical influence, the subject-object relationship of the teacher and the student in a monologic manner.	A learner is a subject of cognitive activity. Subject-subject relationship between teacher and student	Teacher, bachelor, master, senior researcher-researcher (doctoral student) - members of the multidisciplinary team
Complex relations of the higher education institution with production	Relations with production - an alternative model (innovation and entrepreneurship, engineering practice, business interface	Finding solutions to real production issues in the process of educational-scientific-innovative activity

- Engineering competencies in the twenty-first century Based on the above-mentioned points, as an answer to this question, we can describe in detail the necessary competencies in the implementation of engineering activities in the following form: To have broad and deep knowledge of concrete, natural-scientific and technical sciences and to be able to use them in engineering activities;
- Knowing and being able to use software related to the field of the chosen profession;
- Ability to apply fundamental and technical knowledge, technical standards, professional norms for specific situations, taking into account national specificity;
- Willingness to analyze and research complex engineering problems using theoretical and practical methods; the ability to select and evaluate the necessary information;
- Willingness to solve methodological and research description problems if necessary; to find a solution to an engineering problem in complex conditions without sufficient information through common sense;
- Feeling the responsibility of social, cultural and environmental responsibility as a result of engineering activities;
- Ability to evaluate the results of engineering activities; Ability to comply with legal requirements and norms, in particular health, safety requirements in engineering activities;
- Organization and management of engineering activities; Ability to communicate effectively verbally and in writing, especially in a foreign language when necessary;
- Willingness to learn to achieve professional excellence throughout his life;
- Readiness for a sense of responsibility for solutions adopted in engineering activities;

Willingness to apply innovative and creative solutions adopted in engineering activities, i.e., innovative and entrepreneurial-active, possessing leadership qualities, should be fast-moving, flexible. [5] Many of these competencies require subject-oriented knowledge; some require systems thinking and interdisciplinary skills as well as teamwork, leadership and social responsibility.

Based on this, when we do a comparative analysis of engineering paradigms with the professional competencies specified in the qualification requirements, the training of future engineers based on professional competencies and engineering paradigms is one of the most urgent issues today. Paradigms need to be continuously improved with the aim of implementing innovations and taught in special elective subjects as labor market demands.

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