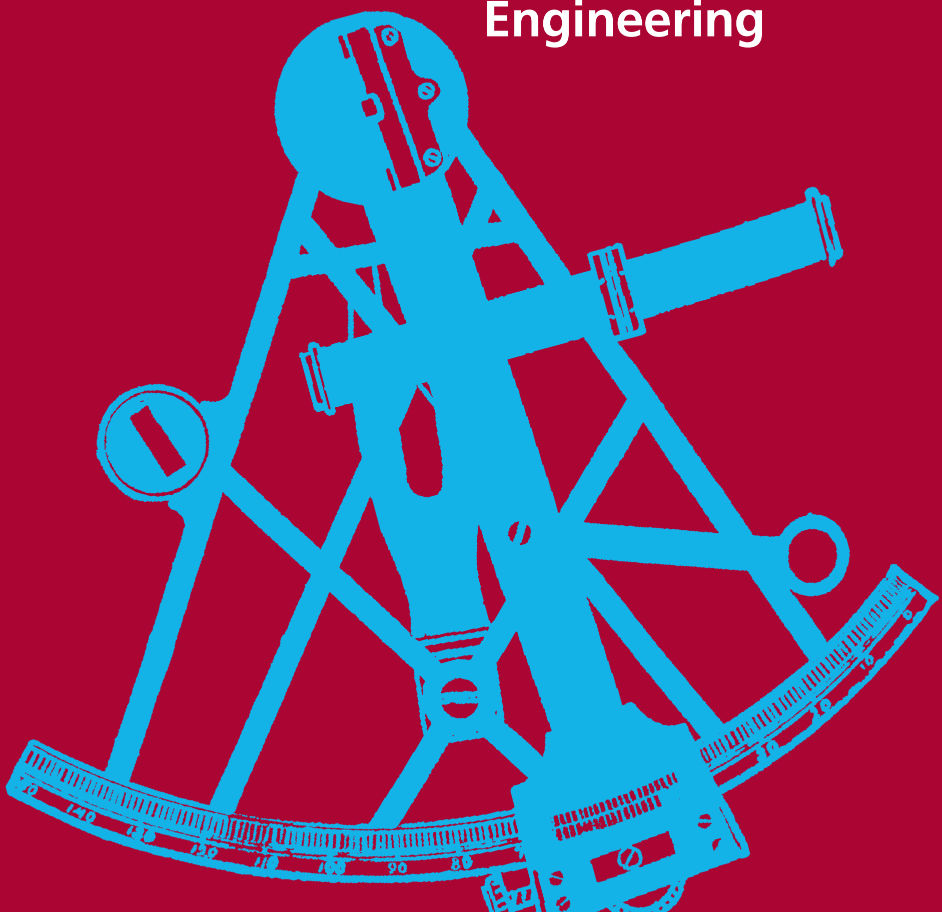
Tuning

Russia

Reference Points for the Design and Delivery of Degree Programmes in Environmental Engineering



Reference Points for the Design and Delivery of Degree Programmes in Environmental Engineering

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Reference Points for the Design and Delivery of Degree Programmes in Environmental Engineering

Reference Points are non-prescriptive indicators and general recommendations that aim to support the design, delivery and articulation of degree programmes in Environmental Engineering. The document has been developed by subject area group, including experts from Russian and European universities, in consultation with different stakeholders (academics, employers, students and graduates).

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Content

Preface

Tuning started as a project in 2000, initiated by higher education institutions and their academics, and strongly supported morally and financially by the European Commission. Over time Tuning has moved beyond the EU and gradually transformed itself into a global methodological system covering educational sectors in many regions of the world.

Androulla Vassiliou, the European Commissioner for Education, Culture, Multilingualism and Youth, underlined when closing the "Tuning in the World: New Degree Profiles for New Societies" Conference in Brussels on 21 November 2012, that whilst Tuning started as an attempt to solve a strictly European problem, it has become a methodology that can be adapted to different higher education structures in very different cultural contexts and that the commitment of the universities, the associations and the national authorities involved is key to the continuing success of this initiative.

The Tuning Russia project has been designed as an independent university-driven project with contributions of university staff members from different countries. The Tuning Russia project reflects the idea that universities do not look for the harmonisation of their degree programmes or any sort of unified, prescriptive or definitive curricula; but, simply for points of convergence and common understanding. The protection of the rich diversity of education has been paramount in the Tuning project from the very start and the Tuning Russia project in no way seeks to restrict the independence of academic and subject specialists, or damage local and national academic authorities. The objectives are completely different. Tuning looks for common reference points. The Reference points are

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non-prescriptive indicators that aim to support the articulation of degree programmes.

The publication of the "Tuning Russia Reference Points" series became a reality due to collective work of Subject Area Groups and project teams at participating European and Russian universities, their academic and administrative personnel to whom we would like to express our sincere gratitude. We stress our deep appreciation to all European and Russian experts who have made a significant contribution to the development of reference points for the design and delivery of degree programmes in various subject areas.

The Tuning process in Russia has been supported by the National Tempus Office in the Russian Federation from the very beginning of the project. Our special thanks go to Director Olga Oleynikova, whose support and recommendations were invaluably important during the implementation of the project. The project and this publication would not have been possible without the coordination and recommendations of Tuning General Co-Coordinators Julia González and Robert Wagenaar.

We hope that readers will find this book both useful and interesting.

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1

General Introduction

The convergence of national educational systems within the EU is an important milestone in the global development of modern higher education in the 21st century. The day when the Bologna Declaration[1] was signed (19 June 1999), is considered the official starting point of the harmonization process of higher education systems within Europe, a process whose end aim consists in the creation of the European Higher Education Area (EHEA). Russia joined the Bologna process in September 2003 at the Berlin Conference of European Ministers in charge of Higher Education.

Signing the Bologna Declaration has led to a series of reforms in the educational systems of the majority of European countries. For higher education institutions (HEIs) these reforms consist in tuning basic teaching programmes in terms of both the structure and the outcomes of degrees. A prominent role should be given to the graduate and degree profiles so that they meet the needs of both the labour market and society, as well as to the specific tasks an academic community has to solve. Therefore, it is particularly important to express all the various educational levels in terms of competences and learning outcomes.

1.1. The contribution of universities to the Bologna Process and Tuning

It is well known that the Tuning Project —"Tuning educational structures"— has developed within the broader context of continuous

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[1] The Bologna Declaration on the European space for higher education. http://ec.europa.eu/education/policies/educ/bologna/bologna.pdf

reforms of European higher education systems, when society at large has been undergoing rapid changes. The name Tuning was chosen for the project to reflect the idea that universities do not look for uniformity in their degree programmes or any sort of unified, prescriptive or definitive European curricula but simply for points of reference, convergence and common understanding. The protection of the rich diversity of European education has been paramount in the Tuning Project from the very start and the project in no way seeks to restrict the independence of academic and subject specialists, or undermine local and national academic authority.

Tuning Educational Structures in Europe[2] started in 2000 as a project to link the political objectives of the Bologna Process and at a later stage the Lisbon Strategy to the higher educational sector. Over time, Tuning has developed into a Process, an approach to (re-) design, develop, implement, evaluate and enhance quality first, second and third cycle degree programmes. The Tuning Project and its methodology constitute one of the academic tools for creating the EHEA. The need for compatible, comparable and competitive higher education in Europe reflects the students' requirements. As student mobility increases, so does the demand for reliable and objective information on the degrees offered by different HEIs. Apart from this, employers both within and outside Europe require reliable information on qualifications awarded and on what these qualifications mean in practice and in the labour market context. Therefore, the process of creating national qualification frameworks is inseparable from the EHEA development process.

Tuning aims to meet the needs of educational institutions and structures and to offer a concrete approach to implementing the Bologna Process at the level of higher education institutions and subject areas. The Tuning approach proposes a methodology to (re-) design, develop, implement and evaluate study programmes for each of the higher education cycles. Furthermore, Tuning serves as a platform for developing reference points at subject area level. These are relevant to making study programmes comparable, compatible and transparent. The agreed-upon reference points for subject areas and their degree programmes are expressed in terms of competences and learning outcomes.

Tuning in general has emerged from the understanding that the Bologna Process is about universities, their students, academic and non-academic

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[2] Tuning Educational Structures in Europe. http://www.unideusto.org/tuningeu/

staff. It is they, with all their knowledge and experience, who should be deciding upon higher education innovation strategies. Tuning is a university-driven project and movement, which came into being as a reaction of HEIs to new challenges and new opportunities that emerged within the process of European integration and the creation of the EHEA.

1.2. Tuning in Russia

The Tuning methodology, which allowed European Universities to cooperate successfully and coordinate their activities aimed at creating unified educational cycles, uniform requirements for the structure of programmes, the development of common approaches to comparison and the assessment of learning outcomes, has become a "road map" for the Bologna process. Developed within the framework of the "Tuning educational programmes in European universities" project, the Tuning methodology as a universal tool for modernizing curricula in the context of achieving professional competences, has today gone beyond the borders of the EU and has acquired international significance. Universities in different countries and continents in expanding cooperation have increasingly resorted to using it to build joint programmes involving academic mobility, integrated education, introduction of a credit system, the exchange of educational modules and the mutual recognition of qualifications.

Russian Universities are also mastering the principles of the Tuning methodology through incorporating generic and subject specific competence descriptions into educational planning at the level of full degrees and individual degree components. Upon the implementation of the third-generation Federal State Educational Standards[3] based on principles compatible with the Tuning methodology —namely, making use of a credit-modular system, increasing the variety and number of elective courses, placing more emphasis on quality, taking into account professional qualification requirements, etc.— the interest in actively using the Tuning methodology to design educational programmes in different areas has increased significantly.

The first Russian HEIs that supported the need to develop the Tuning methodology were the Higher School of Economics, People's Friendship

[3] Federal State Educational Standards. http://xn--80abucjiibhv9a.xn--p1ai/документы/336

University of Russia and the Tomsk State University. In 2006-2008, within the framework of the "Tuning educational programmes in Russian universities"[4] TEMPUS project, these three centres designed bachelor and master degree programmes in the areas of «European Studies» and «Applied Mathematics».

The next step in the promotion of competence-oriented techniques within the system of higher education in Russia was the participation of Moscow State University, the Russian State University for the Humanities, St. Petersburg State University and Chelyabinsk State University along with the EU partners (2007-2008) in the "Russian Tuning-ECTS based model for the Implementation of the Bologna Process in Human Sciences" (RHUSTE)[5] TEMPUS project. Lists of generic and subject-specific competences and Bachelor's and Master's degree programmes in the areas of *History* and *Cultural Studies* were an outcome of that project. The experience of the reform of higher education in Russia in accordance with the principles of the Bologna process was summed up; Tuning methodology was analysed and recommendations on its implementation within the framework of Russian higher education system were advanced.

The "Tuning Russia"[6] project (TEMPUS, 2010-2013), which has brought together four EU universities (the project coordinator - University of Deusto, Bilbao, Spain; University of Groningen, Groningen, Netherlands; Trinity College Dublin, Dublin, Ireland; University of Padua, Padua, Italy), 13 Russian Universities (Astrakhan State University; Don State Technical University; Moscow State Academy of Business Administration; Moscow State Oblast (Region) University; Lomonosov Moscow State University; Moscow State University of Railway Engineering; N.I. Lobachevsky State University of Nizhni Novgorod; Yaroslav-the-Wise Novgorod State University; Russian State University for the Humanities; North Caucasus Federal University; Tver State University; Lev Tolstoy Tula State Pedagogical University; Udmurt State University) and the Association of the Classical Universities of Russia, tries to institutionalise the use of the Tuning methodology in the Russian Federation's educational practice. Its aim is to create a network of Tuning Centres in Russia and to develop a common

[4] Tuning educational programs in Russian universities. http://www.hse.ru/org/hse/iori/pr15

[5] Russian Tuning-ECTS based model for the Implementation of the Bologna Process in Human Sciences (RHUSTE) http://ru-ects.csu.ru/

[6] Tuning Russia. http://tuningrussia.org/

list of generic and subject-specific competences which will be used later on in the process of structuring and describing higher education degree programmes of all levels in the following subject areas: Ecology, Economics and Management, Education, Environmental Engineering, Information and Communication Technologies, Languages, Law, Social Work, and Tourism.

This book contains the key general findings of the Subject Area Group within the Tuning Russia project. These reflect in synthesis the consensus reached by the group members and international experts on the subjects mentioned above. We hope and believe that the material contained in this book will be very useful for all higher education institutions wishing to implement the Bologna Process, and that it will help them to find and use the most suitable tools for adapting or creating higher education programmes in order to respond to the needs of today's society.

Julia González and *Robert Wagenaar*
Tuning General Co-Coordinators

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2

Introduction to the subject area Environmental Engineering

2.1. Definition of the subject area

The problem of environmental protection and the sustainable use of natural resources in recent decades became one of the major directions of scientific and technological progress. This is due not only to the need to solve critical social problems relating to human health and the preservation of the environment, but also to software development and the implementation of clean technologies, the efficient use of natural resources and secondary resources, global monitoring of areas that can monitor, predict and manage the development of the environment.

International contacts in the field of environmental protection became increasingly strong, since many of the problems - the ozone layer safety, the "greenhouse effect", the trans-frontier transport of pollutants, climate change - require a single environmental policy, a common legal framework, material costs, and the compulsory fulfilment of international obligations.

In this large and promising work, the main role belongs, of course, to the enhancement of expertise in the specialist field of «Environmental engineering». Environmental engineers specialize in practical environmental activities, in the development of new methods and technologies for environmental protection and the sustainable use of natural resources, being able to work in educational and research institutions, in large enterprises, in the services of sanitary-epidemiological control and in environmental monitoring activities in central and regional government.

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2.2. The relationship of the subject area with other degree programmes

Considering the professional and research-oriented teaching methods and interdisciplinary approach in the field of "Environmental Engineering", this subject area can be rightfully defined as a set of human, scientific, technical and socio-economic knowledge. The learning outcomes are defined in this combined set of Competences: general culture, basic engineering and subject-specific (professional).

The main problem with this chosen subject area is the difficulty of finding meaningful structural analogies of training programmes on «Environmental engineering» in European and Russian universities[7]. In Russian universities «Environmental engineering» is an educational profile included in areas of training such as 241000 "Energy and Resource processes in chemical engineering, petrochemicals and biotechnology"[8] 280700 "Technospheric safety"[9], 280200 "Protection of the Environment" (engineer-ecologist). The area 241000 "Energy and Resource processes in chemical engineering, petrochemicals and biotechnology" includes the training of bachelors in the profile "Environmental protection and the sustainable use of natural resources" while the area 280700 ""Technospheric safety" in the profile "Environmental Engineering" is not linked to a specific industry. Particular emphasis is placed on learning standards, rules and regulations governing the processes in terms of impact on the environment, saving non-renewable resources of raw materials and energy, reducing harmful effects on human and natural sites, creating safe technical objects, technologically advanced information systems alert in the event of environmental or technological disasters. In most European universities the area "Environmental engineering" has an independent status and presents educational programmes with the same name covering different specializations.

Another problem is the multidisciplinarity and even the interscientific nature of the subject area, which is determined by a fairly wide range of

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7 A Tuning-Ahelo conceptual framework of expected/desired learning outcomes in engineering Tuning Association, on behalf of a Group of Experts, 23 June, 2009. http://www.oecd.org/education/skills-beyond-school/43160507.pdf

8 http://www.edu.ru/db-mon/mo/Data/d_11/m79.html

9 280700 «Technospheric safety» (bachelor), http://www.edu.ru/db-mon/mo/Data/d_09/m723.html

benefits resulting from learning skills. On the one hand, «Environmental engineering» was formed within the subject of common ecology, becoming in time a specific application for a basic and professional direction. On the other hand, it certainly belongs to the engineering sciences, as the objectives of its study are the technical facilities, industrial complexes and industrial technologies considered in the context of their safe environment for design, construction and operation. Using the methods of mathematical modelling, «Environmental engineering» gives full knowledge of the processes occurring in the bio-, geo-and hydrosphere under the influence of various anthropogenic factors, of the development of systems for monitoring emissions of toxic substances into the environment. «Environmental engineering» is closely connected with such specialties and profiles as "Industrial Ecology", "Safety in the technosphere," "Safety and production processes", "Protection in Emergencies", "Environmental regulation of the environment." Today there are many definitions of «Environmental engineering» Applied Science as an area situated at the crossroads of engineering, natural sciences and the humanities. According to many scientists, «Environmental engineering» - is the study of nature-safe manufacturing processes and equipment, the control and regulation of discharges, the emission of waste into the environment, the optimization of the structure of municipal and industrial complexes. In the disciplines of the program should be included energy and transportation systems, industrial systems, the basics of electromagnetic, electrical and acoustic safety, the propagation of chemical and radiation contamination, etc.

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3

Qualifications in Environmental Engineering

The typical degrees offered within this subject area in the Russian Federation are presented in Table 1.

Table 1
Typical degrees in Environmental Engineering

Cycle	Degrees	Qualification awarded	ECTS credits
1st cycle	"Energy and resource processes in chemical engineering, petrochemical and biotechnology" Specialisations: • "Environmental protection and sustainable use of natural resources". • "Rational use of raw materials and energy resources." "Technospheric security" Specialisations: • "Environmental Engineering " • "Protection of the environment and resource conservation"; • "Safety in Technosphere" • "Safety of technological processes and production"; • "Protection in Emergency Situations"; • "Radiation and electromagnetic safety"	Bachelor	240

Cycle	Degrees	Qualification awarded	ECTS credits
2nd cycle	"Energy and resource processes in chemical engineering, petrochemical and biotechnology" Possible master's programs: • "Industrial ecology and management of natural resources" • "The protection of the atmosphere from anthropogenic impacts"; • "Integrated water resources"; • "Protection of the lithosphere of technological impacts"; • "Waste management and recycling of production and consumption." "Technospheric security" Possible master's programs: • "Modelling and control of environmental systems"; • "Information Technology in Environmental Protection"; • "Monitoring areas with high anthropogenic load"; • "Environmental and economic examination and licensing of industrial enterprises"; • "Predicting and managing the consequences of environmental emergencies • "Methods of control of the environment and ecological instrument." "Waste management and recycling of production and consumption."	Master	120
2nd cycle	"Protecting the environment" Possible specialisations: • "Environmental protection and rational use of natural resources"; • "Environmental Engineering" "Technospheric security" Possible specialisations: • "Safety in Technosphere" • "Safety of technological processes and production"; • "Protection in Emergency Situations"	Specialist	At least 300

4

Typical occupations of graduates in Environmental Engineering

Higher education will play a critical role in determining environmental sustainability. Environmental engineers will be the interdisciplinary systems specialists who will bring together, coordinate and manage all the specialists asked to solve the complex environmental problems and promote sustainable development. The Environmental engineering educational system must to avoid the movement in the teaching process towards more and more practical examples which, because of limited classroom time, could lead to sacrifices in the study of fundamentals[10].

In recent years in Russia, there has been an increasing interest in the field of Environmental Engineering education, mainly for those aspects such as the environmental impact assessment and its minimization, treatment of hazardous waste production and consumption. This is due to several mutually reinforcing factors: stricter environmental legislation, an increase in the interest of businesses in the economy of energy and resources, government incentives for this activity. In this regard, the development of Environmental Engineering education meets the trends in the Russian Federation to create a special industry for the disposal and recycling, which enjoys government support.

Today, more than sixty Russian universities provide bachelor degrees in "Environmental Engineering", many of them also retained a five-year programme of training engineers. In the future, they can be implemented

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[10] Association for Engineering Education of Russia www.aeer.ru

in a network of relevant bachelor's and master's degree programmes, making output compatible with European training programmes for general and vocational-oriented competence. The educational programme for master's, observing the principles of continuity and consistency with the common undergraduate training, is devised to enable the graduate to further his/her knowledge and skills in a particular area to the level of independent research and / or research and teaching.

Table 2
Typical occupations of graduates in Environmental Engineering

Cycle	Field of professional activity
1st cycle: **Bachelor**	Bachelor in learning at the university is preparing for the following types of professional activities: • Industrial and technological; • Service and operational; • Design; • Organizational and management; • Expertise, oversight and inspection-audit; • Research. Areas of professional activity bachelor includes designing, implementing the production and operation of energy-and resource-saving and environmentally friendly technologies, development of methods of treatment of industrial and domestic waste and secondary raw materials, minimizing the anthropogenic impact on the environment, human security in the world today; preservation of life and health through the use of modern technology, methods monitoring and forecasting. First cycle environmental engineering degrees enable graduates to hold a position that involves working often under supervision. It is designed to provide the foundation level of the professional environmental engineer's training but is not sufficient for performing autonomous and independent scientific and professional activities. Spheres of employment: • engineering services for environmental safety and control their behaviour; • environmental management at the enterprise, environmental insurance; • project development organizations documentation on environmental safety facilities; • complex systems of the administrative management of occupational health, environment and safety. Engineering positions in organizations in mechanical engineering, energy, oil and gas companies, transport industry, structure of the Ministry of Emergency Situations, construction companies, chemical and petrochemical industry; agencies of government control and supervision.

Cycle	Field of professional activity
2nd cycle: **Master**	Master's learning at the university is preparing graduates for the following types of professional activities: • research; • industrial and technological; • service and operational; • design; • organizational and management; • expertise, oversight and inspection-audit; • educational. Areas of professional activity Master's includes the development of scientific principles, the development and implementation of energy-and resource-saving, environmentally friendly technologies, development of methods of treatment of industrial and domestic waste and secondary raw materials, minimizing the anthropogenic impact on the environment, human security in the world today; preservation of life and health through the use of modern technology, methods monitoring and forecasting. Master is able to self-fulfilment of scientific research, to take part in the development of new methods and systems for the protection of man and the environment, in the analysis of patent information, in the development and implementation of innovative projects in the field of environmental protection. The Master can participate as a leader in the organization of activities to protect the environment at the enterprise level, the territorial-production complex, is able to interact with public authorities on issues of environmental and industrial safety, safety in emergencies. Second cycle degrees, plus the year of supervised practice, enable graduates to work as professional environmental engineers in a professional context. Second cycle graduates can also work in teaching, research and consultancy, and hold very senior positions in their chosen fields: • Exploration Industry (hydrocarbons, minerals etc.) • Consultancy (private agencies including those involved in site survey, environmental management and risk assessment) • Universities (research and education) • Public offices (Environmental Research Institutes including various agencies concerned with soil, water, physical planning, natural hazards, environmental conservation, agriculture etc.) • Related industries (water suppliers etc.) • Teacher (Secondary School) in Earth Science /Geography/Science • Museum functions. • Science journalist etc.

Cycle	Field of professional activity
2nd cycle: **Specialists**	A graduate should be prepared to perform the following types of professional activity: • industrial and technological; • operational; • organizational and management; • research; • design. Areas of professional activity for the engineer include the development, design, commissioning, operation and improvement of environmental engineering and technology, organization and management of environmental work in enterprises and territorial industrial complex examination of projects, technologies and processes, certification of products to maximize the environmental and economic security in human activity, reducing the risk of human impact on the environment, and the analysis and identification of hazards, the protection of human, natural, economic facilities and technosphere from natural and human-induced hazards, remedying the effects of hazards, monitoring and forecasting human impact on the environment, development of new technologies and methods, the protection of rights, economic facilities and environment and sustainable development, the management impact on the environment. The engineer is able independently to conduct research, to take part in the development of new methods and systems for the protection of man and the environment, in the analysis of patent information, in the development and implementation of innovative projects in the field of environmental protection. S/he may participate as a leader in the organization of activities to protect the environment at the enterprise level, the territorial-production complex, is able to interact with public authorities on issues of environmental and industrial safety, safety in emergencies. The graduate may take a engineering positions and manage the relevant units: • in research and development organizations; • the industrial, transport and construction; • in non-economic associations and private businesses; • with agencies for monitoring and control of environmental safety and occupational health and safety.

5

Competences

5.1. Definition of competences and learning outcomes

The introduction of a two or three cycle system makes it necessary to revise all existing study programmes which are not based on the concept of cycles. In practice these programmes have to be redesigned because in a cycle system each cycle should be seen as an entity in itself. Each cycle should not only give access to the following cycle but also to the labour market. This demonstrates the relevance of using the concept of competences as a basis for learning outcomes.

Tuning makes the distinction between learning outcomes and competences in order to distinguish the different roles of the most relevant players: academic staff and students/learners. Expected learning outcomes of a process of learning are formulated by the academic staff, on the basis of input from internal and external stakeholders and academic judgement, preferably involving student representatives during the process. Competences are developed during the process of learning by the student/learner.

Competences are defined in Tuning as a dynamic combination of knowledge, understanding, skills and abilities. Fostering competences is the object of educational programmes. Competences will be formed in various course units and assessed at different stages. As a rule, competences cannot be fully developed within one particular discipline. Competences are normally developed in an integrated and cyclical manner throughout a programme, sensitive not only to the content of learning but to the teaching format and methodology. Yet, in some systems (e.g. in a modular system) it is also feasible to develop a certain subject specific competence during one module focused on this particular competence.

To make levels of learning comparable, the cycle (level) descriptors are developed for specific subject areas and are also expressed in terms of competences.

Learning outcomes are statements of what a learner is expected to know, understand and be able to demonstrate after the completion of a learning experience. According to Tuning, learning outcomes are demonstrated by the students and can be assessed. They can refer to a single course unit or module or else to a period of studies, for example, a first, a second and a third cycle programme. Learning outcomes specify the requirements for the award of a credit. Learning outcomes and assessment criteria together determine the credit allocation requirements, while a grade is given on the basis of students' achievements, which might be above or below the credit-allocation benchmark.

The *Tuning Russia* project defines "learning outcomes" as measurable and assessable competence "components" which are formulated by the teaching staff. Students are expected to be able to reach and demonstrate these learning outcomes at the end of an educational programme or a component of an education programme. Learning outcomes are described with active verbs (be able to do/demonstrate/will have completed…). To reiterate, learning outcomes may belong to a whole programme or to a programme element (unit). Learning outcomes can also belong to one particular thematic (didactic) discipline unit (module). Statements of learning outcomes form the basis for workload calculation and, therefore, for ECTS credit allocation between structural units of a degree programme. It is necessary to achieve the intended learning outcomes in order to be awarded the corresponding number of ECTS credits.

Competences are divided into generic and subject specific. Although Tuning fully recognises the importance of subject specific competences, it has been found that considerable time and effort should be devoted to developing generic competences. Competences described by the *Tuning Russia* project should be used as *reference points* by programme developers but are not meant to be interpreted as prescriptive. In other words, programme development flexibility and autonomy is preserved, while a common language for formulating programme aims and objectives is made available.

The use of learning outcomes allows for much more flexibility than is the case in more traditionally designed study programmes based only on the acquisition of knowledge, because they show that different pathways can lead to comparable outcomes; outcomes which can be much more easily recognized as part of another programme or as the basis for entrance to a higher cycle programme. Their use fully respects the autonomy of other institutions as well as other educational cultures. Therefore this approach allows for diversity, not only in a global, European, national or institutional framework, but also in the context of a single programme.

5.2. List of competences

5.2.1. Selecting competences in accordance with the Tuning methodology

Introducing a more student-centred approach means that the focus is shifted from the educational process to learning outcomes, that the learner's and the teacher's roles change and that the learner becomes the centre of attention. It also becomes crucial to check constantly what generic and specific competences are required by society. Therefore, consultations with different stakeholders need to be conducted and lists of competences considered relevant should be regularly revised. Since the language of competences has come from outside the world of education, it best suits the need for consultation by allowing easy dialogue with stakeholders not involved directly in academic activity. Competence discourse permits the design of new degrees and the elaboration of mechanisms for improving those degrees that already exist.

Accordingly, within the *Tuning Russia* project a consultation process including employers, graduates and academic staff/faculty was organised in order to identify the most important generic and subject-specific competences that might be the focus for different degree programmes. As a result, lists of generic and subject-specific competences for the selected subject areas have been produced (cf. 5.2.2 and 5.2.3).

Consultation on generic and subject-specific competences was carried out with a questionnaire. The aims were to:

- initiate general debate in all Russian subject area groups on competences based on consultations carried out with the different stakeholders: employers, students, graduates and academics;
- collect up-to-date information in order to get a snapshot of the current situation in Russia and possibly to detect current tendencies and changes;

- based on this information, evaluate the difference or similarity of the perspectives of different stakeholder, using precise language comprehensible to all parts involved;
- limit the topic of debate to three different levels: the institutional (the basic and first level of discussion), the level of subject areas (reference points for HEIs) and the generalised level (related to the general situation in Russia);
- compare the results with data obtained through similar consultations carried out in Europe and other countries, in order to determine any possible common tendencies and/or regional and/or subject-area peculiarities.

Respondents were asked 1) to indicate the level of importance and development of a competence and 2) to rank the five most important competences. For each competence, a person filling out the questionnaire had to indicate (1) the level of its importance for (future) professional work and (2) the level up to which this competence was deemed to be developed within a particular degree programme already in place. A four-point scale was used with 1 being equal to "zero" importance/development level and 4 being equal to "high" importance/development level.

The lists of generic and subject-specific competences were drawn up by each *Tuning Russia* Subject Area Group (SAG) in the following way:

a) The Russian labour market and Russian Federation Professional Standards for the occupational area were analysed;
b) The requirements for the basic outputs of Bachelor and Master degrees stipulated in Russian Federation State Educational Standards were analysed;
c) Existing international professional standards for the occupational area were analysed;
d) *Tuning Europe* procedures for selecting generic and subject-specific competences were analysed and adapted;
e) Russian and EU experts were consulted;
f) Initial lists of generic competences suggested by the various Subject Area Groups in the project (SAGs) were discussed and the common core within the lists was identified;
g) Russian academics, employers, students and graduates were consulted about the resulting lists of generic and subject-specific competences;

h) Finally, lists of generic and subject-specific competences were compiled after analysing the results of the stakeholder-consultation process.

The list of generic competences comprises 30 items (section 5.2.2) and separate lists of subject-specific competences have been developed for nine subject areas: Ecology, Economics and Management, Education, Environmental Engineering, Information and Communication Technologies, Languages, Law, Social Work, and Tourism (section 5.2.3). Lists of subject-specific competences can be consulted in separate publications (like this one) —Reference Points— prepared by the SAGs on the basis of discussions in groups, thematic and subject networks and professional communities. These lists account for the results of the consultations with all the stakeholders. Since every subject area has its own peculiarities, each group used slightly different approaches. Nonetheless, in order to obtain comparable results, a basic common procedure was used by all SAGs. In each case, the list was drawn after a consensus had been reached in the group discussion and after studying the ways the subject degrees are organised in the different regions of Russia and in other countries. It should be borne in mind that the resulting documents may still be amplified and amended.

The use of learning outcomes and competences is necessary in order to make study programmes and their course units or modules student centred/output oriented. This approach requires that the key knowledge and skills that a student needs to achieve during the learning process determine the content of the study programme. Competences and learning outcomes, in turn, focus on the requirements both of the discipline and of society in terms of preparing for citizenship and employability.

In an output-based study programme the main emphasis lies on the degree or qualification profile. This profile is determined by the academic staff and endorsed by the responsible authorities. The profile should be based on an identified and recognized need by society. Although every programme profile is unique and based on the judgements and decisions of the academic staff, the academics have to take into account specific features which are seen as being crucial for the subject area concerned. In the *Tuning Russia* project, the academics identified specific features of their own subject area. These are reflected in so-called meta-profiles, which are, in turn, based on the lists of generic and subject specific competences for each subject area (section 5.2.4).

5.2.2. Generic competences

One of the main aims of the *Tuning Russia* project has been that of compiling a unified list of generic competences relevant for various degrees in many subject areas. In order to determine which generic competences appeared to be the most important ones, broad consultations have been carried out with graduates, students, employers and academics. The procedure was as follows:

1. Russian members of each SAG drew initial lists of generic competences they considered key ones;
2. The lists were discussed by Russian members of each SAG with EU experts and were amended if this was deemed necessary;
3. Lists proposed by each SAG were compared and the following categories of competences were distinguished: the common core of generic competences selected by all SAGs was identified; competences selected by the majority of SAGs, those selected only by some SAGs and those selected by only one SAG;
4. The list of 30 generic competences was agreed upon and its Russian and English versions were established in order to be used during the consultation process;
5. Students, employers, graduated and academics were consulted;
6. Questionnaires were analysed and the final list of generic competences, common for all the Project SAGs was drawn. The results were discussed by all SAGs.

The final list comprises the following 30 competences:

Table 3
Generic competences

Competence code	Competence
GC 1	Ability for abstract thinking, analysis and synthesis
GC 2	Ability to work in a team
GC 3	Capacity to generate new ideas (Creativity)
GC 4	Ability to identify, pose and resolve problems
GC 5	Ability to design and manage projects

Competence code	Competence
GC 6	Ability to apply knowledge in practical situations
GC 7	Ability to communicate in a second language
GC 8	Skills in the use of information and communication technologies
GC 9	Capacity to learn and stay up-to-date with learning
GC 10	Ability to communicate both orally and in written form in the native language
GC 11	Ability to work autonomously
GC 12	Ability to make reasoned decisions
GC 13	Ability for critical thinking
GC 14	Appreciation of and respect for diversity and multiculturality
GC 15	Ability to act with social responsibility and civic awareness
GC 16	Ability to act on the basis of ethical reasoning
GC 17	Commitment to the conservation of the environment
GC 18	Ability to communicate with non-experts of one's filed
GC 19	Ability to plan and manage time
GC 20	Ability to evaluate and maintain the quality of work produced
GC 21	Ability to be critical and self-critical
GC 22	Ability to search for, process and analyse information from a variety of sources
GC 23	Commitment to safety
GC 24	Interpersonal and interactional skills
GC 25	Ability to undertake research at an appropriate level
GC 26	Knowledge and understanding of the subject area and understanding of the profession
GC 27	Ability to resolve conflicts and negotiate
GC 28	Ability to focus on quality
GC 29	Ability to focus on results
GC 30	Ability to innovate

Further analysis of the survey responses in the subject group allowed revealing most important general competencies for undergraduate subject area "Environmental Engineering" and reducing the list to 9 competences:

Table 4
Generic competences for subject area Environmental Engineering

New code	Generic competences
GC 1	Ability to work in a team
GC 2	Capacity to generate new ideas
GC 3	Ability to apply knowledge in practical situations
GC 4	Skills in the use of information and communications technologies
GC 5	Ability to work autonomously
GC 6	Ability to plan and manage time
GC 7	Ability to evaluate and maintain the quality of work produced
GC 8	Knowledge and understanding of the subject area and understanding of the profession
GC 9	Ability to resolve conflicts and negotiate

5.2.3. Subject specific competences

The basis of subject-specific competences is represented by skills that enable the graduate to participate in the process in accordance with the regulations to use technical means for measuring the parameters of raw materials and products, to substantiate the specific technical solutions in the design technological processes, to choose the equipment and technologies directed towards minimizing human impact on the environment. At the end of the programme a graduate must have a full set of subject-specific competences, which reflect differences in the content of existing trends and profiles of education.

These competences are acquired in the course of the study of special professional courses. After the completion of the educational programme the student must have a whole set of domain-specific competences, which reflect differences in the content of existing trends and profiles of education. These competences are acquired in the course of the study of special vocational courses. For example, the area of training 241000 " Energy- and resource-saving processes in chemical engineering, petrochemicals and biotechnology", profile "Environmental protection and rational use of natural resources" has the following study modules: "Environmental Chemistry", "Principles of Toxicology", "Industrial Ecology", "Fundamentals of Environmental Management", "Environmental monitoring, management and audit", "Assessing the impact of business on the environment ", "Technology protection of the atmosphere and hydrosphere of pollution", "Rational methods of handling hazardous waste", etc. In the area of training 280700 "Technospheric security", profile "Protecting the natural environment and resources", students are studying courses on "Landscape of resource bases", "The durability of natural resources", "The sources of environmental pollution", " System analysis of environmental problems and resource", "Sector-specific resource and alternative energy", etc. Educational program 280700 "Technospheric security" has its own particular shape in universities for construction studies. In the process of studying professional courses, students gain knowledge and skills in the field of the environmental safety of construction, the documentation of systems and technologies providing environmentally friendly operation, construction materials, the study and preservation of ecosystems, regional and local building and construction sites in specially protected areas, etc. Training has its own characteristics in the direction of «Environmental engineering» in the construction schools. In the process of training students in the direction of «Environmental engineering» in transportation schools, great attention is paid to the environmental safety of transport enterprises, methods to reduce emissions of harmful substances into the atmosphere, to reduce the discharge of polluted wastewater into surface water bodies, to the use and disposal of waste production, to the improvement of the system environmental management.

Group of academics from Moscow State University of Railway Engineering (MIIT) and other Russian universities, based on the learning experience available in January 2011, began compiling a list of general engineering skills and harmonizing it with the members of the profile of the subject area. The composition profile of the subject area consisted of six universities with MIIT as a SAG leader:

- Astrakhan State University (ASU).
- Don State Technical University (DSTU).

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- N.I. Lobachevsky State University of Nizhni Novgorod (UNN).
- North Caucasus Federal University (NCFU).
- Udmurt State University (UdSU).

Initially the group analyzed 24 standards headed by TMA Engineering, as follows: 190300 "Rolling stock of railways," 190401 "Operation of Railways," 190901 "System to ensure the movement of trains," "271501 "Construction of railways." As a result, the group identified the knowledge, skills and abilities that are common to all disciplines of engineering qualifications.

The agreed list of general engineering and specific professional competences was presented at the First General Meeting of the project Tuning Russia in DSTU in April 2011.

Subject-specific competences consist of 25 items, the first 13 of which correspond to the general engineering competences, which any engineer should have after completion of degree programme, regardless of the direction of specialization, and numbers 14 to 25 are items related to the subject-specific competences for the subject area Environmental Engineering.

Table 5
Subject specific competences for Environmental Engineering

Competence code	Competence definition
SC 1	Ability to apprehend, accumulate, analyse and use fundamental and applied knowledge in technical, engineering and natural sciences, using modern information technologies
SC 2	Ability to participate in theoretical and experimental research using mathematical computation and modelling methods, technical devices, controlling and measuring apparatus, etc.
SC 3	Knowledge and understanding of the role and status of engineering as a profession in the social-economic development of the society and impact of engineering solution in a global context

Competence code	Competence definition
SC 4	Possessing of methods of visualization of technical objects by graphical representation and 3D geometric simulation, using computer technologies
SC 5	Ability to participate in creating, implementing, and using technical objects and technologies through all stages of their life cycle
SC 6	Ability to detect an engineering problem and to select a typical or nonstandard method of solution
SC 7	Ability to use existing and develop new technical methods, technologies and equipment for the solution of engineering problems
SC 8	Ability to design and conduct experiments, as well as to analyse and to interpret data
SC 9	Ability to receive profound knowledge in one or more areas of engineering. Aptitude for life-long learning and professional skills improvement
SC 10	Knowledge of methods of the preservation and reproduction of basic technical systems and technologies
SC 11	Possessing of knowledge in interdisciplinary areas
SC 12	Ability to examine technical objects and technologies
SC 13	Ability to think strategically, identify, model and construct original engineering systems, elaborate unique and advanced technologies
SC 14	Ability to understand mechanism of anthropogenic influence on biosphere – *be able to understand the biosphere processes and influence of human being and technical and engineering systems on them*
SC 15	Ability to formulate and defend a position in ecological discussion – *be able to understand the various points of view, to formulate one's own point of view and to maintain that position in discussion on environment protection*
SC 16	Ability to understand the interrelation of scientific and technical progress and environmental protection – *be able to understand trends in techniques and technological development, scientific and technical process as a whole and its influence on the environment*

Competence code	Competence definition
SC 17	Ability to apply principles of rational nature management – *be able to apply knowledge of the basic regularities of the functioning of the biosphere and principles of rational nature management for solving the problems in the field of environmental engineering*
SC 18	Ability to measure environmental parameters – *apply basic technical equipment and equipment used for environmental monitoring*
SC 19	Ability to predict a state of environment – *be able to analyse physical, chemical and biological anthropogenic impact on the environment and to predict its consequences*
SC 20	Ability to apply the requirements and norms of ecological legislation – *be able to apply requirements and norms of the ecological legislation and ecological standards in practice*
SC 21	Ability to identify and solve problems of environmental protection – *be able to understand, analyse and solve problems of environment protection from anthropogenic impact*
SC 22	Ability to carry out the techno-ecological analysis – *be able to carry out the techno-ecological analysis of economical activities and technical documentation*
SC 23	Ability to apply principles of ecological safety – *be able to apply main principles of ecological safety for protection of industrial personnel and the population at large from the possible consequences of failures and accidents*
SC 24	Ability to formulate problems of ecological design – *be able to formulate tasks for the survey and design works in accordance with requirements of environmental protection and rational nature management*
SC 25	Ability to understand the impact of technical solutions in a global environmental context

The result of the first phase of the project was a list of competences agreed upon by members of subject group, after discussion with the TUNING expert, compatible with the requirements of the methodology TUNING corresponding to engineering education, and it consisted of general engineering skills and subject-specific competencies for the direction of Environmental Engineering, based on the specifics assigned to the Engineering domain.

In the following phase a survey was conducted among representatives of four defined target groups - the academic community, employers, alumni and students. In response to the items on the questionnaire, respondents were asked to rate the importance of each competence, the extent of its implementation in the institution and separate from the proposed list the 5 most important.

From May 1 to July 7 of 2011 corrected lists of competences common to all graduates and subject-specific skills were displayed on the website of the University Deusto (www.deusto.es) for the survey of 4 groups of respondents - employers, academics, senior students and graduates. Each participant in the consortium, which is part of the subject "Environmental Engineering", used this limited period of time to conduct a survey of 30 respondents in each profile group.

In addition to the consortium of six universities, the survey involved seven other universities and academies - the Moscow Institute of Radio Engineering, Electronics and Automation (MIREA), Graduate School of Innovative Business MSU (VSHIB), Moscow State Academy of Municipal Economy and Construction (MGAKHiS), Russian University of Chemical Technology named after D. Mendeleev (Chemical Engineering), St. Petersburg State Technological Institute (Technical University) (SPbSTI (TU)), Saratov State Technical University (CSTs), Kazan (Volga region) Federal University (KPFU).

Thus, a large array of answers to the questionnaire was received for generic and subject-specific competences in Environmental Engineering.

Table 6
Survey on competences in Environmental Engineering

Type of competences	Respondents	The number of questionnaires
Generic Competences	Academics	366
Generic Competences	Employers	320
Generic Competences	Students	332
Generic Competences	Graduates	314
Subject Specific Competences	Academics	367
Subject Specific Competences	Employers	315
Subject Specific Competences	Students	341
Subject Specific Competences	Graduates	317
Total:		2,672

The processing of answers was carried out at the Tuning Academy, University of Deusto (Bilbao, Spain). The ranking of competences for importance and level of implementation was carried out as follows: respondents were asked to select the five most important and arrange them in order of decreasing importance. To the first in importance competence was assigned a value of 5, to the second 4, to the third 3, etc.

Analysis of the data for all four groups of respondents allowed us to determine the requirements of employers for graduates, both in terms of generic competences and in terms of the subject-specific, and their assessment for the training of future engineers in university. The involvement in the survey of the academic community and of senior students helped to identify gaps in education and training programmes which need to be adjusted.

Figure 1 shows the results of the survey among the academic community schools. According to the academic community, the most important competences are:

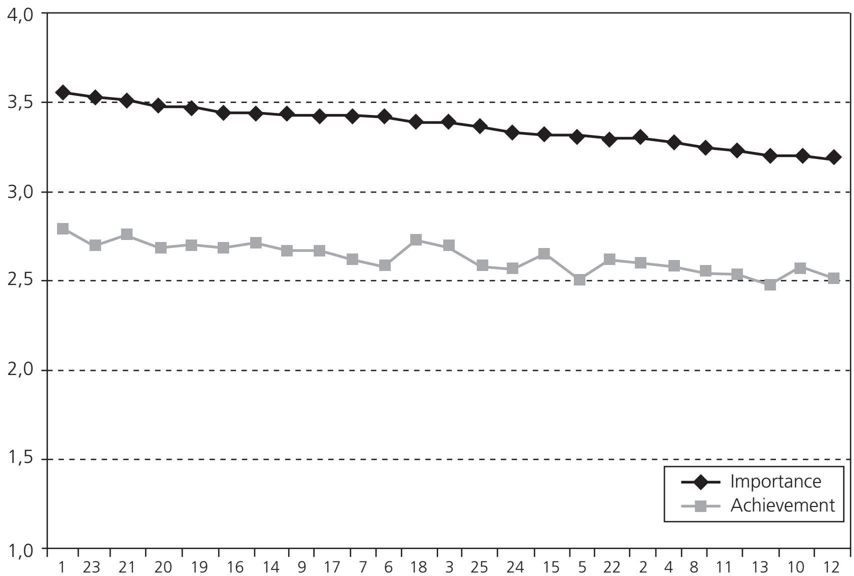
SC 1 - Ability to apprehend, accumulate, analyse and use fundamental and applied knowledge in technical, engineering and natural sciences, using modern information technologies.

SC 23 - Ability to apply principles of ecological safety.

SC 21 - Ability to identify and solve problems of environmental protection.

SC 20 - Ability to apply the requirements and norms of the ecological legislation.

SC 19 - Ability to predict the state of the environment.



Graph 1
The Rating by academics

The least important domain-specific competences considered to be by the academic community are:

SC 10 - Knowledge of methods of preservation and reproduction of basic technical systems and technologies and

SC 12 - Ability to examine technical objects and technologies.

As can be seen from Fig. 1, quite a large gap between the importance of competences and the degree of their achievement in the learning process

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is observed for all 25 subject-specific competences, the extent of their implementation in higher education is much lower than expected.

As can be seen from Fig. 2, from the perspective of employers the most important competences are:

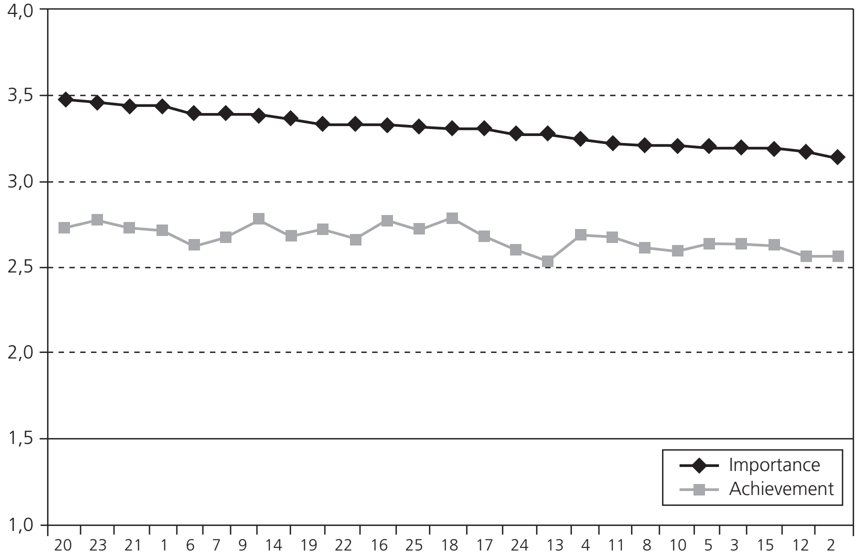
SC 20 - Ability to apply the requirements and norms of the ecological legislation.

SC 23 - Ability to apply principles of ecological safety.

SC 21 - Ability to identify and solve problems of environmental protection.

SC 1 - Ability to apprehend, accumulate, analyse and use fundamental and applied knowledge in technical, engineering and natural sciences, using modern information technologies.

SC 6 - Ability to detect an engineering problem and to select a typical or nonstandard method of solution.



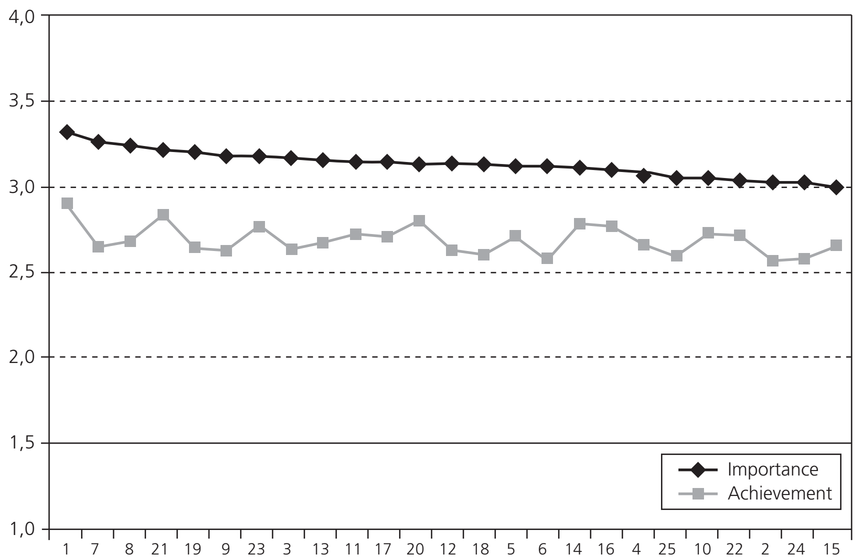
Graph 2
The Rating by employers

Employers consider as the least important competences: SC 2 - Ability to participate in theoretical and experimental studies using mathematical methods of calculation and simulation of technical devices, test equipment, etc., and SC 12 - Ability to examine technical objects and technologies.

According to employers, there is a low degree of attainment of competence in higher education, particularly there is a large gap between the importance and the degree of its attainment for SC 20 - Ability to apply the requirements and norms of the ecological legislation, SC 6 - Ability to detect an engineering problem and to select a typical or nonstandard method of solution SC13 - Ability to think strategically, identify, model, and construct original engineering systems, elaborate unique and advanced technologies.

As seen in Figure 3, the senior students consider the most important competences:

SC 1 - Ability to apprehend, accumulate, analyse and use fundamental and applied knowledge in technical, engineering and natural sciences, using modern information technologies.



Graph 3
The Rating by senior students

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SC 7- Ability to use existing and develop new technical methods, technologies, and equipment for solution of engineering problems.

SC9 - Ability to receive deep knowledge in one or more areas of engineering. Aptitude for life-long learning and professional skills improvement.

SC 21 - Ability to identify and solve problems of environmental protection.

SC 19 - The ability to predict the state of the environment.

Students consider as the least important:

SC 24 - Ability to formulate problems of ecological designing.

SC 15 - Ability to formulate and defend a position in the environmental debate.

According to students, the gap between the importance and the degree of attainment exists but is not too large. The gap is highest for the SC7, 6 and 25 competences.

As seen in Figure 4, **graduates** consider the most important competences:

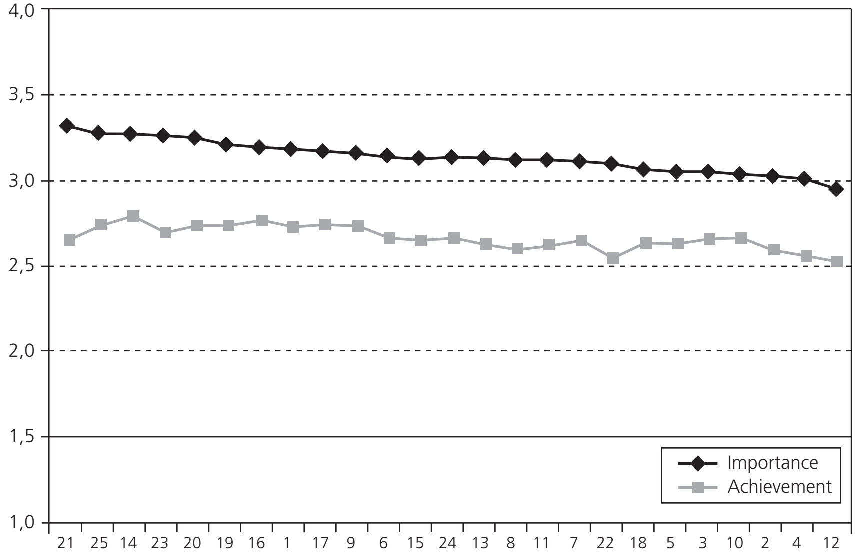
SC 21 - Ability to identify and solve problems of environmental protection.

SC 25 - Ability to understand the impact of technical solutions in a global environmental context.

SC14 - Ability to understand mechanism of anthropogenic influence on biosphere.

SC 23 - Ability to apply principles of ecological safety.

SC 20 - Ability to apply the requirements and norms of the ecological legislation.



Graph 4

The Rating by graduates

They consider the least important they consider to be:

SC 4 - Possessing of methods of visualization of technical objects by graphical representation and 3D geometric simulation, using computer technologies.

SC 12 - Ability to examine technical objects and technologies.

According to **graduates**, the gap between the importance and the degree of attaiment exists but is not too large. The gap is highest for the SC21 and 22 competences.

The analysis of the results of the survey leads to the reduction to 12 of the list of subject-specific competencies for the meta-profile in Environmental engineering (Table 7).

Table 7
Subject specific competencies for the meta-profile in Environmental engineering

Competence code	Competence
SC 1	Ability to apprehend, accumulate and use fundamental and applied knowledge in technical, engineering and natural sciences, using modern information technologies
SC 2	Ability to participate in theoretical and experimental research using mathematical computation and modelling methods, technical devices, controlling and measuring apparatus, etc
SC 3	Possessing methods of visualization of technical objects by graphical representation and 3D geometric simulation, using computer technologies
SC 4	Ability to participate in creating, implementing and using of technical objects and technologies through all stages of their life cycle
SC 5	Ability to detect an engineering problem and to select a typical or nonstandard methods of solution
SC 6	Ability to understand the mechanisms8 of anthropologenic influence on biosphere
SC 7	Ability to apply principles of rational nature management
SC 8	Ability to measure environmental parameters
SC 9	Ability to apply the requirements and the norms of the ecological legislation
SC 10	Ability to identify and solve problems of environmental protection
SC 11	Ability to carry out the techno-ecological analysis
SC 12	Ability to understand the impact of technical solutions in a global environmental context

5.2.4. Meta-profile

A Meta-profile reflects the structure and the interrelation of competences that characterise a particular subject area. Meta-profiles are used for reference, to depict mental models and should demonstrate the variety of possible and existent degree profiles within a particular subject area. Meta-profiles and meta-competences are determined by analysing stakeholder-consultation results through re-categorising the list of competences. Such re-categorisation can be done differently in different subject areas and should reflect the subject area unique characteristics.

5.2.4.1. Meta-competences

Due to the large number of general and subject-specific competences that need to be implemented in the subject area, it is useful to carry out the procedure of re-categorization. It is possible to identify the key competences that at a certain level should be achieved by any graduate of a Bachelor's degree in a given subject area, regardless of the profile (orientation) training, or group competences into larger structures - the meta-competences, denoting their specific terms. The achievement of key skills (meta-competences) should be an input requirement for applicants to master's programmes in a given subject area.

From meta-competences a meta-profile can be generated - a general understanding of a subject area, enabling its general identification and, at the same time, leaving the freedom to develop and implement educational programmes in specific areas of training and specialization in different universities.

Individual sets of meta-competences can have different contents, but they give the tools to compare the contents of a bachelor's in one subject area and provide learners with academic mobility.

A meta-profile is part of a consensus; it is a combination of general and specific competences with the general and specific competences being in interaction.

An analysis of the list, after the reduction of general and subject-specific competences in the subject group "Environmental Engineering", has shown the feasibility of formulating four enlarged meta-competences at bachelor's level. One of them, GCM 1, includes all 9 general competences, which enable graduates to work at a high level in any production team and in any capacity, and to interact with specialists in other subject areas. Three meta-competences are made up of subject-specific competencies on the basis of their reference to different levels of engineering education: basic, applied and specialized in a specific area:

- SCM 1 - The ability to generate and use basic engineering knowledge (including competence SC 1 - The ability to receive, collect, analyse and use basic and applied knowledge in the field of technical, engineering and science, including the use of modern information technology; SC 2 - Ability to take part in the theoretical and experimental studies using mathematical calculations and modelling methods, technical equipment, test equipment, etc.; SC 3 - Own the technical methods of imaging objects using graphic images and three-dimensional geometric modelling, including the use of computer technology ; SC 5 - The ability to identify engineering problems and pick up the typical or standard solution; SC 12 - The ability to understand the impact of the adopted technical solutions for global environmental context.
- SCM 2 - Ability to identify and solve an applied engineering problem (competences SC 4 - The ability to participate in the creation, implementation and operation of the technical facilities and technologies at all stages of their life cycle; SC 8 - The ability to measure environmental parameters; SC 9 - The ability to apply the requirements and standards of environmental laws).
- SCM 3: The ability to identify and solve specific problems in the field of environmental protection (competence SC 6 - Ability to understand the mechanism of human impacts on the biosphere; SC 7 - The ability to apply the principles of environmental management; SC 10 - The ability to understand and solve environmental problems; SC 11 - The ability to conduct technical and environmental analysis).

This approach to the re-categorization of general and subject-specific competences demonstrates that, in the subject area of "Environmental Engineering", there is no predominant influence of any set of skills or meta- competences. They all complement each other and together can provide comprehensive training for students, a high level of graduates, and assure their compliance with modern requirements for specialists with higher education and with labour market needs.

The first meta-competence is composed of subject-specific competences related to the fundamental, basic engineering training, regardless of further specialization, which are presented in the following table:

	Mathematics	physics	chemistry	informatics	ecology	Descriptive geometry. Engineering Graphics	mechanics	Electronics and Electrical Engineering
SC 1	+	+	+	+	+		+	+
SC 2	+	+	+	+	+		+	+
SC 3				+		+	+	
SC 5				+		+	+	+
SC 12		+	+		+			

Fundamental, basic disciplines for the area "Environmental Engineering" form the following general and subject-specific competences:

	GC 3	GC 8	GC 9	SC 6	SC 7	SC 9	SC 10	SC 12
Ecology	+	+		+	+		+	+
Earth Science	+	+		+	+		+	+
Human Physiology	+	+		+				
Toxicology	+	+		+				
Environmental Law	+	+	+			+	+	+
Environmental Management	+	+	+		+	+	+	+

The ability of future engineers to identify and solve specific problems in the field of environmental protection is defined in the following block of relevant disciplines and competences:

	GC 3	GC 5	GC 8	SC 6	SC 7	SC 8	SC 9	SC 10	SC 11
Metrology, standardization and certification	+	+	+			+	+		
The reliability of technical systems and technological risks	+	+	+	+			+	+	
The sources of environmental pollution	+	+	+	+			+	+	+
Technique and environmental technology	+	+	+	+	+	+	+	+	+
Methods and tools for measuring the quality of the environment	+		+	+		+	+	+	
Low waste and resource-saving technologies	+	+	+	+	+	+	+	+	
Environmental impact assessment	+	+	+	+	+		+	+	+

Below are detailed descriptions of generic and subject-specific competencies that are essential for bachelor level "Environmental Engineering".

Competence GC 6: Ability to Plan and Manage Time

1. Description

Competence, "The ability to plan and allocate their time," describes the ability to determine correctly the amount of specialist work, a rational sequence of steps, the actual terms of performance, the ability to engage in various activities in the same period of time in an organized and regular manner.

2. Interaction with other competences, attitudes, interests, values

The most intimate connection of competence "ability to plan and allocate their time" can be traced to the general and subject-specific competences:

GC 1 – Ability to work in a team.

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GC 5 – Ability to work autonomously.

GC 7 – Ability to evaluate and maintain the quality of work produced.

SC 4 – Ability to participate in creating, implementing and using technical tools and technologies through all stages of their life cycle.

These competences cannot be achieved without the skills and competences inherent to the competence GC 6.

3. Importance of this competence for academic and professional life

Competence "The ability to plan and allocate their time" is very important for students during the training period, and for professionals at work in their field. Ability to organize work and to follow strictly the sequence of steps and deadlines helps to complete successfully an educational programme and is required for a specialist in the field of «Environmental engineering» who must not only work independently but also cooperate in carrying out his/her professional duties with a large number of employees of various organizations.

4. How to incorporate it into the academic curriculum

The development of competence "The ability to plan and allocate their time" can be carried out by students in any discipline or educational module. For example, at the beginning of the training the student can be instructed to draw up a plan of work during the semester, and then to check the implementation of the plan in respect of the volume and timing. Especially good are those skills developed by performing this type of learning activity in course design.

Definition: is the act or process of exercising conscious control over the amount of time spent on specific activities, aimed at increasing either efficiency or productivity.

Mastery of this competence is closely related to: planning, scheduling, self-motivation, prioritizing, achievement orientation, self-fulfilment, working autonomously, organizing, monitoring.

Levels of mastery:

- Ability to carry out the offered programme (the work plan).
- Ability to introduce a corrective amendment in the offered programme (the work plan).
- Ability to construct the programme (the work plan) and to carry it out independently.

Indicators:

Sense of duty, responsibility

- The critical approach, ability to adapt, objective estimation of possibilities.
- The creative approach to the task, ability to plan.

Levels of Mastery	Indicators	Descriptors			
		1	2	3	4
First level of mastery: Ability to carry out the offered program (the work plan)	Understand-ing the prof-fered pro-gramme (the work plan)	Absence of understanding the purposes	The programme purpose is clear, but there is no understanding of the sequence of completion of the tasks	The programme purpose is clear, but there is no understanding of the tasks	Understands the purpose of the programme priorities and stages
	Time planning in conformity with programme stages	Absence of ability to manage time	There is a considerable deviation in terms of the completion of tasks	Insignificant deviation in terms of the completion of tasks	Punctuality and responsibility on programme completion
	Completion of stages completely and in time	None of the programme stages is executed	The programme is executed partially	All the programme is completed, but some stages with some deviation of terms	All stages of the programme are executed completely and in the required terms

Levels of Mastery	Indicators	Descriptors			
		1	2	3	4
Second level of mastery: Ability to introduce a corrective amendment in the offered program (the work plan)	Ability to introduce a corrective amendment in the plan of the performance of works	Absence of ability to plan the operating time-table	Ability to correct the time of carrying out one stage, but not the programme as a whole	There are errors in the working out of the plan of work	Ability to plan time according to tasks
	Ability to introduce a corrective amendment in the content of the programme stages	There is no ability to formulate the purpose of stages	Ability to correct distinct stages, but not the programme as a whole	There are defects in the integration of the program stages	Ability to correct the content of the distinct stages according to a final goal
	Understand-ing and changing the prioritization stages	There is no ability to recognize the priority of tasks and to correct it	Is capable to recognize programme defects, but can't correct them	In correcting the programme some defects are allowed	Is able to recognize the priority of tasks and to correct it
Third level of mastery: Ability to make the program (the work plan) and to carry out it independently	Ability to formulate the work programme according to a final goal	Is not able to formulate the tasks (the content of stages)	By drawing up the programme the goal of the work is not fully considered	In drawing up the programme insignificant errors are allowed	Is able to fulfil the work program completely
	Ability to plan the time-table in interaction with other tasks	Is not able to plan the work schedule as a whole	Is able to plan the work schedule, but without considering other tasks	By making the work schedule, simultaneous completion of different tasks is allowed	Is able to make the work schedule completely in interaction with other tasks
	Presence of the creative approach to time management	Can plan a time-table only on a template	There are distinct elements in the independent time management	There is no completeness in the time planning of work	Creativity in time management

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Competence SC 8: Ability to Measure Environmental Parameters – (ability to apply basic technical equipment used for environmental monitoring)

1. Description

Competence "The ability to measure environmental parameters" requires, from a specialist in the field of "Environmental engineering", fundamental knowledge about the environment and the main parameters that characterize its quality and condition, as well as skills that allow him/her to use technical instruments and equipment to perform measurement and control, and to report on them.

2. Interaction with other competences, attitudes, interests, values

The closest connection of the competence "The ability to measure environmental parameters" can be traced to the generic and subject-specific competences:

GC 3 – Ability to apply knowledge in practical situations;

GC 7 – Ability to evaluate and maintain the quality of work produced;

GC 8 – Knowledge and understanding of the subject area and understanding of the profession;

SC 1 – Ability to apprehend, accumulate and use fundamental and applied knowledge in technical, engineering and natural sciences, using modern information technologies;

SC 2 – Ability to participate in theoretical and experimental research using mathematical computation and modelling methods, technical devices, controlling and measuring apparatus, etc.;

SC 6 – Ability to understand the mechanism of anthropologenic influence on biosphere;

SC 10 – Ability to identify and solve problems of environmental protection;

SC 11 – Ability to carry out the techno-ecological analysis.

3. The importance of this competence for academic and professional life

The competence "The ability to measure the parameters of the environment" requires university students to perform laboratory work in the disciplines of the professional cycle, to undertake scientific research and to write reports. In the professional activities of a specialist in «Environmental engineering» knowledge about the environment and its parameters, about methods of measurement and evaluation, about the use of instruments and equipment, are fundamental to enable to hold certain positions in the workplace, in public control and in research organizations.

4. How to incorporate it into the academic curriculum

The development of students' ability to measure environmental parameters can be advanced through the study of natural science disciplines and in the professional cycle, especially when performing laboratory work, scientific research and practical training.

Definition:

Possession of the methods and techniques of laboratory analysis, quantification of the environmental parameters to assess environmental conditions and to make forecasts.

Mastery of this competence is closely related to

knowledge of basic environmental parameters, methods of laboratory analysis, characteristics and capabilities of laboratory equipment, ability to use it, processing of data for assessment and prediction.

Levels of mastery:

1. Knowledge and ability to assess the importance of particular parameters of the environment.
2. Possession of the methodology of the measurement of environmental parameters.

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3. Laboratory analysis data processing, development of databases for subsequent assessment and prediction of environmental condition.

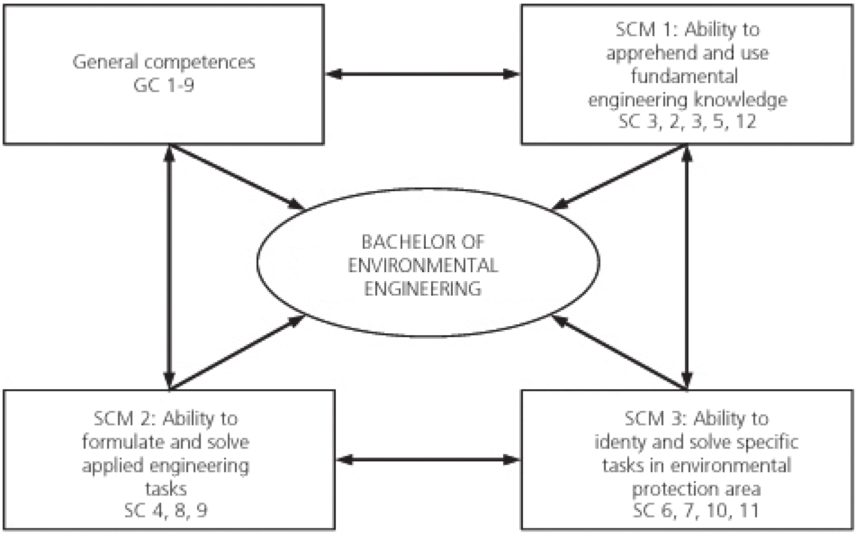
Indicators:

1. Possession of basic knowledge of natural sciences needed to measure environmental variables.
2. Possession of environmental parameters laboratory methods, the skills for carrying them out.
3. Processing and analysis of primary data, the ability to draw conclusions.

Levels of Mastery	Indicators	Descriptors			
		1	2	3	4
First level of mastery: Knowledge and ability to assess the importance of particular parameters of the environment	A basic knowledge of natural sciences	Lack of basic knowledge	Fragmentary knowledge of natural sciences	An average level of theoretical knowledge	A good theoretical training
	Knowledge of laboratory equipment and devices and how they work	Lack of knowledge of laboratory equipment	Familiar with specific laboratory equipment	An average level of knowledge of laboratory equipment	Good knowledge of laboratory equipment
	Knowledge of environmental variables and their ecological significance	Lack of understanding of the ecological values of the environment variables	Is familiar and aware of the importance of individual environmental parameters	An average level of knowledge of environmental parameters	Systematic knowledge of environmental parameters

Levels of Mastery	Indicators	Descriptors			
		1	2	3	4
Second level of mastery: Possession of the methodology of the measurement environmental parameters	Knowledge of methods of laboratory analysis and the ability to apply them	Lack of the knowledge of the environmental laboratory analysis methods	Theoretical knowledge is available, but no comprehensive practical skills	Lack of ownership of some methods of laboratory analysis	Complete mastery of the methods of environmental analysis
	Ability to plan schemes for making some measurements	Not able to design an experiment	Knows how to plan for some stages of the measurement	Knows how to plan meas-urements, but not rationally enough	Knows how to plan schemes for some measurements and experiments
	Ability to develop a programme of observations of the environment	Not able to develop a programme of observations	Able to develop some separate stages of the programme of observations	Able to develop a programme of observations, but lacking the ability to optimize it	Able to develop a holistic programme of observations on the environment
Third level of mastery: Data processing laboratory, development of a databases for subsequent evaluation and prediction of environmental changes	Ability to handle data from laboratory measurements	Cannot handle data from laboratory measurements	Experiencing difficulty in data processing	Able to carry out some processing steps	Fully masters the methods of processing primary data
	Ability to interpret observations and make primary conclusions	Cannot interpret observations and make conclusions	Experiencing difficulty in interpreting data	Able to inter-pret data, but skills are un-derdeveloped for drawing conclusions	Able to interpret data and draw conclusions
	Ability to make observations of the databases for future assessments and forecasts	Cannot make observations of the databases for future assessments and forecasts	Experiencing difficulty in compiling databases	Can produce the databases, but cannot assess their completeness	Able to construct databases and make reports

5.2.4.2. Diagram of meta-profile



Graph 5
Diagram of meta-profile for Environmental engineering

6

Level descriptors and learning outcomes

In a cycle system each cycle should have its own set of learning outcomes formulated in terms of competences. As stated before, learning outcomes are formulated both at programme level and on the level of individual course units or modules. The learning outcomes of the individual units add to the overall learning outcomes of the programme. Competences are developed in a progressive way. This means that they are formed in a number of course units or modules at different stages of the programme. During the design phase of the programme it has to be decided in which units a particular competence has to be formed.

The use of cycles automatically includes the introduction of the concept of levels. For each of these level indicators can be used. They are called level descriptors. As part of the Bologna Process, a group of experts, the so-called Joint Quality Initiative, has developed sets of general descriptors for each cycle, which are called the Dublin descriptors. These cycle descriptors have now been endorsed by the European Ministers of Education as part of the report A Framework for Qualifications of The European Higher Education Area. The approaches of Tuning and the JQI are fully compatible and complementary.

Because cycle descriptors in practice are level descriptors which identify the level of a cycle, Tuning has suggested naming these descriptors cycle level descriptors. The Project participants have produced cycle level descriptors for the first and second cycle for each of the subject areas included in the project. Below, we present generalized description of learning outcomes for each level within our subject area Environmental Engineering.

First-cycle graduates (Bachelors) should:

Cycle	Learning outcomes
1st cycle: Bachelor	Graduates of the first level (bachelors) need to know / understand: the basics of the legal system and legislation, legal, moral and ethical standards in the field of environmental protection, the basic concepts and methods of mathematics, hardware and software implementation of information technology, basic concepts, laws and relations in physics, chemistry, physiology, basic properties of the classes of chemical compounds, bases of interaction of living organisms with the environment, the natural processes in the atmosphere, hydrosphere, lithosphere, factors that determine the stability of the biosphere, characteristics of human impact on the environment, global environmental problems, the main principles of the organization of production processes, methods to assess their effectiveness and impact on the environment; economic basis for the organization of production; framework to protect the environment from various dangers. Bachelors should know / be able to do: to use ethical and legal standards governing the relationship of man to man, society, environment, to use the physical and chemical laws in analyzing and solving the problems of energy and resources, to carry out the analysis and statistical processing of the results of analytical determinations , to assess the technological and economic efficiency, environmental security, to carry out a general assessment of human impact on the environment, to identify hazardous and extremely hazardous areas, zones of acceptable risk, to choose the means of protection for specific tasks to ensure human safety, to determine the cost-effectiveness of measures to safety and the environment. Bachelors should know: the basics of economic and environmental law, management practices of primary operating units, methods of finding and sharing information on computer networks, methods of physical and chemical measurements and correct assessment of their errors, and methods of monitoring and control of environmental parameters, methods of assessment of environmental and economic damage caused by the activities of enterprises, methods of choosing a rational way to minimize the impact on the environment, methods for dealing with emergency and emergency situations.

Cycle	Learning outcomes
2nd cycle: **Master**	Graduates of the second level of HPE (Masters) need to know / understand: the main research areas and concepts, methods and techniques of scientific research, advanced mathematical methods for solving various problems, principles and methods of system analysis, modeling principles of technological and natural processes, modern computer and information technology, used in the field of environmental protection, methods of technical and economic analysis of protective measures, techniques and technologies to protect the environment and people from human impact. Masters should be able to ÷ to plan and carry out scientific research, effectively choose the best computer technology, to create new methods and systems for the protection of man and the environment, to analyze patent information, to develop and implement innovative projects in the field of environmental protection and human rights; to evaluate and predict the economic effects and consequences of on-going and planned processes. Masters should possess: a methodological analysis of the skills of scientific research and its results, the skills to use software packages in the field of environmental protection, ecological and economic methods of analysis and planning, safety management techniques in the technosphere, skills teaching activities.

7

Teaching, learning and assessment

Engineering has classically be defined as the profession that deals with the application of technical, scientific and mathematical knowledge in order to utilize natural laws and physical resources to help design and implement materials, structures, machines, devices, systems and processes that safely realize a desired objective. As such, engineering is at the interface between scientific and mathematical knowledge and human society. The primary activity of engineers is to conceive, design, implement, and operate innovative solutions, apparatus, processes, and systems – to improve the quality of life, to address social needs or problems, and to improve the competitiveness and commercial success of society. The idea of design – of making something that has not existed before – is central to engineering. "While scientists attempt to explain what is, engineers create what has never been".

The education of the engineer must be carefully planned and executed in order to provide the student with the necessary skills and competences to serve successfully as a professional engineer. This education must certainly include a strong grounding in mathematics and in both natural and life sciences. This education must contain training in the engineering sciences related to the area of specialty[11].

[11] Devisilov VA Principles of construction of educational and learning technologies in "Technosphere Safety" // Security in the technosphere.– 2010. – n.º 6. – C. 54-62.

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Teaching should be based on a combination of classical academic education with the simultaneous active implementation of innovative educational technologies.

Teaching - is not only the basic organization of his/her work by the teacher, but a planned and systematic guidance of teacher training and of student cognitive activities, the definition of the content and teaching forms and methods, sequences, creating the best conditions for the assimilation of the content of education and comprehensive development, quality control. Teaching is aimed at forming and developing the necessary learning skills.

The effectiveness of teaching is largely determined by its system, by the expansion of the substantial relationship between the object of study and other branches of knowledge[12].

Learning activities should be based on a problem-oriented system, with active student participation at all stages of education. A key element in this system is the application of knowledge at each successive stage of the mastering of the course content.

Continuous development should be the core element of the educational process of the Environmental Engineer. The educational process should be able:

- to provide an interdisciplinary perspective on issues that will be addressed in environmental practice;
- to develop an understanding of the link between the environment, economic activities and society;
- to develop the ability to use environmental education for solving complex problems.

The learning activities should always include the student in the various processes.

Training is conducted in the form of various kinds of lectures (introductory lectures, review and problem lectures, visual lectures, etc.), seminars,

[12] Krasnogorskaja NN etc. The curriculum bachelor on profile "Protection of the environment and Resource Saving" in the direction 280700 "Technosphere Safety"// "Technosphere Safety". – 2011. – n.º 6. – C. 54-62.

group-work and through the implementation of individual projects. For the best consolidation of the material, excursions and practice should be held on the investigational objects and at industrial sites. Problem-oriented courses, problem solving, research training, learning through laboratory practice, reflective learning, job training, cooperative work in groups, individual and independent learning, and Internet technology should be used as learning activities.

To provide the desired educational outcomes, it is necessary to use a wide variety of educational tools. It is also important to assess periodically the degree of the achievement by students of a certain level of competence. In addition to regular lectures, the educational programme should include a variety of practical and professionally oriented online courses, such as laboratory experiments, business games, interdisciplinary course design, practical work placements, participation in scientific societies.

The realization of a competence-based approach should enable a wide use in the educational process of active and interactive forms of training (on-line seminars, debates, computer conferencing, business and role-playing, case studies, psychological and other types of training, discussion of the results of student research groups, university and intercollegiate teleconferencing) combined with extracurricular activities for the purpose of forming and developing the professional skills of students. For the development of practical skills in the learning process developed in the form of practical tasks relating to case studies, each of which presents some problems. The use of case management can reduce the gap between theory and practice, providing opportunities to demonstrate the practical application of theoretical knowledge. Training by the method of "case studies" should become a necessary complement to lectures that are part of a classical method of university education. Also, as part of the training, courses should be provided for meetings with various companies, government and public organizations, workshops with experts and specialists.

The conjoint classes held in an interactive form must constitute at least 30% of classes. Lecture-type classes for the groups of students may not exceed 50% of the classes.

The maximum allocation of time for classroom training sessions per week during the development of the basic educational programme in full-time education is 27 academic hours.

Industrial practice is of particular importance in the learning process of students. Practice is conducted in outside organizations or departments and laboratories of the university. The programme of practice includes the collection of information characterizing the object of production practice, concise description, indicators of production and economic activity and analysis. A section of the practice can be scientific research carried out by the student.

Assessment

The assessment of quality includes the on-going monitoring of progress, intermediate and final certification.

Monitoring of progress and interim certification may be based on the point-rating system of quality assessment of the educational development of students, the system used by many Russian universities.

The point-rating system is a system of the quantitative assessment of the quality of the development of educational programmes. The discipline in question is divided into a number of independent, logically discrete sections (modules) with control measures.

The objectives of the introduction of the point-rating system are:

- to promote the daily and systematic work of students;
- to increase students' motivation by a greater differentiation of the educational evaluation of their workload;
- to determine the real position of the student in relations to his/her classmates
- to reduce the role of random factors at the formal exams.

The principles of the point-rating system of assessing student performance:

- unified approach of the requirements for students;
- regularity and objectivity of the assessment;
- openness and transparency of the results of student performance for all participants in the educational process.

For a set of rankings, certain milestones must be passed:

- ongoing monitoring;
- landmark control (colloquia, testing, coursework, etc.);
- final control (one-semester test and / or examination).

The rating scale accords with the "traditional" one as follows:

- 85.1 - 100% Excellent.
- 65.1 - 85% Good.
- 50.1 - 65% Satisfactory.
- 0 - 50% Poor.

For the evaluation of students, there is a fund of assessment tools for monitoring progress and interim certification. This fund includes checklists and sample assignments for practical training, laboratory and tests, workshops, tests and exams, tests and computer testing programs, a sample of coursework topics / projects, reports, etc., as well as other forms of control, making it possible to assess the degree of the acquisition of competencies by students.

The final evaluation of students is mandatory and takes place after the conclusion of the educational programme in its entirety. Final certification includes the preparation and defense of the final qualifying work.

Lectures, practical classes, seminars, scientific seminars, master classes, trainings, design work, discussions, roleplaying games, video, situational modelling tasks, sociological research, work in the small groups, training electronic platforms, independent studying of textbooks and abstracts of lectures, individual consultations of teachers, development of the thesis final qualifying work .

One of the most attractive and actively applied active training methods:

1. Role-playing games and cases,
2. Master classes,
3. Trainings.

Assessment methods

One of the important problems in managers' training is the development of methods of their degree of preparation through level assessment.

Here are some of them: written examinations, oral examinations, reports on research work, oral and written representations, expert estimates, tests, portfolio, business games, total general examination, protection of final work.

The educational portfolio is the most interesting.

It is generally understood that the educational portfolio is a form of the process of organising the collection, selection and analysis) of samples and products of educational and informative activity of the trainee, and also the corresponding information materials from external sources (from classmates, teachers, parents, the test centers, public organizations...), intended for the subsequent analysis, all-round quantitative and quality standard of level of a study level of this student and further correction of training process.

Educational portfolios represent a collection of the work of the pupil, comprehensively showing not only his educational results, but also the efforts attached to their achievement, and also the obvious progress in knowledge and abilities by the student in comparison with his/her previous results; The ultimate goal of the configuration of an educational portfolio is reduced to the proof of progress in training by the results, the applied efforts, on the materialized products of educational and informative activity etc. The main sense of an educational portfolio[13] - to display everything of which the student is capable.

[13] «Educational portfolios». Access mode http://portfolioteka.ru/publications/

8

Concluding remarks

International discussions and debates that took place in the working groups with the experts of the 6 Russian universities and the foreign experts in Moscow, Rostov-on-Don, Bilbao, Padua and the forum in Brussels showed the urgency of developing the project in "Environmental Engineering".

Due to the increasing negative impact of technological systems on the environment since the 1960s, it was necessary to change the approach to the training of engineers, environmentalists, to develop a comprehensive education with the inclusion of environmental modules. Environmental engineering as an educational area must combine fundamental and applied science, aimed at obtaining skills that enable specialists engaged professionally in the design, construction and operation of technical systems that minimize human impact and restore natural ecosystems.

Productive exchanges of views in the consortium resulted in a common approach and understanding to train engineers, environmentalists, despite the fact that even in the National Model for the Bachelor of Environmental Engineering in the third generation, there are significant differences in the definition of general culture (GC) and professional (SC) skills for different areas of training. So, towards the preparation of 241000 "Energy-and resource-saving processes in chemical engineering, petrochemicals and biotechnology" there are 12 GC and 24 SC, while in the direction of 280 700 "Technosphere Safety" there are GC 16 and 21 SC. The definitions of some competences do not match each other. For example, the definition of SC 21:

- the ability to design experimental studies to obtain process and analyse the results (in the direction of training 241 000).

- the ability to solve problems in the professional research team (in the direction of 280 700).

From this there follows differences in the curricula, their structure, and thus modular content in the profiles in various Russian universities

Despite the number of current differences in the development of programmes in the discussion, by the consensus of European, African, Latin American and Russian members of the consortium, it is possible to assess the comparability and compatibility of curricula (their elements), by identifying common approaches to teaching, to develop a generic list of key competences and the harmonization of subject-specific competences that define the profile and meta-meta-competencies. The discussion and analysis of focus group interviews in Russia and in Europe revealed the similarity of general competencies for engineers[14]. Proposed by the Russian group "Environmental Engineering" the selection of general engineering skills, regardless of further specialization, found support. It was proposed to continue work in this direction. All this will contribute to further the internationalization of education, the expansion of academic mobility, the definition of common guidelines for the development and programme compatibility and the international recognition of the levels of education, degrees and diplomas.

The demand for environmental engineers is now determined by the need to achieve sustainable development of the society by improving the performance of the environment, by the need to solve the problems associated with global climate change, to provide technological and technosphere safety. Shortage of such specialists is not unique to Russia, but is found also in Europe, Latin America and Africa. Environmental problems are international and, therefore, there is a need to develop educational cooperation in the direction of environmental engineering

The Tuning project has given a lot to the development of training and methodological support of educational programmes in the field of environmental engineering by using the competence approach, the academic and vocational learning outcomes approach. All this should lead to the optimization of the construction of curricula in accordance with the

[14] Report on the cooperation as a synergy group of the thematic network EUCEET (European civil engineering education and training) with Tuning, 2007. – 424 p.

requisite educational levels. As positive results of the joint work on the project should be mentioned the establishment of effective research and teaching links with foreign universities and the access to new information resources and reference databases.

Work on the project marked the beginning of the development of international culture in general and general engineering skills, implementation of which will increase the mobility of students.

9

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10

References

1. The Bologna Declaration on the European space for higher education. http://ec.europa.eu/education/policies/educ/bologna/bologna.pdf
2. TUNING Educational Structures in Europe http://www.unideusto.org/tuningeu/
3. Ministry of Education and science of Russian Federation – Educational Standards in (In Russian), http://xn--80abucjiibhv9a.xn--p1ai/документы/336)
4. A Russian Tuning-ECTS based model for the Implementation of the Bologna Process in Human Sciences (RHUSTE). http://ru-ects.csu.ru/
5. Tuning Russia. http://tuningrussia.org/
6. A Tuning-Ahelo conceptual framework of expected/desired learning outcomes in engineering Tuning Association, on behalf of a Group of Experts, 23 June, 2009. http://www.oecd.org/education/skills-beyond-school/43160507.pdf
7. "On approval and enactment of the federal state educational standards of higher education in the field of training "241000 Energy-saving processes in chemical engineering, petrochemicals and biotechnology" (qualification (degree) "Bachelor") (In Russian) / Ministry of Education and science of Russian Federation / http://www.edu.ru/db-mon/mo/Data/d_11/m79.html
8. Safety in Technosphere (In Russian), http://www.edu.ru/db-mon/mo/Data/d_09/m723.html
9. Association for Engineering Education of Russia. www.aeer.ru

10. Principles of construction of educational and learning technologies in «Technosphere Safety» Devyasilov VA (In Russian). 2010. – n.º 6. – C. 54-62.

11. The training program BA in profile "Protection of the environment and resources" in"Technosphere Safety" Krasnogorskaja NN and others (In Russian), n.º 6. – C. 54-62.

12. Portfolioteka.ru. Portfolio for learners (In Russian). http://portfolioteka.ru/publications.

13. Report on the cooperation as a synergy group of the thematic network EUCEET (European civil engineering education and training) with Tuning, 2007. – 424 p.

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