

КАЗАХСКИЙ НАЦИОНАЛЬНЫЙ УНИВЕРСИТЕТ имени АЛЬ-ФАРАБИ  
ИНСТИТУТ ВЫЧИСЛИТЕЛЬНЫХ ТЕХНОЛОГИЙ  
СИБИРСКОГО ОТДЕЛЕНИЯ РАН

ISSN 1560-7534  
ISSN 1563-0285

## СОВМЕСТНЫЙ ВЫПУСК

по материалам международной научной конференции  
"Вычислительные и информационные технологии в науке, технике и образовании"  
(CITech-2015)  
(24-27 сентября 2015 года)

# ВЫЧИСЛИТЕЛЬНЫЕ ТЕХНОЛОГИИ

Том 20

# ВЕСТНИК КАЗНУ им. АЛЬ-ФАРАБИ

Серия математика, механика и информатика № 3 (86)

## ЧАСТЬ IV

АЛМАТЫ – НОВОСИБИРСК, 2015

## Table of Contents

---

### Session IV. New Information Technologies in Education

---

Concepts of Activization of Trainees Within Structural Model of Education . . . . .	10
<i>D.N. Ashurova, M.U Raimova, Z.Kh. Yuldashev, M.A. Yuldasheva</i>	
Kazakh Morphological Analysis for Statistical Machine Translation: A Case Study . . . . .	15
<i>A. Kartbayev, Y. Bekbolatov</i>	
A Concept Map Approach to Supporting Adaptive e-Learning . . . . .	23
<i>M. Mansurova, A. Nugumanova, Ye. Baiburin, D. Zyryanov</i>	
Design and Development of Online Courses on EdX Platform . . . . .	30
<i>M.E. Mansurova, A.Yu. Pyrkova, Ye. Alimzhanov</i>	
Positive Practice in the Implementation of Moodle in E-Learning . . . . .	36
<i>V. Petrovic, J. Anja</i>	
Structuralization of Categories of the "Knowledge"Pedagogical Science in the Process of Informatization of the Society . . . . .	42
<i>B.K. Shayakmetova, G.T. Omarov, Sh.Ye. Omarova, N.T. Orumbayeva</i>	
Database Design for the Sectoral Frame of IT Qualifications Within TEMPUS Project "QUADRIGA" . . . . .	48
<i>B.A. Urmashev, A.Yu. Pyrkova, M.E. Mansurova, E.P. Makashev, A.Zh. Burlibayev, M.S. Sarsembayev</i>	
Технология Создания Метрических Справочников и Конкордансов Русских Поэтических Текстов . . . . .	54
<i>В.Б. Бараннин, О.Ю. Кожемякина, А.В. Забайкин</i>	
Об Одном Подходе к Обучению Программированию . . . . .	61
<i>И.Н. Скопин</i>	

---

### Session V. Technological Process Automation and Control

---

Data Processing Automation of Geodynamic Monitoring on an Oil and Gas Field . . . . .	73
<i>F. Abdoldina, A. Berlibayeva, G. Umirova</i>	
An Approach to the Development of Distributed Applications for Oil Extraction Problems	83
<i>D. Akhmed-Zaki, M. Mansurova, B. Matkerim</i>	
Technologies of Heterogeneous Programming Systems Integration in the Informational Computing Environment of Mathematical Modeling and Data Analysis . . . . .	93
<i>I.V. Bychkov, G.M. Ruzhnikov, R.K. Fedorov, A.S. Shumilov, I.A. Sidorov, V.P. Potapov</i>	

# Database Design for the Sectoral Frame of IT Qualifications Within TEMPUS Project "QUADRIGA"

Baidalet A. Urmashiev, Anna Yu. Pyrkova, Madina E. Mansurova, Erlan P. Makashev,  
Aimurat Zh. Burlibayev and Magzhan S. Sarsembayev

Al-Farabi Kazakh National University, Almaty, Kazakhstan

{Baidalet.Urmashiev, Anna.Pyrkova}@kaznu.kz, {mansurova01, Makashev\_Yerlan, Aimurat06, magatrone}@  
mail.ru

**Abstract.** One of priority objective of Tempus project "QUADRIGA" is development of the project of a sectoral frame of qualifications (SFQ) in the field of information technologies on the basis of the All-European recommended frame and taking into account experience of the European and Russian higher education institutions.

Implementation of the project will allow to provide a basis for modernization of educational programs, to promote closer cooperation and mutual understanding between universities and employers (the enterprises, industries, public sector) that will be useful to graduates of higher educational institutions of Central Asia and will allow to strengthen the Centers of Career in higher education institutions of Central Asia for expansion of opportunities of graduates in employment and creation of high-quality employment.

Today participants of the project developed the project of a database for a sectoral frame of qualifications taking into account influence of professional competences on formation of the contents, the purposes and problems of disciplines of higher educational institutions.

Thanks to the developed structure of a database it is possible to track interrelation between the labor functions, necessary for successful work in sector of IT technologies, and educational competences of discipline; to see and estimate process of formation of professional competences of the graduate of a higher educational institution; to define the education level demanded for assimilation of necessary skills (undergraduate studies, magistracy, PhD doctoral studies), etc. In the future the team of the QUADRIGA developers will make an attempt to use this database for development of an educational program of IT specialties.

**Keywords:** Sectoral frame of qualifications (SFQ), database, educational program of IT, employers, competences.

## Introduction

Since 2012 al-Farabi KazNU, KIMEP, EKSTU named D. Serikbayev, and the Karaganda state industrial university work on international Tempus project "QUADRIGA". One of priority objective of this project is development of the project of a branch (sectoral) frame of qualifications in the field of information technologies on the basis of the All-European recommended frame and taking into account experience of the European and Russian higher education institutions.

The main direction of reforming of the higher education of the Republic of Kazakhstan is creation of conditions on ensuring its adaptation to changes in economy, and also to entry of an education system into world educational space. It is known that the Republic of Kazakhstan is the first Central Asian state which in 2010 joined the Bologna declaration and became the full participant of the European educational space. The purpose of participation of Kazakhstan in Bologna Process is expansion of access to the European education, further improvement of quality of education, and also increase of mobility of students and teaching structure [1].

Now in the Republic of Kazakhstan the State program of a development of education for 2011-2020, which purpose is cardinal modernization of an education system, significant and steady increase in investments into education, improvement of its quality and an exit to the European level, is realized.

## National and sectoral frameworks of qualifications

One of the actions directed on implementation of this program is introduction to the Labour Code of the Republic of Kazakhstan the addition in the form of chapter 10-1 "National system of qualifications" ("About modification and additions in the Labour code of the Republic of Kazakhstan" from February 17, 2012 No. 566-IV LRK). According to [2] National System of Qualifications (NSQ) is a set of mechanisms of legal and institutional regulation of demand and offers on qualification of experts from labor market (fig. 1). The purpose of introduction of NSQ is creation of flexible system of qualifications in RK on the basis of effective mechanisms of legal and institutional regulation of interaction of professional education and labor market.

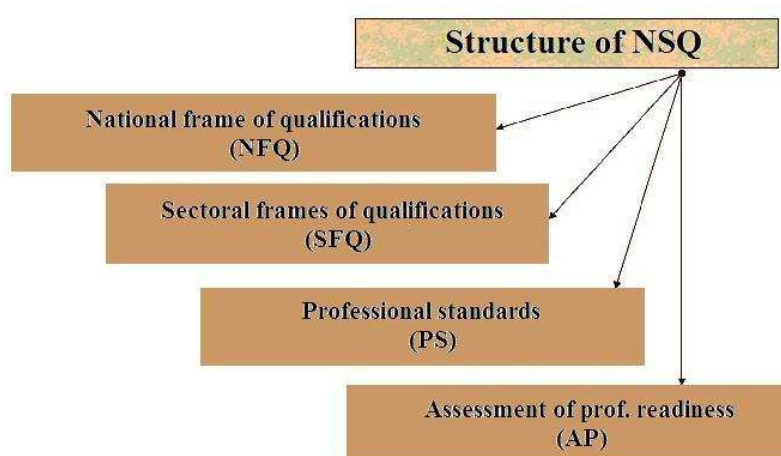


Fig. 1. Structure of NSQ.

The main terms and concepts used in the National Frame of Qualifications (NFQ) and presented in the document "A national frame of qualifications. General provisions" following:

- 1) A national frame of qualifications – the structured description of the qualification levels recognized in labor market;
- 2) The Branch Framework of Qualifications (BFQ) – the structured description of the qualification levels recognized in branch;
- 3) The Professional Standard (PS) – the standard defining in concrete area of professional activity of the requirement to a skill level and competence to the contents, quality and working conditions.

Development of NFQ is conducted together with the Bologna working group, thus the contents and structure of the All-European recommended frame (EFQ) is considered. The all-European recommended frame connects with each other qualification systems of various countries and acts as the instrument of transfer to make more clear qualifications outside the countries and systems. EFQs cover all range of qualifications, from basic (the 1st level, leaving school) to the advanced level (the 8th level, training of doctors). As the instrument of assistance to education during all life of EFQ covers qualifications of all levels.

According to the instruction on application of NFQ ([3]) "The national frame of qualifications defines a uniform scale of qualification levels and is a basis for system of confirmation of compliance and assignment of qualification of experts."

NSK allows:

- 1) describing from uniform positions of the requirement to qualification of workers and graduates when developing professional and educational standards;
- 2) developing estimated materials and procedures of determination of qualification of workers and graduates of all levels of professional education;
- 3) planning various trajectories of education conducting to obtaining concrete qualification, increase of qualification level, career development.

Now some higher education institutions of RK are performers of the international project Tempus "QUADRIGA Frame of qualifications in Central Asia: harmonization with the Bologna principles and regional cooperation" (2012-2015), its main purpose is realization of ideas of the Frame of qualifications in the countries of Central Asia and creation of the Guide on the National frame of qualifications. The main direction of implementation of the QUADRIGA project is improvement of educational systems of the partner countries by further development of the existing requirements to educational standards in certain areas on the basis of new European approaches.

Objectives of Tempus QUADRIGA project are: 1) the analysis of development of the National frame of qualifications in Kyrgyzstan, Kazakhstan and Tajikistan;

2) creation together with the Ministries of Education of the partner countries the National committees on a framework of qualifications in each of the partner countries, and also formation of a regional network of Central Asian committees on NFQ;

3) improvement of the national Regulations concerning educational standards in concrete areas on the basis of ideas of a frame of qualifications, the principles of Bologna Process and experience of higher education institutions of the EU;

4) introduction of new National standards in member countries of Central Asia on information sciences;

5) preparation of subject domain and sector descriptors for levels 6, 7 and 8 on informatics by groups of experts of National committees on a framework of qualifications.

Now with assistance of the Center of Bologna Process and the academic mobility of RK MES the methodical manuals on development of professional standards in various branches of economy of RK [6-7] are prepared. The methodical manual is developed for education and science by National Academy of Education. In this work methodological and applied aspects of formation of a branch frame of qualifications and professional standards in education and sciences are stated in detail. According [6-7] branch frame of qualifications is developed on the basis of NFQ taking into account the following principles:

- reflection of priorities of branch and accounting of business interests of the companies;
- succession and a continuity of development of qualification levels from the lowest to the highest;
- transparency of the description of qualification levels for all users;
- the description of the BFQ qualification levels through indicators of professional activity;
- the description of types of work, but not the workers who are carrying out them and workmanship them functions.

BFQs form the characteristic (descriptors) of qualification levels and subtotals opened through the main indicators of professional activity:

- knowledge;
- skills;
- personal and professional competences which are specified as follows: independence and responsibility; ability to study; communicative and social competence; professional competence.

In Kazakhstan the structure of a branch frame of qualifications includes the following elements:

- 1) name of branch (area of professional activity);
- 2) a skill level (it is specified according to NFQ);
- 3) qualification weight;
- 4) area of professional activity;
- 5) type of work;
- 6) the recommended names of positions for the allocated types of work;
- 7) subframes: production subframe, subframe of operational management and subframe of strategic management;
- 8) the description of qualification levels (NFQ descriptors for concrete qualification level are given);
- 9) the characteristic of qualifications on a subframes:
  - the qualification subtotals allocated within concrete qualification level;
  - the indicators of professional activity corresponding to each qualification subtotal the BFQ;
  - indicators and descriptors, the excellent or specifying descriptors of the concrete qualification level of NFQ;
  - ways of achievement of qualification of the corresponding subtotal according to NFQ.

## Development of database of SQF for IT specialities

Participants of the project carried out the analysis of a condition of the national qualification frameworks; considered the European frame of qualifications with 8 levels corresponding to education levels; studied the principles of creation and introduction of the branch frameworks of qualification (BFQ) on informatics for bachelors, masters and PhD of doctors taking into account opinions of employers, in particular, the BFQ of education, the sphere of information and communication technologies, spheres of tourism and the sphere of oil and gas industry.

Today participants of the project developed the project of a database (fig. 2) for a sectoral frame of qualifications taking into account influence of professional competences on formation of the contents, the purposes and problems of disciplines of higher educational institutions.

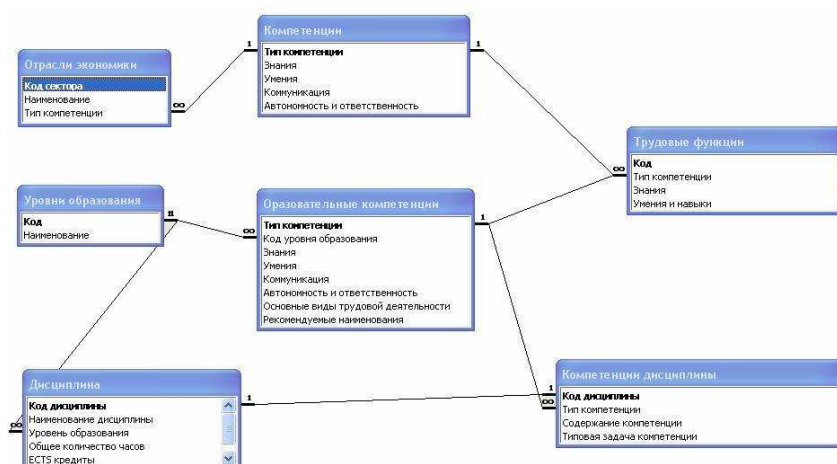


Fig. 2. Structure of database of SQF for IT specialities.

The database basis was the algorithm of development of a sectoral frame of qualifications offered by the European project coordinator Chernyshenko S.V.:

- 1 Transition from competences to results of training
- 2 Sources:
  - 2.1 Workshop - employers - questionnaires.
  - 2.2 Professional standards.
- 3 Review of base of professional standards.
- 4 Choice of labor functions and qualifications.
  - 4.1 Review of statistics on graduates.
  - 4.2 Drawing up list of positions.
  - 4.3 Drawing up list of the companies ( 100).
  - 4.4 Poll of stakeholders (employers, teachers, students, parents of students).
  - 4.5 Forming educational standards.
  - 4.6 Comparing competences and results of training (1: 1).
  - 4.7 Comparing with the State obligatory standard of education (coincidence we exclude).
  - 4.8 Ranging results of training on levels on a branch frame of qualifications.
  - 4.9 Defining specialties and education levels.
- 5 Forming an educational program.
  - 5.1 Composing the list of modules.

## Conclusion

Thanks to the developed structure of a database and the information system (fig. 3), offered as the interface for the developed database, it is possible to track interrelation between the labor functions, necessary for successful work in branch of IT technologies, and educational competences of discipline; to see and estimate process of formation of professional competences of the graduate of a higher educational institution; to define the education level demanded for assimilation of necessary skills (undergraduate studies, magistracy, PhD doctoral studies), etc. In the future the team of the QUADRIGA developers will make an attempt to use this database for development of an educational program of IT specialties [8].



**Fig. 3.** Information system of SQF for IT specialties.

Implementation of the project will allow to provide a basis for modernization of educational programs, to promote closer cooperation and mutual understanding between universities and

employers (the enterprises, industries, public sector) that will be useful to graduates of higher educational institutions of Central Asia and will allow to strengthen the Centers of Career in higher education institutions of Central Asia for expansion of opportunities of graduates in employment and creation of high-quality employment.

Successful implementation of the QUADRIGA project will provide a basis for modernization of the higher education, and also will promote further entry of RK into world educational space.

## References

1. [http://www.edu.gov.kz/ru/deyatelnost/bolonskii\\_process/prisoedinenie\\_k\\_bolonskomu\\_processu/](http://www.edu.gov.kz/ru/deyatelnost/bolonskii_process/prisoedinenie_k_bolonskomu_processu/)
2. The law of the Republic of Kazakhstan "About modification and additions in the Labour code of the Republic of Kazakhstan" Chapter 10-1. National system of qualifications from February 17, 2012 No. 566-IV LRK, No. 566-IV LRK.
3. The national frame of qualifications, approved by the joint order of the Ministry of Education and Science of RK from September 28, 2012, No. 444.
4. Euro-Inf Framework Standards and Accreditation Criteria for Informatics Degree Programmes, <http://www.eqanie.eu/pages/quality-label/framework-standards-criteria.php> (2011-09-01).
5. Computer Science Curriculum 2008: An Interim Revision of CS 2001. Report from the Interim Review Task Force, copyright ACM and IEEE, published by the Association for Computing Machinery, 2008.
6. *Seydakhmetova R.G., Kobenova G.I., Narbekova B.M., Syrymbetova L.S.* A methodical manual on development of professional standards in area of education and sciences – Astana: Center of Bologna Process and academic mobility of RK MSE, 2013. - 117 p.
7. *Seydakhmetova R. G., Pak Yu.N., Breydo I.V., Syrymbetova L.S., Narbekova B.M.* A methodical manual on development of professional standards in the sphere of power industry – Astana: Center of Bologna Process and academic mobility of RK MSE, 2013. – 95 p.
8. *Akhmed-Zaki D.Zh., Mansurova M.E., Pyrkova A.Yu., Urmashiev B.A., Makashev E.P.* Sectoral frame of qualifications as basis of design of professional standards. // Materials of the 44th scientific and methodical conference "The Competence-based Focused System of an Assessment of Knowledge Vol. 1, Almaty (2014) 145-148.