

Trends and Opportunities of Training Highly Qualified IT Specialists in Accordance with International Standards

Sergei S. Voitenko
St. Petersburg State University
62 Tchaikovsky st.
191123 St. Petersburg Russia
s.voitenko@spbu.ru

Lyudmila F. Vyunenکو
St. Petersburg State University
62 Tchaikovsky st.
191123 St. Petersburg Russia
l.vyunenکو@spbu.ru

Alexander V. Yurkov
St. Petersburg State University
62 Tchaikovsky st.
191123 St. Petersburg Russia
a.v.yurkov@spbu.ru

ABSTRACT

The aim of the research is to analyze the conformity of training curriculum in the area of business informatics at the Saint Petersburg State University (SPBSU) to the requirements of the SWEBOK standard. The results of the research would be setting the conditions necessary for training Russian PhD-students according to the international standards of Software Engineering (SE) and recommendations for the corresponding improving of IT-education programs in the University. International cooperation in the field of doctoral training is supported by the project Joint Programs and Framework for Doctoral Education in Software Engineering in the European Union Erasmus+ Program Capacity Building in Higher Education. The overall aim of the project is to support the development, modernization and internalization of SE higher education in the target countries according to the SWEBOK international standard. The standard includes the following areas: Research Methods in the age of Software as a Service, Advanced methods and tools of SE, Problem-based learning in the field of SE, Human-computer interaction in SE, Models of SE and modeling, Mathematical and computational foundations of SE, SE from the economics and business point of view. The last area of the research is widely represented at the Faculty of Economics of Saint Petersburg State University. Business informatics courses are taught here by highly qualified staff for several years.

Categories and Subject Descriptors

K.3.2 [Computers and Education]: Computer and Information Science Education - *IT education standards, international cooperation*

General Terms

Management, Economics, Standardization

Permission to make digital or hard copies of all or part of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. To copy otherwise, or republish, to post on servers or to redistribute to lists, requires prior specific permission and/or a fee.

ICAIT'16, Oct. 6–8, 2016, Aizu-Wakamatsu, Japan.

Copyright 2016 University of Aizu Press.

Keywords

Business informatics, IT education standards, Software Engineering Body of Knowledge (SWEBOK), International cooperation, PhD training

1. INTRODUCTION

The current graduate education system in many countries is based on an apprenticeship model, wherein lab heads train younger researchers in the craft of research. This system has been prominent since the 1800s, when the first 'modern' PhD was awarded by the University of Berlin. Although the scientific enterprise has changed dramatically since then, the PhD system has not. Modernizing the PhD could improve training in areas of research ranging from reproducibility to experimental design and entrepreneurship. It could also help to solve the bottleneck problem by equipping doctorate holders with soft skills that make them more employable wherever they go [4].

The last few decades have witnessed an assortment of rapid and transformative changes in the needs of society and in the institutions created to respond to these needs. As the economy shifts from based on the production of goods to based on the production of knowledge and information it creates a demand for new types of learners and innovators in every profession. Employers and administrators in every sector now report that they expect doctoral programs to create well-rounded disciplinary experts who have the ability to be leaders in their fields and are capable of creating real-world value from knowledge and discovery. In spite of these economic realities, universities—and doctoral programs specifically — largely continue to view Ph.D. training as a means of reproducing the status quo [12].

In Russia for more than 25 years the reform of higher education is being implemented in accordance with the Bologna system. The two main objectives of the reforms are introduction of the new federal state educational standard and transition to the three cycle bachelor-master-doctorate system. The last stage of this multi-level higher education model is particularly important as it contributes to the modern world science. As we see it, the major problem of this progressive essential transformations is that the integrated training conveyor for highly qualified scientific personnel has not been still fully implemented [8]. The comparison of the above mentioned three-cycle process

and the traditional stepped educational procedure of the Russian higher school shows that a specialist in Russia receives more high level of education and training than a bachelor in Bologna model. Graduates from leading Russian universities qualified as specialists in terms of final theses are comparable with foreign masters. However, modern domestic postgraduate training, especially for applied areas, is significantly less efficient than the Institute of PhD-doctoral training. The transfer and adaptation of this institute in the Russian education system is still not implemented. For example, in Saint Petersburg State University there are only a few examples of PhD defenses. Thus, the transition from a stepped model of higher education, which differed Russian higher school, to a two-level model should be supplemented with a well-developed doctoral training, carried out in accordance with international standards. In the field of Software Engineering, one of the most recognized standards is the Software Engineering Body of Knowledge – SWEBOK [1]. For bachelor degree program "Business Informatics" and master degree program "Informational business Analytics" presented at the Faculty of Economics of Saint Petersburg State University another important set of recommendations is standard Business Analysis Body of Knowledge – BABOK [5]. Training at these programs is conducted in the following areas: Investment Analysis of SE Projects, Risk Analysis and Risk Management of SE Projects, Business Intelligence for SE Costing, Technics and Methodology of Simulation Modeling in SE, Perfect Software Engineer Competences, Economics and Competitiveness of SE Education.

2. SPBSU OPPORTUNITIES and TRADITIONS in the DEVELOPMENT of its OWN EDUCATIONAL STANDARDS

In the field of higher education in the Russian Federation three generations of state educational standards have been developed and put into operation over the past 25 years, mandatory for compliance for the universities competing for state accreditation. The main trend of their evolution has been the expansion of academic freedom of universities in shaping the structure and content of education. Federal state educational standards (FSES) were put in place in 2011. FSES advantage was the use of credits compatible with the ECTS to assess the complexity of the mastering of educational programs. In 2012, a new edition of these standards FSES 3+ was developed. In this standard the emphasis is put on the competence of the graduates of educational programs and expanding the rights of educational institutions in determining the structure and content of the programs. Currently FSES 3+ format developed 691 standards within 57 enlarged groups of directions and specialties of undergraduate specialties, graduate and postgraduate studies. A special feature was FSES 3+ division undergraduate and graduate educational programs in academic and applied, depending on the type of the main professional activity of graduates. At the freedom of universities in the planning of the professional competencies of graduates realized in the level of training of highly qualified personnel.

Only a few of the leading Russian universities (including the Saint Petersburg State University) today, which by the Federal Law "On Education in the Russian Federation" are allowed to

develop and implement their own educational standards have the right to develop their own sets of educational standards, determine the structure and content of educational programs at their own direction at all levels of higher education. Saint Petersburg State University's own educational standard approved in 2014 [7], is set up for each direction of training, corresponding to GEF, bachelor, specialty, and master. Master includes several models: academic, academically-oriented and practice-oriented. According to the educational standards of the Saint Petersburg State University, each graduate should possess general competence in terms of: improvement and development of their general intellectual and cultural level; use knowledge of modern achievements of science and education in solving the educational and professional goals; the independent development of new methods of research, changing the profile of their professional activities; independent acquisition of information technologies by means of new knowledge and skills and use them in practice, including in new areas; work with professional texts in English and Russian languages, and others.

The standard specifies requirements for the results of the mastering of educational programs depending on peculiarities directions of training, also includes a list of formed professional competencies. The basis is to match them to the requirements of employers and the results of the mastering of the appropriate level of educational programs in leading universities of the world. For each direction of training the educational standard of the Saint Petersburg State University establishes a list of required professional foreign language competences, which must possess a graduate of magistracy. The standard defines the requirements for the structure of educational programs, the conditions of their implementation, and the quality assessment at the level of the leading universities in the world. Appendix to the educational standard is a list of master's degree programs in directions of preparation, corresponding FSES. It should be noted that the educational standard at the level of training of highly qualified personnel – graduate and PhD-doctorate – in the Saint Petersburg State University is currently missing.

In a recent paper [3] states that elaboration by universities their own educational standards in directions not listed in the Enumeration of Federal state educational standards is a rare phenomenon. However, in our view, this practice should be developed in the near future. The impetus for the development of educational standards will be a need for interdisciplinary programs, mastering which will organically combine the advanced knowledge, skills and professional experience in various fields of fundamental and applied researches of natural science, technical and humanities. The logic of the formation of knowledge-based economy necessitates the development of educational standards of the country's leading universities. Own educational standards of universities contribute to the realization of their missions, taking into account the traditions and development strategies. Standards of leading universities are working to increase their competitiveness on the national and international levels, affect the positioning of universities in the world scientific and educational space. The main direction of development of educational standards independently established by leading Russian universities, is, obviously, to create conditions for the development and implementation of

world-class interdisciplinary educational programs needed for training, sought after a dynamic science and high technology manufacturing. All this is a positive impact on improving the quality of the Russian higher education system.

3. The DEVELOPMENT of the IT EDUCATIONAL DIRECTION at SPBSU

The leading Russian universities – Moscow State University and Saint Petersburg State University – since the mid 80-ies traditionally taught IT at a high theoretical level together with serious mathematical training. These training programs improved in accordance with international educational standards. Immediately after the appearance of «Computing Curricula 2001: Computer Science» and «Software Engineering 2004: Curriculum Guidelines for Undergraduate Degree Programs in Software Engineering» Saint Petersburg State University published their translations into Russian. In 2003, the Moscow State University proposed and adopted a new educational direction "Information Technology", as well as educational standards of Bachelor and Master of IT, focused on the training of professionals demanded in research projects, industry and business [9]. Those were the first Russian educational standards developed with the advice of "Computing Curricula", but unlike the foreign educational programs they have preserved the fundamental nature of training, in particular, a more in-depth and focused mathematical preparation. Already from the 2003/04 school year, the Moscow State University and the Saint Petersburg State University students have begun to conduct training on this educational direction, and in 2006 at Saint Petersburg State University was carried out serious work on bringing the curriculum "Information Technology" in compliance with the recommendations «Computing Curricula: Software Engineering» [10]. The next step was the opening in 2011 in Saint Petersburg State University the direction of training bachelors and masters on the "Software Engineering" speciality. The draft program was focused on the balance between fundamental (mathematical methods, algorithms, mathematical logic), applied technological (private algorithms, technologies and paradigms) and humanitarian (project management, economic and legal basis of the production of software, the theory of inventive problem solving) components.

4. INTERNATIONAL COOPERATION in SE DOCTORAL EDUCATION

Due to the fact that the educational standards for the training of graduate students and PhD-students for IT and SE directions of the Russian legislation are not provided, and the ability to assign their own academic degrees, the Saint Petersburg State University is making efforts for setting the conditions necessary for training Russian PhD-students according to the international standards of SE and recommendations for the corresponding improving of IT-education programs in the University.

In particular, international cooperation in the field of higher qualification scientific personnel training is supported by the project Joint Programs and Framework for Doctoral Education in Software Engineering in the European Union Erasmus+ Program Capacity Building in Higher Education. One global

aim of capacity building would be to change the composition of staff at Higher Education Institutions to make this more representative. Secondly, structural problems within the higher education sector result in inequalities between institutions in terms of staff qualifications, staff/student ratios, availability of postgraduate programs, availability of research funding, library and information services, information technology, management capacity, and infra- structural support [2]. The overall aim of the mentioned project is to support the development, modernization and internalization of SE higher education in the target countries according to the SWEBOK international standard and at the same time to help all partner countries to strengthen their PhD programs and make them more attractive for international students. The project will facilitate building and offering of sustainable multi-disciplinary and multi-regional perspective programs for educating the next generation of software engineering professors [11].

The project proposes training for qualified teaching staff of all partner universities and for PhD students in the target countries. During the 2015-2018 eleven European universities, including the Saint Petersburg State University, will share their experience in creating educational environment according to the international standards. The program is structured in several intense schools which will be organized by different universities. It will help to share specific expertise of partner universities in different areas. Each university can nominate PhD students to attend the different schools. Target countries also can train their staff in these schools. These schools are held in different knowledge areas and disciplines providing typical PhD student information which he or she cannot acquire in one specific university. Individual PhD students can select the best suited schools according to their research profile and create personal path in the proposed program. PhD students and their supervisors will be offered courses on advanced techniques of SE and reviews of the best practices of research projects. Help will be provided in preparation of high-quality scientific publications on the subject, which includes the following areas: Research Methods in the age of Software as a Service, Advanced methods and tools of SE, Problem-based learning in the field of SE, Human-computer interaction in SE, Models of SE and modeling, Mathematical and computational foundations of SE, SE: A View from the point of view of economics and business. The last area of the research is widely represented in the Faculty of Economics of Saint Petersburg State University, business informatics courses being taught here for several years by highly qualified staff [6]. Training is conducted in the following areas: Investment Analysis of SE Projects, Risk Analysis and Risk Management of SE Projects, Business Intelligence for SE Costing, Technics and Methodology of Simulation Modeling in SE, Perfect Software Engineer Competences, Economics and Competitiveness of SE Education. Of course, we understand that SWEBOK standards have the rather limited intersections with educational programs in the direction of business informatics, and take into account the presence of BABOK and other IT standards. However, the problem of the development of educational standards for the preparation of highly qualified scientific personnel is so acute for the university that we use all the opportunities.

5. CONCLUSION

With the nature of jobs in the current market for SE and BI graduates permanently transformed by a changing global economy, graduate education now finds itself with an opportunity to reinvent itself as well. Contemporary Ph.D. students are beginning to realize that their training must change and are demanding that universities provide graduates with the skills necessary to operate professionally within the new economy. Recent research on graduate students [12] emphasize that while the technical and disciplinary-specific training received during doctoral programs is useful, they are missing basic professional skills that are essential in the contemporary economy. The findings of this study suggest that many students in doctoral programs are not only aware that they are lacking these skills, they are willing and looking for flexible, interesting, efficient, and relevant ways to develop them over the course of their graduate programs.

6. ACKNOWLEDGMENTS

The research is partially supported by the Russian Foundation for Basic Research (RFBR), grant 16-06-00221.

7. REFERENCES

- [1] Bourque, P. et al. *Guide to the Software Engineering Body of Knowledge, Version 3.0* - IEEE Computer Society, 2014. Available at <http://www.swebok.org> (accessed 21.06.2016).
- [2] CHET 2002. *Capacity Building Initiative in Higher Education* - Centre for Higher Education Transformation, 2002. Available at <http://www.chet.org.za/download/file/fid/198> (accessed 07.07.2016).
- [3] Chuchalin, A. *Educational Standards of the Leading Russian Universities*. - Higher Education in Russia, 2015, no 4, pp. 14-25.
- [4] Gould, J. *How to Build a Better PhD*. - Nature, Dec 2015, vol. 528, pp. 22-25.
- [5] IIBA 2016. *A Guide to the Business Analysis Body of Knowledge (BABOK Guide), Version 3.0* - International Institute of Business Analysis, 2016. Available at <http://www.iiba.org/babok-guide.aspx> (accessed 07.07.2016).
- [6] Khalin, V., Yurkov, A. et al. *Prikladnaya informatika v ekonomike. Sbornik programm uchebnykh distsiplin po spetsial'nosti 080801 (351400)*. [Applied Informatics for Economy. Collection of educational programs for specialty 080801 (351400)] – Saint Petersburg, 2008, 260 p. (in Russian).
- [7] SPbGU 2014. *Obrazovatel'nye standarty* [SPbSU. Educational standards]. – Saint Petersburg State University, 2014. Available at <http://spbu.ru/structure/documents/mm19xm7g.html> (in Russian, accessed 07.07.2016).
- [8] Sukhomlin V.A. *On the outcome of the higher school reform (reflections of Russian professors)* – Journal of Applied Informatics, 2011, vol. 32, no. 2, pp. 41–48 (in Russian). Available at http://www.appliedinformatics.ru/general/upload/articles_preview/pi3210-41_fs.pdf (accessed 07.07.2016).
- [9] Sukhomlin, V.A., Sukhomlin, V.V. *Kontseptsiya novogo obrazovatel'nogo napravleniya* [The concept of a new educational direction] *Otkrytye sistemy* - Open Systems Journal, 2003, no. 2, pp. 31-34 (in Russian).
- [10] Terekhov, A.A., Terekhov, A.N. *Computing Curricula: Software Engineering i rossiiskoe obrazovanie* [Computing Curricula: Software Engineering and Russian Education] *Otkrytye sistemy* - Open Systems Journal, 2006, no. 8, pp. 31-34 (in Russian).
- [11] Voitenko, S., Vyunenkov, L., Yurkov, A. *Business Informatics and SWEBOK: a Way to Interconnection*. New Challenges of Economic and Business Development – 2016: Society, Innovations and Collaborative Economy. Abstracts of Reports. 2016. p. 125.
- [12] Wheadon, M., Duval-Couetil, N. 2014. *Student Perspectives on Developing More Relevant Ph. D. Programs in STEM Disciplines through Professional Skills Training*. 2014 American Society for Engineering Education Annual Conference, 24, 1. Paper ID # 10495.