Centre for Excellence Experiences of university-industry cooperation in the Russian Federation

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Abstract

This article describes several mechanisms for cooperation between university engineering departments and industry taking as an example, Bauman Moscow State University (BMSTU), a respected engineering university in Russia. Moreover, the research is strongly associated with the development of innovative pedagogical methods and quality evaluation methods. BMSTU hosts the IBM Mainframe Centre of Excellence, founded in 2007 by a memorandum of understanding between BMSTU and IBM. The Centre helps teaching staff to embed new information about IBM technologies into curricula and delivers seminars (including web-seminars) that attract leading specialists from the company and other enterprises that use IBM equipment, software and middleware.

R&D projects jointly financed by Russian government funds and IBM have been successfully completed within the framework of the Centre's activities and students who took part in these projects as part of their engineering studies were shown to attain high marks when compared with other non-participating students. In addition, a number of these students received prestigious external awards and prizes for their work. The article shows a statistical comparison between students who took part in the industry based project and those who were purely university based. To complete the longitudinal study, fifty two students who graduated from the Computer Systems and Networks department in the last five years were asked about their present status, level of salary and the influence on their early career of their participation in the Centre of Excellence work.

Keywords: industry; statistical comparison; engineering education quality methods, employability.

Introduction

The Bauman Moscow State Technical University (BMSTU) is one of the biggest and oldest universities in Russia with the annual enrolment of over 3,500 students and the total number of more than 170,000 graduates. The university includes 8 Research and Education Units and the staff are composed of about 61% who are Associate Professors (PhD-holders), 26% of full professors (holders of Doctors of Science degree) and 13% of faculty staff (holders of Diploma of Specialist). They teach 20, 000 students and 800 doctoral students. Annually, around 1,000 BMSTU scientists, including almost 700 faculty members, involve 1020 students in their research activities. 18 Faculties and Research Institutes are organized in the 8 Research and Education Units offering a huge range of courses in manufacturing engineering, computer science, control systems, integrated automation, radio electronics, laser technology, medical engineering, power engineering, special-purpose engineering, fundamental sciences, engineering business and management, jurisdiction, social science, and linguistics. The BMSTU has strong relations with industry and external research institutions as well as with universities in foreign countries. One important aspect of the relationships between the BMSTU and industry is that it is intended to enhance the employability of its graduates. This article describes different ways of achieving this using, as an example, the activities of the Computer Systems and Networks Department.

The BMSTU hosts an IBM Mainframe Centre of Excellence founded in 2007 according to a Memorandum of Understanding between BMSTU and the IBM company. This was to become a special incubator for relationships between university and enterprises. It is based in the Computer Systems and Network Department within the Informatics and Control Systems Faculty. The Centre of Excellence now works with many different enterprises using necessarily flexible policies. The authors of this article have specific roles in the Centre; Dr. Elena Smirnova is the centre's director and also an associate professor at Computer Science department, while Professor Vladimir Suzev is the scientific advisor and heads the Computer Science department. Other professors and instructors from this and other departments are also actively involved in its operation. It is used by scientists, doctoral students and undergraduates.

Since the Centre's foundation, four significant externally funded research and development projects financed by the Russian Government and IBM have been successfully completed. One of these projects, funded by RF Ministry of education and science from 2010 - 2012, studied the quality of engineering education and student competences. It involved 4 professors, 14 scientists, 6 PhD students and 15 undergraduate students and was financed to 3 000 000 rubles (€74 000). Practical results of this work were disseminated in publications and participation in conferences (Bobrovsky A.V,. et al. 2012; Smirnova E.V., 2012). In addition, this project led to the development of new methods, software products, databases and intellectual property has been registered for these as appropriate. The products have been demonstrated at International and Russian exhibitions and won the Russian Exhibition Center medal at "Education 2010" and "Education 2011".

The Role of Engineering Education Centres in enhancing employability

There are a lot of problems in engineering education in Russia. Issues concern new types of engineering applications (for example, Internet oriented engineers: web-designers, web-programmers), new types of educational means (for example, the use of online, video and e-learning techniques), new methodical approaches in education quality estimation and new types of educational processes such as design-based learning, problem and project approaches.

University level education in engineering should provide a firm grounding in the principles of engineering science and technology, while inculcating an engineering approach that enable graduates to enter the world of work and tackle "real world" problems. The best degrees worldwide develop in their students a scientific and technical understanding alongside a practical application to problem-solving. This synthesis calls for such skills as communication and negotiation; teamworking and inter-disciplinary working; and planning, costing and other key business process skills. Graduates with these skills are highly attractive to industry. This was confirmed in the UK by the Royal Academy of Engineering (King, J,E., 2007), who confirmed that industry seeks engineering graduates who have "practical experience of real industrial environments". Specifically, "industry … regards the ability to apply theoretical knowledge to real industrial problems" as the single most desirable attribute in new recruits.

The authors have developed the project based approach in engineering graduate preparation within the remit of the Centre for Excellence. Such kind of approach is becoming more and more popular but Russian education tends to be very traditional. The Centre for Engineering and Design Education (CEDE) at Loughborough University (LU), UK was consulted to assist with the Russian Centre's development and provides ample evidence that such a Centre can prove to be a highly effective support mechanism for discipline-specific academics to develop and maintain valuable national networks and collaborations along with considerable esteem for the host university. The CEDE, which developed out of the National (Higher Education Academy) support centre for the engineering Discipline is unique in the UK and continues to achieve success and recognition within the local engineering education community and through its national and international networks. The relationship started between BMSTU and CEDE in January 2013 when scientists from these two university took part in a Russian Federation Program (p220) competition and is set to continue through inter-university cooperative staff visits. Both institutions (BMSTU and LU) have been keen to develop and exploit closer ties between university and enterprise. From the beginning of its creation in 2005 the IBM Mainframe Centre of Excellence has been involving students into its activity based on an actual enterprise's needs and led to the launch of an IBM Competency Center for employment at BMSTU.

Major businesses, like IBM operate on a global platform and a survey from Monash University (2004) asked employers of ICT graduates to suggest ways in which universities could better prepare their alumni for work in industry. The most popular response by a factor of 2, was that universities should provide students with more work experience and this agrees with findings of many other surveys. Others suggested that there should be more channels for communication between universities and employers, e.g. that industry should play a greater role in course and curriculum design and that students should be made more aware of what to expect in industry and be given more training in generic (transferable) skills. Only 9% of respondents were seeking more specific technical skills

The conference "IBM technologies in education and business" (Moscow, 2009) became a place for hard dialogue between universities and enterprises (Dyukova Y. 2009); see also Figure 1. The universities' representatives stated that industry does not provide proper requests for specialists – their specific competence and the number of employees needed. The industry representatives (vise versa) responded that they need graduates who are familiar with the fundamental pros and cons of every existing computer architecture without needing deep knowledge of specific product details; the graduates should understand common concepts of operating systems' development; they need to know about ITIL and ITSM standards and have knowledge about specific features of big heterogenic computing networks based on corporate standards.

Figure 1: Conference "IBM technologies in education and business" in BMSTU made by IBM Mainframe Center of Excellence, Moscow, Russia: April 2009 http://mainframe.bmstu.ru/konf/

Method and design of the study: postgraduates survey

The idea of the research was to find if there was any correlation between the alumni's present professional status and their style of study during their time as students. A survey sample of 52 former students gave their opinions about the quality of the BMSTU engineering education and their level of post-university life. The comparative study explores whether taking part in Center's activity as well as in their educational and project-related practices lead to a more successful career. To study empirically the characteristics of the project based approach, the researchers formulated following research questions:

1. Do students who were active in the Centre become more successful after graduation?
2. Is there correlation between the former students' estimations and their actual level of success?

Formalised survey data

Students were asked their opinion about the quality of BMSTU engineering education and to give information about their present employment status.

Table 1: Former students' (2009 graduates) present educational level

Educational level	Number of persons	%
Diploma engineer	33	63
Bachelor	12	23
Master	19	37
PhD student	6	12
Special training (certificates)	9	17
Other kinds of qualification improvement courses (certificates)	0	0

Note: Sum in % more than 100, because survey allowed to point to more than 1 choice

Table 2: Former students' (2009 graduates) perceptions of BMSTU education quality

Educational quality esteem	Number of persons	%
1 (very poor)	0	0
2 (poor)	0	0
3 (satisfied)	12	23
4 (good)	22	42
5 (excellent)	18	35

Table 3: Former students' (2009 graduates) activity during their study

Note: Sum in % more than 100, because survey allowed to point to more than 1 choice

Type of activity	Number of persons	%
Took part in scientific work at the Department	6	12
Was an employee at the Department	3	6
Took part in IBM Mainframe Centre activity	7	13
Help to tutors and to scientific leader from time to time	19	37
Peer mentored laboratory work for junior students	15	29
Did not take part in any activity	18	35

Table 4: Former students' (2009 graduates) satisfaction with diploma project

Graduates' mark (self perception)	Number of persons	%
Satisfied	0	0
Good	12	23
Excellent	40	77

Table 5: Former students' (2009 graduates) current employment status

Work position	Number of persons	%
Engineer	21	40
Senior /Leading engineer	21	40
Head of Sector	4	8
Director of Department	0	0
Top-manager	3	6
Own business	3	6

Table 6: Former students' (2009 graduates) who moved on from their first employer

Number of graduates moved on from their first employer	Number of persons	%
1	28	54
2	12	23
3	9	17
4	0	0
5 and more	3	6

Table 7: Former students' (2009 graduates) present salary level

Salary	Number of persons	%
< 30 000 rubles (€735)	0	0
30 000 - 49 000 rubles (€735 – 1200)	9	17
50 000 - 69 000 rubles (€1250 -1700)	6	12
70 000 - 99 000 rubles (€1750 – 2400)	25	48
100 000 - 149 000 rubles (€2450 – 3650)	12	23
> 150 000 rubles (€3700)	0	0

Survey results analysis

Computer systems and Network Department's postgraduates are in great demand throughout the wide fields of Russian enterprises. The high level of their salary proves it: 71 % of respondents who graduated in 2011 have more than 70 000 rubles monthly (approximately €1 700) a relatively high figure in Russia. However only 40 % of them have attained leading positions and 60 % are working as line engineers (See figure 2).

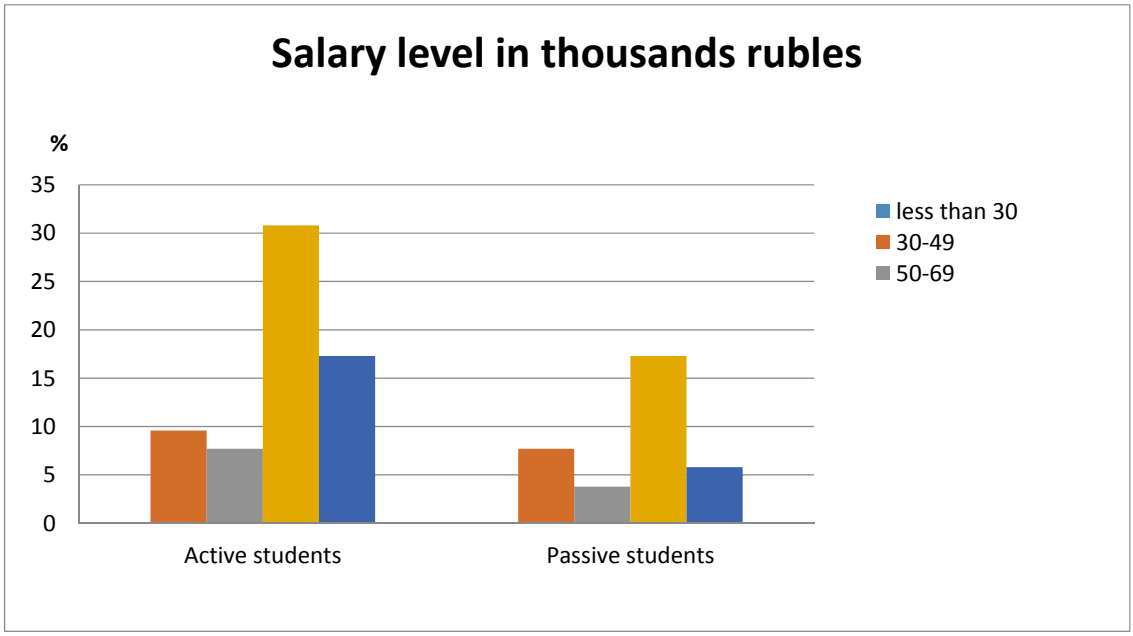

Figure 2 – Monthly Salary of graduates two years after graduation

As it is shown at figure 2, 54% of respondents did not change their place of work after they graduated from university. And 23% have changed their employer only once, so commonly more than 77% employers remain in work at one place for more than one year.

Students' activity during university study and their career

Correlation between the graduate careers and their activity while at university is shown in figure 3. It is interesting that all 31% of active graduates - who carried on scientific research work at the Department, or who were a part-time employee or who took part in the IBM Mainframe Centre of Excellence activity, are within of 40 % of alumni who made it to a leading position. It should be added that 65 % of respondents who were active in university time now have a monthly salary of more than 70 000 rubles. (€1700)

Diploma marks and current salary

Inactive former students who did not take part in scientific or social life at the Department generally estimated the quality of the educational process at the university as low.

Conclusion

These research results led to the objective conclusion about the usefulness of students' participation in scientific, teaching and social life of the Department as a great push towards their future fortunate career. We chose only two criteria to measure graduates' success: level of current salary and position. As we could see, the salary of active students is more, than the salary of passive ones. However the survey analysis adds weight to the idea that students who are active in the Centre become more successful after graduation and there is a correlation between the former students' estimations and their actual level of success.

The Centre for Excellence plans to continue this longitudinal study into the future and to involve other Russian Institutions with the ultimate aim of informing appropriate curriculum change and modernisation of the engineering curriculum to bring it more in line with worldwide best practice and the needs of global industry.

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