Int. J. Engng Ed. Vol. 26, No. 5, pp. 1032–1041, 2010
Printed in Great Britain.

0949-149X/91 $3.00+0.00

Higher Engineering Education in Russia: Incentives for Real Change*

MARIA DOBRYAKOVA
University—Higher School of Economics, 20 Myasnitskaya Street, Moscow 101000, Russia.
E-mail: dobryakova@hse.ru

ISAK FROUMIN
University—Higher School of Economics, World Bank, 20 Myasnitskaya Street, Moscow 101000, Russia.
E-mail: ifroumin@hse.ru

The paper is focused on changes in higher engineering education in Russia over the last decade. We assume that, as a result of technological and organizational changes in the markets young engineers are taught to work in, changes in education may be called for. The key change in the markets for engineers in Russia consists of the transition from planned to market economy, and thus the appearance of markets per se, and also in a shift away from a focus on the defense industry. To identify the possible changes and assess the current state of engineering education, we compare opinions of four target groups: university administrators, students, recent graduates, and employers.

Keywords: engineering education in Russia; university change; qualitative sociology

1. INTRODUCTION

THERE IS A GROWING BULK of literature, especially US-based, arguing that in the last 10–15 years there have been noticeable changes in engineering education in the United Stated and Europe—both in terms of content and methodology. Why did these changes occur? Juan Lucena with colleagues, in their recent comprehensive article [1], summarize general trends for the USA, Europe, and Latin America and provide a good mapping of the key relevant events and factors. In the United States, employers, due to technological and later organizational changes that had taken place, began to demand a new quality of university graduates. To define this quality, key stakeholders started to work in closer cooperation: employers, universities, and the state. This new vision was reflected in a number of reports and initiatives such as the 'Engineer 2020 Project' [2, 3]. As a result, a set of competence-based professional standards—Engineering Criteria 2000—was developed and adopted by the Accreditation Board for Engineering and Technology (ABET), and the curriculum started to be changed accordingly. This movement is so influential that it has acquired a global dimension, with several other countries joining this convention. NB: the initial impetus in this case comes from the economy, from employers.

The European Union has been preoccupied with harmonizing their higher education systems (which of course include engineering education as well), while also trying to preserve each country's identity. The changes started from matching the regulatory framework and the structure of education programs. This is a different starting point and a different motivation than in the US, which has also produced different effects so far: mostly in the structure of programs and quality assurance mechanisms. However, this development also led to changes in the curriculum and classroom practices in engineering education through Pan-European projects aimed at developing common European understanding of new learning outcomes for different engineering areas [4, 5]. To note: the initial impetus in this case comes from the state(s).

What are the new standards about? They focus on the characteristics (competencies) of the new engineer who is: (1) globally mobile, s/he has to work in a global environment (the consequences for the competencies being: foreign language proficiency, ability to communicate with people from other cultures, a global vision of the problems) [6, 7]; (2) able to work in new organizational environments (which, in terms of competencies, requires a better adaptability to uncertainty, less hierarchy, more flexibility, better professional communication skills) [8]; (3) oriented towards complex perspectives and interdisciplinary thinking—to be able to solve new technological tasks and introduce innovations [2, 3, 7, 9].

How does this apply to Russia? We are witnesses to dramatic changes in higher education in all post-

* Accepted 15 October 2009.
The research was carried out within the framework of the fundamental research program of the University—Higher School of Economics in 2009.

socialist countries caused by the transition toward a market-driven economy [10]. Universities have had to adjust to a new life. They have needed to search for new sources of funding and involve professors into entrepreneurial activities [11]. The system as a whole has gone through a series of structural reforms in the past 15 years, notably moving within a still largely centralized system towards a greater university autonomy in the 1990s, and then through a reestablishment of federal control by means of new forms of state management. In 2003, Russia joined the Bologna process and went through a complex and radical structural transformation, replacing traditional diploma training (for engineers it took 5–6 years of training) with the two-tier system [12].

Obviously, these system-wide changes influenced Russian engineering education. It had big difficulties adjusting to the Bologna process but gradually many universities introduced two-tier programs in engineering. Moreover, they struggled with the lack of funding for new equipment and found creative ways to raise money through tuition and partnerships with business. There are a number of studies of the changes in the governance, structure and funding of engineering education [13, 14]. These studies demonstrate that almost all Russian engineering schools have adjusted their organizational structures to the new rules of the game. They have increased the intake of students in the market relevant areas and built partnerships with local, national and multinational companies. These studies also show that the government is working hard to eliminate narrow specializations and create broader training pathways to achieve greater flexibility (especially in the light of Bologna inspired changes) [15, 12]. However, these studies do not look into the reality of teaching and learning at engineering schools. They do not provide any data on how the classroom practices have changed during the past decade and the new vision of learning outcomes for future engineers. There are a lot of publications describing the particular innovative experience of a professor or a group of professors [e.g. see 16, and *Inzhenernoe Obrazovanie* (Engineering Education) journal[1]]. But there is no analysis of how (or whether) these innovative practices are disseminated. Moreover, the discussions around the Bologna process reveal that many professors and university leaders believe that their main task is to defend the proud Russian tradition in training engineers against these changes and innovations.

So the following questions naturally arise: what are those changes in everyday operation of engineering schools? who brings them about? what are the driving forces, and where, if at all, is Russian engineering education forced to move?

Central to all these questions is the question of incentives to change engineering education beyond governance and funding. Is there a clear understanding and perception of these incentives and signals shared by all the stakeholders? Very unlikely, and it is interesting and important to reveal and compare the understandings.

To understand how these incentives work, one needs to answer another question: who influences the curriculum and the classroom practice—the state? employers? professors? students? Related to this: why do engineering universities open certain specializations and close other ones? What is the success of an educational program in engineering? How is it related to the success or failure of the corresponding industry? We have tried to answer these questions for the Russian case.

2. RESEARCH METHODS AND DATA

To answer these questions we need to address all the forces that influence engineering education: universities and their students; employers and the state (see Fig. 1). The necessity to bring the latter two into the analysis is probably what makes engineering education different from, say, social sciences—the former is inevitably connected with the industrial and R&D sector, whose role cannot be overlooked. This is the reason why engineering education research cannot be built accurately into conventional educational studies[2]: it has to integrate a share of labor market studies and organizational studies of the industrial and R&D sector.

The research presented in this paper is part of a larger cross-national project 'Higher Education in the Global Knowledge Economy' conducted in 2008–2009 in China, India, and Russia[3]. Here we analyze only a minor set of empirical results obtained for Russia, making an attempt to understand the overall current condition of the Russian engineering education. We approach all the stakeholders and compare their views on the same matters —thus, we can obtain a comprehensive picture of their demands (see Fig. 1) and the factors that drive these changes. This is the first research of the kind in this area known to us, and before we proceed to policy recommendations that need to be grounded statistically, we try to identify

[1] http://aeer.ru/winn/magazine.phtml

[2] This problem was, in particular, discussed by the new SEFI working group on engineering education research held in Aalborg, on 5–6 February, 2009.

[3] The general outline of the research is set out by a research group from the Stanford University School of Education (headed by Prof. Martin Carnoy). The field research in Russia is performed by the University—Higher School of Economics (Moscow). Put very briefly, the key idea of the research is to analyze the shift from the military orientation of engineering industries (and, thus, education) to the market/entrepreneurial one (supposedly, varying in the countries under study)—while analyzing a broader shift from an economy based on natural resources and cheap labor to a knowledge-based economy. The initial method lies mostly in economics of education. However, in Russia we have started with a more qualitative approach—which is discussed in this paper.

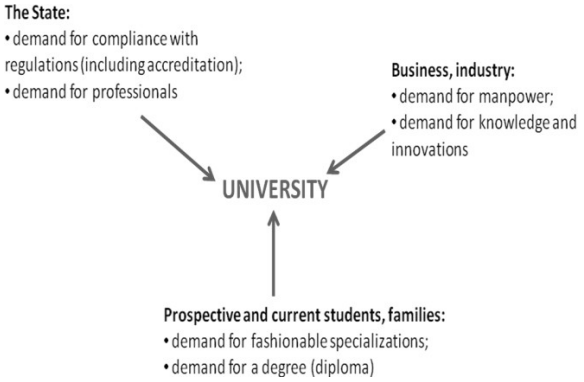


Fig. 1. Demands that shape university stakeholders.

and describe the major tendencies. Ours, then, is an explorative study made with broad strokes.

In such cases, when little is known about the problem, qualitative sociology is most appropriate. This is by no means something new to sociology, but its application to engineering education is much less widespread. A brief summary of qualitative research methodology for technology students is given by Maria C. Hoepfl [17]. For a deeper methodological analysis see for example the classical works by Anselm Strauss and many others [18, 19, 20].

We believe, at this stage of the investigation, quantitative methodology (large samples surveyed by formal questionnaires) is somewhat premature. However, to be consistent with our Chinese and Indian partners who started from the opposite end working on economics of education, we also conducted formal surveys of engineering students. These are not representative of the system as a whole, but rather provide a good counter-reflection to our qualitative interviews. An additional dimension of this research project is an analysis of the general context of the development of Russian engineering education, including the study of the trends in the regulatory environment and of the main indicators describing enrollment, staff and funding of engineering schools.

In Russia, the research was conducted in four cities: Moscow, St. Petersburg, Tomsk, and Kazan[4]. We chose technical universities (in the cities under study, those are 1st and 2nd tier universities; the weakest 3rd tier group is not represented in our sample), and within them—faculties of electrical, radioelectronics, and mechanical engineering, engine—and machine-building, aerospace, laser physics and optics faculties. In total we have 15 universities and 39 faculties.

In each university, we approached the following four groups:

(1) academic administration staff (responsible for academic curriculum, R&D activities—rectors, vice-rectors, deans)[5]—4–8 expert semiformal interviews per university (75 interviews in total);
(2) employers—semiformal interviews (32 interviews in total; these employers hired from 10 to 660 graduates in 2008–2009);
(3) students finishing their BA or MA degree[6]—a formal questionnaire (1368 respondents in total[7]);
(4) recent graduates—a formal questionnaire (511 respondents);

We also conducted 2 interviews with representatives of the Association of Engineering Education of Russia, and the Association of Technical Universities of Russia, analyzed documents published by these associations and results of the annual competition 'Engineer of the Year' to understand their criteria of what 'the best' means.

The guidelines for the interviews and questionnaires focused on the following issues:

- Is there a match between results of engineering education and demands of regional economies and labor markets? What are the feedback mechanisms? What are the forms of communication between employers and universities? Are employers content with the quality of education? Are there institutional arrangements that help attract and retain highly qualified engineers (best graduates) in the region? Do graduates find employment at enterprises they are intended and trained for?
- Does the quality of education meet the expectations of university graduates? Are graduates content with the education they received? What do they lack? Are they aware of all the opportunities offered by their universities?
- To what extent are faculty and students involved in R&D activities, and what are the mechanisms and results of their involvement? What is the proportion of theoretically oriented students versus more practically/business oriented ones?
- Do engineering universities pay particular attention to preparing their students for the knowledge economy? Do they try to develop creative, innovative, entrepreneurial attitudes? Is there any change in teaching practices pertaining to

[4] The Kazan research was done separately in 2007 as part of a pilot survey that was conducted by the World Bank (the project was headed by Isak Froumin).

[5] At this stage of the project, faculty members were not interviewed. We assume that, to a certain extent, their position is represented in extended interviews with the academic administrators who usually have a broader vision. However, at the next stage of the project we plan to include this group too.

[6] In Russia, also graduates of 5-year education programs. The transition from 5-year programs to 4-year bachelor's and 2-year master's programs in engineering education, which is currently taking place, was a particular focus in the Russian case—we analyze advantages and disadvantages of this transition as seen by the stakeholders.

[7] An unattended technical delay has prevented us from including data for St. Petersburg students and graduates so far.

the development of such attitudes and skills? In general, are there any changes (and what are they, and what should they be) in the teaching practices that are influenced by the new orientation of the engineering industries—largely shifting away from the military industrial complex?

Interviews with university academic administrators lasted from 1 to 2.5 hours. All the interviews were tape-recorded and then transcribed. Interviews with employers combined a questionnaire with open-ended questions, the latter (1-hour length on average) were tape-recorded and transcribed. We followed the same guidelines, but attempted to be less formal and with each respondent talked only about problems s/he was in a position to judge; we tried not to interrupt our interviewees which allowed us to identify areas that had not occurred to us as relevant. There is a specific advantage in doing such research in Russia, as we could ask our respondents to compare the current situation with the Soviet one—such a clear marking point made it easier to draw comparisons.

Surveys of university students and graduates used a questionnaire; unfortunately, some universities we addressed (even those where we had conducted interviews with administration) refused—referring to their defense profile (though our questionnaires contained no espionage questions)—to allow us survey their students and graduates.

To sum up the methodological part: the advantage of this research methodology consists in its ability to identify key insights and to counterbalance the views of the stakeholders in the context of the dynamics of main statistical indicators, and thus provide an overall picture of the up-to-date situation in Russian engineering education in broad strokes.

In this paper, we also do not go into differences between the Russian regions under study—assuming this would be of a lesser interest for the international audience[8].

3. PRESENTATION AND DISCUSSION

3.1 The recent context for Russian engineering universities

In order to be able to discuss the results of our survey, we need to provide a very brief overview of the Russian education situation which engineering universities find themselves in.

Today about 22% of Russian students (more than 1.6 million) are enrolled in engineering and technical fields; this share has declined over the last decade (from 33% in 1995) [21]. Despite the impressive growth of the private sector in Russian higher education, an absolute majority of engineering (and technical) students in Russia (98.5%) attend the 246 public universities. The latter offer their students both grant funded places (students are enrolled on a competitive basis and pay no fee, financing coming from the federal budget), and fee-paying places (their share in a university is regulated by the state; competition for such places is usually lower). Around 30% of all students in engineering areas at public universities pay fees[9]. This means that the universities depend greatly on their revenues from students' tuition.

The factors and challenges universities currently face can be grouped as follows.

a. Related to changes in the economy and labor market:

- decline of the parent/customer industries, which are no longer attractive for the students: the wages are too low;
- emerging needs of high-tech industries;
- greater labor mobility (including global mobility of professionals).

b. Related to financing of education:

- systemic underfinancing of higher education and research in universities, which results in low salaries for the faculty, which in its turn makes the teaching profession unattractive and leads to ageing of the faculty (in total, in the Russian HEIs the share of teachers older than 65 grew from 6.2% in 1999 to 12.5% in 2007) [21]. And, related to this;
- deterioration of technical facilities, when universities cannot provide access for their students to modern equipment (in 2004, the average age of laboratory equipment was 25 years [13]);
- since about 2006, the government has started to award grants to the best universities on a competitive basis (university development programs).

c. Regulatory and institutional changes (these should be regarded as neutral but in reality become a matter of dispute):

- the introduction of/transition to the international 2-level system of education: 4-year bachelor programs plus 2-year master programs (previously we have had 5-year programs[10]);
- national unified examination, introduced instead of university entrance exams and designed to provide more equality of opportunity for school leavers to enter university;

[8] But as a note we must stress that there are such differences, with the major cities of Moscow and St. Petersburg being noticeably ahead of the vast majority of regional third-tier universities. But this would make the subject for another paper, more in-Russia oriented.

[9] Authors' calculations based on [21].

[10] In fact, students in many technical universities studied 5.5 or 6 years. So the transition to 4+2 does not actually touch the duration of education. The most disputable issue this transition brings about is whether after 4 years of studies a bachelor is able to start to work.

- new, more flexible regulation (state educational standards) of curriculum policies are being introduced.

d. Societal:

- economic structure of the country has been transformed, with a shift from planned to market economy. The military industrial complex, central to the Soviet economy and formerly the target of engineering education, has been sidelined;
  demographic decrease of prospective students.

3.2 How universities react to the challenges: emerging typology

Taking all the above listed changes into account and on the basis of our interviews with university administration representatives, we have grouped Russian engineering universities into three types along the tradition-innovation continuum representing the shift from planning to knowledge economy (see Fig. 2). Such grouping is a simplification for the purposes of the discussion. One university may combine traits of several types and fall in between.

The first type is represented by universities who were strong in the past (i.e. in the Soviet period); most of them were closely connected with the defense industry. They see their advantages in their traditions (schools of engineering) and call for restoring them rather than for proceeding onwards. They complain of the lack of demand for their knowledge, but still regard the defense industry as their key customer—feeling in a way disappointed and offended that the state does not order as many cannons and helicopters as before. Their position is passive, they are waiting for the state to turn to them ('for a miracle to come' . . .); and even though some employers badly need their students, they do not try to restructure their education and take into account recommendations from these employers. They complain of the poorer 'quality' of prospective students, but do nothing to attract the best of them—on the contrary, they open fee-paying specializations with lower competition (where, by default, less talented students would go). Their central interest is financial resources—no matter if they contribute to advancement of engineering education or not. We called this type *Wannabes*.

At the opposite end of the continuum is the type of universities which we characterized as *Beyond-the-trend*. These universities seem to be ahead of what the state offers (grant competitions) or imposes (transition to 4+2); they are more research oriented and have always worked in close cooperation with employers (but their employers are usually also in R&D). They are flexible and active and try 'recombinant' practices. Of course, in the situation of general underfinancing of education, they are short of financial resources, but instead of waiting for the situation to change, they act: forming partnerships with advanced enterprises and, thus, getting access to modern expensive equipment; working with school children trying to find and attract the most talented; opening up new specializations related to their main profile (like 'management in R&D', 'marketing R&D'). 'Beyond-the-trend' with them means that they even may invent a way of their own—not simply being ahead of the state's ideas.

Between these two ends lies the type of *Perfectly normal* universities. This group is most influential in this field, as it is here that the standards are developed and institutionalized; it is here that signals from the state are implemented and magnified (like appeals to create quality management systems). Universities from this group would by all means be winners of state competitions; they would meet all the formal requirements. What they probably would lack is some freedom of imagination that may be needed for an innovation (or, they would be the nest for incremental innovations, whereas radical innovations are more likely to be born in *Beyond-the-trend* universities). However, this group can be regarded as the most stable and reliable in terms of building education patterns for the future.

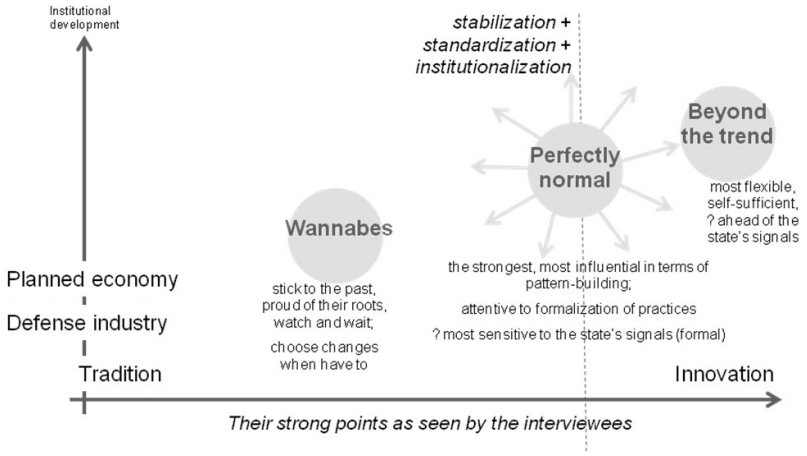


Fig. 2. Universities' reaction to challenges: a typology.

Table 1. Types of universities by their attitude and reaction to the recent challenges

Challenges	Wannabes	Perfectly normal	Beyond the trend
4+2	Formal, slow.	Formal/partially Advance the standards	Do not care much; introduced it long ago
Nat. Unif. Exam + poorer quality of prospective students	Lament	Introduce adaptive courses	Combine with other mechanisms of searching the talented
Decline of the 'parent/ customer' industry	Lament	Form partnerships with stable enterprises, focus on practical skills	Form partnerships with strong enterprises, focus on innovations
Underfinancing	Open popular fee-paying low quality specializations and regional branches, go to VocEd	Open popular fee-paying specializations related to their main profile	Rely on/recombine internal resources in an entrepreneurial way
State competitions	Passive	Active, winners, Advance the formal standards	Active, winners
International context	Do not care, feel superior (traditions) & deprived (facilities) Almost no interest in the change of teaching methods!	Care for the standards	Care for research
Deterioration of technical facilities	Lament	Buy through winning competitions	Buy through winning competitions, use partner enterprises' facilities

The differences between the three types analyzed against their attitude and reaction to the recent challenges are summed up in Table 1.

3.3. Voices and attitudes: a cross-examination

3.3.1 Universities

Respondents from all three types of universities are convinced that they are doing everything they can. However, as we have seen, the scope of their capability varies from one type to another—from waiting to acting; from advancing research to going for revenues into fee-paying non-engineering specializations, vocational education. All claim to work with employers and be attentive to their needs. Most claim that their students are well integrated into the research and international professional community, have a good command of foreign languages and obtain good practical skills. However, almost all university leaders admitted that when deciding to open a new faculty or specialization, they are guided by demand from their prospective students—choosing those which are most popular, in the hope of gaining money. They seldom try to foresee the future of their industry in order to define areas of training. The most popular ones are normally concerned with economics; law, management, IT, and their titles invariably include the word 'innovation'. When implemented creatively and reasonably, these new specializations may introduce you to economics or management as applied to engineering. Unfortunately, there are also poorer implementations, when 'management' is but some abstract management taught worse than at classical or specialized universities. There are but rare and very limited in scale cases when demand from employers was taken into account first (and in all such cases employers made certain financial and organizational inputs). University leaders practically ignored the challenge to change their teaching methods, to create an inquiry-based learning environment[11].

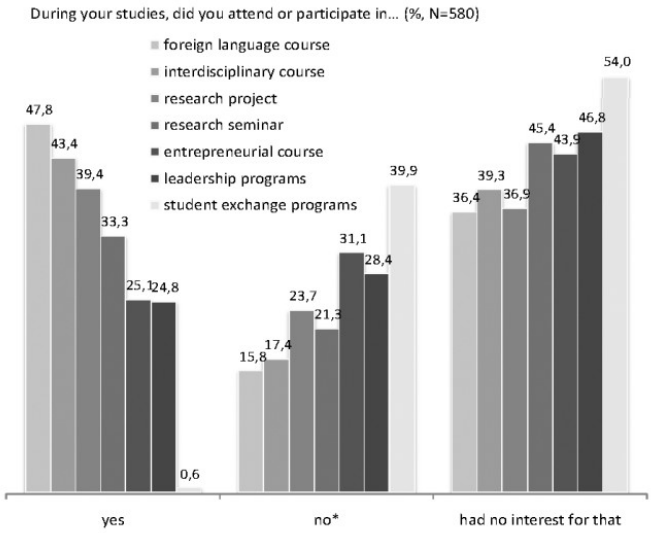
The engineering education professional community seems to be passive and fragmented. Although there are several associations who meet more or less regularly, they generate no discussion, suggest no solutions, and identify no problems those unborn solutions can be applied to. There are several specialized journals, but no real living journal that would bring the engineering community together[12].

3.3.2 Students and graduates

According to our survey, about 30% of students doubt that they are well educated, that they would have chosen the same major, or could be globally mobile (able to work in another country). Nearly 35% of students never read or referred to English-language publications in their essays and other written academic papers (20% reported they did this often). Almost 80% of students never participated in real projects for real customers during their studies (4% did this often). Quite an impressive picture—the first impulse is to blame the university for this. These data correspond with the conclusion of the Russian researchers of the higher education sector: 'While in the late 1980's and early 1990's over 70% of post-graduate students and almost 30% of full-time students took part in research and innova-

[11] This problem, however, is not unique to Russia. See, for example [23].

[12] For example, the journal 'Engineering Education' (*Inzhenernoe obrazovanie*) has survived 4 issues in total through 2003–2007: http://aeer.ru/winn/magazine.phtml



* 'No' = for any reason other than the absence of interest: the course/program was not offered at the university; student had no time for it, etc.

Note: All the categories ('yes'+'no'+'no interest') within one course/program add to 100%, and show the distribution of students' participation in this very activity.

Fig. 3. Students' participation in additional learning opportunities offered by their university.

tion activities, the current level of participation is 3–4 times lower' [22].

However, such passivity may not be the fault of the university. Both faculty and employers complain of low motivation among students. This is supported by the student survey: 35–55% of students were uninterested in additional learning opportunities provided by their university (Fig. 3).

As far as graduates are concerned, most of them (up to 90%) are satisfied with the education they received (45% are absolutely satisfied and 45% are mostly satisfied). They say they lack practical skills and a foreign language proficiency (see Fig. 4). 16% of graduates believe that there is no demand for their profession in the region they live. This is, however, not an obstacle for their career: they find jobs easily (90% found a job immediately after graduation)—and, with 30%, the job is not related to their education.

3.3.3 Employers

On the one hand, employers express no particular enthusiasm about the quality of young specialists who come to them: 'young people who come to us know nothing about our work'; 'textbooks are outdated, there are no new ones'.

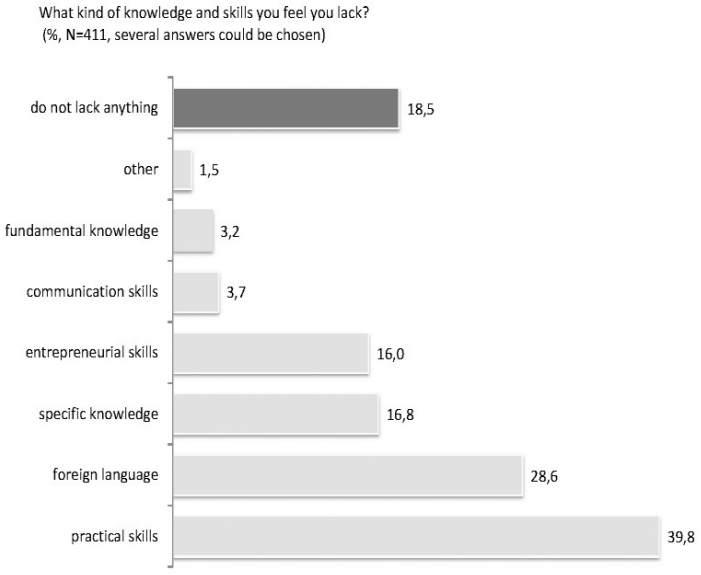


Fig. 4. Knowledge and skills graduates report they lack.

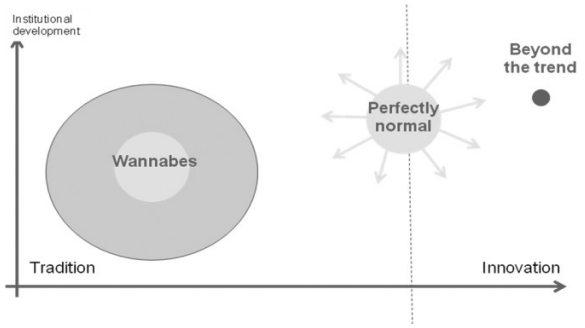


Fig. 5. Types of universities: shares.

Graduates are poorly motivated: 'They enter aircraft manufacturing faculties, and then do not come to us. Why did they enter these faculties?'. Universities do not encourage their graduates to go into enterprises they were taught for; they are not interested in knowing where their students go.

Employers need and cannot easily find specialists: 'we lack people with a systemic vision to develop integral and analog systems—and such courses are taught only in two universities', 'we need radio engineers, material engineers, vacuum technologists who understand those processes—and universities do not teach this. Nobody knows what our universities educate students for'.

On the other hand, they believe that it is first of all the state that must change the situation: it is the state that is to provide financial resources. And they doubt that universities can overcome the negative trend: 'universities cannot give specific skills that are needed at particular enterprises; university faculty normally have never worked in the production sphere'.

Quite remarkably, most employers we talked to report they have working contacts with particular universities and, in many cases, participate in composing the curriculum. At the same time, even these employers do not express much satisfaction about the quality of students' practical skills. And they mention some additional training (in an area other than the student's major) as one of the most advantageous characteristics of a job candidate.

3.3.4 The State

The state is very active and concerned. One can agree that the 'higher education poses a major economic challenge today and is a particularly privileged area in Russia as it retains comparative advantages inherited from the Soviet period. The federal state reformers face the difficulty of making it competitive on a global scale without losing control of it' [24]. It is particularly true of engineering education because the government considers these institutions as a possible driving force of the innovation economy. However, the government's role is limited to the development of a regulatory framework that strengthens the control and pressure over the institutions but does not create incentives for creative and conscientious changes. In the recent years, the government has organized grant competitions to select and support the best universities. But there are no clear signals as to what the new learning outcomes should be, or how to change methods of teaching and the culture of learning. There seem to be no attempts to match the demands of the changing labor market with the demands of families.

4. CONCLUSIONS

The approach used allowed us to juxtapose views that otherwise might have been left disconnected which would not provide an overall picture.

If we try to assess the qualitative picture quantitatively and compare the size of our types of universities, the *Beyond-the-trend* would be the smallest one (which is in fact normal: the very best cannot be most widespread) and the *Wannabes* would be the biggest (which is much of a disappointment and a reason for concern). See Fig. 5.

The positive changes that have taken place in Russian engineering universities are limited to buying new technical facilities, and the introduction of new regulatory mechanisms (the national unified examination, and transition of 4+2—both have no specific relation to engineering education)—but have left the engineering contents of education untouched. The education process itself remains unchanged: lectures still make up the core form of communication between teachers and students, there are very few interdisciplinary courses (and the lack of these hardly encourages innovative thinking), students in the main cannot regulate their individual curriculum (about 30% of students could choose 1–2 elective courses, and 57% of students reported that all their courses were required ones).

The change in universities has to do with survival rather than striving for progress, it is 'running away' rather than 'running for'. Employers are fragmented, their efforts are scattered, there is no active or central body that could direct and consolidate those efforts.

For changes in the system of engineering education to take place, at least one of the stakeholders must be actively interested in it: either the state, or employers, or students, or universities themselves. So far, however, no party expresses such an interest. The parties seem to be in balance.

Students do not demand changes—on the contrary, they vote for non-engineering specializations in technical universities (which forces universities to open and develop such specializations).

Universities are interested in attracting financial resources: from students (who enter fee-paying places in the newly opened popular specializations); from the state (through winning competitions for grants).

The state, even though it organizes competitions for the best, does not set a framework for the development of engineering education, and in fact all the grant funds are spent on purchase of new

equipment. There is no doubt that technical facilities are necessary, but we assume they are not enough to maintain and advance the quality of education.

Employers complain of the deficit in specialists, but quite often have nothing to offer them (the wages they offer are, on average, the same or slightly lower than for graduates of economic universities); they try to collaborate with universities, but their efforts are scattered and do not produce any noticeable effect at the national level.

Acknowledgements—We would like to thank our partners from China and India—Jandhyala B. G. Tilak, Prashant Loyalka, Wang Rong, and most of all the Stanford headquarters represented by Martin Carnoy for his initial idea, launching and pushing the project onwards. We also very much appreciate the explorative, communicative, analytical and critical efforts of our colleagues from the Russian team: Natalya Abolina, Igor Chirikov, Tatiana Fomicheva, Lyudmila Mezentseva, Ivan Pavlyutkin, Natalya Petrova, Boris Startsev, and Valentina Vedeneeva. And of course we are most grateful to the universities and employers who kindly let us in and frankly shared their views.

REFERENCES

1. J. C. Lucena, G. L. Downey, B. Jesiek and Sh. Elber, Competencies beyond countries: The reorganization of engineering education in the United States, Europe, and Latin America. *Journal of Engineering Education*. October, 2008, pp. 433–447.
2. The Engineer of 2020: Visions of Engineering in the New Century. The National Academies Press, Washington, D. C., 2004.
3. The Engineer of 2020: Adapting Engineering Education to the New Century. The National Academies Press, Washington, D. C., 2005.
4. F. Maffioli and G. Augusti, Tuning engineering education into the European higher education orchestra. *European Journal of Engineering Education*, **28**(3), 2003, pp. 251–273.
5. A. E. Ward, J. Jasenek and J. M. Thiriet, The application of the Tuning methodology to the Electrical and Information Engineering disciplines across Europe. EAEEIE Annual Conference, June 29–July 2 2008. 19th volume, 2008, pp. 94–99.
6. G. L. Downey, J. C. Lucena and C. Mitcham, Engineering ethics and identity: emerging initiatives in comparative perspective. *Science and Engineering Ethics*, **13**, 2007, pp. 463–487.
7. J. C. Lucena, Flexible engineers: history, challenges, and opportunities for engineering education. *Bulletin of Science, Technology and Society*, **23**(6), 2003, pp. 419–435.
8. J. C. Lucena, Globalization and organizational change: engineers' experiences and their implications for engineering education. *European Journal of Engineering Education*, **31**(3), 2006, pp. 321–338.
9. T. Grindel (ed.), In search of global engineering excellence: educating the next generation of engineers for the global workplace. Continental AG, Hanover, 2006.
10. T. Grose, Shadowed by the past, PRISM, Summer 2009.
11. T. Gounko and W. Smaleb, Who Chooses the Tune? An Analysis of New Initiatives in Russian Higher Education. *Higher Education Policy*, **19,** 2006, pp. 319–341.
12. A. Chuchalin, O. Boev and A. Kriushova, The Russian system of higher education in view of the Bologna process. *International Journal of Electrical Engineering Education*, **44**(2), 2007, pp. 109–117.
13. I. G. Dezhina, I. D. Froumin, *Inzhenernoe obrazovanie v Rossii i ego svyaz' s innovatsionnoy deyatelnostyiu* [Engineering education in Russia and its relation to innovation activities], *Ot znaniy k blagosostoyaniu: integratsia nauki i vysshego obrazovania dlya razvitia Rossii*. From Knowledge to Welfare: Integration of Science and Higher Education for the Development of Russia. World Bank, Moscow, 2004, pp. 278–318.
14. G. A. Mesyats and Y. P. Pokholkov, *Rossiyskoe inzhenernoe obrazovanie: problem i puti transformatsii* [Russian engineering education: problems and ways of transformation]. *Inzhenernoe Obrazovanie* [Engineering Education], **1**, 2003, pp. 4–10. http://aeer.ru/winn/magazine/magazine1.phtml [accessed August 2009]
15. A. V. Medvedev and Y. A. Nurgaleeva, Ob organizatsii obrazovatelnogo protsessa v svete Bolonskoy deklaratsii [On the organization of education process in the light of the Bolonya declaration]. Inzhenernoe Obrazovanie [Engineering Education], **4**, 2007, pp. 114–119. http://www.aeer.ru/winn/magazine/m4/art_15.pdf [accessed August 2009]
16. D. V. Pouzankov, *Novoe inzhenernoe obrazivanie dlya innnovatsionnoy ekonomiki na osnove integratsii nauki, obrazovania i biznesa: prodposylki k realizatsii proektnogo podkhoda* [New engineering education for the innovation economy on the basis of the integration of science, education and business: assumptions for the project-based approach], *Ot znaniy k blagosostoyaniu: integratsia nauki i vysshego obrazovania dlya razvitia Rossii*. From Knowledge to Welfare: Integration of Science and Higher Education for the Development of Russia. World Bank, Moscow, 2004, pp. 339–349.
17. M. C. Hoepfl, Choosing Qualitative Research: A Primer for Technology Education Researchers. *Journal of Technology Education*, 1997, **9**(1). http://scholar.lib.vt.edu/ejournals/JTE/v9n1/hoepfl.html [accessed August 2009]
18. B. G. Glaser and A. L. Strauss, The discovery of grounded theory. Aldine Publishing Company, Chicago, 1967.
19. A. Strauss and J. Corbin, Basics of qualitative research: Grounded theory procedures and techniques. Sage Publications, Newbury Park, 1990.
20. H. Schwartz and J. Jakobs, Qualitative Sociology: A Method to the Madness. The Free Press, New York, 1979.

21. *Obrazovanie v Rossii: 2007. Statistichesky ezhegodnik* [Education in Russia: 2007. Statistical Yearbook]. Moscow, 2007.
22. N. Kovaleva and S. Zaichenko, The Russian System of Higher Education and its Position in the NSI. Paper presented at 'UNIVERSIDAD 2006' 5th International Congress on Higher Education. Cuba, 13–17 February, 2006.
23. Creating a Culture for Scholarly and Systematic Innovation in Engineering Education. Phase I report. American Society for Engineering Education, Washington, D. C., June 2009.
24. C. Sigman, Higher Education in Russia: Potential and Challenges. Russie.Nei.Visions, 28. Paris: IFRI, Paris, 2008.

Maria Dobryakova is Director of Online Media at the Higher School of Economics (HSE). She holds a Ph.D. in Sociology. In 2002–2008 she was executive editor of the electronic journal 'Economic Sociology' (http://ecsoc.hse.ru) and co-headed several translation projects seminal for the development of economic sociology in Russia. Before joining the HSE in 2006, she headed the grants and publication programs at the Independent Institute for Social Policy, Moscow (2003–2006), and worked as a program assistant for the Higher Education and Scholarship Program at the Ford Foundation Moscow Office (2000–2002).

Isak Froumin is a Senior Education Specialist at the World Bank based in Moscow. His work program included support to higher education reform, introduction of information technologies into education, textbook production reform and school restructuring. Since March 2008 he is also a strategic development advisor for the Higher School of Economics (HSE) in Moscow and Academic Supervisor of the Education Development Institute. He is supervising the university strategic planning and educational research program. Before joining the World Bank in 1999 he was a principal of a university laboratory school and Chair of Education Theory Department at the Krasnoyarsk State University in Russia.