AUDIT OF ENGINEERING QUALIFICATIONS AS REGIONAL EDUCATIONAL POLICY DIRECTION

L. Bannikova, I. Sholina, N. Reprintseva

Federal State Autonomous Educational Institution of Higher Education “Ural Federal University” (RUSSIAN FEDERATION)

Abstract

Definition of long-term needs of the industrial region for engineers, a shortage problem solution of engineering qualifications may be considered as a form and result of long-term interaction between employers and educational organizations in producing of required competencies. The article summarizes the experience of use of sociological approaches to the needs forecasting for engineering cadres. The advantage of sociological forecasting involves the ability to use a combination of quantitative / formalized and qualitative / unformalized methods for collecting and analyzing information in work, both with large and small data sets in a situation of objective studies, taking into account the specifics of the investigated enterprises. Method of sociological analysis of qualifications provided surveys of stakeholders (engineers, managers of engineering projects). The stakeholder evaluation model of learning outcomes was aimed to clarify the disparity of assessments in importance and the presence level of competence development of future engineers. Evaluation of prognostic background, necessity of analysis of conditions and factors that have affected, affect or can affect to development of needs of the region in engineering qualifications led to our turning to the research of innovative behavior of large industrial enterprises of the region.

Keywords: Engineer, engineering qualifications, stakeholder model, learning outcomes.

1 INTRODUCTION

Growing awareness of the importance of technological innovation for the competitiveness of economy and national security requires new priorities for engineering. Engineers play an increasingly important role in the modern society. The importance of quality engineering training for the development of modernization processes is obvious. The study of the problems of discrepancy between the pattern of demand and supply on the Russian labor market, and lack of engineers remain the topics that are actively discussed by economists, politicians and sociologists. The standard formulation of this discrepancy looks like a statement about the shortage of engineers and oversupply of economists and lawyers on the Russian labor market.

The administrative methods such as changing the training structure, increasing the number of students admitted to the natural-science and engineering areas of training, did not smooth out the severity of the problem of deficit in engineering qualifications. Currently, the target figures of admission to the areas and specialties of engineering training have stabilized at the level of 45-46% from the total number of allocated state-financed openings. At the same time, employers still have a shortage in engineering staff.

The evaluation on employment of university engineering graduates in comparison with graduates from other professions and training programs, analysis of the factors determining such employment, allowed researchers to conclude that a diploma on engineering education does not provide significant advantages in graduate-employability. The employment rates among young engineers are not higher than those among other graduates, and the reasons for the declared shortage of engineers don’t lie in the number of graduates. [1, 2] The existing argument on increasing the number of students in engineering departments does not seem convincing enough, because training of employees of this profile, without providing significant advantages on the labor market, costs 17-95% more expensive for the state. [1]

The article establishes the point that the reasons for the lack of engineering qualifications do not lie in the number of graduates in technical training areas, but in the lack of competencies among young professionals, the discrepancy between the requirements of stakeholders for young engineers and real learning outcomes. The forecast for the need in personnel should be based on data from regional employers about the current and prospective needs in personnel. [3] The Sverdlovsk region was
included in the range of pilot territories involved in the implementation of the new standards for staff for industrial growth, so it was logical to analyze the requirements of the main customers for engineering qualifications, large industrial enterprises in the region, in order to identify the features of their innovative behavior.

2 METHODOLOGY

The issues of the gap between the stakeholders’ requirements and real results of the Russian engineering training remain the subject of an active interest for researchers. [4, 5] Assessing the level of professional training in technical universities, researchers emphasize the predominance of traditional forms and methods of teaching, low quality of admission to engineering professions, insufficient development of soft skills; weak interaction among education, business and government in engineering training. [5, 6]

Characterizing new requirements for young engineers’ qualifications, experts advise engineering schools to take into account that in the future students will learn in a different way. Future engineering programs should be built around the development of skills, rather than teaching the available knowledge. Teachers should teach methods, not ready-made solutions, form analytical skills, skills for design and problem solving. [7, 8]

The growing need in interdisciplinary skills requires closer and more coordinated interaction of manufacturing enterprises, universities and scientific organizations. Such cooperation serves as a pledge of adequate transferability of knowledge and formation of the competencies that employers will demand in the future. [9, 10] Professional engineering community is actively discussing the need to create a system of practice-oriented education, professional interaction between representatives of education and practical engineering. [11, 12]

New approaches to the analysis of demand on the engineering labor market are being formed, a transition from traditional quantitative methods of analyzing the need for engineering personnel to qualitative methods of analyzing the competence-based structure of employment has been outlined. This approach was first implemented in the methodology developed by the Center for Budget Monitoring of the Petrozavodsk State University in cooperation with the Moscow School of Management "Skolkovo". [13, 14] During the development of the model, modern management methods of forecasting (foresight technology) and employer surveys using the new Job & Competence Description technology were used.

In order to evaluate the levels of competences expected by stakeholders and current level of interpersonal and soft skills of engineering graduates from higher education institutions, the research group conducted the sociological survey among the main stakeholders.

The lecturers of engineering disciplines from Ekaterinburg universities (N = 146) and practicing engineers from the largest regional enterprises (N = 240) participated as stakeholders in this survey. The same blocks of questions on evaluation of learning outcomes and competences allowed conducting a comparative analysis of the stakeholders’ assessment. The pilot study of innovative behavior of enterprises in the key sectors of the regional economy provided the authors with an opportunity to identify the areas of interaction between the university and enterprises in the formation of a system for scientific research and development, as well as training of qualified engineering personnel.

A selective set of pilot survey was presented by sixteen enterprises from the key regional industries. The method of research is a formalized expert survey. The heads of research centers and scientific and technical departments of enterprises took on the role of experts. The survey revealed the features and problems of managing innovative research and development in production regional companies. [15]

3 RESULTS

Such competencies as out-of-box thinking, broad general engineering and cultural outlook, research skills were included into the top three qualities of modern engineers expected by employers. For lecturers of engineering disciplines, the priorities look different: the most important competence for a modern engineer, in their opinion, remains high qualification in the field of applied sciences. Every second among the interviewed lecturers of engineering disciplines mentioned this quality as the most significant. When asked about the priority objectives of teaching activities, the largest number of
samples in all age groups received a response option "to give a solid knowledge of their subject and teach how to use them in future practical activities".

Emphasized differences among the evaluation of employers, practicing engineers and lecturers of engineering disciplines are very indicative. High qualification in the field of applied sciences, of course, remains important for the modern labor market. These are issues for the mainstream training of technical specialists, process engineers and operators. At the same time, practicing engineers and employers distinguish research competences, non-standard thinking, broad general engineering and cultural outlook as priority qualities. (Table 1).

**Table 1. The most important qualities of the modern elite corps of engineers (%)**. *

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Practicing engineers</th>
<th>Lecturers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deep natural-science, mathematical and humanitarian fundamentality of education</td>
<td>42</td>
<td>39</td>
</tr>
<tr>
<td>High qualification in the field of applied sciences</td>
<td>36</td>
<td>54</td>
</tr>
<tr>
<td>Interest for and skills of research activities</td>
<td>50</td>
<td>49</td>
</tr>
<tr>
<td>Communicative competencies corresponding to international educational and professional standards</td>
<td>26</td>
<td>16</td>
</tr>
<tr>
<td>Out-of-box thinking</td>
<td>64</td>
<td>46</td>
</tr>
<tr>
<td>Skills of professional communication in English</td>
<td>10</td>
<td>9</td>
</tr>
<tr>
<td>Socially responsible engineering outlook</td>
<td>20</td>
<td>25</td>
</tr>
<tr>
<td>Stable motivation to work by profession</td>
<td>37</td>
<td>37</td>
</tr>
<tr>
<td>Broad general, cultural and moral mindset</td>
<td>52</td>
<td>41</td>
</tr>
</tbody>
</table>

*The amount exceeds 100%, because one respondent could give several answers at the same time.

In order to make an idea of possible content and scope of the advanced demand for research competencies among technical specialists, the pilot assessment of innovative activity was carried out in regional production enterprises. It revealed that the set of expected competencies by types of engineering activities and the nature of innovative development are in mutual determination. For example, an enterprise with an average innovation status, which belongs to a stable industry but is oriented to the introduction of new products and technologies, differs by modeling a new type of engineering activity with an appropriate set of competencies for system and sphere engineering. The preferred forms of cooperation between an enterprise and the university in these cases are the opening of the basic departments for mechanical engineering training and dual Masters’ degree programs for research engineers training inside an enterprise.

For a company with a low innovation status, currently implementing a survival strategy, a high level of fundamental training remains a priority among the expected engineering competencies, and the corporate system of supplementary professional education is a preferred organizational form for acquiring additional practical competencies. [16]

Evaluation of the innovation status of enterprises in the Sverdlovsk region has revealed an interesting regularity: companies belonging to the same technological structure, with the same level of high technology products, but with various degrees of cooperation including cooperation with external developers, have a different innovation potential. The overwhelming majority of enterprises included

International experts in measuring innovation input note that innovation in low- and medium-tech (NST) industries is often given less attention to than in high-tech industries and conclude that innovation in the NSTs can have a strong impact on economic growth by total weight of these branches in the economy. [17] Taking into account the specific weight of such industries in the economy of the Urals region, stimulation and expansion of forms and methods of cooperation between enterprises and external developers (mainly with universities) can be assessed as a promising direction. It can help to implement the national technology initiative and shape the economy's demand for new prospective engineering competencies, the emergence of professions associated with
fundamentally new technologies, production (business) processes.

4 CONCLUSIONS

Modernization of the regional economy requires adequate staffing, targeted training of a new generation of engineering personnel with a variety of professional competencies. The formation of such specialists is possible only with a clearly expressed practice-oriented orientation of the educational process. [18]

The use of models for assessing stakeholders’ behavior is caused by the growing need of industries in interdisciplinary skills, which requires closer and more coordinated cooperation of production enterprises with universities and scientific organizations. The information obtained as a result of analyzing the key stakeholders’ opinion is significant not only for employers but also for higher educational institutions, for long-term planning and development of new training programs in promising specialties, clarifying existing basic educational programs, developing supplementary professional education programs, active exploiting own scientific research results and vocational guidance of potential applicants.

ACKNOWLEDGEMENTS

Research is carried out with financial support of Russian Humanitarian Science Foundation within the project № 15-03-00069 «Formation of professional ethos of the modern engineer: gender and functional aspects».

REFERENCES


4535


