METABK 57(4) 367-370 (2018)
UDC – UDK 669.1/669.18-338.45.009.01:349.15/.17:658.26.004.14:669.14.018=11

COMPETENCY MODEL FOR SCIENCE AND TECHNOLOGY (S&T) PERSONNEL FOR THE IRON AND STEEL INDUSTRY

Received – Primljeno: 2018-03-20
Accepted – Prihvaćeno: 2018-06-10
Review Paper – Pregledni rad

The article presents the competency model for S&T personnel for the iron and steel industry. The study performed has made it possible to determine a cluster of competencies required for innovative development of production involving development of energy-efficient technologies and high-performance steels. The results of the performed analysis have shown that for highly qualified professionals it is not sufficient just to have professional knowledge and demonstrate personal efficiency and ability to work in a team. They should also have professional engineering excellence skills, management skills and should be innovation-focused.

Key words: iron and steel industry, competencies, S&T personnel, energy-efficient, high-performance steels

INTRODUCTION

The contemporary economic development paradigm dictates that knowledge and innovations are the most important resources of any industry, including the iron and steel sector. Not only are knowledge and skills becoming a source of innovative production development, but a major driver of economic growth.

The strategy of the Russian iron and steel industry development for 2014 – 2020 and for the period up to 2030 places a priority on innovations related to development of new products and products with higher technical availability, as well as innovations aimed at improvement of technologies, improvement of the environment and reduction in the consumption of all types of utilities. At the same time, the escalating problem of supply of highly qualified personnel for iron and steel companies has been observed, which hinders development of the industry. The fulfillment of the set objectives should be closely linked to the initiatives on resolving the deficit of professional competencies - the most valuable capital of any employee.

Despite a large number of papers on approaches to topology of competencies [1 – 5], there is no common approach to identification of promising competencies and the gap between the existing and the required competencies, as well as the significance of general and specific skills of S&T personnel.

The international system for competencies assessment developed by the European Centre for the Development of Vocational Training (Cedefop) [6] is the most known and practically useful. In Russia, a similar mechanism for assessment of competencies is still under development. A competency-based approach is mainly used by educational institutions which provide training of highly qualified specialists. During the educational process, students acquire universal and general professional competencies, as well as specific professional competencies according to a bachelor degree program based on the occupational standards.

Business practices of high-tech companies have shown that in conditions of the fast changing labor market, short product life cycles, globalization of the markets of educational services and scientific developments, highly qualified professionals need to master knew knowledge in order to stay competitive. This requires developing key competencies that would allow solving specific problems.

METHODOLOGY

The competency model is a list of competencies describing an employee's qualities in terms of knowledge, skills, behavior and experience he or she requires to work efficiently. To build a competency model various methods and their combinations [3, 7, 8] are used, starting from making data bases of the existing personnel competencies and development of competencies with the use of mathematical modelling methods with involvement of expert groups.

At the initial stage of the research, an array of competencies was identified based on the study of theoretical and practical works in the area of education, management, staffing requirements of steelmaking companies, as well as based on the interviews with benchmarking leads and assessment of the engineering staff professionalism [2 – 5, 7 – 10]. The performed studies showed that it would be appropriate to split competencies into the following groups: a) instrumental competencies, characterizing professional knowledge and

A. Kozhevnikov (avk7777@bk.ru), N. Bolobanova, I. Kozhevnikova: Cherepovets State University, Cherepovets, Russia

communicative skills; b) interpersonal competencies, representing functional flexibility and teamwork; c) system competencies, characterizing managerial skills, the ability to mobilize available resources, the ability to perceive the new; d) special competencies linked to a specific professional occupation For the purposes of this research, professional activities related to the implementation of innovations aimed at improvement of steel rolling technologies, including development of energy-efficient technologies and new high-performance steels, were considered.

For the purposes of this research, professional activities related to the implementation of innovations aimed at improvement of steel rolling technologies, including development of energy-efficient technologies and new high-performance steels, were considered.

Subsequent development of a competency model for S&T personnel capable to initiate and apply innovations involved examination of competencies through conducting a questionnaire survey among groups of respondents with the use of the approaches described in papers [2, 5]: 1) analysis of the answers to indirect questions about the value of a university degree, professional experience, level of satisfaction by the received professional education; 2) competency measurement by descriptors describing the relevant routines (professional duties, main activities or specific activities at the work place); 3) direct assessment (self-assessment) of the competencies a respondent possesses or of the required competencies. Taking into account our research [2], the competency model for S&T personnel for the iron and steel industry was formed and presented in table 1.

RESULTS AND DISCUSSION

Analysis of the developed model has shown that professional performance of S&T personnel is determined by a great variety of parameters and characteris-

Table 1 **Competency model for science and technology personnel for the iron and steel industry**

Competency type	Category	Competency
Instrumental	1 Using professional knowledge	1 Theoretical speciality knowledge
		2 Analytical skills
		3 Organizational and planning skills
		4 Problem solving and decision-making skills
	2 Communicative skills	5 Computer and Internet skills
		6 Making reports, memos and other documents
		7 Presenting the results of your work to an audience (at a conference, workshop, etc.)
		8 Talking on professional topics in a foreign language
Interpersonal	9 Teamwork	9 Critical assessment of your own and others' ideas
		10 Mobilization and use of your colleagues' skills
		11 Seeking compromise solutions
		12 Ability to see new opportunities
	13 Personal effectiveness	13 Efficient teamwork
		14 Ability to work under stress (under the pressure of circumstances)
		15 Articulating your thoughts in an accessible way
		16 Defending your point of view
System	17 Professional engineering excellence	17 Ability to put knowledge into practice
		18 Learning ability
		19 Ability to adapt to new situations
		20 Ability to generate new ideas (creativity)
	21 Managerial skills	21 Organizing and coordinating teamwork
		22 Efficient use of time
		23 Ability to develop and manage projects
		24 Efficient implementation of your ideas
		25 Ability to sell your product or service
Special	26 Development of energy-efficient technologies for steel strip production	26 Ability to use advanced methodological approaches and computer technologies for development of new technological processes
		27 Ability to develop new and improve the existing techniques and methods for modelling of the process parameters
		28 Ability to assess the production process efficiency by various criteria and performance metrics with the use of the lean production principles
		29 Ability to manage technological resources while ensuring safety and efficiency of the process
	30 Predicting quality parameters of rolled products and energy costs	30 Ability to use methods for analysis, assessment and prediction of quality parameters of rolled products and energy costs
		31 Ability to prepare analytics to evaluate and develop production of high-performance steels
		32 Ability to plan and predict parameters of the technological process being developed
		33 Ability to evaluate strategic decisions in the field of rolled steel production considering the development and prediction results

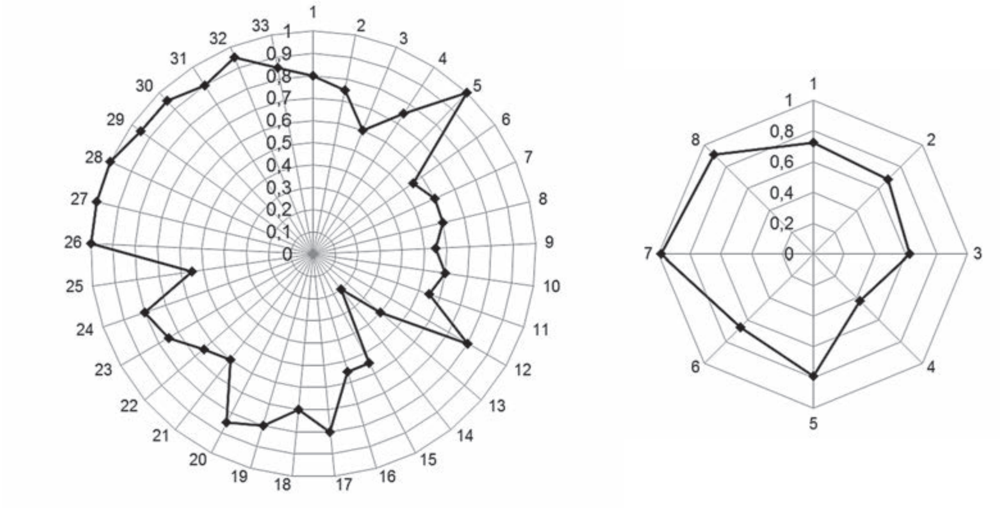

Figure 1 The selected competencies (a) and categories of competencies (b) as per the scale of desirability d from 0 to 1 for S&T personnel involved in the implementation of innovations

tics and has a significant influence on competitive advantages of iron and steel companies both at the domestic and the international markets of steel products. In this regard, the list of the most important (key) competences to evaluate scientific personnel capacities is of great interest. The most important competencies were determined by expert evaluation [11, 12] through collecting, processing and consolidating information from HR specialists in the field of recruitment and training of personnel for iron and steel companies. First, a group of 29 candidates was selected, and the candidates were ranked by their expertise with the use of a point-based system for assessment of their professional competencies. Next, a short list of the most competent candidates for the given task was made and a group of 14 experts was formed, which is in compliance with the requirements of homogeneity and representativeness of an expert group.

Each expert was asked to give his or her opinion in any form on the influence of personnel competencies on efficient development of an iron and steel company. The experts were also asked to give a score from 0 to 5 on a 5-point scale to assess the minimum degree of development of a relevant competence for S&T personnel for the iron and steel industry.

For expert assessment and processing of the assessment results the one-dimensional scaling method [11, 12] was used. This method is based on the scale of dimensionless desirability d, developed by Harrington [13], with an interval of values of d from zero to one. The value of $d = 0$ on this scale corresponds to an absolutely unacceptable value of the parameter under study, while $d = 1$ corresponds to the best value of the parameter, with further improvement either impossible or irrelevant. In our case, key competencies should have the value of desirability function $d = 0{,}8 – 1$. Figure 1 shows the selected: *a* – competencies, *b* – categories of competencies as per the scale of desirability d for S&T personnel involved in the development of energy-efficient technologies and new steels. The competencies and categories are given according to the numbers assigned to them in Table 1.

As a result of the expert assessment, three major categories which have the most significant influence on personnel efficiency in the implementation of innovations were indentified. These are professional engineering excellence, development of energy-efficient technologies for steel strip production and predicting quality parameters of rolled products and energy costs. Also, fifteen competencies which have the most significant influence on innovative activity, measure up to the level of high technologies and form intellectual capital were determined.

CONCLUSION

The conducted research is aimed at addressing the problem of the lack of professional competencies, as well as the need to identify promising competencies of S&T personnel for the iron and steel industry. The research has made it possible to form a cluster of competencies required for innovative development of production, including development of energy-efficient technologies and high-performance steels. The main conclusion is that highly qualified professionals for the iron and steel industry are required to have system and special competencies, which means they should have professional engineering excellence skills, management skills and should be innovation-focused.

Since there have not been enough special researches in Russia on analysis of a competency system according to functions performed by employees, the proposed model may be used for the development of a national system of competencies to support selection and training of personnel capable to initiate and implement innovations, as well as for the development of the relevant tools.

Acknowledgements

This research was financially supported by the Ministry of Education and Science of the Russian Federation within the framework of the project part of state task of Cherepovets State University (№ 11.3943.2017/4.6).

REFERENCES

[1] Boyatzis R. Competencies in the 21st century. Journal of Management Development 27 (2008) 1, 5-12. DOI 10.1108/02621710810840730.

[2] Kozhevnikov A.V. Competences of engineers in the iron and steel industry. IOP Conference Series: Materials Science and Engineering 287 (2017) 012008 DOI 10.1088/1757-899X/287/1/012008.

[3] Uiddet S., Holliford S. Rukovodstvo po kompe-tenciyam, GIPPO, Moskva, 2008. pp. 9-90. (in Russian).

[4] Parry S. B. The quest for competences: competency studies can help you make HR decision, but the results are only as good as the study. Training (1996) 33, 48-56.

[5] Shmatko N.A. Kompetencii inzhenernyh kadrov: opyt sravnitel'nogo issledovaniya v Rossii i stranah EC. Forsajt (2012) 4, 32-47. (in Russian).

[6] Wilson R.A., Cörvers F., Gardiner B. et al. Skills supply and demand in Europe. Medium-term forecast up to 2020. Luxembourg, 2010.

[7] Roberts G. Rekrument i otbor. Podhod, osnovannyj na kompetenciyah, GIPPO, Moskva, 2010, pp. 123-160. (in Russian).

[8] Vudraf CH. Centry razvitiya i ocenki, GIPPO, Moskva, 2005, pp. 178-240. (in Russian).

[9] Kozhevnikov A.V., Bolobanova N.L., Kozhevnikova I.A. Praktiko-orientirovannyj podhod s mezhdisciplinarnymi komponentami pri podgotovke inzhenernyh kadrov dlya metallurgicheskoj promyshlennosti. Materialy III Mezhdunarodnoj nauchnoj konferencii «Nauchno-tekhnicheskij progress v chernoj metal-lurgii – 2017», Cherepovec, 2017, pp. 135-141. (in Russian).

[10] Solomennikova S.I. Primenenie kompetent-nostnogo podhoda dlya ocenki personala proiz-vodstva vysokotekhnologicheskogo sektora pro-myshlennosti, Vestnik IzhGTU 49 (2011) 1, 139-140. (in Russian).

[11] Baldin K.V. Konceptual'nye osnovy primene-niya metoda ehkspertnogo ocenivaniya v predprinimatel'stve: monografiya, UGTU, Uhta, 2016. pp. 6-42.

[12] Kozlov V.E., Bogomolov A.V., Rudakov S.V., Olenchenko V.T. Matematicheskoe obespechenie obrabotki rejtingovoj informacii v zadachah ehkspertnogo ocenivaniya. Mir izmerenij (2012) 9, 42-49. (in Russian).

[13] Lyubushin N.P., Brikach G.E. Ispol'zovanie obobshchennoj funkcii zhelatel'nosti Harringtona v mnogoparametricheskih ehkonomicheskih za-dachah. Ehkonomicheskij analiz: teoriya i praktika 369 (2014) 18, 2-10. (in Russian).

Note: The person responsible for the translation of the paper into the English language is Natalia Skrobot, Cherepovets, Russia