

CONDITIONS AND CONTRADICTIONS OF CONTINUOUS PROFESSIONAL DEVELOPMENT AT MECHANICAL ENGINEERING ENTERPRISES (ON THE EXAMPLE OF THE OMSK REGION)

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Abstract

The limitations of the approaches to professional development presented in theory and practice are due to the fact that: firstly, the methods of development are broadcast reflecting static technologies, rigid borders of professional activity. The methods of professional development of competencies poorly take into account the motivational and value aspects of labor activity. Meanwhile, the requirements of the fourth industrial revolution are focused on design methods of labor organization, interdisciplinary communications, a high degree of adaptability to changes. The aim of the study is to determine the conditions and contradictions in the process of vocational training of engineering and technical workers in accordance with the requirements of the fourth industrial revolution. Research objectives: on the basis of theoretical analysis and practice of personnel development in advanced enterprises, to assess the gap in the development of competencies between the required level and the actual; to evaluate the effectiveness of the applied methods of development of engineering and technical workers; to formulate organizational and substantive contradictions in the professional development of personnel. To achieve this goal, we analyzed professional development practices at two Omsk machine-building enterprises (document analysis, expert survey, questionnaire survey).

Key words: professional development, competencies, methods of personnel development, the fourth industrial revolution, contradictions of professional development

JEL Code: J21, J24

Introduction

At the present stage of engineering and technical activities in the context of the fourth industrial revolution, the issue of developing the competencies of workers and engineers is becoming more and more acute. High standards of product quality, the complexity of

technical objects, frequent changes in the range of products produced set high requirements for professional knowledge, intellectual abilities of technical workers and personal qualities that allow us to flexibly respond to changes in the external environment, creatively solve problems and take personal responsibility for the result of work. However, today there is a situation where such requirements are not met by the traditional system of personnel development, as a result of which there is a gap between the demanded and the actual level of competence development. The discrepancy between technical and technological development and personnel competencies reduces the efficiency of investments, therefore, practice forms mechanisms for developing competencies by trial and error without the necessary scientific justification and the development of new principles of continuous professional development.

The rationale for the importance of an intra-organizational learning approach through the use of modern technologies is presented in the works of Aliukov S., Radzikhovskaya V., Guryanova K. (2018). The relevance and continuity of professional development is presented in the articles Mizintseva M., Sardaryan A., Chavykina M. (2019); Mansurova T., Rudneva N. (2018); Kudryashev V., Moiseeva E. (2017); Zeer, E., Zinnatova M., Tretyakova V. (2018). Training of technical workers is presented in the works of Didkovskaya, Y. (2020); Zhang T., Wang Z., Sun Li. (2014). Trends of changing technological trends and their impact on the formation of employee competencies are considered in the works of Kannan K. and Garad A. (2021); Fallon J. (2005); Longo F., Padovano A., Umbrella S. (2020). The use of new methods, including computer learning, is presented in the works of Sooraksa N. (2012), Pechenaya L., Ivanova-Shvets I., Domarev A., Mirzabalaeva (2019).

1 Sample model and method

The aim of the study is to determine the conditions and contradictions in the process of vocational training of engineering and technical workers in accordance with the requirements of the fourth industrial revolution. Research objectives: on the basis of theoretical analysis and practice of personnel development in advanced enterprises, to assess the gap in the development of competencies between the required level and the actual; to evaluate the effectiveness of the applied methods of development of engineering and technical workers; to formulate organizational and substantive contradictions in the professional development of personnel.

The main hypothesis was the assumption that the existing methods of professional development do not allow the formation of competencies in accordance with the requirements

of the fourth industrial revolution. To solve the problems, objective information was collected: analysis of statistical information about the engineering industry, analysis of regulatory and legal information; analysis of information on ongoing projects and programs for the development of competencies; analysis of regulatory requirements at the level of the industrial enterprises under study (financial statements, intra-organizational regulations, standards, programs, reporting documents on personnel training and development).

The collection of subjective information was carried out in the form of a survey of engineering and technical workers of the two largest Omsk machine-building enterprises (N = 922). The representativeness of the sample is presented in table 1. The confidence interval is 0.05, the confidence probability is 95%. Methods of descriptive statistics, correlation analysis were used to process the data.

Tab. 1: Sample of the study

Groups of employees	General population	%	Sample population	%
Joint-stock company «OmPO «Irtysh»				
Heads (chiefs, deputy chiefs / chiefs of technological and design bureaus, sectors / foremen)	116	13,5	116	24
Workers (main workers of the main production units)	477	55.8	213	43.9
Engineers	263	30.7	156	32.1
Total	856	100	485	100
Joint-stock company «ONIIP»				
Heads (chiefs, deputy chiefs / chiefs of technological and design bureaus, sectors / foremen)	106	16.8	106	24.3
Workers (main workers of the main production units)	137	21.7	137	31.3
Engineers	389	61.5	194	44.4
Total	632	100	437	100

source: own research

2 Results

Analysis of documents and programs for personnel development showed that the continuous development of technical workers in industrial enterprises is associated with a number of

problems. The first block of problems and contradictions was identified at the level of management of the competence development process:

1) there is no organized interaction of the specialized department with other departments that implement the goals of developing competencies. This testifies to the inconsistency of the actions of the divisions and the absence of a unified policy in this area;

2) there is no consistency of competence guidelines in the development of technical workers of industrial enterprises. It was revealed that competencies are practically not reflected at the strategic level, and are absent at the level of operational management (in training programs);

3) weak relationship between planning the development of competencies and changes in the content of workers' labor. This indicates the predominance of a formal approach in training.

These conclusions were confirmed by the processing of the survey results.

The survey data indicate that the potential for the development of competencies is greater than it is used in practice (see tables 2 and 3).

Tab. 2: Difference between average assessments of the importance of technical and supra-professional competencies and their deficit (coefficient of significance: 0 - not important, 3 - very important)

Competencies	Engineers (0-3)	Workers	T. (value)
Technical competencies			
The importance of knowledge of calculation methods and the ability to carry them out	2.19	1.98	2.538 (0.011)
Lack of knowledge of the features, design of equipment and the ability to work on it	0.63	0.46	0.529 (0.012)
Lack of knowledge of software products	0.94	0.70	2.927 (0.004)
Lack of knowledge of the characteristics of materials	0.64	0.48	2.266 (0.024)
Lack of knowledge and skills in related technical professions	1.13	0.66	5.779 (0,000)
Supra-professional competencies			
The importance of knowledge of the English language	1.51	0.65	11.012 (0.000)
The importance of being creative in problem solving	2.48	2.37	1.676 (0.094)
Lack of economic knowledge	0.88	0.64	2.904 (0.004)
Lack of knowledge of the English language	1.18	0.71	5.156 (0.000)
Lack of ability to perceive the task holistically	0.53	0.37	2.602 0.010

source: own research

Tab. 3: Summary average estimates of the importance and lack of technical and supra-professional competencies among workers and engineers

Competencies	Engineers	Workers
Technical		
Importance of competencies	2.16	2.32
Lack of competencies	0.69	0.48
Supra-professional		
Importance of competencies	2.42	2.26
Lack of competencies	0.49	0.40

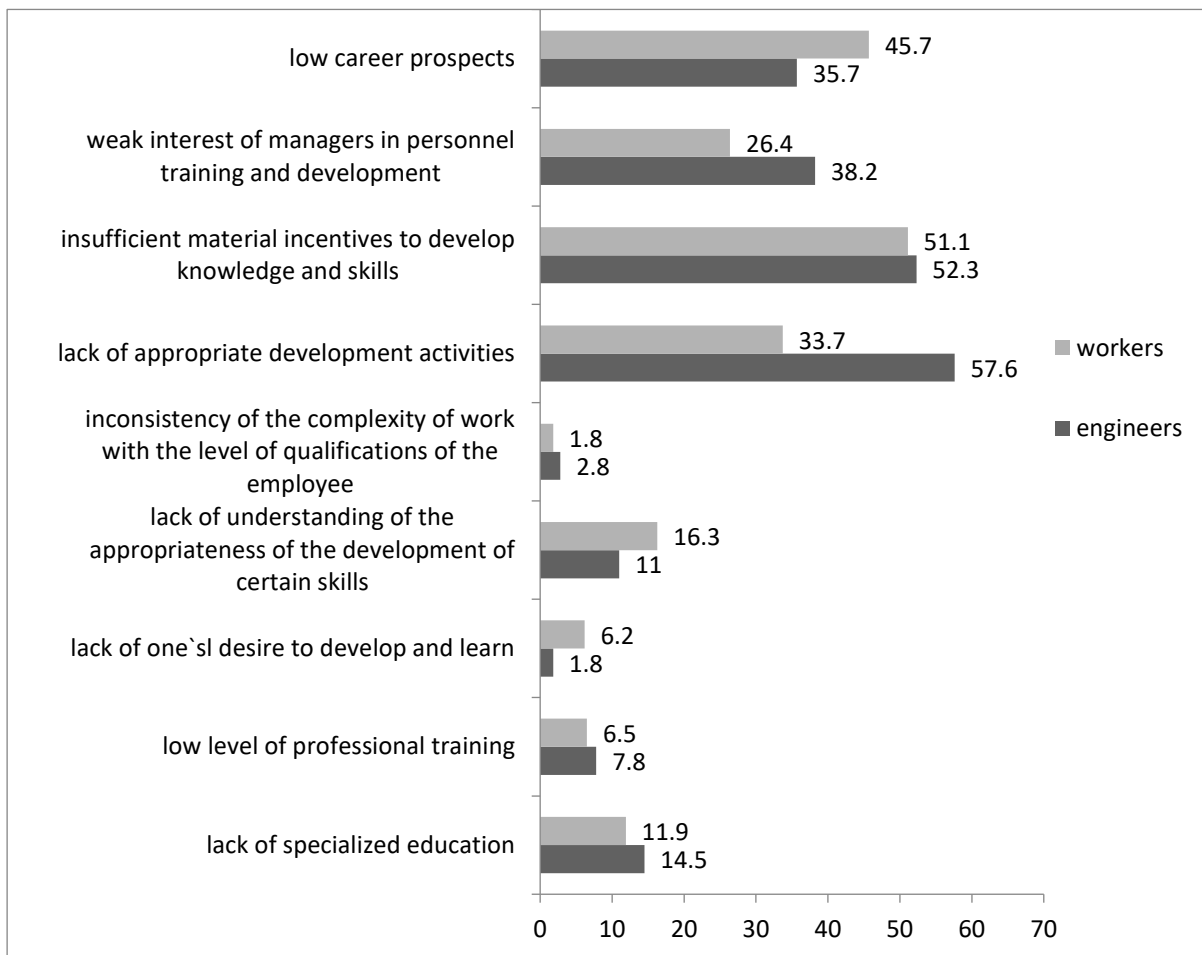
source: own research

It was concluded that the need for the development of supra-professional competencies is realized to a lesser extent than in the development of technical competencies. Therefore, there is an obvious contradiction between the focus of practice on the development of engineering competencies with a low share of over-professional development. However, an analysis of objective requirements (technical characteristics of new equipment, requirements of professional standards) indicates that it is necessary to develop both groups of competencies. Therefore, in the development of personnel, the interconnection of technical and supra-professional competencies is necessary. The basis for this conclusion is the results of the correlation analysis.

The correlation between technical and supra-professional competencies showed that the lack of technical competencies is associated with a deficit of supra-professional competencies and vice versa. For many competencies, the values of the Gamma coefficients are more than 0.5, which indicates the presence of a strong positive relationship. For example, engineers lack the ability to develop technical solutions associated with a lack of skills to interact with people (the coefficient is 0.62 at $p < 0.01$), to think logically and analyze (the coefficient is 0.63 at $p < 0.01$), to approach the solution of problems creatively (the coefficient is 0.57 at $p < 0.01$), to perceive the task holistically (the coefficient is 0.53 at $p < 0.01$). The workers lack the ability to read technological documentation associated with a lack of ability to think logically and analyze (the coefficient is 0.71 at $p < 0.01$), to quickly adapt to new tasks (the coefficient is 0.67 at $p < 0.01$), to take personal responsibility (the coefficient is 0.76 at $p < 0.01$), to be creative in solving problems (the coefficient is 0.67 at $p < 0.01$) and to perceive tasks holistically (the coefficient is 0.71 at $p < 0.01$). Due to the volume of the calculation tables, they are not presented in this article.

Resolving a contradiction requires clarifying the reasons for the gap in competencies. Figure 1 shows that organizational reasons (objective) are in the first place in terms of the greatest severity. Professional and personal reasons (subjective) are in the second place.

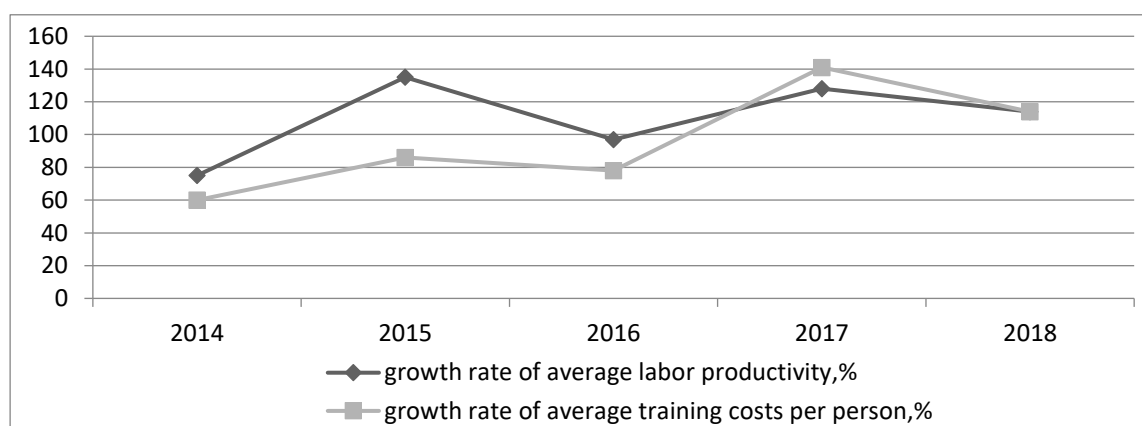
Fig.1: Reasons for the gap in the competencies of workers and engineers (% of respondents)



source: own research

The second block of contradictions was revealed at the level of the effectiveness of the development of competencies and resource provision. First, there is an imbalance between the cost of training and its effectiveness. Figure 2 shows that the growth rate of training costs exceeds the growth rate of labor productivity.

Fig.2: Dynamics of average labor productivity and average costs of employee training for 2014-2018



source: own research

Subjective assessments of the effects of training in 2020 showed that training has the greatest impact on the growth of labor productivity and the reduction of deviations and errors in work. Moreover, this effect is achieved to a greater extent through learning in the process of work (see table 4).

Tab. 4: Influence of the development of competencies on performance indicators (managers' assessment; %; plus - indicators have increased, minus - indicators have decreased)

Indicators	Regarding workers	Regarding engineers
Labour productivity	+45.4	+58.2
Downtime caused by employee`s fault	-28.4	-25.1
Breaches of work discipline	-25.8	-23.2
Delay in technology implementation	-31.2	-34.4
Losses from defects, deviations, errors in work	-51.1	-68.4
Losses from staff turnover	-19.1	-15.4

source: own research

To analyze the factors influencing the reduction of the competence gap, a regression analysis was carried out. The deficit of technical and supra-professional competences of technical workers was used as a dependent variable. As predictors of the model, variables were used that reflect the motives of employees, the reasons for gaps in competencies, goals, frequency of training, resources (quality of teaching, level of qualifications of teachers),

complexity of tasks performed, characteristics of employees (level and profile of education, work experience, age). Calculations of linear regression coefficients are presented in table 5.

Tab. 5: Results of regression analysis of factors affecting the competency gap (linear regression)

Variables	Regression coefficients	
	Engineers	Workers
Technical competencies		
Weak level of professional training	0.270**	0.496**
Lack of specialized education	0.543***	0.439***
Awareness of development goals (competencies)	-0.162*	-
Training frequency	0.149*	-
Lack of development activities	0.034*	0.053**
Motivation for learning (tendency to improve professional activity)	-	-0.064*
Supra-professional competencies		
Weak level of professional training	0.433***	0.367***
Lack of specialized education	0.420***	0.336*
Awareness of development goals (competencies)	-0.278***	0.287***
Motivation for learning (tendency to improve professional activity)	-0.052***	-0.54**

***p<0,01, **p<0,05, *p<0,1

source: own research

Conclusion

Thus, the contradictions in the development of the competencies of technical workers can be divided into 2 groups. The first group reflects the organizational aspects associated with the level of management of this process, the quality of programs, the frequency of training, etc. The second group is associated with motivational and content aspects.

It has been proved that technical and supra-professional competences, with the correct organization of the development process, can reinforce each other, and not be perceived as antagonists.

The narrowing of the gap in the technical and supra-professional competences of workers and engineers is influenced, first of all, by the level of professional training and the profile of education. It was also revealed that in the improvement of supra-professional competencies, the awareness of the development goals by employees is important. The clearer they are for them, the greater the benefits from learning will be. For technical competence,

this conclusion applies to engineers. Employee motivation also helps to close the gap. The development of technical competencies will enhance the presence of a motive for improving professional activity, and the development of over-professional competencies will increase the motivation for career advancement. An indicator such as training frequency has the opposite effect on narrowing the technical competence gap. The influence of this indicator on the development of supra-professional competencies was not revealed. The obtained result may indicate that the frequency of training does not guarantee the quality of competence development.

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