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**DEVELOPING READINESS OF TECHNICAL UNIVERSITIES  
GRADUATES FOR PROFESSIONAL SUBSTITUTABILITY**

Valentin Mikhelkevich (a)\*, Pavel Kravtsov (b)  
\*Corresponding author

(a) Samara State Technical University, Molodogvardeyskaya str., 244, Samara, Russian Federation, j918@yandex.ru  
(b) Samara State Technical University, 244 Molodogvardeyskaya str., Samara, Russian Federation, epa6@yandex.ru

**Abstract**

The paper deals with socio-didactic problems that arise when graduates of technical universities are employed in job positions that impose such qualification and functional requirements which do not fully correspond to the level, profile or training programme these graduates received at their technical university. This phenomenon, referred to as professional substitutability, leads to these graduates further training thus lengthening their labour adaptation period in the workplace, which depends on the degree of discrepancy between the required and actual levels of the graduates' university training. In the conditions of uncertainty over the development prospects of many enterprises, the use of graduates' professional substitutability becomes a forced permanent condition for enterprises functioning. It means that readiness for professional substitutability is one of the important competitive advantages of employees. So, it is important to develop students' competence-based and psychological readiness to change types and content of their upcoming work, to help them master main, secondary and additional professional and functional competencies at the deepest possible level of complexity at the stage of university training. In this research, the authors provide a theoretical foundation and introduce methodological principles for developing technical university graduates' functional flexibility and their readiness for professional substitutability.

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## **1. Introduction**

The increasing discrepancy between the requirements imposed by employers to the competencies of technical universities graduates and their professional training content is a distinctive distinguishing feature of the modern labour market. This discrepancy is caused by objective reasons. They are the incompleteness of reliable forecast estimates of personnel needs due to the lack of long-term orders list, a poor strategy for their own development at most enterprises, disagreement between educational and professional standards, rapid changes in industrial technologies and equipment configuration in leading industries. As a result, when university graduates are employed, they are often accepted for positions that do not fully correspond to the qualification level of their training. It leads to a so-called professional substitutability, which is accompanied by the extension of labour adaptation period of young specialists at the enterprise.

## **2. Problem Statement**

The article deals with the problem of developing technical university graduates' readiness for employment in the conditions of uncertainty of the types and content of their upcoming professional activity.

## **3. Research Questions**

The authors provide methodological support for developing technical university graduates' readiness for professional substitutability and determine the dependence of the level of graduates' readiness for professional substitutability on the depth of integration linkages between universities and enterprises.

## **4. Purpose of the Study**

In this research, the authors aim to provide a theoretical foundation and introduce methodological principles for developing technical university graduates' readiness for professional substitutability.

## **5. Research Methods**

In the research, the authors used praximic methods, the method of forecasting, the analysis of pedagogical literature on the diversification and functional specialization of engineering work, the methods of pedagogical observation and pedagogical experiment, the methods of studying and generalizing of Russian and international pedagogical experience, regulatory and legal documentation in the field of higher technical and additional education.

## **6. Findings**

The system of vocational education should meet the needs of the labour market, quickly adapting to its changes. But in practice, the implementation of such a flexible response is an impossible task for the existing inertial and conservative educational system. The interaction of educational institutions with employers while developing the content of training programmes and organizing students' on-the-job

training programmes at enterprises as well as the employers' occasional participation in the educational process can no longer help to solve this problem (Aituganov et al., 2009). After all, when hiring graduates, the employer is not interested if their level of training meets the requirements of the Federal State Educational Standards. The employer takes into account graduates' professional competence as well as their ability to act effectively in an industrial environment (Blinov et al., 2010). For graduates, in their turn, their educational qualification can be considered high-quality if it allows them to successfully compete in the labour market, get a well-paid job and make a successful career in their profession. However, the disproportions of supply and demand in the labour market with its inherent stochastic and fast-moving changes create problems in the employment of technical university graduates (Eremina & Zoroastrova, 2015; Koltunova, 2014). Every so often, graduates of technical universities are employed in job positions that impose such qualification and functional requirements which do not fully correspond to the level, profile or training programme these graduates received at their technical university or to the professional standards requirements. Such situations result in graduated professional substitutability.

Professional substitutability is divided into two types: horizontal and vertical.

Horizontal professional substitutability reflects situations in which a university graduate is employed for a position which qualification level coincides with the qualification level of this university graduate, but does not correspond to his/her university specialization. For example, a bachelor who qualified for the training programme known as 13.03.02 "Electric power engineering and electrical engineering" and who specialised in "Electric driver and automation of industrial installations and technological complexes", can fill a position corresponding to the same training programme but requiring a different specialisation, that is "Power supply of industrial enterprises". A graduate will be in an even more difficult situation if, due to the lack of vacancies in his field of training, he will be forced to find a job at a workplace where he will have to perform, for example, the duties of an engineer who qualified for the training programme known as 23.05.05 "Train traffic support systems", specialization "Automation and telemechanics in railway transport". Naturally, this young specialist will have to complete an additional professional development program or a professional retraining programme, which will significantly affect the timing of his labour adaptation.

Vertical professional substitutability reflects situations in which a university graduate is employed for a position which qualification level coincides with the qualification level of this university graduate, but qualification requirements for this position are lower or higher than the level of his qualifications obtained at the university. For example, there are situations when a university graduate is for some reason employed (for example, because of a higher salary level) for a higher-level worker position with a lower qualification level. At the same time, there are situations when a university graduate is hired for a position which qualification level is a step higher than the graduate's qualification. In this case, his excellent academic success, achievements in research or in experimental design and invention, confirmed by diplomas, certificates, patents contained in his portfolio, as well as his desire to continue education are taken into account. However, for both types of professional substitutability, the period of professional, psychological and social adaptation for this category of university graduates will be longer compared to graduates whose workplace does not require additional training (Pakhnevskaya et al., 2019).

Professional substitutability is usually considered as a forced annoying obstacle reducing the labour adaptation period of employees, and the best way to avoid it when employing young specialists is their targeted individual training supported by industrial enterprises, research and design organizations and institutions. However, this approach is only partially correct and works only in the initial period of a young specialist work after employment. An analysis of current trends in the development of the labour market does not give grounds for assumptions. Much less it guarantees that the content of professional activity and qualification requirements for the workplace will remain unchanged for a long period of time (Merkulova, 2005). Rapid changes that occur in the structure, content and conditions of various types of engineering work lead to the fact that the readiness of enterprise personnel to change the nature of their work becomes normal and is even encouraged by employers. Industrial enterprises strive for functional flexibility in the use of personnel, which means the ability of an organization to make certain changes in the nature of the use of its employees, as well as in the content of their work activities in accordance with changing production conditions (Sotnikova, 2018).

The basis of functional flexibility is the constant improvement and development of professionalism both in the main qualification and in related fields (Bordovskaya, 2018). People's knowledge, skills and abilities must always be up-to-date and have to meet modern requirements. Building up functional flexibility is one of the important conditions for career planning. It also increases employees' competitiveness (Didkovskaya, 2015). The large-scale introduction of the competence-based approach into the personnel training system for organizations and the recognition of personnel competencies as the dominant parameter when hiring led to the emergence of the concept of competence-based competitiveness of an employee. Competence-based competitiveness characterizes an employee's ability to win an economic competition for a high-quality workplace in a specific field of his professional training from other applicants due to the best compliance of the existing professional competencies with the requirements of the functional potential of workplaces and the subjective preferences of employers. The wider the scope of application of the acquired competencies, the higher the value of the employee in the labor market is.

Thus, in the conditions of uncertainty over the development prospects of many enterprises, the use of graduates' professional substitutability becomes a natural permanent condition for enterprises functioning. It means that readiness for professional substitutability is one of the important competitive advantages of employees (Larina, 2016). Therefore, it is necessary to form students' competence-based and psychological readiness for professional substitutability in the upcoming work activity at the stage of university training. To do this, it is necessary to use the advantages of functionally-oriented training system of specialists (Mikhelkevich & Kravtsov, 2009).

The methodological core of the functionally oriented training of specialists in technical universities is the idea of the functional structure of engineering activity.

At the same time, both vertical and horizontal substitutability in terms of content represent the transition of an employee from performing engineering functions assigned to one workplace to performing functions assigned to another workplace.

The authors believe that in order to help students successfully face such transitions, the following three main conditions must be met in the process of their training in the system of functional-oriented education. They are as follows:

- informing students about the connection between the competitiveness of graduates in the labour market with their readiness for professional substitutability and their ability to achieve the maximum possible level of functional flexibility at the stage of studying at the university;
- mastering algorithms of various types of professional activity (engineering functions) by the students;
- formation and development of integration linkages between universities and enterprises in the field of additional postgraduate education.

Let's take a closer look at each of these conditions.

The first condition means that employers are interested in that the fact that labour adaptation of university graduates should be as short as possible. This information should be brought to students' attention. At the same time, several aspects of labour adaptation are highlighted:

- professional adaptation;
- psycho-physiological adaptation;
- socio-psychological adaptation;
- organizational adaptation.

Despite the difference between the aspects of adaptation, they are all in constant interaction.

Experience shows that of all types of labour adaptation, professional adaptation is the longest in terms of time, and most often the most difficult in terms of content for young professionals. Nonetheless, the professional adaptation of any specialist is largely reduced to the formation of his professionally significant qualities (Postalyuk & Prudnikova, 2020) and to mastering certain types of engineering activities (acquiring skills to perform certain engineering functions) related to the specific requirements of his new workplace.

Meanwhile, the working program of the optional discipline "Functional Engineering Specialization" is aimed at studying methodological foundations of various types of engineering activities and their organisation specifics, at the acquisition of practical skills in performing various engineering functions, at measuring and evaluating the levels of formation of functional and professional competencies at the stage of training students at the university (Mikhelkevich & Kravtsov, 2010). A significant part of the problems associated with the upcoming professional adaptation can be solved in the system of functionally oriented training of specialists by mastering the relevant disciplines of functional engineering specializations, performing functionally-oriented coursework and projects, organizing functionally-oriented educational and production practices. In addition, the opportunities for students to get acquainted with the features of their future workplace become even wider with the targeted nature and individualization of training within the framework of functional-oriented training of specialists.

A significant place in the discipline "Functional Engineering Specialization" is given to introducing students to modern methods of increasing the functional flexibility of personnel. One of these methods is the method of personnel stratification into functional competence categories, based on the idea of professional competencies cooperation in the context of labour functional division according to the criterion of maximum compliance of the employee's professional training potential with the parameters of the functional competence model of the workplace (Milyaeva & Bavykina, 2014). It is shown that the increase in the level of competence-based competitiveness of an employee can be provided in two ways, which are

associated either with an increase in the level of functional flexibility of the employee due to the consistent development of basic, secondary and additional professional competencies (readiness for horizontal substitution is formed this way), or with an increase in the level of qualification due to the consistent development of professional competencies of ordinary, medium and high levels of complexity (readiness for vertical substitution is then formed).

Informing students about the possibilities of forming readiness for professional substitutability and methods of achieving it at the stage of studying at the university creates the necessary motivation for students focused on successful career growth after their employment.

The fulfillment of the second condition of proactive preparation of students for professional substitutability is associated with the transfer of emphasis in teaching students from binding to specific manufacturing technologies, specific element base of technical objects, specific operating conditions of industrial equipment to the development of general algorithms for various types of professional activities. The authors further explain the difference between these approaches taking a design engineer university training as an example. If an enterprise is interested in hiring a young specialist to perform work on the design of power supplies, then it is possible to teach a student to design this type of technical objects in two or three months (during the period of pre-graduate practice and students work on their diploma papers) within the framework of a targeted training agreement. But there is another way to do it. Firstly, the student is introduced to the general principles of design work organization, with account of specific the features of this engineering activity, the designer's job profile diagram and a list of professionally significant qualities. The student gets acquainted with the capabilities of computer-aided design systems and learn the rules for using specialized computer programs. On this basis, he further considers the particular task of designing power supplies as one of possible technical objects. In both cases, the level of specialist training required by the employer is provided. But sometimes the company can be satisfied with a narrow and ordinary functional specialization of the employee. However, the interests of the student associated with his further professional growth might require a more thorough approach to the level of mastering the type of engineering activity he has chosen (Zeer, 2014). Here, the wider the system-theoretical base of functional-oriented training is, the higher its effectiveness in achieving functional flexibility, competence and readiness for professional substitutability grows.

It should be noted that the academic discipline "Algorithms and methods for solving problems of professional activity" is part of the bachelor's training curriculum is a part of the programme 13.03.02 "Electric Power and electrical Engineering" and is designed for two semesters.

There is also the third condition for preparing students for the upcoming professional replacement. This condition provides for the continuation of cooperation between universities and employers after the employment of graduates in the field of design and implementation of joint educational programs of additional postgraduate education. This is necessary for the constant updating of employees' readiness to change the conditions and content of their work as well as for organizing advanced training and professional retraining of personnel. The beneficial effect of continuous employee training on the company's performance is confirmed by the vivid example of one of the world's largest multinational telecommunications conglomerates, AT&T Inc., which is changing its identity. It is turning from a telecommunications company into a cloud computing company. Instead of mass layoffs and hiring, the

company went the other way. AT&T decided to quickly retrain its current employees, striving to create a culture of continuous learning, making employee training and development a central element of its entire organization. At the same time, training becomes a significant part of employees working time. According to the chief Executive Officer, Chairman of the Board of Directors, R. Stevenson (Randall L. Stephenson) the competencies of people who do not spend 5-10 hours a week in online training will become obsolete with the advent of new technologies. The corporate training system, as such technologies and new tools for their implementation become available, allows employees to study them, and the organization itself to maintain its position in the telecommunications services market.

This example shows that the readiness for professional substitutability is important not only for the employment of graduates immediately after graduation, but also should be maintained at the level necessary for maintaining and increasing competence-based competitiveness throughout their further working career. All figures and tables should be referred in the text and numbered in the order in which they are mentioned.

## 7. Conclusion

In the conditions of uncertainty of the prospects for the development of many industrial enterprises, the processes of professional substitutability become inevitable. Both university graduates and their employers as well as the whole system of higher professional education should be prepared for that. When graduates are employed for substitute job positions, that impose such qualification and functional requirements which do not fully correspond to the level, profile or training programme these graduates received at their technical university, there is a need for these graduates to acquire new additional knowledge and master additional competencies, taking into account the characteristics of the substitute workplace.

The amount of additional knowledge and competencies required depends on the degree of discrepancy between the required and actual levels of graduates training, and directly affects the period of labour adaptation of a young specialist at the enterprise. To reduce the labour adaptation period, it is advisable to prepare students for the upcoming professional substitutability even during their studies at the university, using the opportunities provided by the system of functionally oriented training of specialists.

Timely informing students about the need for constant readiness to change the content and working conditions, mastering algorithms for various types of upcoming professional activities and joint development by universities and employers of additional postgraduate corporate training programs aimed at developing the functional flexibility of enterprise personnel, ensures the formation of readiness of graduates of technical universities for professional substitutability at various stages of their work.

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