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Assessment of Demand for Personnel in Textile Industry on The Basis of Data Analysis of Online Job Portals

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Abstract. The article analyzes the current methodological approaches to the analysis of the online labour market and identification of the demand-supply imbalance. The article also shows the limits for the application of these approaches for the labour market in Belarus. The authors have developed and tested a methodological approach to the collecting a database on vacancies from online job portals, classification and processing of the collected data. The research helped to determine the demand for personnel in textile industry and its matching to the structure of CVs posted by applicants. Thus, the data collected from online job portals help educational institutions develop more precise enrollment plans which ensures timely training of personnel that is required by the industry. In the methodological aspect the article illustrates how the use of Big Data improves analysis and forecast of the demand in the labour market.

INTRODUCTION

Development of the digital economy, changes in tasks (their multidimensionality and flexibility), higher professional mobility, including functional mobility (i.e. combination of competencies), intensification of knowledge depreciation are the reasons to search for new means and channels to select necessary workers (or the set of competencies) [1,2]. Production of textiles, leather and fur garments is a significant type of economic activity in economic and social aspects in Belarus. Its share in the total manufacturing industry of the country is 3.4% [3], and it is 9.5% in the average number of employees. However the industry is constantly experiencing a personnel deficit (which affects the total number of employees in the industry (in 2019 it reached 92.1% to the level of 2015)). At the same time, it is not attractive to young people as in Belarus the level of wages is 65.1% to the average monthly wages in the manufacturing industry [3]. These conditions necessitate the development of a mechanism to forecast the demand for personnel at the industry level in order to ensure their timely training at educational institutions. The analysis of the Development of Textile Industry Program for 2015-2020 with the Perspective for the Year of 2030, approved by the Board of BelLegProm Concern, does not provide any information on staffing in the industry and does not take preventive measures to train the personnel for companies of the Concern. Despite the fact that the output of major kinds of textile manufacture, which was discretely changing in 1995-2020 (Fig.1), remained at the same level, the dynamics of the number of workers and specialists trained in "Engineering and Technology" speciality has significantly decreased (Table 1) [4]. Thus, in perspective, businesses of this kind of economic activity may get into the "personnel trap" and a lack of new skills.

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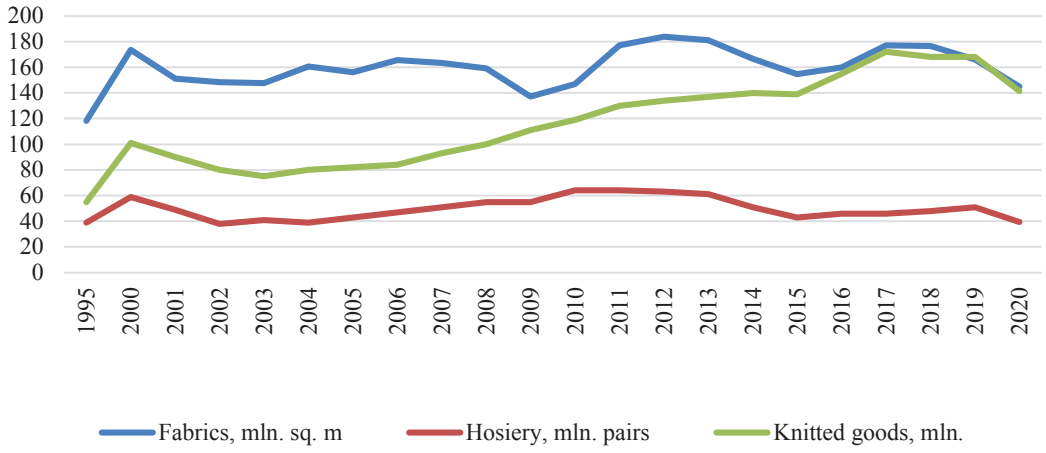

FIGURE 1. Production of certain kinds of textile products by volume (1995-2020).

TABLE 1. Dynamics of the number of workers and specialists trained by Belarusian educational institutions in "Engineering and Technology" speciality.

The number of school leavers:	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
The number of workers trained at vocational education and training institutions (thousands of people)	17.63	15.6	14.2	13.8	13.8	13.4	13.0
The number of workers trained at secondary specialized education institutions (thousands of people)	14.7	12.4	11.5	11.7	10.7	10.1	10.1
The number of specialists graduated from higher education institutions (thousands of people)	13.1	14.3	13.5	12.9	15.3	12.5	11.0
Trained total, thousands of people	45.43	42.3	39.2	38.4	39.8	36.0	34.1
in % to the total number of trained specialists in all specialities	27.4	27.48	26.9	27.48	27.27	28.63	29.14

At the same time, it should be admitted that educational institutions do not allocate separate specialites by the type of economic activity. It is the Ministry of Labour and Social Protection that carries out this allocation, however, it is based on the different parameters: the number of vacancies listed in the National Bank of Vacancies and the number of the unemployed listed in the state employment service. Yet these statistics are not complete. Such conditions make forecasts of demand for personnel at the industry level unreliable. However, it is these forecasts that educational institutions use to make admission plans. Moreover, they do not set admission figures on the basis of the types of economic activities and vocational qualification groups but on areas of training and specialities.

Digitalisation of economy creates the demand for new professions and specialities, which are given top priority when posted on the online job portals. They create another picture of the labour market which differs from the vision of the Ministry of Labour and Social Protection. Despite the developed methodological approaches, there is no consolidated analysis nor forecast of demanded professions. [5, 6]. Thus, two hypotheses are being tested:

1. online sources of information on vacancies and CVs are more informative for the decision-making process;
2. determination of the demand for personnel in the context of occupation-and-qualification groups and regions is a more effective way to ensure harmonisation of the labour market and the system of education than the forecasting based on larger types of economic activity and areas of training.

The current methods of the analysis and forecast of the demand for personnel are based on three empirical data:

3. the data obtained from the labour force survey which show that in 2019 63.3% of the employed had a primary occupation that corresponded to their qualification, 17.2% had an occupation at lower level than their qualification was, 3.7% had an occupation of a higher level, and 15.9% of the employed had a job of the corresponding level, though it did not relate to their qualification [7];
4. the labour market condition (based on the Ministry of Labour and Social Protection data on the number of vacancies in the National Bank of Vacancies and the registered number of the unemployed), which is represented by 10 vacancies per an unemployed;
5. survey on the demand for personnel, conducted by the Ministry of Labour and Social Protection on a sampling organizations, however, it's data cannot be regarded as representative [8].

Enrollment plans of educational institutions are developed based on these data taking into account demographic trends. However, these databases neither show the actual data on the unemployment and the labour market condition nor enable to measure the deficit (surplus) of the personnel and qualification in the context of types of economic activities and occupation-and-qualification groups and regions and to determine the demand for new skills [9] taking into account digitalisaton of the economy and data on vacancies posted on online job portals.

The lack of information for the forecasting as well as the record of vacancies posted on online job portals necessitate the development of a new method of analysis and forecast of the labour demand. The goal of the research is a theoretical justification of a new approach to the forecast of labour demand in the context of digitalisation of the economy. The approach is based on Big Data and Artificial Intelligence technologies which enables to identify the most scarce professions and specialities in the textile and light industry in Belarus.

MATERIALS AND METHODS

Theoretical and methodological approaches to the forecast of the labour demand in textile industry, methods of creating an empirical base for the research.

The analysis of theoretical approaches to the forecast of the labour demand in the industry in the context of digitalisation of the economy helped to outline several trends: analysis of the data from online job portals and ranking of the online job portals by priority when using there data [5], analysis of competencies in the context of definite professions [10], extrapolation of statistical and administrative data [8], analysis of web-pages of individual companies [11-13].

Thus, it proves that information on vacancies and CVs from online resources is a more effective tool to detect earlier signals on the labour market compared to the data received from administrative and statistical sources [8,10]. It helps educational institutions to take timely measures in response to these signals. With the use of Big Data the decision making process becomes more effective [14, 15]. The study of current approaches to the forecast of the labour demand in the industry shows that the methods for the development of empirical base and its analysis have changed under the digitalisation of the economy since the data from online job portals became available for the analysis. And the analysis of these data requires new methods for the empirical base processing based on the Big Data and Artificial Intelligence technologies. Also, not only the number of employees and vacancies is used for the assessment of the labour demand and supply but also competencies, which are indicated in either CVs or vacancy descriptions. This resulted in the ability to use uniform and consistent classifiers such as the International Standard Classification of Education (ISCED), the European Standard Classification of Occupations (ESCO-08), the Statistical classification of economic activities (NACE) and competencies (ISCO). Consolidation of the existing approaches helped to develop a methodology for the analysis of the labour market in the industry. The methodology includes six stages:

1. grouping of vacancies and CVs according to the profession-and-qualification groups (1st digit of the ISCO code) with the use of Universal Sentence Encoder app;

2. transferring of processed and classified data into ClickHouse Database and their visualization with the help of Superset;

3. establishing the match between the number of CVs and vacancies in the textile and light industry. The matching is based on two categories which are the type of economic activity and the region;

4. calculation of the labour market condition (the number of CVs per 1 vacancy, difference between the number of vacancies and CVs) in the context of occupation-and-qualification groups, identification of the occupation-and-qualification groups with the highest demand for labour;

5. detailed analysis of professions from occupation-and-qualification groups with the highest demand for labour (4th digit of the ISCO code), creation of a detailed list of the most demanded professions;

provision of information to educational institutions and school leavers about the market condition in the context of the detailed list of professions according to the classification compatible with the one used in the educational system.

RESULTS AND DISCUSSION

Data on vacancies and CVs obtained by scraping from the largest online job portals of Belarus are used as the empirical database for the research of the labour demand in the textile industry of Belarus (non-state vacancy aggregator Belmeta.com, non-state online service Rabota.by, and non-state employment service GSZ.gov.by). Aggregated data include 474 051 CVs and 56 328 vacancies posted and/or updated form March 2020 to March 2021. 5 395 CVs and 1 518 vacancies which relate to the textile and light industry were extracted from the bulk data set. The characteristics of the empirical database of the research is given in Table 2.

TABLE 2. The empirical database of the research*.

Quantity	Territory					
	Minsk Region	Mogilev Region	Brest Region	Gomel Region	Grodno Region	Vitebsk Region
The number of CVs	1674	795	887	786	596	657
The number of vacancies	372	207	209	196	264	270

* The information from online job portals was extracted by means of scraping based on the artificial intelligence software. It performed the data deduplication based on the calculation of similar text documents by their vector representation [4,5]. USE (Universal Sentence Encoder) was used as a model classification as it supports multiple languages and encodes entire sentences which provides for the required accuracy of processing and comparison of text information.

The aggregated current labour demand in the textile and light industry of Belarus is estimated by 1 518 vacancies (which is about 1.8% of the average number of employees in industry) [3]. Grouping of extracted vacancies and CVs according to the occupation-and-qualification groups (1st digit of the ISCO classification) shows that the labour market condition in textile industry equals to 3.55 CVs per one vacancy, wherein the ratio is 1 CVs per one vacancy in the "skilled workers" category, in "mechanics, machine operators, machinists and other workers who control, operate and provide maintenance service" category it is 0.64 CVs per one vacancy, in "specialists" category it is 8.42 CVs per one vacancy (which differs from the official statistics) (See Fig. 2). That is, the data obtained from online job portals provide for more accurate assessment of the situation on the labour market in industry.

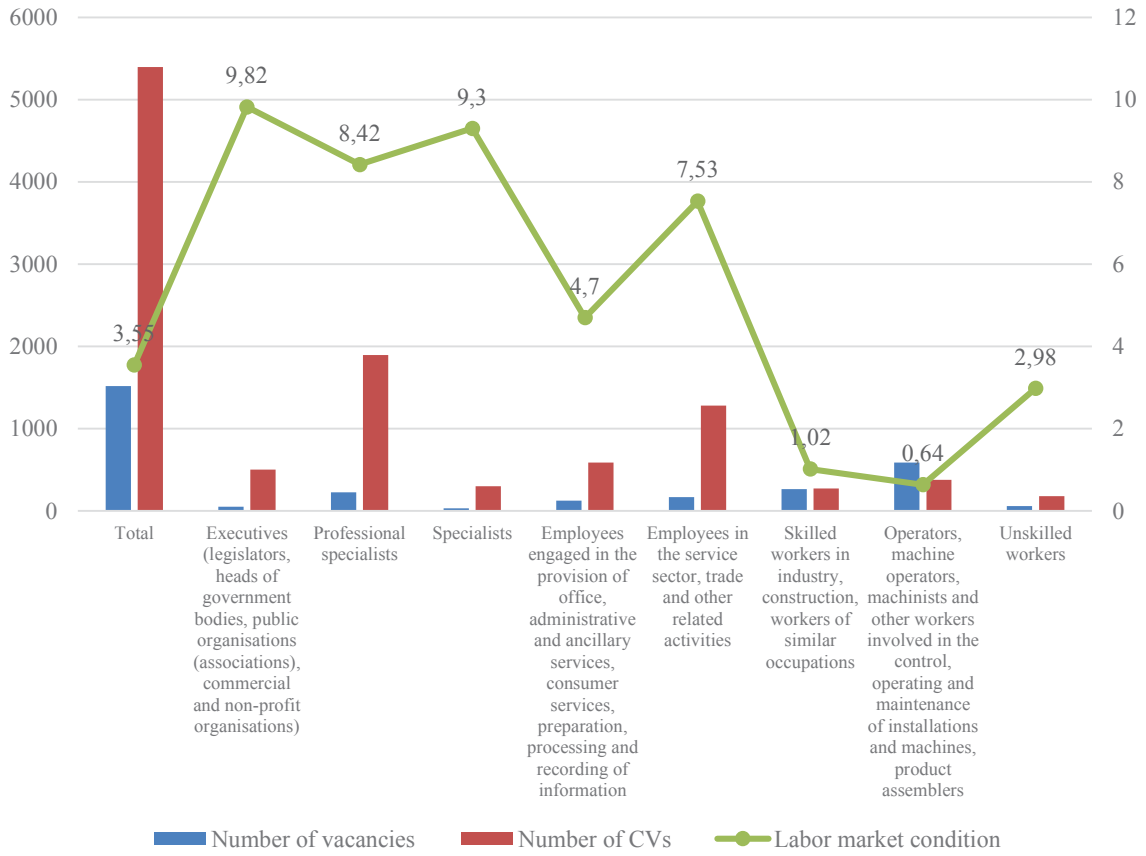

FIGURE 2. The labour market condition in the textile industry (based on the data from the online job portals of Belarus), 2021.

TABLE 3. The labour market condition in the textile and light industry in the context of occupation-and-qualification groups and territories in Belarus (the number of CVs per 1 vacancy).

Territory	Number of the occupation-and-qualification group by ISCO							
	Managers	**Professional**	**Technicians and associate professionals**	**Clerical support workers**	**Service and sales workers**	**Craft and related trades workers**	**Plant and machine operators, and assemblers**	**Elementary occupations**
Minsk Region	9.8	11.5	106 CVs per 0 vacancies	11.1	4.42	1.5	0.83	3.3
Brest Region	14.4	6.45	33	20.3	14.2	2.1	0.73	7.25
Vitebsk Region	10.3	4.33	12.5	9.25	13.45	0.59	0.232	3.5
Gomel Region	10.7	7.85	34 CVs per 0 vacancies	5.18	10.6	0.85	0.60	6.0
Grodno Region	4.0	3.6	6.8	9.0	6.1	0.44	0.44	3.4
Mogilev Region	15.0	6.1	14.0	12.1	11.3	1.17	0.54	1.7
Total	9.4	6.5	23.0	10.5	8.4	0.99	0.58	3.58

The analysis of the labour market condition in the textile and light industry in Belarus (by the difference between the number of vacancies and CVs) in the context of occupation-and-qualification groups and territories (Table 3) shows the following:

- in general, the number of CVs is higher than the number of vacancies on the labour market of the textile and light industry which indicates a surplus of labour in the industry's labour market;
- surplus supply in the context of occupation-and-qualification groups exists in all the regions of Belarus except for the groups "Skilled workers in industry, construction, workers of similar occupations", and "Operators, machine operators, machinists and other workers involved in the control, operating and maintenance of installations and machines, product assemblers" where the labour demand excesses labour supply;
- the deficit of 40.74% (Vitebsk Region), 14.58% (Grodno Region) and 55.17% (Gomel Region) exists in the group of occupations for skilled workers that is not eliminated by the supply in other regions. The total labour deficit is 0.73% in occupations of this group;
- there is labour deficit in all the regions across Belarus in the group "Operators, machine operators, machinists and other workers involved in the control, operating and maintenance of installations and machines, product assemblers". The labour deficit is 16.36% in Minsk Region, 26.79% in Brest Region, 76.8% in Vitebsk Region, 39.13% in Gomel Region, 55.91% in Grodno Region, and 45.78% in Mogilev Region. Thus, the total labour deficit is 41.73% for this group of occupations in Belarus.

A detailed analysis of the two occupation-and-qualification groups with labour deficit allocated the 5 most demanded occupations in each group (the 4th digit of the ISCO code).

TABLE 4. Deviation in the number of CVs from the number of vacancies in the context of the most demanded occupations by the ISCO group "Skilled workers in industry, construction, workers of similar occupations" (four digits of the ISCO code).

ISCO code	ISCO group	Vacancies, items	CVs, items	Labour market condition (the number of CVs per 1 vacancy)	Deficit, %
7 233	Industrial machinery mechanic	50	3	0.06	94.0
7 412	Electrical mechanic	67	34	0.507	49.25
7 532	Clothing cutter	32	0	No CVs found	100.0
7 126	Plumber	36	4	0.11	88.89
7 412	Automotive electrician	7	0	No CVs found	100.0

11 deficit occupations were identified in the ISCO group "Operators, machine operators, machinists and other workers involved in the control, operating and maintenance of installations and machines, product assemblers". Table 6 presents data on five of them.

TABLE 5. Deviation in the number of CVs from the number of vacancies in the context of the most demanded occupations by the ISCO group "Operators, machine operators, machinists and other workers involved in the control, operating and maintenance of installations and machines, product assemblers" (four digits of the ISCO code).

ISCO code	ISCO group	Vacancies, items	CVs, items	Labour market condition (the number of CVs per 1 vacancy)	Deficit, %
8 153	Sewing machine operator	541	204	0.37	62.29
8 341	Land-based machinery operator	30	8	0.26	73.33
8 156	Footwear stitching machine operator	20	0	No CVs found	100.0
8 332	Cargo vehicle driver	19	0	No CVs found	100.0
8 344	Forklift operator	11	0	No CVs found	100.0

These data can be taken into consideration and used by educational institutions that train specialists in these specialities. At the moment, the disadvantage of this model is the limited number of online portals the vacancies and CVs were downloaded from (only the largest 3 were used). However, in the course of digitalization of the economy the problem can be resolved as the online labour market will expand.

CONCLUSION

The results present the total labour demand in the textile and light industry of Belarus in the context of occupation-and-qualification groups. This information is required by educational institutions to set targets for students' admission and career guidance. This technique can be used to determine the most demanded occupations in the industry by the 4th digit in the classification code and proves to be quite a precise tool for forecasting. The most demanded trades in the textile and light industry are the following: Industrial machinery mechanic, Electrical mechanic, Clothing cutter, Plumber, Automotive electrician. There is labour deficit in the group "Operators, machine operators, machinists and other workers involved in the control, operating and maintenance of installations and machines, product assemblers" for the following occupations: Sewing machine operator, Land-based machinery operator, Footwear stitching machine operator, Cargo vehicle driver, Forklift operator. The results confirm the assessment of the labour deficit in the textile industry of Belarus. Also, the results reveal the structural inconsistency in the labour market of Belarus textile industry. Thus, the research has proved the hypothesis that online sources of information on vacancies and CVs are more informative for the decision-making process. Determination of the demand for personnel in the context of occupation-and-qualification groups and regions is a more effective way to ensure harmonisation of the labour market and the system of education than the traditional forecasting based on larger types of economic activity and areas of training. It precisely identifies the most demanded occupations, helps to make the order to educational institutions, gives a precise information alert to the vocational guidance system using harmonised classifications of occupations and areas of training.

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