USING LABOR MARKET DATA FOR ANALYSIS AND EDUCATION

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Education systems provide specialists of different levels and specializations for the labor market. However, in the modern dynamic world of artificial intelligence, pandemic, and remote work, the labor market is evolving dramatically from year to year. Universities and colleges must keep track of these changes to adapt educational programs and manage the number of student slots offered for different specializations. Detailed demand statistics from the labor market are a good data source for analysis to gauge current needs and predict future demand. Usually, there is no single source of data on all vacancies and CVs. Therefore, it is necessary to collect, preprocess, analyze and visualize existing fragmented data. In this work, we study different raw data sources, their strong and weak points. A set of basic metrics is proposed to be derived from the data for analysis. Several types of roles are defined as primary users of the aimed system, their features and standard use cases. A conceptual system design is proposed to fulfill the requirements of the labor market analysis task. The evolutionary prototypes of the services are presented.

Keywords: labor market, monitoring, professional standards, educational standards, informational services, Application Programming Interface (API).

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1. Introduction

The labor market is a dynamic complex system that influences many different factors, such as the economic, demographic situation, quality, interests of market participants, technological progress and digitalization, psychological aspects, etc. The labor market and the vocational education system are closely related. Ideally, the education system should be able to quickly and adequately adapt to changes in the labor market in order to meet the real needs of a changing economy. However, reality does not coincide with the ideal [1]. The inadequacy to current market requirements for qualifications and skills is widespread in developing and developed countries [2-5]. Therefore, the problem of analyzing the labor market is multifaceted and relevant for all its participants, since its successful solution allows the following: to receive up-to-date and reliable information about the labor market; to assess the level of salary and the degree to which it matches the qualifications and experience of the company's employees; to implement comprehensive measures for the material motivation of employees.

However, there are factors that complicate labor market analysis. Some of them are the lack of uniformity in the wording of vacancies by employers and CVs by applicants; a large number of information sources to be analyzed; the lack of unified systemic approaches to the analysis of the labor market from the standpoint of changes in the requirements for the qualifications of the manpower and the reflection of the future needs of the labor market in the content of educational programs. The problem affects all participants in the labor market: educational organization, employee, student, HR specialist, federal, regional and local government authorities. The problem consequence is the difficulty in obtaining an objective assessment of the labor market state, the high work intensity of labor market analysis. Its successful solution will save the analyst's time, increase the reliability of information about the labor market and ensure the effective forecasting of labor market needs in personnel. Labor market information systems are an important tool in the development of labor and employment policies [6].

2. Information and analytical platform

An information and analytical platform for monitoring and forecasting the personnel needs of the labor market is developed within the Russian Science Foundation grant (project No. 19-71-30008). This tool is a multifunctional software and hardware complex aimed to support socio-economic applications, namely, the monitoring, analysis and forecasting of the development of the labor market in the Russian Federation. The software and hardware platform is designed using open-source solutions to cover full-cycle data analysis and machine learning experiments, from data gathering to visualization.

The platform is based on a set of informational services: Salary Info, Vacancies Info, Competencies Info, Requirements Info, Responsibilities Info, Downloading Data and Reports, Analysis of Professional Standards, Reports Configurator.

2.1 Users

These informational services are focused on the following users: Analyst, User, Operator.

Analyst reveals the quantitative and qualitative characteristics of the situation on the labor market to create its social picture in a certain time interval.

User studies the demand and price of labor in a specific geographic area, taking into account the education and qualifications of the applicant.

Operator registers the sources of vacancies in the system, configures the system, i.e. sets keywords for the search string, sets up the task scheduler; establishes links between the competencies of the applicant and the requirements for him from the employer.

Labor market analysts can be regional and local government bodies, recruitment agencies,

educational organizations, HR specialists. Users can be employees, students and interested parties.

2.2 Data & Data Sources

The main information sources are publications in the media, the Internet, etc. that post the requirements for candidates for vacancies, specialized resources, such as salary-meters sites, etc. The data is harvested from open sources. The main data sources are:

- HeadHunter official website — one of the largest job and employee search sites in the world (according to the Similarweb rating). The Internet resource contains about 51 million CVs, 1,032 thousand vacancies in the database (https://hh.ru);
- SuperJob official website — IT-company carrying out the development in the field of technologies for recruitment and job search (https://www.superjob.ru);
- Web portal "Work in Russia" — federal state information system of the Federal Service for Labor and Employment (https://trudvsem.ru);
- Official Internet resource of the Ministry of Labor and Social Protection of the Russian Federation (https://profstandart.rosmintrud.ru/).
  The following data volumes are currently available for analysis for the period from 2015:

- Number of Professional Standards: 1,396;
- Number of vacancies: ~ 800 thousand/month;
- Total data volume: ~ 10 TB.

2.3 Informational Services

Salary Service allows an unauthorized user to view information about salaries in the text (tabular presentation) and graphic form (several kinds of visualization), taking into account the time interval and region. Figure 1 illustrates the per-region plot for min and max advertised salaries of researchers.
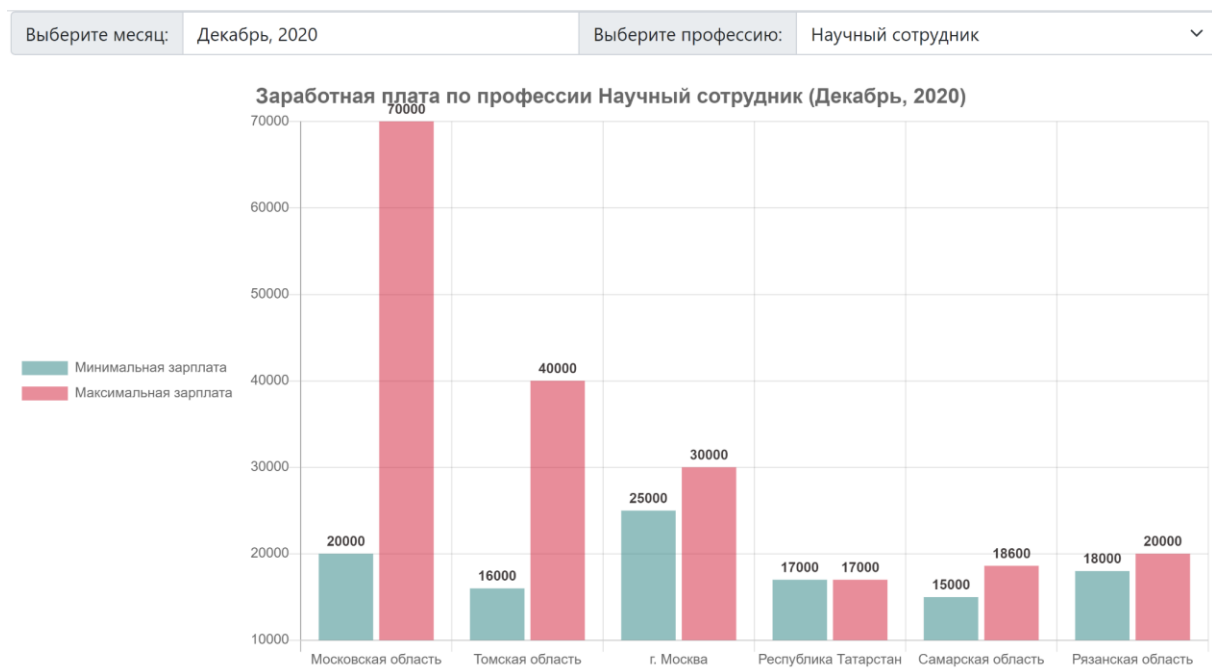

Figure 1. Salaries plot for a scientist (min/max per region)

Vacancies Service allows an unauthorized user to view information about the most in-demand vacancies in a specific geographic area (fig. 2) and professional field [fig. 3].
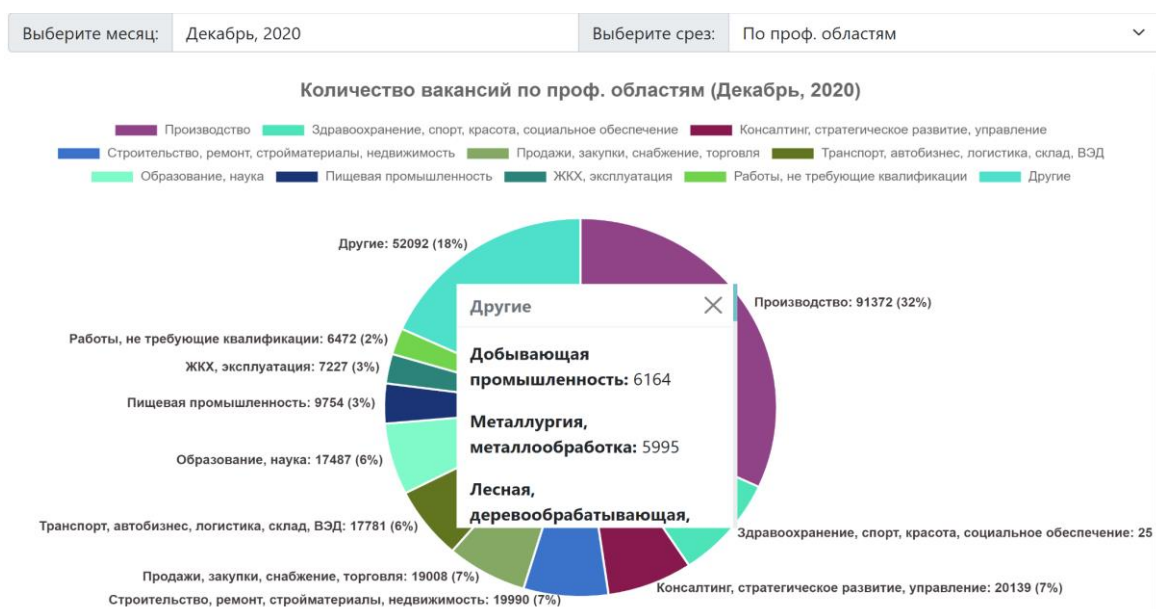
Figure 2. Number of vacancies per region

Figure 3. Number of vacancies per prof. field

Competencies Service allows an unauthorized user to receive a report on the demand for vocational education competencies in the labor market for the selected time interval. It can be useful for representatives of educational organizations involved in the development and updating of educational programs since it helps tracking the potential demand for graduates in the labor market.

Bachelor specialties corresponding to the most demanded vacancies in the labor market for November 2020 on the example of Plekhanov Russian University of Economics are presented in figure 4.

The *Top List of Educational Professional Competencies* service allows an unauthorized user to view information about the most in-demand educational professional competencies in the labor market for a specific time interval. The Top5 list of educational professional competencies for economic specialties of Plekhanov Russian University of Economics is shown in table 1 (data for November 2019).
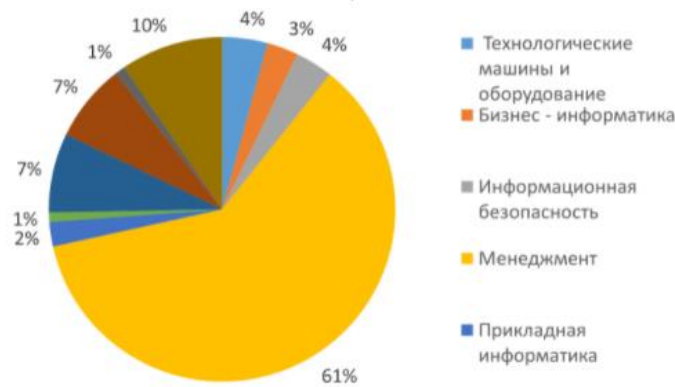
Figure 4. Bachelor specialties corresponding to the most demanded vacancies for November 2020 on the example of Plekhanov Russian University of Economics

Table 1. Top5 list of educational professional competencies for PRUE economic specialties

Professional Competence	% of Demand
Ability to apply the basic principles and standards of financial accounting for the formation of accounting policies and reporting of the organization	27.9%
Possession of skills in preparing financial statements and understanding the impact of various methods and methods of financial accounting on the financial results of the organization	22.3%
Understanding the role of financial markets and institutions, the ability to analyze various financial instruments	20.7%
Possession of methods of making strategic, tactical and operational decisions in the management of the operational (production) activities of organizations	14.9%
Ability to develop business plans for the creation and development of new organizations (areas of activity, products)	14.2%

The *"% of Demand"* column is the percentage of the number of vacancies in which the requirements correspond to professional competencies to the total number of vacancies (in a given professional field).

The *Analysis of Professional Standards* service allows an unauthorized user to collate wordings of the indicators of achievement of educational competencies, positions, duties and labor functions of an employee (from job descriptions) with extractions from Professional Standards, concerning with positions, requirements for education and training, labor actions, necessary skills, knowledge and other characteristics. It will be useful for HR specialists, developers of educational programs.

The *Reports Configurator* service allows an analyst to generate a report on changes in the labor market in the text and graphic form (histograms and graphs of changes in the studied value), taking into account the time interval, region and selected indicators (salary, vocational education competencies, requirements for applicants, duties of the applicant); determine the main quantitative characteristics of the studied quantity (calculate the main statistical indicators: mathematical expectation, standard deviation, kurtosis, asymmetry, minimum, maximum, score, coefficient of variation, variance); highlight the main trends in the development of the indicator and conduct a primary analytical assessment (build trend models of changes in wages over time, depending on the selected indicators); analyze the heterogeneity of the territorial distribution of the studied value (divide regions into clusters, calculate the centroids (mean values) of the clusters and determine their deviations from the sample mean values).

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3. Conclusion

The prototypes of the *Salaries Info*, *Vacancies Info*, *Competencies Info* services are implemented. The *Analysis of Professional Standards*, *Report Configurator*, *Top List of Educational Professional Competencies* services are under development.

In the future, these services will be integrated into a publicly available information and analytical platform. The creation of the information and analytical platform will expand the ability to monitor and forecast the situation on the labor market, as well as to analyze staffing needs.

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