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METHODOLOGY FOR FORECASTING LABOR RESOURCE REQUIREMENTS IN A CONSTRUCTION ORGANIZATION

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Abstract

With the construction industry in the Republic of Belarus developing rapidly, a systematic approach to human resource management is becoming increasingly important, particularly in the context of implementing large-scale infrastructure projects and introducing innovative technologies. The construction sector has a multiplier effect on the national economy, stimulating the growth of related industries and generating a stable demand for qualified personnel. Consequently, forecasting labor demand has become a critical task, ensuring that construction organizations maintain the required number of specialists with appropriate qualifications.

The article discusses the methodological foundations of forecasting the personnel needs of construction organizations, including the development and application of specialized coefficients that reflect the specifics of activities, the complexity of facilities, the internal resources of the enterprise, and the dynamics of personnel movement. An algorithm for calculation is proposed, which covers the entire cycle of personnel planning: from collecting initial data and analyzing the current staff composition to modeling the future need for specialists. Its structure includes mechanisms for accounting for the dynamics of labor resources, including turnover, age-related attrition, and staff replacements, as well as the projected volume of construction work, which allows for an accurate determination of the number and type of specialists required to complete projects within the specified timeframe.

Taking these factors into account allows not only to identify potential personnel risks, but also to form a balanced HR management strategy focused on the sustainable development of the organization. This approach enables timely response to changes in the staff composition, optimization of the recruitment and adaptation of new employees, and improving the efficiency of the existing labor potential. The use of these tools is particularly important for construction organizations operating under conditions of high project load, seasonality, and technological changes, where personnel stability directly affects the quality and timing of work.

Keywords: turnover rate, replacement rate, age-related attrition, construction site characteristics, types of construction work, personnel requirements, additional personnel needs.

МЕТОДИКА ПРОГНОЗИРОВАНИЯ ПОТРЕБНОСТИ В КАДРАХ ДЛЯ СТРОИТЕЛЬНОЙ ОРГАНИЗАЦИИ

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Реферат

В условиях активного развития строительного комплекса Республики Беларусь возрастает значимость системного подхода к управлению трудовыми ресурсами, особенно в контексте реализации масштабных инфраструктурных проектов и внедрения инновационных технологий. Строительный комплекс оказывает мультипликативное влияние на экономику, стимулируя развитие смежных отраслей и формируя устойчивый спрос на квалифицированные кадры. В связи с этим актуальной задачей становится прогнозирование потребности в трудовых ресурсах, позволяющее обеспечить строительные организации необходимым количеством специалистов соответствующего уровня квалификации.

В статье рассматриваются методологические основы прогнозирования кадровой потребности строительных организаций, включая разработку и применение специализированных коэффициентов, отражающих специфику видов деятельности, сложности объектов, внутренние ресурсы предприятия и динамику движения персонала. Предложен алгоритм расчета, охватывающий весь цикл кадрового планирования: от сбора исходных данных и анализа текущего состава персонала до моделирования будущей потребности в специалистах. В его структуру заложены механизмы учета динамики трудовых ресурсов, включая текучесть, возрастное выбытие и кадровые замещения, а также прогнозируемые объемы строительных работ, что позволяет точно определить, сколько и каких специалистов потребуется для реализации проектов в заданные сроки.

Учет этих факторов позволяет не только выявить потенциальные кадровые риски, но и сформировать сбалансированную стратегию управления персоналом, ориентированную на устойчивое развитие организации. Такой подход обеспечивает возможность своевременного реагирования на изменения в кадровом составе, оптимизации процессов найма и адаптации новых сотрудников, а также повышения эффективности использования имеющегося трудового потенциала. Применение данных инструментов особенно важно для строительных организаций, работающих в условиях высокой проектной нагрузки, сезонности и технологических изменений, где кадровая стабильность напрямую влияет на качество и сроки выполнения работ.

Ключевые слова: коэффициент текучести, коэффициент замещения, возрастное выбытие, характеристика объекта строительства, виды строительных работ, потребность в кадрах, дополнительная потребность в кадрах.

Introduction

The development of the construction industry is an essential element of sustainable economic growth, not only providing the material foundation for infrastructure, but also setting the pace for the modernization of related sectors. In the context of technological transformations and the digitalization of the economy, there is an increasing need for precise staffing planning, particularly in sectors where labor resources play a crucial role in the implementation of complex projects.

Construction organizations face challenges related to changes in employment patterns, increased requirements for staff qualifications, and the need to adapt to new management practices. In this regard, the development of effective tools for forecasting labor requirements, which take into account the specifics of the industry, the dynamics of projects, and the internal characteristics of enterprises, is particularly relevant.

Methodology for Forecasting the Demand for Labor Resources

The construction industry traditionally occupies a key position in the national economy of the Republic of Belarus, functioning not only as a production sector but also as a strategic driver of economic growth. As A. V. Kapustkina notes, “Investment and construction activities represent a key sector of the economy

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that significantly contributes to infrastructure development, job creation, and the improvement of people's quality of life" [1].

Under modern conditions, the construction sector exerts a multiplicative effect on the development of related industries, including the production of building materials, transport logistics, mechanical engineering, architectural and design services, and activities associated with the operation of real estate assets. "The construction sector encompasses diverse areas – social, municipal, transport, industrial, agricultural, energy, and others – the functioning of which directly influences the capacity to improve citizens' well-being" [2].

The investment attractiveness of the construction industry remains consistently high, owing to its substantial contribution to the implementation of state infrastructure programs, housing development, and the modernization of production facilities. The adoption of innovative technologies, digital solutions, and advanced building materials enables the execution of complex tasks that meet contemporary standards of quality, energy efficiency, and environmental safety. This, in turn, "determines the industry's demand for qualified specialists equipped with skills in digital construction management, design, and the erection of buildings and structures using new technologies based on digital methods" [3].

Against the backdrop of the industry's dynamic development, the demand for qualified labor resources capable of adapting to technological change and effectively addressing professional challenges is steadily increasing. Ensuring that construction organizations are staffed with competent specialists is a priority of the government's personnel policy. As V. A. Praslov emphasizes, "The effective development of industries and production complexes is closely dependent on their human resources" [4].

Particular attention today is devoted to forecasting the economy's demand for labor resources. This issue has been addressed in the works of Doctor of Economics, Professor T. N. Leonova, Doctor of Economics, Professor O. V. Zabelina, Candidate of Sociological Sciences, Associate Professor O. A. Volovik, Doctor of Economics, Professor P. P. Lutovinov, Candidate of Economics P. G. Abdulmanapov, Doctor of Physical and Mathematical Sciences, Professor V. A. Gurtov, Doctor of Technical Sciences, Professor E. A. Pitukhin. Doctor of Economics, Professor E. A. Varshavsky. Doctor of Economics I. I. Akulova, Doctor of Technical Sciences, Academician of RAASN E. M. Chernyshov, Candidate of Economics, Associate Professor L. V. Pankova, and many others [5–13].

In order to address this issue systematically, the Republic of Belarus is developing and implementing methods for forecasting labor resource requirements, covering both the economy as a whole and the construction sector in particular. These methods are based on the analysis of current and planned projects, the assessment of labor intensity, and consideration of the demographic and professional characteristics of the workforce.

It should be emphasized that the construction industry, while sharing certain features with other sectors of the economy, possesses a number of specific characteristics. These include a high degree of project individualization, seasonal production cycles, a significant share of manual labor, and the necessity of strict compliance with construction standards and regulations.

The methodology for forecasting labor requirements in construction organizations relies on a comprehensive analysis of the workload associated with the implementation of current and future projects. It takes into account parameters such as task complexity, project scale, and the technological specifics of the methods and materials employed. As A. V. Kashepov observes, "the traditional interdisciplinary economic, demographic, and macroeconomic approach to forming a labor force balance remains effective under current conditions" [14].

The purpose of this methodology is to ensure that organizations have the required number of qualified labor resources at the right time and in the right place, thereby supporting the effective implementation of production plans and reducing risks associated with staff shortages.

When forecasting labor resource requirements for a construction organization, the following key indicators should be considered.

1. Types of construction activities. It is essential to determine which types of construction are being undertaken – housing, industrial, civil, infrastructure, and others. Each type has its own requirements for worker qualifications and the specifics of technological processes. For example, reports of the Ministry of Education and Science of the Russian Federation emphasize that "the calculation of the planned volume of construction and installation work should take into account the output per worker and the number of teams" [15].

In the Republic of Belarus, Resolution of the Ministry of Architecture and Construction dated June 30, 2022, No. 66 "On Approval of the Instructions on the Procedure for Determining the Type of Construction Activity and the Name of the Construction Project" [16], together with the Code on Architectural, Urban Planning, and Construction Activities, defines the following types of construction activities:

- Construction of a facility;
- Reconstruction of a facility;
- Modernization of a facility;
- Technical modernization of a facility;
- Major repair of a facility;
- Demolition of a facility;
- Repair and restoration work performed on material historical and cultural assets;
- Installation of all types of equipment;
- Preservation of an unfinished construction facility.

To forecast labor resource requirements for a construction organization, we introduce the **coefficient of personnel requirements by type of construction activity (Kca)**.

2. Types of construction work. Specific types of construction work are analyzed – earthworks, concrete, installation, finishing, and others. Each type requires specialists of a particular profile, which affects both the structure and the number of personnel. The construction work classifier [17], developed on the basis of SN 1.03.04-2020 – Organization of Construction Production; TKP 45-1.03-161-2009 – General Requirements for Construction Work; TKP 45-1.03-298-2014 – Procedure for Acceptance of Completed Construction and Special Works; TKP 45-1.03-307-2017 – Quality Control of Construction Work, defines the following types of construction work:

- Earthworks;
- Foundation works;
- Installation works;
- Masonry works;
- Concrete and reinforced concrete works;
- Roofing works;
- Finishing works;
- Carpentry and joinery works;
- Plumbing works;
- Electrical installation works;
- Thermal insulation works;
- Facade works;
- Landscaping;
- Low-voltage systems.

To forecast labor resource requirements for a construction organization, we introduce the **coefficient of staffing for construction work (Kcw)**.

3. Characteristics of a Construction Project. The characteristics of a construction project represent a set of parameters that define its structural, spatial, technological, and operational features. These parameters have a direct impact on the organization of the construction process, the choice of technological solutions, the volume of required resources, and the measures necessary to ensure occupational safety. Key characteristics include: the type of structural system, the number of floors, building density, geographical location, functional purpose of the facility, as well as engineering-geological and climatic conditions.

As emphasized by A. V. Ishchenko and co-authors, "when forming the production program of a construction organization, it is necessary to take into account the specifics of the project, including its structural features, the complexity of architectural solutions, and the conditions under which the work is performed" [18]. These parameters directly influence the labor intensity of construction processes and, consequently, the calculation of labor resource requirements.

For the quantitative assessment of the impact of project-specific features on labor costs, it is recommended to use the **coefficient of production specificity of the project (Ksp)**, which reflects the degree of complexity and uniqueness of the construction project.

4. Characteristics of a Construction Organization. The characteristics of a construction organization encompass a set of organizational, personnel, technical, technological, and financial-economic parameters that determine its ability to effectively implement construction projects in accordance with current legislation, technical standards, and the requirements of a specific facility.

As noted in the article "12 Indicators of Labor Resource Efficiency in Production" published on the Rus-Kvant portal [19], "the analysis of labor resource utilization in an enterprise must take into account the availability of the necessary personnel, labor productivity, the efficiency of working time utilization, the wage system, and workforce mobility."

The importance of a comprehensive assessment of the internal resources of an enterprise is emphasized, including human capital, organizational structure, and management system. This fully corresponds to the criteria embedded in the **coefficient of organizational and technical potential (KotP)**.

5. Indicators of Workforce Mobility in a Construction Organization. In modern conditions, the stability of the workforce in construction organizations is a crucial factor determining their production reliability and overall efficiency. A high level of staff turnover leads to significant costs: financial (recruitment and adaptation of new employees), organizational (disruption of process continuity), and social – such as deterioration of the psychological climate within the team, reduced trust, and weakened cohesion.

As economist A. Shkel notes, "frequent staff turnover has a negative impact on the systematic development of production: labor productivity growth slows down, and product quality deteriorates" [20]. This is particularly relevant for the construction industry, where work efficiency directly depends on the coordination of actions and the qualifications of personnel.

To analyze workforce mobility, a number of quantitative indicators are applied.

5.1 Labor Turnover and Staff Turnover Ratio (Kt). Labor turnover includes all employees who have left the organization during a given period. However, when calculating the staff turnover ratio, only dismissals not related to production or state necessity are taken into account – for example, resignations at one's own request, dismissals for violation of labor discipline, or termination due to professional incompetence. These cases form what is known as excessive turnover, which reflects internal problems in personnel management.

According to the methodology presented on the Normativka.by portal, "the staff turnover ratio is an important indicator of workforce stability and makes it possible to identify problems in motivation, working conditions, and personnel policy" [21]. Analyzing the dynamics of **Kt** over several years allows forecasting of HR risks and timely adjustment of managerial decisions.

The reasons for dismissals that are not taken into account when calculating staff turnover include:

- Staff reductions or downsizing;
- Enterprise reorganization;
- Change of management and related personnel reshuffling;
- Retirement.

5.2 Replacement Ratio (Kr). For a more complete picture of workforce changes, the replacement ratio is used. It reflects the relationship between the number of employees who need to be replaced and the total number of employees who have left the organization. It is calculated using the formula

$$\mathrm{Kr} = \frac{\mathrm{K}_{re}}{\mathrm{K}_{ex}}, \quad (1)$$

where Kr – replacement ratio;

Kre – number of employees to be replaced, i. e., the number of workers whose positions must be filled. They may leave for various reasons, such as resignation, retirement, illness, etc.;

Kex – total number of employees who left the organization during a given period (e. g., within a year).

For example, if 10 employees left the organization during the year and 8 of them need to be replaced to maintain normal operations, then Kr = 8/10 = 0,8.

This means that 80 % of the departed employees must be replaced.

5.3 Age-Related Attrition Ratio (Kaa). The age-related attrition ratio reflects the natural causes of employee departure – retirement, disability, and mortality. It is calculated using the formula

$$Kaa = \frac{Number\ of\ deaths\ in\ the\ age\ group}{Average\ number\ of\ employees\ in\ the\ given\ age\ group} * 1000. \quad (2)$$

This indicator makes it possible to account for demographic risks and to plan personnel policy with consideration of the age structure of the workforce.

Based on the statistical yearbooks of the Republic of Belarus for 2012–2018, the age-related attrition ratio was calculated with differentiation by age groups (table 1).

Table 1 – Age-Related Attrition Ratio by Age Groups

Age Group	20–29	30–39	40–49	50–59	60–69	70 and older
Age-Related Attrition Ratio	0,7	1,8	4,3	9,4	22,2	78,4

Note – Source: Own development based on [22–24].

Taking all these indicators into account, the algorithm for forecasting labor resource requirements for an individual construction organization will be as follows.

1. Formation of Input Parameters.

At this stage, the number of personnel, their specialties, and qualifications are determined. The staff turnover ratio (**Kt**) is calculated for the study period, followed by extrapolation to forecast this indicator for the next five years. In addition, the replacement ratio is determined for the analyzed period.

2. Determination of Labor Resources in the Forecast Period

$$\mathrm{LR_t} = \frac{\mathrm{V_t^{c.w.}}}{\mathrm{PT_t} * \mathrm{K_{ca}} * \mathrm{K_{cw}} * \mathrm{K_{sp}} * \mathrm{K_{otp}}}, \quad (3)$$

where $\mathrm{LR_t}$ – number of labor resources in the tt-th forecast year, persons;

$\mathrm{V_t^{c.w.}}$ – volume of contract work in the tt-th forecast year, rubles;

$\mathrm{PT_t}$ – labor productivity in the organization in the tt-th forecast year, rubles per person;

$\mathrm{K_{ca}}$ – coefficient of personnel requirements by type of construction activity;

$\mathrm{K_{cw}}$ – coefficient of staffing for construction work;

$\mathrm{K_{sp}}$ – coefficient of production specificity of the project;

$\mathrm{K_{otp}}$ – coefficient of organizational and technical potential of the organizatio.

3. Determination of Labor Resources in the Current Period Considering the Age-Related Attrition Ratio (Kaa)

$$\mathrm{LR_t^{Kaa}} = \sum_{i=1}^{n} \mathrm{LR_{t-1}} * \mathrm{Kaa}, \quad (4)$$

where $\mathrm{LR_t^{Kaa}}$ – number of labor resources in the current period considering the age-related attrition ratio;

$\mathrm{LR_{t-1}}$ – number of labor resources in the previous year, person;

Kaa – age-related attrition rati;

i – age group;

n – number of age groups.

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4. Determination of the Number of Additional Employees Required for a New Project or Increased Work Volume

$$ARt=La+Lc, \quad (5)$$

$$La=LR_t^{Kaa} * Kt * Kr, \quad (6)$$

$$Lc=LR_t - LR_t^{Kaa}, \quad (7)$$

where AR_t – annual additional need for labor resources in the tt–th forecast year, person;

La – attrition-related demand in construction in the tt–th forecast year, persons;

Lc – creation-related demand in the tt–th forecast year, persons;

Kr – replacement ratio;

Kt – staff turnover ratio.

The additional demand for personnel or labor surplus is usually calculated separately for each category of workers, taking into account their profession, qualification (grade), and other factors.

In construction, a significant proportion of workers typically possess multiple related professions. Therefore, when forecasting labor resource requirements, it is necessary to consider the professional mobility of workers, since this determines which specific professions require the recruitment of new employees.

Conclusion

An important tool of strategic planning in a construction organization is the methodology for forecasting labor resource requirements. The proposed methodology takes into account a wide range of factors: types of construction activities and works, characteristics of projects and organizations, as well as demographic and workforce indicators. The introduced coefficients make it possible to adapt calculations to the specifics of particular projects and organizations. The forecasting algorithm covers both current and future periods, ensuring flexibility and accuracy in planning.

The application of this methodology will allow for the development of a sustainable personnel policy, reducing the risks associated with staff shortages, improving the efficiency of construction projects, and optimizing the costs of staff recruitment and training.

Thus, the developed methodology is an integral part of the modern labor management system in a construction organization and serves as a basis for making informed management decisions.

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