



IMPROVING METHODS FOR ASSESSING THE EFFICIENCY OF LABOR RESOURCES IN THE CONTEXT OF DIGITALIZATION

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Abstract: The digital transformation of the economy is fundamentally changing the nature of labor, organizational processes, and approaches to evaluating employee performance. Traditional methods of assessing labor-resource efficiency, which primarily rely on labor productivity, output per employee, and working-time indicators, are becoming insufficient for capturing the effects of digital technologies, employee competencies, and the changing structure of work. This article examines approaches to improving the assessment of labor-resource efficiency in the context of digitalization. Particular attention is given to the integration of labor productivity, digital competencies, technology utilization, working-time efficiency, human capital, and economic outcomes into a comprehensive assessment system. The study proposes a methodological approach based on a system of quantitative and qualitative indicators and the use of statistical and econometric methods. The proposed approach can improve the objectivity of labor-resource assessment, identify internal reserves for increasing productivity, and support more effective managerial decision-making in digitally transforming organizations.

Keywords: labor resources, labor efficiency, labor productivity, digitalization, digital competencies, human capital, digital technologies, efficiency assessment, econometric analysis, labor market.

Introduction.

Digitalization has become one of the major factors influencing the transformation of modern economic systems. The widespread adoption of information technologies, artificial intelligence, automation, cloud computing, digital platforms, and data analytics is changing not only production and service processes but also the content and organization of labor. Under these conditions, the efficiency of labor resources increasingly depends not only on the amount of labor expended but also on employees' ability to work effectively with digital technologies.

Labor resources represent one of the most important factors of production and economic development. Their effective utilization determines the ability of enterprises to increase output, improve service quality, reduce costs, and strengthen competitiveness. Traditionally, labor-resource efficiency has been assessed through indicators such as labor productivity, output per employee, working-time utilization, labor intensity, and wage-to-



output ratios. Although these indicators remain important, they do not fully reflect the changes associated with digital transformation.

Digital technologies can simultaneously increase labor productivity and change the structure of employment. Automation may reduce the need for routine labor while increasing demand for employees with analytical, technological, and creative competencies. Consequently, assessing labor efficiency requires consideration of both the quantitative results of labor and the qualitative characteristics of human capital.

The relevance of improving labor-resource efficiency assessment is therefore determined by the need to develop methodological approaches that reflect the contemporary characteristics of digitalized economic activity. An effective assessment system should identify not only how much output is generated by an employee but also how efficiently digital technologies, working time, knowledge, skills, and organizational resources are combined to achieve economic results.

The purpose of this study is to develop an improved methodological approach to assessing labor-resource efficiency under digitalization.

The objectives are to:

- clarify the economic content of labor-resource efficiency in a digital environment;
- identify the limitations of traditional assessment methods;
- systematize quantitative and qualitative indicators of labor efficiency;
- develop an integrated approach to assessing labor-resource efficiency;
- determine the role of digital competencies and technological adoption in labor productivity;
- propose directions for improving labor-resource management.

Literature review.

The theoretical foundations of labor-resource efficiency are closely associated with theories of labor productivity, human capital, technological change, and economic growth. Classical economic approaches primarily considered labor as a factor of production and emphasized the relationship between labor input and economic output.

Human capital theory expanded this understanding by emphasizing the economic value of education, professional qualifications, experience, and skills. From this perspective, labor efficiency depends not only on the quantity of workers but also on the quality of their knowledge and competencies.

Modern research increasingly focuses on the relationship between technological progress and labor productivity. Digital technologies can reduce transaction costs, automate routine operations, improve information availability, and support managerial decision-making. At the same time, their effectiveness depends on employees' ability to use these technologies.

International organizations increasingly recommend considering productivity together with skills, working conditions, technological adoption, and employment characteristics. This



indicates a transition from a narrow productivity-based approach toward a multidimensional assessment of labor efficiency.

However, an important methodological problem remains: traditional labor-efficiency indicators do not fully capture the contribution of digital competencies, technological adoption, and intangible human capital to economic outcomes. This creates a need for an integrated assessment methodology.

Research methodology.

The study applies systematic, comparative, statistical, index, and econometric methods. The methodological framework is based on the assumption that labor-resource efficiency is a multidimensional phenomenon determined by the interaction of labor inputs, human capital, technology, organizational factors, and economic outcomes.

The traditional labor productivity indicator can be expressed as:

$$LP = \frac{Q}{L}$$

where:

LP - labor productivity; Q - output or value of services produced; L - labor input or number of employees.

However, in a digital environment, this indicator should be supplemented with additional variables.

The proposed assessment system includes five groups of indicators:

Indicator group	Examples
Labor productivity	Output per employee, value added per employee
Labor utilization	Working-time utilization, labor intensity
Human capital	Qualification, education, experience, professional development
Digitalization	Digital competence, technology adoption, automation level
Economic efficiency	Revenue per employee, profitability of labor, value added

For an integrated assessment, individual indicators can be normalized and combined into a composite index:

$$I_{LE} = \sum_{i=1}^n w_i Z_i$$



where ILE is the integrated labor-efficiency index, Z_i is the normalized value of the i -th indicator, and w_i is its weight.

The relationship between digitalization and labor productivity can also be examined through a regression model:

$$LP = \beta_0 + \beta_1 D + \beta_2 C + \beta_3 W + \beta_4 H + \varepsilon$$

where D represents the level of digital technology adoption, C represents employees' digital competencies, W represents working-time efficiency, H represents human-capital characteristics, and ε represents the error term.

Such an approach makes it possible to determine not only the level of labor efficiency but also the factors responsible for its changes.

Results and discussion.

The analysis demonstrates that digitalization changes the relationship between labor input and economic output. In traditional production systems, increasing productivity is often associated with increasing the physical intensity of labor or improving the organization of working time. In digitally transformed organizations, productivity increasingly depends on the interaction between employees and technologies.

One of the major methodological improvements is therefore the inclusion of digital competencies as an independent component of labor-resource efficiency. An employee who possesses appropriate digital skills can process information faster, use automated systems more effectively, reduce operational errors, and make better-informed decisions.

The second important component is the degree of technology utilization. Merely purchasing digital technologies does not necessarily increase labor efficiency. The economic effect depends on how effectively employees integrate these technologies into their daily activities.

The third component is working-time efficiency. Digital tools can reduce time spent on routine operations, document processing, communication, and information search. Consequently, the assessment methodology should distinguish between total working time and productive working time.

The fourth component is human capital quality. Employees with higher qualifications and stronger professional competencies generally have greater capacity to adapt to technological changes. Therefore, investments in training and professional development should be considered not only as personnel expenses but also as investments in future labor productivity.

Based on these considerations, labor-resource efficiency in a digital economy can be represented as:

Human capital → Digital competence → Technology utilization → Working-time efficiency → Labor productivity → Economic outcome



This approach allows organizations to identify the specific stage at which efficiency losses occur.

For example, low productivity may result not from insufficient employee effort but from inadequate digital skills, poorly integrated software, inefficient organizational processes, or insufficient technological infrastructure. Consequently, management decisions should be based on diagnosing the underlying causes rather than simply increasing workload or reducing staff.

The proposed methodology also creates opportunities for comparative analysis between enterprises, regions, and economic sectors. By applying a composite labor-efficiency index, organizations can identify strengths and weaknesses in labor utilization and determine priorities for digital transformation.

Conclusion.

Digitalization requires a fundamental reconsideration of existing approaches to assessing labor-resource efficiency. Traditional indicators such as output per employee and labor productivity remain important, but they cannot independently capture the complex effects of digital technologies, human capital, and changing work processes.

The study establishes that labor-resource efficiency in a digital economy should be assessed through an integrated system incorporating labor productivity, working-time utilization, human capital, digital competencies, technology utilization, and economic results.

The proposed methodology makes it possible to identify the factors influencing labor efficiency more accurately and provides a basis for evidence-based management decisions. Its application can help enterprises identify unused labor potential, improve the effectiveness of digital investments, strengthen employee competencies, and increase overall economic efficiency.

Thus, improving labor-resource efficiency assessment in the context of digitalization should be viewed not simply as a modification of existing productivity indicators but as the transition toward a multidimensional digital labor-efficiency assessment system.

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