ICT Provision for Labor Resources and Its Impact on Labor Productivity

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Abstract. The study analyses the impact of information and communications technologies provision for labor resources (ICTPLR) on the productivity of employees.

We used formal logical and heuristic research methods to solve the problem of component and factor analysis of ICTPLR, including classification and typology, induction and deduction, proof, comparison, analysis and synthesis.

As a result, we substantiated that it is advisable to group ICTPLR indicators in the context of the following components: social, economic, software and hardware, and consumer. We proposed to analyze ICTPLR of an enterprise or a region in relation to two aspects of assessment: the first is the digitalization level of the labor activity of economic entities; the second is the level of knowledge and competence of employees in the field of information and communications technologies (ICT). Inconsistency between these two aspects can lead to excessive ICT provision and inefficient digitalization costs. Insufficient level of ICT provision or other imbalances negatively affect the productivity of employees, which requires corrective management decisions. A formula for calculating the dynamic labor productivity determined by the influence of ICTPLR is proposed. The study substantiated that the increase in ICTPLR, which is not accompanied by outstripping growth in revenue from the sale of goods, works, services or corresponding decrease in the number of employees, leads to decrease in labor productivity.

Keywords: ICT · Labor resources · Labor productivity · Information economy · Digitalization · Resourcing

JEL Code: J24 · O30

1 Introduction

The process and results of the labor activity of a modern person are becoming more and more digital. This is due to the growth of the ICT sector (production and trade of IT equipment, services, development of software and digital goods, telecommunications) in the economies of the leading countries, and the digitalization of the labor activity in other industries and fields. No one is surprised by the organization of employee work remotely using digital access to the firm’s information resources. The vast majority of qualified employees’ workplaces are equipped with personal computers with access to
Internal and external information resources, including via the Internet. Digitalization of labor has gained the highest relevance in the context of restrictive measures introduced by governments of various countries in 2020 related to preventing the spread of coronavirus infection (COVID-19).

In the Russian Federation according to statistics (Abdrakhmanova et al. 2019; Guly 2019) the gross value added created by organizations in the ICT sector grew by 7.4% from 2,273.9 billion rubles in 2017 to 2,443 billion rubles in 2018. Investments in fixed assets of organizations in the ICT sector grew by 26% from 475 billion rubles in 2017 to 598.3 billion rubles in 2018. Nevertheless, the share of the ICT sector in the gross value added of the Russian business sector by the end of 2018 (2.6%) is lower than in some other countries (Israel – 5.4%; Switzerland – 4.7%; Estonia – 4.5%; Finland – 3.9%). This shows that Russia and its regions have significant economic potential for developing ICT. This potential is determined by many factors, but all of them somehow characterize the use of information economic resources.

Information economic resources (IER) is a set of relevant information involved in economic relations that provides positive changes in the market value of other economic resources and/or the creation of new (improved) economic benefits in order to improve the efficiency and development of the socio-economic system. As can be seen from the above definition, IER should have a positive effect on the economic potential of labor resources and, as a consequence, the growth of labor productivity, which requires a more detailed consideration.

The hypothesis of the study is that in the context of the digitalization of the economy, the provision of information economic resources for employees of an organization or employed in the economy of a country/region largely determines the level and potential for productivity growth.

The purpose of the study is to substantiate the influence of ICT provision for labor resources on labor productivity and to determine approaches to the formation of indicators for assessing this relationship.

2 Methodology and Results

In theory and practice, the term “information support” is traditionally interpreted as the process of transmitting the requested information to interested users (Bochkarev 2019; Brillouin 1960; Smirnova et al. 2017; Sukharev 2018). From a user’s perspective, if “information support” is the process of obtaining information, then why do some employees have more information available, while others do not have access to it? Some employees process a large array of information received, while others leave it unclaimed. This means that the process of obtaining and processing information will depend on its availability and on the employee’s abilities to perceive and use it, which together can be summarized as “information provision”.

The term “capital provision for labor (capital-labor ratio)” is widely used in economic theory and practice. It characterizes the unit cost of fixed assets per employee with various calculation modifications. The term “energy provision for labor (per capita power consumption)” is often found in the specialized literature. It estimates the
average consumption of various energy types (thermal, electrical, mechanical, etc.) per employee.

In the era of digitalization of socio-economic processes, the labor activity is increasingly saturated with ICT and related operations. In this regard, we propose to evaluate the indicator of ICT provision for labor resources (hereinafter - ICTPLR), by which we mean the volume of information economic resources of the organization involved in economic activity per employee, taking into account his ICT skills level and use of ICT by him.

The issues of ICTPLR and its impact on labor productivity are little studied, but indirectly considered in Guly (2019), Ershov (1988), Kondaurova and Gemmerling (2019), Markhaichuk (2018), Morozov and Morozova (2018), Petrishche (2012), Shadrina and Batyrshina (2018), Tagarov (2018). Umerova' (2016) system of indicators characterizing the state of the labor resources of the territory (region) doesn’t include the indicators characterizing their information provision. Maximova and Popova (2019) directly point to the need for the development of informative measures of labor productivity that take into account the processes of the economy’ digitalization.

In relation to research issues, the work of academician A.P. Yershov is one of the most interesting. Back in 1988 he suggested assessing the level of technical equipment of society that would satisfy any information needs of each person (Yershov 1988). He introduced the specific informational armament of society as an evaluation criterion, which is defined as the ratio of the total computing power of a country to its population. In his opinion, his criterion allows not only to quantify the current level of country’s informatization, but also to predict the expected level of its development based on statistical data on population growth in different countries of the world and the level of their computing potential.

Currently, the processing power of computer systems is excessive for solving most of the tasks of a person related to the implementation of his work function. Modern employee uses ICT for most of the day, but at the same time he uses a minimum of its computing power. The similar situation is with home personal computers. No wonder distributed computing is widely used nowadays when the idle power of computer equipment is remotely leased to those who lack it (scientific calculations, cryptography, etc.).

For this reason, the information armament of society proposed by Yershov (1988) currently rather characterizes the information and technical potential of society, the assessment of which will be more useful for predicting its development as a whole, than for the current analysis of various aspects of labor digitalization. Moreover, in order to study ICTPLR, the assessment of specific indicators is necessary not for the population, but for various indicators of the real or potential number of employees (able-bodied population, number of employees, etc.).

Shadrina and Batyrshina (2018) generalized and classified specialized software for personnel management automation to assess the role of ICT in human resource management.

Kondaurova and Gemmerling (2019) made an attempt to systematize the types of information that affect the development of human resources of the enterprise. Authors marked out information about achievements in science, new management methods,
advanced production methods, new suppliers, global economic processes, new sales markets, as well as socio-economic, financial and legal information. In our opinion, some types of information in the proposed classification absorb others, but the very idea of systematization deserves attention.

Morozov and Morozova (2018) noted that digital technologies lead to transformations of human behavior, which is associated with fundamentally new information communications developing in the digital economy.

Determining the social need for information tools for regional development, Petrishche (2012) noted that the regional economic system, firstly, independently produces accounting and analytical information and organizes its flow; secondly, it is built into larger systems (national economy, international economic organizations, world economic system); thirdly, has a complex internal structure. Therefore, it is necessary to take into account the regional specificity when assessing the impact of ICTPLR on labor productivity. It is associated with the level of information development of the territory and its integration into higher-level information systems.

Tagarov and Tagarov (2018) made an attempt to generalize the criteria for evaluating the information economy, that to one degree or another can be used to analyze ICTPLR. The authors identified social, economic, technical and consumer criteria, the content of which requires additional detailing in relation to the issues of our study.

First of all, taking into account the absence of an established criteria base containing approved normative or threshold values of indicators for assessing the level of informatization and digitalization of society development, we will use a component grouping of indicators instead of dividing them into criteria for the purposes of our study. Thus, the study and analysis of the ICTPLR indicators should be carried out in the context of four components (Fig. 1):

![Components of the assessment of ICT provision for labor resources (ICTPLR)](image)

Fig. 1. Components of the assessment of ICTPLR

We adjusted the initial name of the third component due to the fact that the level of equipment for labor activities related to the use of ICT is determined not only by the availability and novelty of computing and related equipment, but also by the available software products and databases. Therefore, the name “software and hardware component” more closely corresponds to the set of indicators considered in the future.

Let us consider in more detail the semantic content of the selected components and the group of their forming ICTPLR indicators.

The social component, in our opinion, should be evaluated through the influence of ICT used in the social sphere on the quality of labor resources. The implementation of social functions through digitalization mechanisms increases the efficiency of public
administration by reducing the time it takes to provide and wait for social services, lowering the costs of maintaining the apparatus serving the population, and reducing associated costs (storage and forwarding of information, transportation services, etc.).

Thus, the analysis of the social component of ICT PLR should include the digitalization indicators of the population receiving social services, educational institutions, health care and other organizations in the social sphere. One of the most important indicators of the social component of ICTPLR is statistical characteristic of the employment structure in relation to assessing the share of workers employed in ICT sector and/or actively using them in organizations of any other industries and fields.

The economic component of ICT PLR combines indicators that characterize the volume of material, labor and financial resources allocated for digitalization. The most significant indicators here include: the book value of tangible and intangible assets used for operating activities involving ICT; the investment aimed at the development of digital technologies, including staff training and own development, etc. It should be noted that performance indicators, such as, for example, the share of gross value added of the ICT sector in the country’s GDP, are not used for assessing ICTPLR, since they do not characterize resource provision. In the future, we will consider the performance indicators as the main ones when assessing the impact of ICT PLR on labor productivity.

The software and hardware component combines indicators characterizing the engineering, technical and software equipment of labor activities related to the use of ICT. These include the average age of computer equipment; the percentage of its physical and moral depreciation; the number of personal computers per worker; the number of workplaces equipped with universal or specialized software that provides the opportunity to reduce the time of performing labor operations and/or improve their quality; the speed of access to the Internet and the availability of access to the necessary databases, etc.

The consumer component of ICT PLR is related to the fact that employees of enterprises and organizations, in addition to using ICT to implement their work functions, also act as consumers of goods and services in digital form. The higher the level of employees training in the use of modern information technologies in their professional activities, the more they use them, acting as consumers, and vice versa. Thus, the development level of the population’s digital consumer culture can indirectly characterize the level of employees training in the field of ICT. We can distinguish the following indicators of the consumer component of ICTPLR: the use of the Internet for ordering goods and services, Internet banking, receiving public services using digital resources, and so on.

The basic set of indicators characterizing the ICTPLR in the component context is presented in Fig. 2. The set of indicators can expand, narrow or adjust depending on the specific tasks and their detail.

ICTPLR of an enterprise or a region can be analyzed in relation to two aspects of assessment: the first is the digitalization level of the labor activity of economic entities; the second is the level of knowledge and competence of employees in the field of ICT. Indeed, the high level of software and hardware equipment of the organization does not yet imply the effective use of ICT, as the qualifications and skills of the personnel may
simply not correspond to the necessary labor functions. This discrepancy leads to excessive ICT provision and inefficient digitalization costs.

Insufficient level of ICT provision for economic activity or disproportions between levels negatively affect the productivity of employees, which requires corrective management decisions.

Thus, ICTPLR depends on three key factors:

1) the level of employees training in the use of modern information technologies in their professional activities;
2) the level of digitalization of economic processes in a particular enterprise;
3) the degree to which the employee’s professional qualifications in the field of modern information technologies meet the needs of economic activity.

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**Fig. 2.** The basic set of indicators characterizing ICTPLR

After considering the resource aspect of ICTPLR, it is necessary to consider its impact on labor productivity in order to achieve the goal of our study. The growth of labor productivity in medium and large enterprises of basic non-primary sectors of the economy is stated as a key goal of the National Project “Labor Productivity and
Employment Support”, approved by the Presidium of the Presidential Council for Strategic Development and National Projects (Protocol No. 16 of December 24, 2018).

We need to determine the indicators of human performance in the conditions of digitalization to create the methodology for calculating labor productivity. These include:

- the share of the gross value added of ICT sector in the country’s GDP;
- the share of revenue that the organization receives from the use of information technologies in the total amount of revenue;
- revenue growth from the sale of goods, works, and services based on the results of the introduction of ICT into the work of employees.

The first two indicators characterize the contribution of information technology to the total result of activities at various levels, and can be used to study labor productivity only indirectly. Indeed, increasing the share of the ICT sector or the income from their use in the total volume is not an end in itself. The goal of increasing labor productivity is to increase the specific resource return from the use of labor resources in this case.

Thus, the third indicator “Revenue growth from the sale of goods, works, services based on the results of introducing ICT into the work of employees” will be the main indicator of the result for assessing the impact of ICTPLR on labor productivity. The indicator of labor productivity itself in this case is determined not in a static, but in a dynamic form. It should be noted that in real practice, it is necessary to determine the lag, which will make up the difference in the dates of implementation of information technologies and obtaining the result. It is also advisable to level the effect of other factors not related to the labor digitalization in the organization on revenue growth.

The formula for dynamic labor productivity, determined by the influence of ICTPLR, will take the form:

$$LP_{ICTPLR} = \frac{\Delta Q_{ICT}}{N_E \cdot K_{ICT} \cdot K_{ICTPLR}}.$$  

It is necessary to introduce correction factors in the denominator of the formula for calculating labor productivity in addition to the dynamics of changes in the number of employees:

1) $K_{ICT}$ – coefficient of employee involvement in the use of ICT;
2) $K_{ICTPLR}$ – coefficient of change in ICTPLR.

$K_{ICT}$ characterizes the share of the organization’s employees using ICT in their labor activity in the reporting period (from 0 to 1).

$K_{ICTPLR}$ shows the dynamics of ICTPLR assessment in the reporting period compared to the previous period for one or more indicators presented in the classification in Fig. 2.

The formula shows that the increase in ICTPLR, not accompanied by the outstripping growth in revenue from the sale of goods, works, services or a corresponding decrease in the number of employees, leads to the decrease in labor productivity. It is necessary not only to invest in the digitalization of labor processes in order to ensure
the increase in labor productivity due to the ICTPLR, but also to immediately create new or modernize existing jobs, initially securing for them a faster growth of work volumes per unit of time.

3 Conclusions

Summarizing the above, we note that the study of ICT provision for labor resources in conjunction with labor productivity is a complex multifactorial task. Its solution requires the combination of issues:

– informatization of society both as the supplier of labor resources to the labor market, and as the main consumer of goods, works, services obtained using ICT;
– development of ICT in business, which determines the requirements for labor resources and sets the target level of labor productivity;
– the willingness of the employee to use ICT resources in his work and to increase his level of ICT literacy;
– adaptation of modern systems and technologies of personnel management to the features of the digital economy and the level of informatization of labor processes.

Comparing various factors of digitalization of the economy and modeling their impact on labor productivity can become a complex task of further research. The multiplicity and diversity of issues related to digitalization of labor processes requires the systematic approach to solving problems of increasing labor productivity.

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