UDC: 331.103.108

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Integration of biometric technologies into a personnel management system in a digital economy

Abstract. Digital technologies are widely used by the world population and development of digital economy is reflected in national projects, as well as in federal and regional programs. Therefore, the topic of biometric technologies is especially important now because such technologies have been used in various areas of economic activity. Yet, despite great opportunities which biometric technologies have, their use in personnel work has not been sufficiently studied. The paper presents a comprehensive analysis of the possibility of integration of biometric technologies into the personnel management system and provides an assessment of their impact on the efficiency of modern companies. Statistical data analysis is theoretical and practical basis of the study. Problems and negative factors that prevent the introduction of biometrics in modern business segment are determined more relevant on its basis. The authors of the paper have analyzed the current state and growth rate of the global market of biometric systems.

As a result of this study, the approach to assessing the effectiveness of introducing biometric technologies into personnel management system of modern companies has been scientifically proven. Also, it has been determined that biometric technologies can simplify the procedure for normalizing labour processes because biometric time recorders allow for tracking the time of employees' stay in various departments, detailed movement schemes, the efficiency of each employee's activity during the working day. Due to biometric time recorders, it is also possible to prepare reports about work and rest conditions of employees, evaluate the effectiveness of their work and keep records of employees transferred to distance work. Further, it is possible to formulate labour standards of various categories of employees and form the total wage fund. It has been found that the integration of biometric technologies into personnel management system will increase the intensity of the use of organizations' labour resources.

Keywords: Biometric Technologies; Efficiency; Personnel Management; Labour Rationing; Economics; Management System and Access Control (MSAC)

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Інтеграція біометричних технологій у систему управління персоналом в умовах побудови цифрової економіки

Анотація. Цифрові технології широко увійшли в життя та діяльність населення країн усього світу, а питання розвитку цифрової економіки знайшли відображення в як у національних проектах, так і в федеральних і регіональних програмах. У зв'язку з цим тема біометричних технологій є особливо

значущою, оскільки такі технології знайшли застосування в різних сферах економічної діяльності. Однак, попри великі можливості, які виникають через застосування біометричних технологій, питання їх використання в кадровій роботі ще недостатньо досліджені в науковій літературі. У статті представлено комплексний аналіз можливості інтеграції біометричних технологій у систему управління персоналом, а також дано оцінку їх впливу на ефективність роботи сучасних компаній. Теоретичною та практичною основою дослідження послужили аналіз даних статистики, SWOT-аналіз із застосуванням комплексного підходу. На їх основі було визначено актуальні проблеми й негативні фактори, що перешкоджають впровадженню біометрії в сучасний бізнес сегмент.

Проаналізовано сучасний стан і темпи зростання світового ринку біометричних систем. У результаті проведеного дослідження було науково обґрунтовано підхід до оцінки ефективності впровадження біометричних технологій у систему управління персоналом сучасних підприємств і виявлено, що біометричні технології здатні спростити процедуру нормування трудових процесів, оскільки біометрична система обліку робочого часу дозволяє відстежувати час перебування співробітників в різних відділах, докладні схеми переміщення, ефективність роботи кожного співробітника, активність під час робочого дня; складати звіти режиму праці та відпочинку працівників і давати оцінку ефективності їхньої роботи; вести облік роботи співробітників, переведених на віддалену роботу, а також формувати структуру норм праці для різних категорій працівників і визначати сукупний фонд оплати праці. Було виявлено, що інтеграція біометричних технологій у систему управління персоналом дозволить підвищити інтенсивність використання трудових ресурсів організації.

Ключові слова: біометричні технології; ефективність; управління персоналом; нормування праці; економіка.

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**Интеграция биометрических технологий в систему управления персоналом
в условиях построения цифровой экономики**

Аннотация. Цифровые технологии широко вошли в жизнь и деятельность населения стран во всем мире, а вопросы развития цифровой экономики нашли отражение как в национальных проектах, так и в федеральных и региональных программах. В связи с этим в настоящее время тема биометрических технологий является особо значимой, так как такие технологии нашли применение в различных сферах экономической деятельности. Однако, несмотря на большие возможности, которые открывает применение биометрических технологий, использование их в кадровой работе недостаточно исследовано. В статье представлен комплексный анализ возможности интеграции биометрических технологий в систему управления персоналом и дана оценка их влияния на эффективность работы современных компаний. Теоретической и практической основой исследования послужили анализ данных статистики, SWOT-анализ с применением комплексного подхода. На их основе были определены актуальные проблемы и негативные факторы, препятствующие внедрению биометрии в современный бизнес-сегмент.

Проанализировано современное состояние и темпы роста мирового рынка биометрических систем. В результате проведенного исследования был научно обоснован подход к оценке эффективности внедрения биометрических технологий в систему управления персоналом современных компаний. Также было установлено, что биометрические технологии способны упростить процедуру нормирования трудовых процессов, поскольку биометрическая система учета рабочего времени позволяет отслеживать время пребывания сотрудников в различных отделах, подробные схемы перемещения, эффективность работы каждого сотрудника, активность во время рабочего дня; составлять отчеты режима труда и отдыха работников и давать оценку эффективности их работы, вести учет работы сотрудников, переведенных на удаленную работу, а также формировать структуру норм труда различных категорий сотрудников и совокупный фонд оплаты труда.

Исследование показало, что интеграция биометрических технологий в систему управления персоналом позволит повысить интенсивность использования трудовых ресурсов организации.

Ключевые слова: биометрические технологии; эффективность; управление персоналом; нормирование труда; экономика.

1. Introduction

In the modern world, the importance of digital technologies is in no doubt. Digital technologies are widely used in the life of the world population, and questions of digital economy development have been reflected in national projects, as well as federal and regional programs.

Currently, the topic of biometric technologies is especially relevant, since such technologies have been used in various areas of economic activity, including introduction of biometric

technologies into banking service system, the use of biometric technologies in migration control, their application in healthcare, the commercial sector of the economy, retail, etc. The biometric market is represented by a wide variety of fingerprint identification technologies which incluse facial image, iris, voice, etc.

According to Juniper Research forecasts, over the next six years, the average annual growth rate of the mobile device market with biometric functions will be more than 25%, and number of such devices in the world will increase from 160 million in 2016 to 760 million by 2022. The successful application of user identification biometric systems in mobile banking is a vivid example. The world's largest banks such as the Bank of America, JPMorgan Chase, and Wells Fargo use fingerprints (Review of the international market of biometric technologies and their application in the financial sector, 2018).

Today's difficult conditions dictate to use all available resources, especially labour resources. Transformation of traditional personnel management technologies is important due to the development of innovations in personnel management when building digital economic environment.

One of these innovative areas is integration of biometric technologies into personnel management. Experience of foreign companies operating on the global biometric market is its evidence.

India, Canada, the USA, Brazil, Mexico, the UK and China present an example of introduction of biometric technologies in various areas of activities. Aadhaar (India) has the world's largest biometric identification system. More than 2 billion people (more than 90%) over the age of 18 are already registered. This system is implemented within the state program known as the Unique Identification Authority of India. In Japan, for example, vein recognition segment is quite developed thanks to Fujitsu and Hitachi.

Kazan Smart Security Company is actively developing behavioural biometric technologies in the Russian market. According to their optimistic forecasts, the demand for such technologies will increase. The Russian market is also represented by relatively new emotion recognition products, among which are HeedBook and EmoDetect from Neurobotics Company. World companies such as Google, Microsoft, IBM, and Facebook are actively applying biometric technologies systems.

However, despite great opportunities, the use of biometric technologies in personnel work has not been sufficiently studied. This circumstance determined the need to conduct a comprehensive analysis of the possibility of integrating biometric technologies into personnel management, as well as assessing their impact on the efficiency of modern companies. It is relevant to identify and analyze negative factors that impede the introduction of biometrics in the modern business segment.

2. Brief Literature Review

The study of personnel management is described by various authors, including those who did the analysis of introduction of innovative, digital technologies in personnel management on the enterprise. L. L. Nardeev, I. Yu. Krylova (2018), A. L. Lazutin (2018), T. E. Lebedeva (2018), D. I. Chmykhova, T. A. Burtseva, E. A. Lyaskovskaya and V. V Kozlova (2018) unanimously point an urgent need for modern managers and personnel managers to introduce innovative technologies in their work with personnel in order to be able to make timely decisions in critical situations.

A. L. Lazutina and T. E. Lebedeva (2018) note a need of an integrated approach to studying the question of creation of an effective personnel management system in the conditions of digital economy.

A. Mazaraki and A. Fomina (2016) describe justification of need for managers of the organizations of timely and reliable information as one of the major tools for control of internal operations and making managerial decisions in their work «Tools for management accounting».

In her work «Biometric technologies as a mechanism for ensuring information security in digital economy», I. Yu. Krylova (2018) rightly notes that, in addition to the state segment and health care, biometric technologies have begun to be actively introduced in the commercial segment. The global biometric technology market increases growth rates every year, which is evidenced by statistics. For example, the consulting company Acuity Market Intelligence notes that such technologies are being actively introduced in almost 70% of companies operating in the global biometric market. And according to the forecast of the international company J'son & Partners Consulting, by 2022 the

volume of this kind of market will be more than USD 40 billion. Over the past five years, the market volume has grown from USD 12.19 billion in 2015 to USD 28. 22 billion, which is more than twofold (Figure 1). According to agency forecasts, the growth rate will have positive dynamics.

According to the analytical report by J'son & Partners Market Watch, the largest consumers of biometric technologies in Russia are Otkrinie Bank, Pochta Bank, Sheremetyevo Airport, Alfa-Bank, Gazovik (FC Orenburg) stadium, B&N Bank, Tinkoff, Renaissance Insurance, Promsvyaz-bank, Azbuka vkusa, Svyaznoy, X5 Retail Group, SWiP, Papa John's, Amaks Hotel & Resort, Hotel Management, the Synergy University, SkyEng, MTS Innovation Center, etc.

Authors such as V. Kulikov (2003), E. A. Grishina. (2015), I. Yu. Krylova (2018), N. K. Yavor-sky (2020), I. V. Rychenkova, M. V. Rychenkov and V.S Kireev (2014), N. A. Korenevsky and R. A. Tomakova (2019), R. Volner and P. Boreš (2009), S. Unal and B. Tekim (2018), R. King, S. Lee and A. Jain (2015), J. Bersin (2017) describe biometric technologies.

For example, in their paper «The economic effect of the introduction of an automated access control and management system as a factor in increasing competitiveness», I. V. Rychenkova, M. V. Rychenkov and V. S. Kireev (2014) evaluate financial and non-financial benefits and losses from the introduction of biometric technologies in the organization of automation of control and personnel management system. They also state that due to the use of an automated system, time for proces-sing (about 30%), entering information into the database and issuing a pass is significantly reduced.

S. Unal and V. Tekim (2018), in their paper «The use of biometric technology for effective per-sonnel management system in organization» describe the possibility and effectiveness of using biometric technologies to monitor the attendance of an organization's staff by using web systems.

Currently, there are many companies offering the implementation of such technologies in the system of standardization and accounting of labour processes, proving advantages based on their successful application in foreign companies. Today, large campaigns such as Vzor Techno-logy, 3DiVi, HBS, ITV/Axxonsoft, Prosoft, Rostelecom, NEC Neva, Sonda Technology, SWIP, Te-vian, Vocord, AAM Systems, Idemia, Technoserv, and Biometrics are the main suppliers in the bio-metric technology market.

The analysis of modern domestic and foreign literature has proven the importance of integra-ting innovative technologies in the field of human resources management, as well as the relevance of introduction of biometric technologies in personnel management.

However, the use of biometric technologies personnel management system has not yet been sufficiently reflected in scientific literature.

3. Purpose

The purpose of this study is to provide a comprehensive analysis of integration of biometric technologies into the system of personnel management of modern companies in the context of digital economy formation, as well as to identify positive aspects and negative factors impeding the introduction of biometrics in modern business segment.
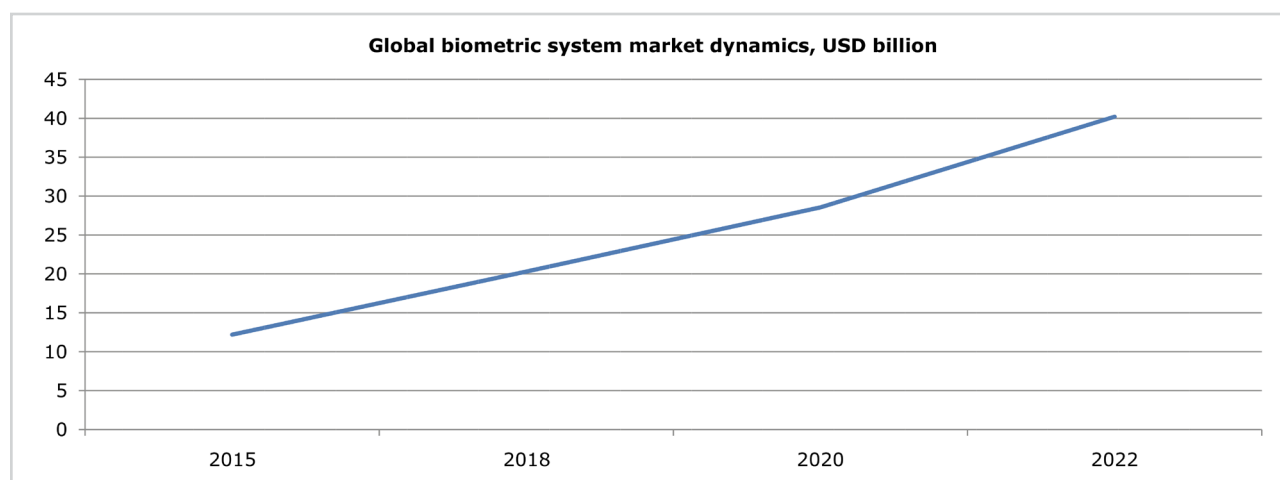

Figure 1:
Dynamics of the global market of biometric systems, USD billion
Source: Compiled by the authors based on the overview of international biometric technology market and its application in the financial sector by J'son & Partners Consulting (2018)

4. Methodology

A statistical data analysis and SWOT analysis are the theoretical and practical bases of the study.

5. Results

Company leaders, HR managers and HRs have many endless tasks which require a quick, timely, and, above all, correct solutions. HR management includes numerous functions (personnel planning, recruitment, standardization of labour processes, etc.), the implementation of which will be much easier and more efficient with the introduction of biometric technologies by systematizing and automating all working processes with personnel and reducing labour intensity of HR functions. Therefore, Josh Bersin, one of the world's famous HR analysts, notes the need to introduce innovative technologies in HR. Those should be new tools. Such tools of the new generation can be called biometric technologies, which can be successfully integrated into personnel management.

According to statistics from various sources, most of temporary losses occur due to poor organization of work processes. Employees may spend more than 30% of their working time not doing their work duties.

Time recording allows company managers to obtain information about employees (arrivals and leaves, etc.). Biometrics in MSAC (management system and access control) and in time recording systems are up-to-date tools for modern companies to optimize the salary fund costs. According to J'son & Partners forecasts, soon the share of biometric MSAC will increase to 27% in total volume of such technologies in Russia. The market segment of such technologies is aimed at the commercial sector, industrial enterprises, business centres, etc.

For example, Ivideon offers an MSAC system based on FACE ID technologies, which includes video recognition of employees' faces, an online access control service, working time reports and employee working time control.

Figure 2 shows the integration of biometric technologies into HR system. For example, technologies for the formation, representation, personnel development, as well as technologies aimed at rational use of the existing labour resources of organizations can function more effectively with the introduction of biometric capabilities.

While the studying the related issues, we identified the following advantages of integrating biometrics into the personnel work of companies.
1. Transparency of employees' work. It means that the head of the company can receive reliable information about employees' locations in real time, which will reduce temporary losses and allow for the most effective regulation of labour costs.
2. Automation of employees' time recording can allow optimizing the work of personnel services. In the presence of biometric devices, the system can calculate automatically all the data about employees necessary for HR: total time per day, disability days for calculating sick leave,
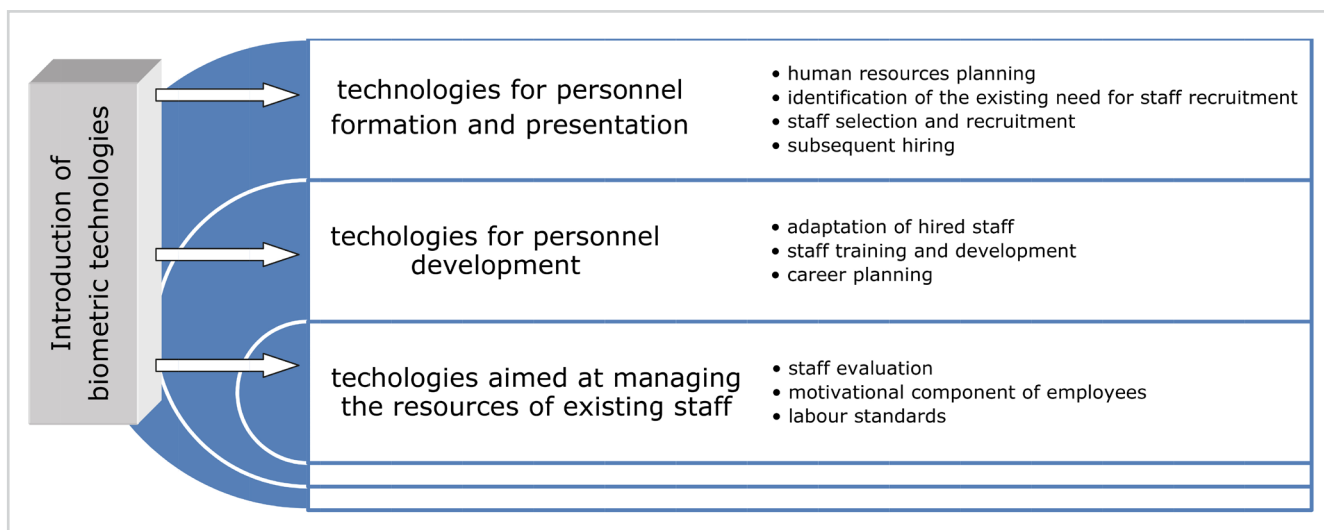

Figure 2:
Integration of biometric technologies into personnel management
Source: Compiled by the authors

downtime days or absenteeism, extra hours, etc. In case the employer needs information about time and attendance, he can quickly and easily download a full report. There are some types of software that work with these systems, allowing employers to see the attendance of some employees in system in no more than 10 seconds. The availability and reality of the information allows HR managers to create work schedule easily, considering the presence or absence of extra hours (overtime), as well as what time the employee needs to perform certain functions.

3. Reduction of labour intensity of HR functions.
4. Improvement of departmental connectivity. The ability to integrate biometric technologies with the organization's human resources software and to link directly to the payroll system. This will allow it to be automated and adjusted without special participation of HR.
5. Productivity growth, including increasing employees' motivation.
6. An increase in planning process efficiency by improving the quality of analytical data.
7. Saving money. The installation of biometric systems for the organization is a one-time investment that will make the management process more transparent and save money for the entire business.
8. Increasing the efficiency of the entire company by accelerating the adoption of personnel and management decisions, improving their quality.

Thus, management of companies can clearly and, above all, timely and fast receive and view information about employees, as well as the time spent directly on fulfilling their functional duties. Based on this, the manager can evaluate the effectiveness of using working hours by employees.

Biometrics can be synchronized with already known human resources management software technologies in the information systems market. For example, to evaluate the work of personnel, optimize labour intensity and increase labour productivity, the manager can make a sample use of the following scheme (Table 1).

The effectiveness of biometric technologies, in this case, can be calculated based on the reduction of labour disruptions and savings in employee time. For example, if time loses of one staff member is ten minutes in total per day, hence for 10 staff members there would be 100 minutes, i.e. 1 hour and 40 minutes. For a five-day working week - 500 minutes or more than 8 hours, i.e. another full unaccounted working day. If an average salary is RUB 30 000 (around USD 404), then we get that with a five-day working week, one working day is more than RUB 1300 (around USD 17.5). This amount is an organization loss, which it may not allow.

The introduction of biometric technologies into management system of an organization will require certain costs. The investment includes the amount of expenses for equipment and software purchase, for staff training to use the system, for the equipment operation, etc.

Thus, based on the obtained data, we can calculate the payback period for investments in biometric technologies, as well as obtained economic effect, as the ratio of initial investments to organizational savings from the introduction of biometric technology system in the management of the organization's personnel, as well as minimize losses from labour discipline violations.

In order to assess the efficiency of funds invested use in such technologies the return on total investments, which is expressed by the ratio of profit amount before taxes and interests paid on long-term liabilities to the total amount of long-term liabilities and equity (investment), should be applied. This indicator shows the income received by organizations per unit of value of invested money, i.e. the productivity of application of such investments. It is also necessary to evaluate the return-on-investment index in biometric technologies by conducting a general analysis of the return on investment in the company's assets. This is the excess of the profit obtained from the introduction of technologies over the initial capital investments.

Table 1:
A Sample scheme for analyzing the working time of employees

Sample for the period

from _____ till _____.

Employee ID	Full name	Job title	Time of arrival at the workplace		Time of leaving the workplace		Duration of working day		Delta (+, -)	Total working time for the whole period		Delta (+, -)	Offence of time sheet, hours
			plan	fact	plan	fact	plan	fact		plan	fact		
	Ivanov I.I.	manager											
	Ivanov I.I.	manager											
n….	……	……											

Source: Compiled by the authors

Also, it is required to evaluate the dynamics of profitability and profitability of the enterprise before and after the introduction of innovative technologies in the organization, changes in the average monthly production per employee.

A quantitative assessment of their strong and weak points, opportunities and perceived threats was carried out by means of a comprehensive analysis of the integration of biotechnologies into human resources management (Table 2).

The arithmetic average U is calculated for each SWOT matrix field. Figure 3 shows strengths, weaknesses, capabilities and threats in comparison with each other, which allows for assessing the attractiveness of the starting position of biometric technologies in modern companies.

The SWOT analysis of integration of biometric technologies into organization management shows that significant financial costs are weak points. However, the analysis of strong points has revealed great opportunities and prospects for the development of the company and its competitiveness. Also, the integration of technologies will promote continuous and uninterrupted functioning of the control system and personnel management.

Table 2:
SWOT analysis of integration of biometric technology into Organization Management

S - Strengths, **U=443**	W - Weaknesses, **U=315**
S1: Adequacy of information and transparency of employees work Z=8 P=10 V=80 S2: Objectivity of received information Z=10 P=10 V=100 S3: Automation of working time recording Z=9 P=8 V=72. S4: Optimization of HR work Z=9 P=7 V=63 S5: Information accessibility and actuality Z=8 P=6 V=48 S6: One-time investment for the purchase of equipment and software Z=8 P=10 V=80	W1: Insufficient financial resources in organizations due to high costs Z=8 P=9 V=72 W2: Lack of practical skills to implement biometric technologies and lack of work experience Z=8 P=9 V=72 W3: Additional investments for staff training Z=9 P=9 V=81 W4: Poor awareness Z=9 P=10 V=90
O - Opportunities, **U=554**	T - Threats, **U=222**
O1: Reduction of HR labour intensity=9 P=8 V=72 O2: Improvement of departments interrelation Z=7 P=8 V=56. O3: Efficiency increase of the entire company by accelerating the adoption of personnel and management decisions, improving their quality Z=9 P=10 V=90. O4: Funds savings Z=7 P=7 V=49. O5: Improvement of planning process efficiency by improving the quality of analytical data Z=8 P=8 V=64. O6: Increase of stuff motivation Z=8 P=10 V=80 O7: Increase of workforce productivity Z=8 P=10 V=80.	T1: Possibility of failure or system failure Z=7 P=10 V=70 T2: Possible unforeseen material expenditures Z=8 P=9 V=72 T3: Distrust of the system by employees of the company Z=8 P=10 V=80

Note:
Z - evaluation;
P - importance for us;
V - significance (calculated as Z*P).
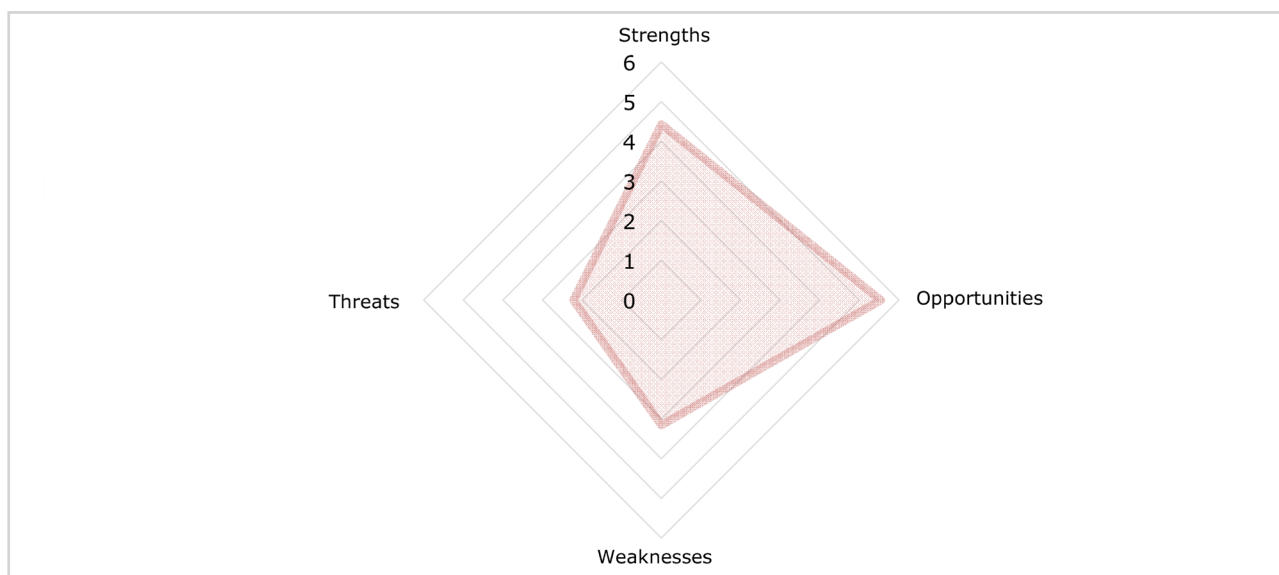Source: Compiled by the authors

Figure 3:
SWOT analysis of integration of biometric technologies into organization management
Source: Compiled by the authors

6. Conclusions

Integration of biometric technologies into the personnel management system will make it easier to work with the personnel, simplify normalization process of labour functions, and the process of planning and optimizing personnel potential, which will significantly increase the efficiency of the entire company.

Biometric technologies can simplify standardization of labour processes, and biometric time recording system makes it possible to:

1) monitor the stay time of employees in various departments, detailed movement schemes, the efficiency of each employee, and activity during a workday;
2) compile reports on working and rest conditions of employees and evaluate the effectiveness of their work, keep records of distance work of the employees;
3) form the structure of labour standards of various categories of employees and the total wage fund.

Thus, the integration of biometric technologies into personnel management will increase the intensity of the use of organizations' labour resources.

The introduction of biometric technologies requires a significant one-time investment. However, it is a reasonable investment and all large companies should take it into consideration when it comes to managing resources and productivity.

An integrated approach to evaluation methods of the economic impact of integration biometrics into organizations' human resources management gives a comprehensive overview of the benefits of such innovative technologies, as well as of possible barriers and risks associated with them. This will allow modern managers to make right decisions in order to maintain a high level of competitiveness and development in view of the formation of a digital economy.

The obtained results make it possible to assume that the volume of the global biometric technology market will increase soon. Moreover, in addition to the state segment, such technologies will actively continue to be introduced by commercial companies.

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