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CONTENTS

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INTELLECTUAL ECONOMICS
2020, No. 14(1), p. 5–30

PROBLEMS OF FINANCIAL MARKET DEVELOPMENT IN CENTRAL ASIA (ON THE MODEL OF KAZAKHSTAN)

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Abstract. *This article is devoted to the development of the financial market in Central Asia. The economic situation in the states of the region and their competitiveness are also considered. The study used the IMF, WEF, and WB databases, as well as statistics of the EAEU countries. The authors used logical conclusions, the selection of necessary information, and systems analysis when considering the business environment and state regulation measures in the countries of the region. It is noted that the banking sector of Kazakhstan is the most integrated one into the global financial system. Uncertainty in the development of banks in Kyrgyzstan, the isolation of the banking sector in Turkmenistan, and the dependence of credit institutions in Uzbekistan and Tajikistan on administrative intervention are presented. The rates of competitiveness of the financial markets of Central Asian countries are very low – even Kazakhstan, with a fairly developed market of securities, is in 114th place among the 144 countries of the world. Legislation regulating the operation of the stock markets of the Central Asian countries has not yet been formed, Kazakhstan and Kyrgyzstan do not meet international standards, and Tajikistan and Turkmenistan do not officially have stock exchanges. The example of Kazakhstan shows that the capitalization of the stock market is growing, and the stock market ecosystem has been built. The placement of shares of national companies on the London Stock Exchange allowed for the increase of capital, but small trading volumes, an insufficient number of financial instruments, and a limited number of investors hinder the development of the domestic stock market. It is proposed to involve local business structures, enterprises, and the population in investing in socially significant projects through the issuance of municipal bonds.*

Keywords: *Central Asian countries, competitive, banking sector, financial market, stock exchange.*

JEL: *G14, G18.*

1. Introduction

After the collapse of the Soviet Union, Central Asian (CA) countries chose various ways to liberalize the economy, privatize state property, and switch to a market-based management model. They differ in the intensity of their reforms, their management methods, and the degree of centralization of their economies. In the course of time, mistakes in the management of the economy of these countries, border conflicts, and disputes over the solution of water-power problems have worsened the situation and led to strained relations. Today, the region's countries are developing unevenly, and the existing prerequisites for regional economic integration have not been sufficiently used. The countries entered the path of market transformations simultaneously, but today one can see differentiation in the development of financial markets.

Kazakhstan is actively implementing reforms in the field of finances: the International Financial Center Astana was created at the international exhibition EXPO–2017 site; the project "People's IPO" is being implemented; and KEGOC, KazTransOil, and Kazatomprom shares are being successfully sold. However, despite the steady growth of GDP, lending in the economy is narrowing, the national currency exchange rate is unstable, and the banking sector is feverish [1; 2].

Uzbekistan has favorable conditions for the development of mineral resource industries. For a long time elements of the planned economy have been preserved, and currently the government is actively involved in the financial sector. The market environment and measures for the development of the banking sector and micro-credit institutions have been formed [3].

Turkmenistan intensively develops agriculture in irrigated oases thanks to the Kara Kum Canal, and has huge resources of gas and oil [4]. The model of the financial market is one with a significant role of the state in the economy and the strict regulation of private business acts. The country is focused on direct investment, which creates additional demand in the national market. Laws regulating activities in the securities market and the creation of market development institutions have been adopted.

Tajikistan is poorly resourced, with the exception of water. In the 1990s the country was engulfed in civil war and remains one of the poorest in the CIS [5]. The budget is supported by remittances from migrant workers working abroad. The government is implementing a system to encourage and facilitate access to portfolio investments and the formation of microfinance institutions.

Despite the stabilization of the economic situation after political distress, Kyrgyzstan has not fully restored its potential. In order to create a favorable environment and increase the potential of the financial market, a microfinance system has been established with the support of international organizations. However, the financial infrastructure re-

mains weak, the development of the banking system is limited by the size of the domestic market, and bank services are not available for the remote regions of the Republic [6; 7].

The development of a balanced financial system remains an urgent task for emerging markets in Central Asian countries. The initial period of the rapid development and expansion of credit activity – which relied on foreign capital, currency inflows from exports, and remittances – helped to include banks, businesses, and households in the financial market. However, these initiatives have led to instability and low financial efficiency – today, almost the entire banking sector in the region is experiencing problems.

Countries in the region, with the exception of Kazakhstan, lag behind in the Global Competitiveness Ranking, and financial institutions have not yet developed their participation in the global capital market. These states are open, to different degrees, for international and regional trade, different forms of cooperation, and cooperative business. The current restrictions on cooperation should be considered as a temporary phenomenon, since the Decision of the Supreme Eurasian Economic Council on October 1, 2019 in Yerevan has already approved the Concept of forming a common financial market in the EAEU [8].

The Concept points out that the common financial market covers the banking sector**,** securities market sector, and the insurance sector of each member state, as well as the complex of relations that govern the interaction between the sectors of the financial market. Therefore, there is a huge potential for the integration of financial markets. The regional financial market will become a softer and more balanced form of inclusion for the insufficiently developed systems of Central Asian countries into the global flow of capital.

It should be noted that there are not many in-depth studies on the formation and development of financial markets in these countries, and they are mainly conducted at the local level and are covered in scientific journals published within the country. There are no works that consider Central Asian countries as a single region with a common financial market. There are no works devoted to the development of the internal stock market, the improvement of legislation and the regulatory framework, nor the involvement of great masses of population and business structures into the regional financial market. In addition, most publications have a political subtext when explaining the decisions and legislative initiatives of the authorities.

On this evidence, this article aims to study the problems of the formation of financial markets in Central Asia, and to identify the reasons behind the weakness of the banking system and micro-credit institutions, using Kazakhstan‘s opportunities for the development of the domestic stock market as an example.

Research objectives: to analyze the economic situation in Central Asian countries and the competitiveness of economies; to show the difficulties of developing the banking sector and what actions are necessary to form the stock market. The socio-economic processes related to the financial market of Central Asian countries are the object of the study.

2. Materials and methods

The presence of different models of financial markets in global practice creates a need to use different research methods. In the course of writing this article, logical conclusions, methods of selecting the necessary information, the grouping of this information, and both systems and statistical analysis were used. The use of a context-specific approach allowed the authors to consider special conditions for the development of the banking sector and the securities market in the countries of Central Asia. When considering the socio-economic situation in the countries, a systems approach was used which revealed a general negative factor – the raw materials and agricultural nature of the economies and the insufficient attraction of investment. Based on the IMF, WEF, and WB database, as well as the statistics of the EAEU states, an objective analysis of the financial markets of the countries was carried out, and it was concluded that the development of the domestic stock market would help to increase their competitiveness.

Considering the economies of these countries, the authors resorted to comparison to establish similarities and differences between countries and the processes occurring in them by comparing the main indices of development. The similarities in the historical past have determined the similarities in the development of economies and the processes of formation of financial markets. Here an analogy is used, by which knowledge about one country is obtained on the basis of its similarity with another in cultural, historical, and geographical contexts. Knowledge of these cognition methods allowed the authors to identify the reasons for the weak development of the banking sector and securities market, which explains the rather complex and slow transition of individual Central Asian states to market relations.

Using methods of processing and analyzing statistical data regarding the countries' GDP, their global competitiveness, and their situations with finances, it was found that the successful development of countries in the modern world is facilitated by an effective regulatory environment, advanced reforms in the banking sector, and the involvement of the population and business structures in investing in stock market instruments.

3. Results and discussion

3.1. The Economic situation in the Central Asian region

In a region of more than 71 million people with a total GDP of US$265.2 billion in 2018, there are two leaders: in terms of population – Uzbekistan (over 45% of the region's population), and in terms of the size of the economy – Kazakhstan (approximately 60% of regional GDP) – Fig. 1 [9; 10].

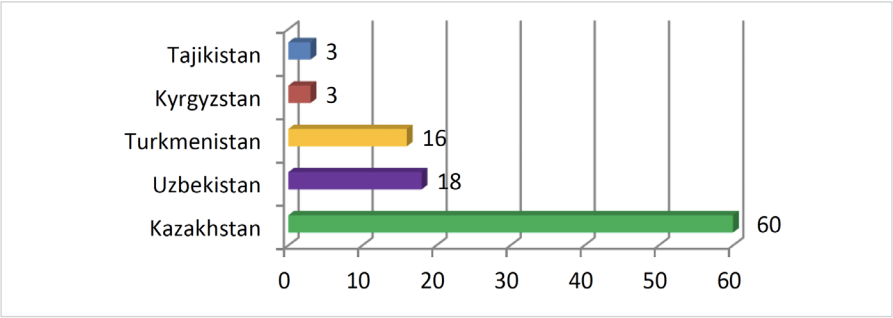

Figure 1. *The share of GDP of Central Asian countries in total in 2018. Source: [9; 10].*

Kazakhstan is positioned as a country with a global territory and significant economic potential. Reforms aimed at strengthening budgetary institutions, overcoming the weakness of the banking sector, and modernizing monetary policy in order to maintain low inflation and promote a flexible exchange rate are being actively implemented [11].

Uzbekistan's natural resources contribute to the development of an industrial complex based on natural raw materials. For a long time, the country was dominated by traditional methods of management, and market transformations began only in the last 2–3 years. Currently, the investment environment and measures to encourage investments, including guarantees on the protection of investors' rights, have been formed [12].

Kyrgyzstan has long been the first and only country in the region to join the WTO, which can be seen as a product of its vigorous implementation of early economic reforms. Gold mining at the world's largest Kumtor deposit provides a significant portion of earnings. Mining and power industries are oriented towards exports [13].

Turkmenistan has chosen a hyper-cautious approach to economic reforms as the state's dominant influence in the economy remains. Export and currency control is strictly monitored, which deters foreign investors, and there are no incentives for innovation. Due to high oil and gas prices, export revenues are increasing [4].

Tajikistan is more poorly developed among the Central Asian countries [14]. Experts note the unripe and insufficiently developed legislation, especially surrounding tax, and there are problems with poverty and unemployment. Currently, the authorities are focusing on providing various preferences, attracting benefits from investing money in the hydropower industry and the development of mining.

The region of Central Asia is, however, ahead on some indices. According to IMF estimates, exchange rates, taking into account regional devaluation after major external shocks in 2014–2016, correspond to the main macroeconomic indicators. In the period of 2000–2018, the economies of the countries showed an average growth of 7.6%, which was due to the export of raw materials (Kazakhstan, Turkmenistan, Uzbekistan) and money transfers (Tajikistan, Kyrgyzstan, Uzbekistan). At the same time, the main index – GDP

per capita – is extremely low, from US$1,280 to US$2,090 in Tajikistan, Kyrgyzstan, and Uzbekistan, while the picture is better in Kazakhstan and Turkmenistan (Table 1).

Table 1. *Comparison of some countries' GDP per capita, 2019.*

No.	Countries of the world	GDP per capita Nominal, US$	No.	Countries of the world	GDP per capita, Nominal, US$
1	Norway	78,330	12	Turkmenistan	8,990
2	USA	67,430	13	Turkey	9,680
3	Germany	47,990	14	Belarus	6,740
4	France	42,640	15	Georgia	4,630
5	UK	40,390	16	Azerbaijan	4,720
6	Israel	44,470	17	Armenia	4,760
7	Japan	43,040	18	Ukraine	3,880
8	Russia	11,310	19	Uzbekistan	2,090
9	Kazakhstan	9,670	20	Kyrgyzstan	1,340
10	China	10,870	21	Tajikistan	1,280

Source: [15; 16].

In terms of competitiveness, only Kazakhstan is at an average level. Tajikistan is in 104th place, Kyrgyzstan is in 96th place, and both Turkmenistan and Uzbekistan are not represented in the ranking at all. A more in-depth analysis of the components of the Global Competitiveness Index shows that the countries of the Central Asian region are significantly behind in development in comparison with some CIS countries (Table 2). According to these indicators, Russia, Azerbaijan, and Kazakhstan are at an average level, whilst Kyrgyzstan and Tajikistan show very low indicators.

It should be noted that a number of problems hinder the region's potential growth and integration into world markets: access to financing is difficult; there is a high tax burden on the real sector of the economy; there are significant transaction costs; there are high trade costs and long periods of transportation due to an undeveloped logistics infrastructure. For example, the average cost of sending a container to Shanghai or Rotterdam from Central Asian countries is more than five times higher than from European countries. These difficulties are reflected in the "Ease of Doing Business" rating (Fig. 2).

Table 2. *Rating of some countries of the CIS and Central Asia by major indices of global development, 2017–2018.*

	Index of Global Competitiveness	Health and primary education	Higher education and training	Labor market efficiency	Infrastructure	Innovation	Technological readiness
Russia	43	54	32	60	35	49	57
Armenia	69	55	69	51	80	70	77
Azerbaijan	58	74	68	17	51	33	56
Kazakhstan	55	59	56	35	68	84	52
Kyrgyzstan	96	75	89	113	109	126	102
Tajikistan	104	73	76	34	99	86	114

Source: [17–21]; 2018–2019 data

It should be noted that Central Asian countries are relatively small in number, and the size of their economies is not very attractive to investors. If they are presented as a common economic region, they will be more competitive compared to countries such as Azerbaijan, Armenia, Afghanistan, and Georgia, and will become more comparable in terms of population and size of economy to countries such as Pakistan, Iran, Turkey, and Russia. In response to these challenges, the EAEU is creating a common financial market to jointly solve regional problems via mutually beneficial cooperation [22]. In light of this, the authors regard it as important to consider the state of the banking sector and the stock market of Central Asian countries in this study.

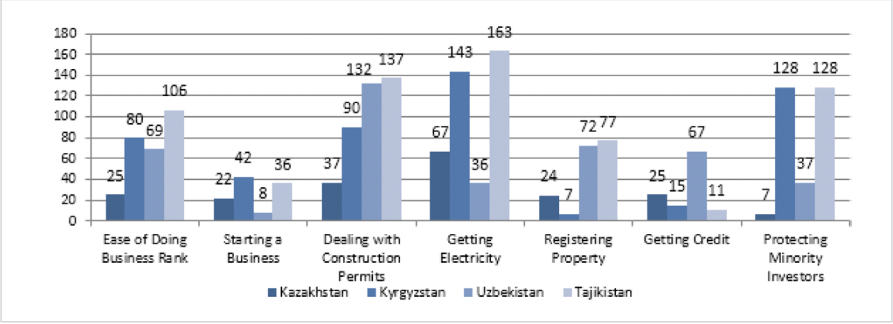

Figure 2. *Rating of "Ease of doing business" in Central Asian countries, 2019.*

Source: [20; 23; 24].

3.2 The banking sector of Central Asian countries

The Central Asian region belongs to the group of emerging markets. The volatility of national currencies and the multidirectional development of the financial sectors create uncertainty in the economy. Despite reformatting in the 1990s, local economies proceeded to be hostages of conflicting political processes. The situation is complicated by imperfect banking regulation, the lack of transparency of activity from financial market participants, the peculiarities of doing business in these countries, etc. A common feature of banking systems in all countries is the limited size of the internal market.

Despite the expanding network of banking institutions in the regions of all of these countries, the level of access of the population in poor and remote areas is still low [25]. The uncertainty in the development of banks in Kyrgyzstan, their isolation in Turkmenistan, and the marked dependence of credit institutions in Uzbekistan and Tajikistan on administrative interventions has all determined the need for a separate review of the banking systems in these countries [26]. The leader in terms of the number of commercial banks is Kazakhstan with 33. As seen in Table 3, Kazakhstan and Kyrgyzstan actively attract foreign capital, and operate banks with international participation.

Kazakhstan's banking sector is the most integrated into the global financial system, and is more prepared for recessionary events**.** The key to its sustainability is the transition to the Basel III standards during the period of 2013–2018. Among the main problems of the country's banking system is the poor quality of the advances portfolio, which does not allow banks to increase ratings and gain access to global capital markets. There was a decrease in the role of banks in the real sector of the economy and a contraction of the field of their activities. In 2018, lending to the corporate sector decreased by 8.7%, to SMEs by 18%, and to agriculture by 48% [26].

Table 3. *Amount of banks Central Asian countries*

Types of banks	Kazakhstan	Uzbekistan	Kyrgyzstan	Tajikistan
Commercial banks, total	33	27	25	17
National banks	–	3	2	1
Banks with the participation of foreign capital	15	5	11	7

Source: [27].

Sometimes, the solution to problems in the banking sector depend directly on the political will of the country's leadership. At the beginning of 2017, the government allocated a target transfer for the rehabilitation of banks from the National Fund in the amount of US$3.4 billion. This transfer was distributed almost completely in support of only one bank – Qazkom. In the view of the authors**,** the state should not be obligated to cover the risks of the bank's shareholders. Support measures that do not use budget funds are needed [27]. This is why, in January of 2020, the President of Kazakhstan Kassym-

Zhomart Tokayev instructed the improvement of the financial stability of the banking sector and the completion of the program of capital re-equipment of banks [28].

Kyrgyzstan satisfactorily survived the financial crisis of 2008–2009, but the political instability in 2010 led to a decrease in the deposit base of banks by one third due to the outflow of non-residents. Weak financial infrastructure and difficult access to private sector loans are hindering economic growth. Political risks that may provoke economic instability are not excluded. A limiting factor in the development of the banking system is the limited size of the internal market and the unavailability of banking services for remote regions of the Republic. Taking this into account, banks on the periphery began to open branches, providing local residents with a wide range of services.

Today, the country's banks are characterized by maintaining their capital and a moderate increase in assets. The total assets of the financial sector can be broken down into: 88.4% – the share of the banking sector; 9.9% – the share of non-banking institutions; and 1.7% – the share of other organizations. The share of foreign capital in the authorized capital of banks is 44% [29]. Since 2017, banks in Kyrgyzstan have been operating under legislation adapted to world practice. It is assumed that measures to consolidate bank capital and the participation of foreign financial corporations in the country's banking system will allow access to modern business technologies and the successful implementation of national projects.

Starting from a low position, the banking system of *Uzbekistan* is developing dynamically. In the past two years along, bank assets have grown by 54% and deposits by 60%. Programs to support the real sector of the economy, focused on the introduction of new production and the modernization of existing methods, function efficiently. To solve the problems of unemployment, banks are set the task of increasing the volume of lending to small business and providing funds for "start-up projects." These loans can be issued without collateral if there are one or two individuals acting as guarantors.

However, the problem of the banking system is in the weak desire of the population to make deposits in commercial banks and investments in securities. Therefore, to increase the resource base of banks, the state is actively implementing a system of non-cash payments. The number of terminals that accept payment by bank cards in trade and service facilities is approximately 210,000, while in Kyrgyzstan this number is 100 times less. At the same time, it is extremely difficult to withdraw money as cash from the card [30]. The banking sector in Uzbekistan is dominated by institutions with state participation, and 30% of the market is monopolized by Vnesheconombank. The Central Bank, despite its independent status, is a de facto executor of government directives. The risks of this approach include a high degree of integration of the state, the economy, and the banking sector, and tight control over currency transactions and cash.

Banks of *Tajikistan* are experiencing serious difficulties, as the ratio of capital to assets in 2018 decreased to 5.4%, while according to the requirements it should be 12%. At the beginning of 2017, the state recapitalized four banks to the total amount of US$400 million (7.1% of GDP) [31]. Shrinkage in the financial sector has led to tighter lending conditions for SMEs. Borrowers have suffered before, as in 2014–2017 when the Tajik Somoni depreciated by half and 60% of loans were issued in US dollars. The share of

problem loans from banks increased from 30% to 54.7% in three years, whilst private sector lending decreased from 23% of GDP to 10% [32].

Strong measures are being taken to regulate and supervise the banking sector. However, this is not enough for the development of the private sector, and there are macro-environment imbalances such as: inefficient public administration; a weak investment climate; the direct intervention of authorities in the credit process; and the non-transparency of state-owned companies. A weak deposit base, the high cost of lending, an increase in the share of bad loans, and a lack of reliable sources of funding are the results of the banks' inept work.

The financial sector of *Turkmenistan* is in the initial stage of formation. There are 11 banks in the Country, 7 of which are state-owned, and among the joint-stock banks there is a joint Turkmen–Turkish Commercial Bank. The banking system is controlled by the state which prevents its integration into regional finances, not to mention the global sphere. The public sector accounts for approximately 85% of all loans. The lack of market-based banking practices and poor access to credit for individuals and private entrepreneurs are the main restrictions for foreign banks, and slow down access to capital in the country [33].

Central Asian countries are not sufficiently integrated into the global financial system. On the one hand, this allows them to neutralize the risks of financial crises. On the other hand, this restricts the flow of foreign capital into these countries. The presence of foreign banks in Kazakhstan and Kyrgyzstan has helped to increase the competitiveness of local banks and improve the competitive environment. At the same time, banks with foreign capital can be agents of external shocks originating from the countries of origin of the head offices.

There are cases when they are reluctant to lend to small and medium-sized businesses, and preferences are given to large clients in order to minimize costs and risks. Also, the reasons for credit "one-sidedness" lie in difficulties with the availability and reliability of information about the activities of private firms. Risks can also come from the excessive concentration of capital within single financial clusters, a typical example of which is Almaty (Kazakhstan). However, a second financial center is now being created in Nur-Sultan (prev. Astana).

Unfortunately, despite the status of a legal entity under the legislation of Kazakhstan, foreign banks remain isolated from major projects of national and regional significance, to which local banks are allowed access. Administrative and regulatory restrictions may result in a ban on certain types of transactions, as well as the forced transfer of large companies for servicing to local banks [25]. Regulatory protectionism may also limit the share of foreign capital in the local banking sector. Due to high dollarization, the banking systems of Central Asian countries remain dependent on exchange rate fluctuations, which does not allow them to expand their deposit bases or lending to the economy, and reduces the quality of their loan portfolios.

3.3. The stock market of Central Asia countries

Since 2000, the Central Asian countries have registered impressive economic growth, mainly due to the export of raw materials. However, the end of the commodity super cycle and the slowdown of growth rates against the background of the global financial crisis revealed risks associated with resource dependence and an influx of remittances from abroad. This situation creates difficulties for global investors and global investment banks that invest in emerging markets. One of the main constraints is the regulatory environment. Laws which are unclear to the investors, the existence of opportunities for money laundering, and a non-transparent property structure that hides the real owners of assets all deter potential investors.

The legislation regulating the operation of stock markets in Central Asia was formed in the 1990s according to one "pattern." In Kazakhstan and Kyrgyzstan, there is moderate compliance with the standards of the International Organization of Securities Market Regulators (IOSCO), while in Tajikistan and Turkmenistan the level of compliance remains low. OECD experts note that in the countries of the region it is important to create a comfortable investment climate, quick access to financing, the availability of convenient infrastructure, and to improve the professional skills of financial managers [34].

For example, they recommend that *Uzbekistan* implement reforms in three areas: state regulation, trade–transport connectivity, and business environment. Experts help local officials to improve the competence of investors and show the country's investment opportunities. Among the experts are Kazakhstani brokers, some of whom work in the financial sector of Uzbekistan. Such a cooperation will help to build a capital market, as Western companies have huge funds for investments that can be attracted to the economy through the stock exchange.

An important task is to build a pool of retail investors and local institutional investors. In this regard, there is a need for privatization. It is commonly understood that if one or two Uzbek companies are listed this will not produce the desired effect, but if there are 30–40 companies in the listing then investors will be interested in investing money as they have more choice. In Uzbekistan the government is directly involved in the financial sector, and there are several micro-credit programs that are managed through specific funds and commercial banks. There are 28 micro credit- institutions, whose assets total 123.7 billion Uzbek Soums (€27 million) [35]. Today in the country there are 624 joint-stock companies with approximately 900,000 individuals and legal entities among the shareholders. Within this, 50.1% of the shares are owned by international investors.

The total turnover of corporate securities in 2017 amounted to 7.3% of the country's GDP. For comparison, this figure is 133.8% in South Korea, 127.1% in Japan, 48.7% in Turkey, 43.8% in Germany, and 8.6% in Russia [36]. At the end of 2018, the volume of trading on the Toshkent Stock Exchange increased 2.3 times compared to 2017, amounting to 687.9 billion Soums (US$82.5 million according to the Central Bank's exchange rate as of December 31, 2018) [35; 37].

There are currently only two types of securities in the country – shares and bonds. On the stock exchange, transactions are mostly made in shares. The Central Depository does

not have correspondent relations with the depositories of foreign States [38]. For this reason, it is impossible to purchase shares of foreign companies on the stock exchange. For comparison: on the Moscow Exchange Russian and foreign shares, depositary receipts, and investment shares are traded. RF corporate bonds denominated in Rubles and foreign currency, corporate Eurobonds, and Russian sovereign Eurobonds can also be purchased at the auction.

The President of Uzbekistan, Shavkat Mirziyoyev, at a meeting of government gave the instruction to bring the ratio of freely traded securities to GDP up to 10–15% by the end of 2025 [39]. It was also pointed out that there is a need to review the legislation, to create a favorable regulatory environment, to simplify the work of the financial market, and to remove unnecessary restrictions. The importance of attracting foreign brokers and banks to trading was stressed. To do this, it is necessary to strengthen the protection of the rights of investors and minority shareholders, and to improve the procedure for paying and collecting dividends.

Tajikistan is the poorest of the CIS countries – 19.5% of the population live on less than US$1.90 a day, and 56.6% live on less than US$3.10 a day [40]. The country suffered from the recent economic downturn caused by the economic crisis in Russia, which led to a reduction in remittances from US$4.2 billion to US$1.9 billion from migrant workers working abroad [41].

The National Bank is making efforts to develop a system to encourage and facilitate access to portfolio investments. The National Bank and commercial banks have started creating a new Central Asian Stock Exchange, but this is the first stage of the work. In 2016, the government of Tajikistan presented the National development strategy for 2016–2030, which emphasizes the importance of investment as a driving force of economic growth and the improvement of the business climate in the country. However, in 2018 the Chairman of the State Investment Committee, Farrukh Khamralizoda, said that competition led to the closure of 30,000 enterprises in 2017. In fact, this was influenced by strict regulatory mechanisms and the tax burden [42].

In Tajikistan, 124 micro-financial institutions (MFIs) are members of the Association and play an important role in financing the economy, accounting for 17% of outstanding loans. MFIs pay special attention to solving social problems and the empowerment of women. Among the clients of these organizations, women constitute 40% and account for 32% of loans.

According to the state statistics, portfolio investments in Tajikistan at the end of 2017 amounted to US$576.2 million, including debt on Eurobonds in the amount of US$500 million. There is no securities market in the country, and the government does not consider this sector to be a significant part of the national economy [42]. There is little liquidity in the capital markets, and the country has no official stock market. No policy has been developed to facilitate the free flow of financial resources on markets of commodities, services, or labor power.

Tajikistan does not impose any restrictions on payments and transfers for current international transactions, which is in accordance with the IMF rules (article VIII). Transfers from all international sources are treated as income and are levied. Loans are

distributed on market terms, but commercial banks are under pressure from management elites, so only a few are given profitable loans for commercially dubious projects. At the beginning of 2018, according to the National Bank data, 35.8% were non-operating loans. At the same time, private investment rates in Tajikistan are invariably lower than in other Central Asian countries. Electronic banking and payment verification systems are not developed in the country, and most payments are made by bank transfer [31; 32].

Traditionally, Tajikistan does not restrict the conversion or transfer of funds if these amounts are considered reasonable. Until 2016, the "reasonable" limit meant no more than US$10,000 per transaction. Later, the National Bank reorganized currency operations and closed all private exchange offices. Today, only bank exchange offices are allowed to exchange foreign currency upon passport presentation.

Kyrgyzstan was the first country in the region to join the WTO, and benefits from the free market environment. The best way to access Kyrgyzstan is through the Canadian company Centerra Gold, the securities of which are ruled on the Toronto Stock Exchange. The company owns 70% of the largest Kumtor gold mine, and Kyrgyzstan's government owns 30%. At a total expense of US$733 for an ounce, and with 4.489 million ounces of proven gold reserves, the mine is of great value to the country. The company provides 9.7% of Kyrgyz GDP [6].

The system of micro-financing in the country was created with the support of international donor institutions. The first association MFI was established in 2015 with the aim of creating a favorable environment and building the capacity of the financial sector. According to the data of the National Bank of the country, there are currently 5 MFIs, 232 micro-credit companies, 74 micro-credit agencies, and 172 credit unions [43]. The main problem of MFIs is access to financial resources. Only six credit unions are allowed to attract deposits from the population, and MFIs' operating expenses are quite high (on average 20% of the advances portfolio). As a result, the interest rate on micro-loans is 10% higher on average. With the exception of banks and the micro-financing sector, other financial institutions play a minor role in the Kyrgyz economy. Thus, the stock of government securities is 3% of GDP, of which banks own 1.3% and institutional investors hold 1.4%. Today, the stock market capitalization is only 4% of the GDP [44].

The official opening of the Kyrgyz Stock Exchange (KSE) took place in May of 1995, when the country was in the process of privatization. In 2000, the KSE was reincorporated and the Istanbul Stock Exchange became the largest shareholder. The KSE is now a closed joint-stock company on a non-commercial basis with 18 shareholders. Active trading is carried out on the primary and secondary markets, and the exchange presents shares of companies in industry and the service sector. The volume of trading on the KSE in December of 2019 amounted to 26.285 million Soms (US$381 million) [45].

The KSE has 21 companies, each of which has a different degree of state ownership. If these companies sell their government shares, however, they will find some undervalued companies, and may stimulate interest in the exchange as liquidity increases. Currently, most local residents tend to invest in the corporate bonds market, as they prefer the flow of funds to capital increase. In addition, a well-functioning stock market could encourage some private companies to IPO, which would be the first event in the country's history.

For example, the Stroypark company, with good growth indices for the Kyrgyz economy, could enter the market for the initial placement of securities.

Intensive development of the stock market began in the period of 2008–2009. Since then, the State service for regulation and supervision of the financial market has registered 15 issues of corporate bonds, eight of which are recognized as effective ones. Corporate bonds are allowed to be issued by domestic companies to attract investment in housing, and as a result investors were able to improve their financial well-being.

The majority of investors into corporate bonds are individuals (68%), followed by companies (25%) and commercial banks (7%) [45]. The procedure for buying a corporate bond is very simple – one can simply go to a financial company with an identity card and become an investor. Unfortunately, the population's demand for corporate bonds is very low across a fairly wide range of offers. Experts point out several reasons for this. From the point of view of investors, this is due to low financial literacy, ignorance as to the existence of the bond market, an unwillingness to take risks, the desire for quick profit, and a lack of access to financial companies in the regions (most companies have branches only in the capital Bishkek).

Considering the high level of poverty in Kyrgyzstan (officially 25%), many people do not have enough income to make savings and the majority of depositors belong to the upper-middle class. According to experts, the population is reluctant to use financial institutions for borrowing and saving. In 2018, approximately 40% of the adult population had accounts in financial institutions, of which 6% were inactive ones [29].

On the other hand, there is a fairly high level of shadow economy, even whilst a company must disclose all of its cash flows in order to get listed. Referring to the events of 2010, when there were interethnic clashes and anti-government protests, many businesses do not believe in legislation on property rights and are afraid of raiding. The problem is in the lack of free circulation on the stock market – only 6–7% of the shares of large companies are available to public investors. In addition, some legislative initiatives are controversial. Therefore, three years ago, lawmakers proposed to cancel preferential conditions for paying income tax for individuals who buy securities. Fortunately, these amendments were not supported as, had they been adopted, efforts to promote shares on the market and develop stock instruments would have been futile.

A stock market model with a significant role of the state and state property in the economy, and strict regulation of private entrepreneurship, is typical for *Turkmenistan.* Due to the fact that the country has been showing high growth rates in GDP for a number of years (approximately 10%), there is a surplus of the state budget, more than 70% of which is directed towards social purposes [4; 9; 10]. Turkmenistan focuses on direct investments which create additional demand in the national market, contributing to the stabilization of the financial and economic situation.

Currently there is no stock exchange in the country, only the State commodity-raw material exchange of Turkmenistan operates. Trading is carried out for the following types of goods: petroleum products, cotton, textile products and other light industry products, and white salt. Since 2008, the Interbank Currency Exchange of Turkmenistan has been functioning, where trading for the purchase and sale of foreign currency is held.

This exchange is a structural division of the Central Bank, and in practice there is no market of corporate and government bonds.

In recent years, laws that regulate activities on the securities market and the creation of market institutions have been adopted. Thus, in 2014 new laws "On Securities and Stock exchanges in Turkmenistan" and "On commodity-raw material exchanges and exchange trading" came into force, which allocate the mechanism of state regulation of exchanges' activity [46].

The state program for the development of the securities market has been approved, and the rules of issue and conditions for admission to the circulation of securities issued by foreign issuers on the local market have been established. The Ministry of Finance plans to issue state stock bonds with a maturity of up to five years. Specific measures have been taken to create a stock exchange, develop its instruments, and attract a wide range of investors. This will allow the creation of a stock market and the use of effective financial instruments.

Turkmenistan is expanding cooperation with international financial and economic institutes. In foreign policy, the predominance of the Eastern vector is noticeable, and China is becoming the main partner of Turkmenistan. Of all the Central Asian countries, Turkmenistan is the most committed supporter of the Chinese Silk Road Economic Belt project as a new model of regional cooperation.

3.4 The Formation of the stock market in Kazakhstan

Kazakhstan is a country with a limited internal market, and suffers from the effect of a "resource curse," i.e., the abundance of resources (oil in particular) hinders the implementation of reforms and the development of institutes [47]. This negative impact is not because of the availability of natural resources, but is due to the dominance of raw material branches in the national economy. Therefore, the country's financial capabilities depend on the global prices of resources and the exchange rate of the national currency.

Unfortunately, the oil rent does not allow the country do anything other than develop it. Kazakhstan does not use natural resource rent independently. Most of the hydrocarbons and financial resources are controlled by multinational companies. The presence of China in the oil industry causes discontent among the population, as the Chinese actively invest in infrastructure projects and invest in the acquisition of small companies [48]. As a result, Kazakhstan has at its disposal approximately 20% of the revenues from oil exports. High GDP dynamics are transformed not into the development and diversification of the economy, but into the profits of participants of international consortia.

The quasi-public sector has a strong influence on the economy, and its purchases amount to approximately US$10.5 billion. In the financial sector it accounts for 32% of all funds of the population and legal entities placed in banks. Therefore, attempts to diversify the economy and develop other branches have so far yielded weak results [49]. Rates of Global Competitiveness for 2017–2018 give an idea of the state of the country's financial market. In general, the financial market is in 114th place out of 144 countries

[50]. The "Regulation of securities exchanges," "Soundness of banks," and "Financing through local equity market" have particularly low rates (Table 4).

Table 4. *Rates of competitiveness of the financial market of Kazakhstan, 2017–2018*

No.	Rates	Place	Score
1	Availability of financial services	95	3.8
2	Affordability of financial services	95	3.4
3	Financing through local equity market	108	2.9
4	Ease of access to loans	98	3.4
5	Venture capital availability	102	2.5
6	Soundness of banks	114	3.8
7	Regulation of securities exchanges	117	3.4
8	Legal rights index 0–10 (best)	85	4.0

Source: [50].

Despite these negative characteristics, the overall state of the securities market is encouraging [51], and the total trading volume on Kazakhstan Stock Exchange (KASE) in 2018 was US$456 million (Table 5). The stock market and the "Securities of investment funds" sector constantly demonstrate positive dynamics. The securities of 383 names of 151 issuers were available for trading on the exchange, and the Central Depository has approximately 110 thousand personal accounts opened by individuals. The capitalization of the KASE stock market is constantly growing, which is associated with the expansion of the list of companies.

Some "blue-chip" securities in Kazakhstan are listed on the London Stock Exchange (LSE). In 2005, the first Kazakhstani companies to enter the LSE were KAZ Minerals and KazakhGold – the two largest producers of copper and gold in the country [52]. KAZ Minerals placed 26.2% of their shares at a price of £5.4 per security, and raised £661.4 million or US$1.117 billion. By the end of 2005, the share price had risen to £7.74, and the company itself was included in the leading index of the Financial Times Stock Exchange 100 (FTSE 100). The stock price continued to grow for several years, and is currently valued at £630. The KazakhGold company managed to attain more than US$196 million by selling 25% of their shares at US$15 per share. In 2012, the company was delisted due to its takeover by PolyusGold, which became the owner of 93% of the capital [53; 54].

Table 5. *Trading volume on the KASE market in 2017–2018, millions of US$*

No.	KASE market	2018	2017
1	Securities market, including:	10,382.5	3,954.2
	Shares	810.6	752.9

No.	KASE market	2018	2017
	Corporate securities	3,471. 9	1,526.8
	State securities of the Republic of Kazakhstan (SS)	5,894.1	1,672.7
	Bonds of the Ministry of Finance	121.0	0
	Securities of investment funds	3.3	1.5
2	Foreign currency market	37,076.1	31,519.3
3	Money market, including:	408,408.5	249,040.1
	Repurchase agreement operations	222,038.9	171,858.7
	Currency swap transactions	186,369.6	77,181.4
4	Derivatives market	66.5	0.3
	Total trading volume	455,933.3	284,513.3

Note: conversion TO DOLLARS WAS MADE AT THE CORRESPONDING RATE OF 2017, 2018.
Source: [51].

In 2007, the Eurasian Natural Resources Corporation (ENRC) transferred 252.5 million new shares, or 20% of its share capital, to the LSE. Despite the onset of the global crisis, the share price showed an increase from £5.4 to £15.3 within six months. However, since 2010 the mining giant has been hit by a series of public scandals, after which the share price as of April 2013 was estimated at just £2.70. The company's delisting from the LSE was also accompanied by a scandal, and the owners of freely traded shares were unhappy with the proposed share repurchase price of £0.51.

In 2018, the largest uranium producer in Kazakhstan, Kazatomprom JSC, was listed. The National Welfare Fund Samruk-Kazyna, which owns the company, offered investors on the stock exchanges in London and Astana 15% of their shares, with a total value of US$451 million. Demand exceeded stock offering by 1.7 times [54; 55], and the initial price of the share of US$11 rose by a quarter, meaning that the state attained a 25% increase in the company's shares. In emerging markets, liquidity is usually 30–40%, in this case it was 60–80%.

However, the domestic stock market is not sufficiently developed. The portion of stock trade in total volume is only 8%, which is 2.375 times less than the volume of stock trading included in the FTSE 100 index. In addition, shares of some companies on the official list are not available on the market, among which are the securities of the largest firms that are leaders in Kazakhstani economy. The share of the secondary market in the turnover of the stock exchange is small and continues to decline. The main problem here is the predominance of contractual transactions. By presidential Decree of April 12, 2011, the Agency for regulation and supervision of the financial market and financial institutions was abolished, with the transfer of functions and powers to the National Bank. On May 14, 2019, Deputy Chairman of the National Bank Oleg Smolyakov said that it was decided to re-establish an independent body for the control and supervision of the

financial market and financial institutions. The Agency and KASE are taking measures to combat direct transactions, but their prevalence in the present remains high [56].

IPO market activity is low. Thus, approximately 7,000 large and medium-sized private companies and 1,000 large state-owned companies operate in Kazakhstan. At the same time, the KASE listing includes the shares of only 140 companies. Most transactions are made with the securities of a very limited number of issuers (about 10), mainly from the banking and mining sectors.

Experts writing in the *Financial Times* believe that Kazakhstani IPOs have rather high risks in case of change of ownership, privatization of enterprises, uncertainty of rate regulation, etc. [57; 58]. The goals of the "People's IPO" were to establish new standards of corporate governance and neutralize the consequences of dubious privatization procedures in the 1990s, when business groups with which the ruling family of Kazakhstan was closely linked seized control of oil, metals, and financial assets. Currently, in the atmosphere of political dispute and discussions about this issue, the authorities are promoting the idea of public participation in the IPO. However, most people lack the necessary money and skills needed to invest in the local stock market.

A peculiarity of the development of the financial system of Kazakhstan is the uneven concentration of financial resources, which are mainly focused on the extractive industry and in two megacities – Almaty and Nur-Sultan. Investors often lack reliable and liquid instruments, and the real sector of the economy has not had enough investments to expand and develop its business. This problem is related to the reluctance of issuing companies to enter the stock market by placing their shares among third parties. Their entry would allow for the diversification and loading of the Kazakhstani securities market, as well as the attraction of investments to these companies.

Over time, great hopes were put on the Regional Financial Centre Almaty (RFCA) [59]. The program included a system of innovations in and improvement of the investment climate, and the transformation of the center into a leading site of Central Asia. However, the domestic market became an "appendage" of developed financial centers and was bypassed by internal investments into foreign markets.

In trying to change this situation, the government has created the Astana International Financial Center (AIFC), where the Astana International Exchange (AIX), a mortgage company, and insurance companies will be located. Banks, micro-credit institutions, Islamic Financing institutions, and others will open their offices, and all documentation will be maintained in English for easier integration into the global stock market. The strategic goal is to create a competitive financial hub that meets international standards, and that might enter into the top ten financial centers of Asia [1].

Thanks to AIFC, the stock market ecosystem has been built. For investors' access to the exchange, 21 brokers provide services, among which are representatives of the UK, Eastern Europe, Russia, Hong Kong, and China. NASDAQ is one of the AIFC's shareholders, and it has provided the trading platform. Today, AIX lists government securities, Eurobonds of the national railway carrier, bonds of private and quasi-public companies, shares, and global depositary receipts of domestic joint-stock companies. Kazakhstani companies have good experience in corporate business, but because of the

small market there are no large turnovers, so it is advisable to secure a footing in foreign markets, primarily in Central Asia, the EAEU, and the CIS.

3.5 The Domestic Stock Market: One of the Versions of Development

In our view, the future competitiveness of Central Asian economies will be determined by the level of development of the national stock market. In turn, the state depends on foreign direct investments, portfolio investments, and internal business environment – i.e., the stock market must be supported by domestic economic agents including domestic enterprises, business structures, and population. Today, the population, the so-called small investors, are practically not involved in the securities market.

The money market and the foreign exchange market mainly prevail in the stock market of Kazakhstan. The volume of trading in the primary market of government securities reached US$5.894 million, of which US$260 million were raised by the executive bodies of 14 regions at 0.35% per annum, within the framework of the state program of housing financing. The share of municipal bonds is about 4.5%, while in world practice it is much higher: in the USA – 11.5%, in France – 6.6%, in Japan – 6%, and in Russia – 6% [60–62].

It is important to note that municipal bonds have already appeared on the securities market as a one-time action to solve local problems. In 1999 they were first issued in the West of Kazakhstan in the Mangystau region, and the regional Akimat (local authority) became the first executive body in Central Asia to receive a credit rating from Fitch [63; 64]. Later the municipalities of the city of Almaty, the city of Astana, and the Atyrau region placed their loans on KASE.

However, this experience proved to be of little use since a limited problem was solved: investing in gas supply, water supply, and road construction. There were no truly innovative projects, and no funds from enterprises, financial structures, or household savings were used. Currently, the programs of "Affordable housing" and "Credit housing" are being implemented, but only the quasi-state National Managing Holding "Baiterek" participates in them, buying shares of local executive bodies.

To change this situation, we have proposed the launch of a municipal bond market for investing in socially significant programs in the regions, using the Turkestanskaya region – Kazakhstan's largest – as an example. As part of the study, the authors selected projects on infrastructure, domestic tourism, the processing of agricultural products, and creating effective clusters. These projects have not been implemented due to a lack of funding, but they are of great importance for the population of the region. Analysis of the resource capabilities of banks, financial institutions, and business structures of the region for participation in the formation of the stock market has been conducted. The volume of municipal bonds' issuance is set at US$110 million, which is 7% of the region's annual budget.

A sociological study was conducted by means of questionnaires and interviews with specialists, experts, and select groups of the population in order to identify the possibilities of using spare money to buy municipal bonds [65]. A scheme of business-processes for organizing the issue and circulation of municipal bonds without using budget funds

has been developed. Calculations of bond yield and comparative analysis of them with corporate and government securities prove the practicality of their issue for building the stock market of the region. As of today, some of our proposals have been accepted by the local authorities for study with further implementation.

To strengthen the financial constituent of the region's economy, it is proposed to back up the issue of bonds with the tax load of local authorities or by municipal property. The Unified Pension Fund has huge resources, and it is not incidental that the media is constantly discussing its use. In recent years, the Government has twice voluntarily allocated significant funds from this Fund to support the liquidity of two or three large banks, although all banks in the country are private and operate within the same legal framework.

The insurance sector, which has total assets of more than US$2.5 billion, or 1.9% of GDP, also displays interest in municipal bonds [66], as the survey showed that they were ready to invest in them. What benefits could the financial market receive? This is primarily the launch of instruments to stimulate the regional economy which meet the interests of the population, stimulate entrepreneurship, and involve local authorities as active players in the stock market.

4. Conclusions

1. The analysis showed that Central Asian countries are developing unevenly, and the existing prerequisites for regional integration were not employed. The main indices that reflect the progress of reforms, the state of scientific and technological development, and the ease of doing business display weak dynamics. These countries are relatively small in number, and the size of their economies is not very attractive to investors. In order to be more competitive in comparison with other countries of Asia, the Caucasus, and the Middle East, it is advisable for the states of the region to present themselves as a single economic territory.
2. The limited size of the domestic market, imperfect banking regulation, and the dependence of credit institutions on administrative intervention create difficulties for investors. Central Asian countries should collectively move towards improving the state regulation of financial markets, creating a business environment, and building a pool of local investors. It is also necessary to increase the trade–transport connectivity of the countries.
3. Kazakhstan is one of the countries with a limited domestic market, and financial opportunities depend upon world prices for resources. Despite the progress of reforms, investors lack reliable and liquid instruments, and the real economy does not have enough investment to expand business. Issuing companies are encouraged to actively enter the stock market, diversify and load the Kazakhstani securities market, and attract both business structures and the population to it. It is recommended to launch a municipal bond market for investing in socially significant programs in the regions.
4. Central Asian countries will benefit from financial integration. Usually, stock markets win based on the size of the economy, which reduces the expenses and cost of financial

products and develops competition. Regional financial schemes will allow countries to implement interstate projects in the fields of energy industry, water resources, logistics, agriculture, etc. The harmonization of business practice with regulatory systems of the banking and financial sectors will strengthen the investment potential of countries, accelerating the formation of the domestic stock market. All of this will contribute to closer cooperation between the Central Asian States and the free movement of goods, services, capital, and labor.

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MODEL SCENARIOS OF SUSTAINABLE DEVELOPMENT STRATEGY IN THE FORMULATION OF MECHANISMS FOR ENTERPRISE SUPPORT RESOURCES

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Abstract: *In this article we have considered methods of information and analytical support used in the formulation of a sustainable economic development strategy for industrial enterprises. The purpose of this study is the methodological and applied justification for choosing a scenario for sustainable development in the system of strategic management of industrial enterprises in order to improve their performance indicators, competitiveness, and social responsibility. We have offered a methodical approach for the criterion assessment of qualitative, quantitative, and financial indicators of both the enterprise and the external environment's strategic potential. Analysis of enterprise management systems has been carried out on the basis of calculations taking into account the national program of sustainable development, and a further strategy for the development of industrial enterprises has been offered. It is substantiated that, to form effective strategies aimed at ensuring sustainable economic development, an analytical system of support for strategic decisions is needed. One of the components of such a system is a set of adequate mathematical models that will determine the key factors of the internal environment at an enterprise that affect its sustainable development. Its usage in practice will allow for the optimization of costs in functional areas when developing corporate decomposition strategy, and will allow for the building of determining factor models, the reflection of the relationship between key indicators, the compilation of forecast reports, and the performing of both situational and sensitivity analysis.*

Keywords: *strategy, sustainable development, model, management decisions, industrial enterprises, efficiency.*

JEL: *G1*

Introduction

Presently, we consider to be essential the procedures for assessing the options for (or choice of) development strategy based on the results of complex informative experimental research conducted on the basis of several dynamic economic and mathematical models. These procedures are characterized by the direct participation of decision-making justification in modeling research, using computational procedures through balancing the combination of an experimental computer modeling approach with different analytical methods and approaches. These include: expert and intelligent systems; logistical approaches; and simulation–optimization (iterative) computational procedures, and are integral components of analytical tools of theoretical and applied economics.

At the same time, the study of management systems internationally has shown that managers and analysts of many companies compile not only financial statements for the last year, but also projected financial statements for several years. These documents are intended for both internal planning and for provision to external users.

Methods

The principles of forecasting are classified into three groups of methods (Velesko and Loginov 2001): extrapolation, modeling, and expert judgment. Methods of extrapolation (least squares, moving averages, exponential smoothing, etc.) are based on statistically justified trends in the changes of certain quantitative object characteristics. Extrapolation methods are the most common among all methods of economic forecasting (Velesko and Loginov 2001). Extrapolation is defined as a way to find function beyond the area of its definition, using information about this function's behavior from points within its defined area.

Modelling methods use techniques of structural, network, and matrix modelling, amongst others. They make it possible to use selected models to obtain financial forecast indicators.

Expert judgement methods are informal methods, and are used in cases where it is impossible to take into account the impact of many factors due to the significant complexity of forecasting objects. When formalized forecasting methods cannot be applied, it is necessary to use the knowledge and experience of experts (Velesko and Loginov 2001).

Forecasting by using the percentage of sales method is to increase (or decrease) indicators of income from the sale of products (works, services), balance sheet items, and statements of financial performance (except those that do not depend on changes in sales) by the same percentage. Predictions regarding the direct dependence on income

change because of sales rates, and other items should be verified on the basis of empirical data (Gontareva 2011; Chorna, Zhuvagina, and Filipishyna 2014).

Forecasting by using the regression method (provided there is a linear or nonlinear dependence between indicators that are predicted) makes it possible to obtain the future value of a performance indicator, which is a random variable, depending on the change of one or several indicators.

Forecasting based on the method of normative coefficients aims to obtain an optimal balance sheet and statement of financial performance, based on indicators such as equity capital profitability, or liquidity. This forecast is used to assess those changes in assets and sources of their formation that need to be made in future to achieve optimal profitability and a stable financial condition. The method of preparing projected financial statements based on normative coefficients is widely used by enterprises whose management is based on the concept of strategic control (Velesko and Loginov 2001; Gontareva 2011; Gonchar 2014; Nazarova et al. 2020).

In cases when the forecast of financial statements is based on future management decisions, it is useful to use the method of regulation of items. In this case, the percentage of sales method, regression equations, or normative coefficients cannot be applied, as they will lead to inadequate forecasting. Strategic management decisions can radically change the current structure of a balance sheet, and lead to a temporary reduction in profitability if there is a need for technical re-equipment, research and development, etc. Forecasting based on the regulation of items is used when enterprise administration makes significant, sometimes far from optimal in a financial context, management decisions that are strategic and might be linked to self-preservation in the context of further competition.

The variety of methods for preparing sustainable development programs is determined by users' needs for strategic information, and enterprise leaders are the main among them (Koval et al. 2020). Forecast reports reflect an administration's ideas about future enterprise operation by considering possible changes in economic, social, political, legal, and competitive conditions, and model how they will influence the key indicators of sustainable development of an industrial enterprise (Shmygol et al. 2020). Professionals involved in the preparation of information for strategic decision-making should have the basic tools to create, process, and analyze forecast reports in conditions of uncertainty. The ability to prepare projected reports and choose an optimal strategy for sustainable development for the future is the main factor in avoiding mistakes in business, and the basis for managing the financial and investment activities of an enterprise (Koval, Kovshun et al. 2019).

Results

The sustainable economic development of industrial enterprises requires the formulation of a decision-making system aimed at ensuring effective development. The formulation of such decisions requires high-quality informational support for the sustainable development of a business entity. Improving the process quality of developing strategy components is the basis for ensuring the sustainable development of economic

subsystems (Yeshchenko, Koval, and Tsvirko 2019). The study of economic systems is carried out by using methods of economic analysis, which allow for the creation of an effective basis for modeling sustainable economic development at industrial enterprises (Yankovyi et al. 2019).

For forecasting, it is proposed to use the method of multiple regression, which will make it possible to identify the degree of relationship between indicators and to make predictions over time. It will also serve as the basis for monitoring the strategic climate and the strategic potential of an enterprise for readiness, and the ability of a business entity to carry out activities in compliance with the principles of sustainable development (Baklanova, Petrova, and Koval 2020).

The main criteria for selecting factors are the accuracy, reliability, and efficiency of obtaining information, as well as the ability to predict them. Based on these requirements, we have selected as result indicators (Y) the following groups of financial performance indicators to build the model, where:

EFI_1 – Total value of assets, UAH million
EFI_2 – Receivables, UAH million
EFI_3 – Accounts payable, UAH million

As internal factor indicators (X), we have selected indicators of economic activity:

EII_1 – Fixed assets, UAH million
EII_2 – Production volume, UAH million
EII_3 – Costs per 1 UAH of marketable products, kopecks
EII_4 – Net income, UAH million
SI_1 – Average number, thousand people
SI_2 – Average monthly salary, UAH
SI_3 – Productivity, UAH

Taking into account that enterprises are influenced by both internal and external factors, it is recommended that this analysis is carried out according to several external indicators (Z):

FE_1 – Prices for raw materials, UAH / unit
FE_2 – Prices of marketable products, UAH / unit
FE_3 – Export ratio, %
FE_4 – Inflation index, %

To explain the variation of effective feature y in statistical reports of the years 2004–2016 (Orekhova 2013; Schumpeter and Backhaus 2003; Danilov-Danilyan 2003), we have chosen m of factorial features

$$x_1,x_2,\ldots,x_5,i= 1...5: (y_i,x_{1i},x_{2i},x_{3i},x_{4i},x_{5i}),i=1,2,\ldots n.$$

The relationships between features are given by a correlation matrix consisting of paired correlation coefficients:

$$Q_{m+1} = \begin{array}{c|cccccc} & y & x_1 & x_2 & x_3 & x_4 & x_5 \\ \hline y & 1 & r_{yx_1} & r_{yx_2} & r_{yx_3} & r_{yx_4} & r_{yx_5} \\ x_1 & r_{x_1y} & 1 & r_{x_1x_2} & r_{x_1x_3} & r_{x_1x_4} & r_{x_1x_5} \\ x_2 & r_{x_2y} & r_{x_2x_1} & 1 & r_{x_2x_3} & r_{x_2x_4} & r_{x_2x_5} \\ x_3 & r_{x_3y} & r_{x_3x_1} & r_{x_3x_2} & 1 & r_{x_3x_4} & r_{x_3x_5} \\ x_4 & r_{x_4y} & r_{x_3x_1} & r_{x_4x_2} & r_{x_4x_3} & 1 & r_{x_4x_5} \\ x_5 & r_{x_5y} & r_{x_5x_1} & r_{x_5x_2} & r_{x_5x_3} & r_{x_4x_5} & 1 \end{array}$$

It is possible to set a random paired correlation coefficient r_{yx_i}. between each pair of features (Oleinik 2000):

$$r_{yx_i} = \frac{\sum_{i=1}^{n}(x_i-\bar{x})*(y_i-\bar{y})}{n*S_x*S_y} \quad (1.1)$$

where $\bar{x}$, $\bar{y}$ are the average values of factorial and effective features; and S_x, S_y are the average squared deviations of factorial and effective features.

When conducting this research, we took into account that, when calculating paired correlation coefficient r_{yx_i}, all of the explained variations of effective feature *y* depend on the change of factorial feature x_i. It should be noted that this statement will be true if feature x_i does not correlate with other factorial features. However, as is noted by some scientists (Oleinik 2000), such cases in statistical practice are extremely rare and, as a rule, paired correlation coefficients between factorial features are different from zero. In this case, variation of feature *y*, found by calculating r_{yx_i} through variation of feature x_i, is actually due to the influence of several features that correlate with each other.

To identify the "pure" influence of x_i on *y,* we will conduct such a choice when all factorial features except x_i achieve fixed values. The correlation coefficient, calculated under such conditions, reflects closeness of correlation only between *y* and x_i, so that the influence of other features on *y* is excluded. This correlation coefficient is called 'sample', and is denoted as $r_{yx_i/x_1,x_2,\ldots,x_m}$ (Oleinik 2000; Filipishyna et al. 2018). An index before a fraction indicates a pair of features that correlate with each other, and an index after a fraction *(m-1)* indicates factorial features which get fixed values.

Sample correlation coefficients are calculated using correlation matrix Q_{m+1}, by the formula (Oleinik 2000):

$$r_{yx_i/x_1,x_2,\ldots,x_m} = \frac{A_{1,j+1}}{\sqrt{A_{1,1}*A_{i+1,i+1}}} \quad (1.2)$$

where $A_{i,k}$ is an algebraic determinant of the correlation matrix element located at the intersection of the *i*-row and the *k*-column of the matrix.

Correlation coefficients between effective and factorial features are calculated when conducting research on sample statistics, therefore any statistical indicator and correlation coefficient can be defined with some error. In this regard, there is a need to verify the significance of the correlation coefficient calculated on the basis of sample data. It is known (Oleinik 2000) that a sample correlation coefficient is considered significant if conclusions about the presence and nature of correlation, made on the basis of the sample, are valid for the general population.

Testing the significance of paired correlation coefficients is carried out taking into account known criteria (Oleinik 2000): if $|t_{x_i}| > t_{K_a}$, then the correlation relationship between variables is considered significant. If $|t_{x_i}| \leq t_{K_a}$, then the difference between sample correlation coefficient r_{yx_i} and a correlation coefficient which is equal to zero is insignificant, and the difference of r_{yx_i} from zero is explained by the random nature of data selection. According to the research results, taking into account above criteria, the significance of correlation coefficients r_{yx_1}, r_{yx_2}, r_{yx_3}, r_{yx_4}, r_{yx_5} was established. Recognizing the significance of correlation coefficients, according to the accepted level of significance, it can be stated that error probability will not exceed 0.05, because the calculated values of statistics t_{xi} are higher than the critical value $t_{K,a}$.

The second test of the significance of paired correlation coefficients involves defining the critical value of correlation coefficient r_{kp}. In particular, it is known (Oleinik 2000) that the critical value of students' statistics $t_{K,a}$, corresponds to the critical value of the correlation coefficient r_{kp}:

$$t_{kp} = \frac{t_{K,a}}{\sqrt{t^2_{K,a}+K}}, \tag{1.3}$$

In the case of $|r_{yx_i}| > r_{kp}$, then the sample correlation coefficient is significant, otherwise the hypothesis of insignificance of difference between r_{yx_i} and the correlation coefficient of the general population is accepted.

We set the value of the critical correlation coefficient r_{kp}. = 0.58, depending on the number of degrees of freedom of *K* at the level of significance *a* = 0.05 (Oleinik 2000). In the second test, using comparison of the paired correlation coefficients with the critical value of the correlation coefficient, we can consider the correlation coefficients r_{yx_1}, r_{yx_2}, r_{yx_3}, r_{yx_4}, r_{yx_5} significant. We check the significance of sample correlation coefficients in the same way, but the number of degrees of freedom is defined by the formula (Oleinik 2000; Filipishyna et al. 2018):

$$K = n\text{-}m\text{-}1, \tag{1.4}$$

where *n* represents the number of calculated levels and *m* the number of feature factors.

The decision to form variety *D* – the great number of factorial features used to explain the effective features and build an adequate regression model – is based on the comparison of calculated feature *F*-inclusion with its minimum table value. If the calculated value of

F-inclusion for factorial feature x_i is higher than the minimum, then the corresponding factorial feature will be included in variety *D*.

It is also necessary to define the value of *F*-inclusion F_{yx_i}, *i*= 1,2,...,5 on the first row of the correlation matrix (Oleinik 2000):

$$F_{yx_i} = r^2_{yx_i} * (n-2)/(1-r^2_{yx_i}) \quad (1.5)$$

According to the research results, it is established that each calculated value of *F*-inclusion is higher than the table minimum of *F*-inclusion. Thus, the condition $F_{yx_i} > F^{\text{табл}}_{\text{вкл}}$ is fulfilled, which allows us to draw a conclusion about the possibility of explaining the variation of effective feature *y* and construct an adequate mathematical model.

To form variety *D*, it is necessary to define the possibility of including a variety of other factorial features which are given in Table 1. For this purpose, using separate correlation coefficients we define the corresponding values of *F*-inclusion (Oleinik 2000):

$$F_{yx_i/x_j} = r^2_{yx_i/x_j} * (n-3)/(1-r^2_{yx_i/x_j}) \quad (1.6)$$

The results of these calculations are given in Table 1 and Table 2.

Table 1. *Internal factors' impact on the effectiveness of the financial indicators of industrial enterprises' activity in Ukraine.*

	Solvency ratio for internal factors	Financial stability index	Ratio of debt to net worth	Debt ratio	Quick liquidity ratio	Cash ratio	Terms of receivables	Profitability of sales	Working capital return time
Rental production	0.2583	0.2543	0.277	0.4318	0.4097	0.5468	-0.387	0.6181	-0.256
Costs per UAH 1 of marketable products, kopecks	-0.548	-0.481	-0.639	-0.53	-0.456	-0.59	0.5389	-0.94	0.3848
Number	0.7614	0.7086	0.5445	0.4011	0.2643	0.5106	-0.649	0.443	-0.637
Productivity	-0.758	-0.634	-0.465	-0.261	-0.131	-0.279	0.6049	-0.236	0.6548
Average salary	-0.506	-0.353	-0.405	-0.04	0.0309	-0.139	0.4161	-0.438	0.3245
Net profit	-0.37	-0.232	-0.289	-0.053	-0.004	-0.09	0.2017	-0.313	0.1175
Receivables	-0.736	-0.535	-0.419	-0.196	-0.061	-0.255	0.8162	-0.343	0.8232
Accounts payable	-0.817	-0.603	-0.607	-0.406	-0.285	-0.342	0.6898	-0.463	0.6655

Table 2. *External factors' impact on the effectiveness of financial indicators on industrial enterprises' activity in Ukraine*

		Solvency ratio for internal factors	Financial stability index	Ratio of debt to net worth	Debt ratio	Quick liquidity ratio	Cash ratio	Terms of receivables	Profitability of sales	Working capital return time	Receivables and accounts payable ratio
Prices of raw materials	Iron ore	-0.86	-0.63	-0.61	-0.22	-0.11	-0.38	0.58	-0.66	0.44	0.02
	Sintering ore	-0.87	-0.64	-0.62	-0.22	-0.10	-0.35	0.50	-0.60	0.35	-0.02
	Concentrate	-0.86	-0.63	-0.65	-0.23	-0.13	-0.35	0.46	-0.61	0.29	-0.07
	Steel pellet	-0.88	-0.59	-0.64	-0.20	-0.11	-0.31	0.46	-0.60	0.32	-0.09
	Natural gas, t/m^3	-0.90	-0.66	-0.79	-0.31	-0.19	-0.46	0.62	-0.82	0.45	-0.07
	Electric energy t/kWh	-0.88	-0.64	-0.73	-0.23	-0.11	-0.39	0.58	-0.76	0.43	-0.01
Rental prices	Domestic market	-0.87	-0.61	-0.63	-0.18	-0.07	-0.32	0.50	-0.62	0.36	-0.01
	Foreign market	-0.85	-0.58	-0.59	-0.13	-0.02	-0.29	0.50	-0.58	0.38	0.02

Based on the developed methodology of selection of the most influential factors using a step-by-step procedure, we have formed the variety from the following seven internal factorial features and four external factorial features: $D = \{EII_2, EII_3, EFI_2, EFI_3, SI_1, SI_2, SI_3, FE_1, FE_2, FE_3, FE_4\}$, which includes internal and external factors. For the mathematical description of an industrial enterprise's functioning, we have used indicators of the enterprise's financial stability as an effective feature. This study confirms the previous hypothesis that, at the present stage of industrial enterprises' development, the strategic climate requires constant attention and forecasting.

A methodical approach for formulating the variety of factorial features has been developed, helping to build a multifactorial regression model of an industrial enterprise's economy and to establish a relationship between indicators of financial stability and factors.

An analytical system for the support of strategic decisions is needed in order to formulate effective strategies aimed at ensuring sustainable economic development. One of such a system's components is a set of adequate mathematical models that describe the complex process of an industrial enterprise's functioning. The economic relationship between features for the general population can be described by linear or nonlinear functional dependence. To identify this relationship, a sample of volume n was carried out according to statistical reports of the years 2006–2012 (Schumpeter and Backhaus 2003; Danilov-Danilyan 2003; Filipishyna et al. 2018):

$$(y_i, x_{1i}, x_{2i}, x_{3i}, x_{4i}, x_{5i}),\ i=1,2,\ldots n. \tag{1.7}$$

Defining the parameters of the mathematical models is carried out using the method of least squares (Oleinik 2000).

In particular, to define the parameters of linear functional dependence:

$$y_i = a_0 + a_1 * x_{1i} + a_2 * x_{2i} + a_3 * x_{3i} + a_4 * x_{4i} + a_5 * x_{5i} \quad (1.8)$$

The practical implementation of the developed algorithm, as well as the complex testing of the obtained models' accuracies, is performed using the Excel analysis package. To assess the accuracy of the multifactorial models obtained and the economic relationships between effective features and the factors, we have used the value of residual variance (Oleinik 2000; Filipishyna et al. 2018):

$$S^2_{зл} = \frac{\sum_{i=1}^{n}(y_i^{пч} - y_i)^2}{n-(m+1)} \quad (1.9)$$

where $y_i^{пч}$, y_i represent, respectively, the initial (empirical) and theoretical values of the effective feature;

n – amount of data in the sample;

m – number of factors;

m+1 – number of parameters in regression equation.

In order to compare and evaluate the models' accuracies, we also use a value of average approximation error (Filipishyna et al. 2018):

$$|\bar{e}| = \frac{1}{n} * \sum_{i=1}^{n} \left| \frac{y_i^{пч} - y_i}{y_i^{пч}} \right| * 100\% \quad (1.10)$$

The model for which the value of residual variance and the value of average approximation error is smaller is more accurate, because there is less scattering of effective features relative to conditional mathematical expectation.

When building a model to prevent multicollinearity, it is necessary to exclude those variables that are closely related. After determining regression coefficients, the regression equation takes the following form (Table 3).

Table 3. *Consolidated matrix of pairwise regression*

Indicator	Internal factors			External factors		
	EII2	EII3	EII4	FE1	FE3	FE4
Equity ratio		-0.76	0.76	-0.91	-0.95	-0.90
Stability ratio			0.71	-0.77	-0.82	-0.76
Sales ratio	-0.94			0.82	0.90	0.81

According to the results of the research conducted at metallurgical enterprises in the period of 2001–2018, a decision-making model for sustainable development was ob-

tained, considering the influence of internal factors on an industrial enterprise (Chorna, Filipishyna, Nord et al. 2019; Table 4).

Table 4. *Decision-making model for sustainable development considering the influence of internal factors on an industrial enterprise*

Indicator	Model	MR	R^2
Equity ratio	$EFI1 = 1.77\text{-}0.0415EII_2\text{-}0.77EII_3\text{-}3.95SI_2 + 0.0772SI_3$	0.82	0.67
Stability ratio	$EFI2 = 25.51\text{-}1.12EII_2\text{-}14.14EII_3\text{-}113.41SI_2 + +0.22SI_3$	0.83	0.69
Sales ratio	$EFI3 = 0.0229\text{-}0.6EII_2 + 2.59EII_3 + 17.66SI_2\text{-}$ $\text{-}0.046SI_3$	0.86	0.73

It should be noted that the introduction of these forecasting methods will contribute to the further development of the "enterprise – state" interaction system (Petrova et al. 2020). The study showed that some enterprises have had a positive impact on the implementation of measures to improve production structure, with a reduction in employee numbers. This is especially evident against the background of large, city-forming enterprises. For enterprises, this is definitely a positive factor. For regions where enterprises are located, and for the state as a whole, these are negatives. Reducing the number of employees leads to:

- the reduction of revenues in local budgets in the form of personal income tax; reduction of revenues in social funds;
- the increase of payment costs to temporarily unemployed citizens in accordance with applicable law.

Therefore, the state as a whole and local governments may increasingly face the problem of taking into account the forecast indicators of enterprises and the implementation of measures that could offset the negative social consequences of reducing the numbers of employees at enterprises.

Such measures may include:

- the creation of new jobs at the expense of state or local budgets. At the same time, it is possible to establish small separate enterprises producing consumer goods, enterprises processing industrial waste (Ciuła et al. 2019; Koval, Mikhno, Hajduga et al. 2019), enterprises providing services to population, etc.;
- the conclusion of prior agreements with enterprises regarding the creation of new jobs, including production (or the provision of services) using technology that is not traditional for these enterprises. At the same time, in order to interest enterprises in creating new jobs, investments from state or local budgets may be attracted, or tax benefits may be provided.

One positive factor for most financial indicators is the growth of rental production during this period of analysis. However, despite the fact that there is an increase in rental production and a decrease in the number of employees, labor productivity is negative. This happened due to the influence of external factors. Firstly, metal prices decreased.

The most negative effect of the decline in prices was made on the financial indicators of enterprises classified in strategic "large" and "major" groups. Most of these enterprises are part of vertically integrated financial and industrial companies. Along with the deterioration of the economic situation in the ferrous metals market, the level of sales prices for enterprises' products has also been badly influenced by the fact that enterprises under such integration have lost their independence, including with the sales of manufactured products. Vertically integrated financial and industrial companies operating in Ukraine own the main block of shares of almost all metallurgical enterprises.

Which factors can the state use to effectively influence the activities of metallurgical enterprises under such conditions? The final result of such an impact should be the improvement of indicators and a corresponding increase in budget revenues. There can neither be any reforms, nor reprivatization, as in this case Ukraine would lose any assistance from foreign, and perhaps domestic, investors (Filipishyna et al. 2018).

One of the most effective state measures for enterprises' activities, including within the metallurgical industry, may be the intensification of domestic market activity, including metal consumption and the improvement of market infrastructure.

State measures for the development of the domestic market and the support of domestic producers might be different, including the following:

- state orders for certain types of products or services, the production or provision of which can boost domestic market activity in general. Financing of such state orders can be provided both at the expense of budgetary funds, and on a parity basis;
- state initiation of intersectoral agreements for the production of certain types of products or goods, and state support for such production by providing soft loans with an annual rate not more than the National Bank of Ukraine refinancing rate;
- providing tax benefits for the period of preparation and development of the production of goods that are needed in the domestic market of Ukraine;
- providing changes to current tax legislation, including:
  a) a reduction of the VAT rate of not more than 10% for all products or services of an industrial purpose, and which are produced for domestic market consumption;
  b) an obligatory VAT payment within the period prescribed by law when importing groups of goods, the production of which is sufficient in the domestic market of Ukraine, into the customs territory of Ukraine;
  c) VAT charges to the customs value of exported goods, if these goods have wide domestic demand and their export causes artificial deficit.

Among external factors that affected the effectiveness of financial indicators most negatively were price increases for natural gas and electricity. A highly negative impact of these factors are not only significant price increases for these energy types, but also a high level of production energy intensity (Koval, Sribna, and Gaska 2019; Koval, Sribna, Mykolenko et al. 2019). In total, these two energy sources account for almost 20% of the total production costs of metallurgical manufacture, with natural gas alone comprising almost 12%. The energy intensity of one ton of steel production in Ukraine is 11.6% higher than the world average. Metallurgical manufacturers, as well as enterprises from other industries, face the problem of reducing production energy intensity. This is not

only a factor in increasing the competitiveness of Ukrainian producers, but also in ensuring the sustainable economic development of Ukraine (Kostetska et al. 2020).

Using the methods of this methodology for assessing the impact of factors and forecasting financial results will allow the management structure of enterprises to make effective decisions on: planning production growth; the formation of the optimal number of employees; changes in the organizational structure of enterprise; changes related to restructuring (outsourcing, downsizing, etc.); planning enterprise activity considering observance, and if necessary changing it in line with the results of the dynamics of financial activity; and the formation of additional necessary funds for certain values of projected financial statements (Chorna, Filipishyna, Nord et al. 2019; Chorna, Filipishyna, Krutova et al. 2019; Luchaninova et al. 2019; Kvasha et al. 2019).

Conclusions

Strategic management decisions can change the current structure of a balance sheet radically, and lead to temporary a decrease in profitability if there is a need for technical re-equipment, research and development, etc. Forecasting based on the regulation of items is used when enterprise administration makes significant, sometimes far from optimal in a financial sense, management decisions that are strategic and might be necessary in the context of further competition.

The selection of a model of sustainable development plays an important role in defining the index of sustainable development and the classification of industrial enterprises according to the criterion of sustainability. Among the advantages of this method, it can be noted that enterprises belonging to a certain class of decisions can be considered to have the possibility of sustainable development inherent in them.

Comparison of the integrated stability of an industrial enterprise with region integrated stability in most cases coincides, which confirms the close relationship between them in terms of the directions of sustainable development. Detailed analysis of the sustainability indicator at a regional level and at the level of an industrial enterprise makes it possible to identify the weaknesses of sustainable development across the entire system.

Management needs to focus attention on these threats by constantly monitoring them and developing programs to eliminate them. Therefore, effective decision-making requires reliable information and an analytical base, as well as methods for formulating a strategy for the sustainable economic development of industrial enterprises.

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ASSESSMENT OF QUALITY MANAGEMENT SYSTEMS OF SERVICE COMPANIES

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Abstract: *Decision-making in the formation of quality management systems for compliance with the requirements of the international standard ISO 9001:2015 should be a strategically important area of activity for enterprises in the service sector, and should be based on the use of effective methods, measures, methodology, and other quality management tools. The aim of this article is to study the existing methodological approaches to the evaluation of the quality management systems of enterprises and to develop effective practical tools for their application in the field of engineering services. The existing methodological approaches to the evaluation of the quality management systems of enterprises are considered, and attention is focused on the advantages and disadvantages of each of them. Directions for the estimation of the quality management systems of enterprises in the sphere of engineering services on the basis of requirements of the international stan-*

dard ISO 9001:2015 are offered. An algorithm for the expert evaluation of the processes of quality management systems of an enterprise in the field of engineering services is developed, and recommendations for its application are provided. The expediency of applying the methodology of the balanced scorecard (BSC) for the evaluation of quality management systems of enterprises in the field of engineering services is also substantiated. A strategic map of an enterprise in the field of engineering services is formed on the basis of a balanced system of indicators for the assessment of quality management systems. A comparative analysis of the costs of the business processes of an enterprise in the field of engineering services before and after the implementation of the quality management system is conducted, alongside the calculation of the economic effect of this implementation.

Keywords: *quality management system, sphere of engineering services, ISO 9001:2015 standard, algorithm of expert evaluation of processes, economic effect.*

JEL Classification codes: *L15, L21, L84, M21*

1. Introduction

In the context of Ukraine's integration into the European and world space, the formation, implementation, and certification of quality management systems (QMS) in the context of the requirements of international standards ISO 9000 series is relevant for domestic enterprises. In particular in the field of engineering services, ISO 9001:2015 stimulates their competitiveness and the development of their innovation potential. It is obvious that the formation of effective QMS can provide a guarantee for improving the quality of services (works) which meet the requirements of all stakeholders in the field of engineering services, and ensure the achievement of key business goals and high economic performance. Decision-making by senior management on the formation of QMS in accordance with the requirements of ISO 9001:2015 should be a strategically important area of activity of an enterprise which is based on the use of effective methods, measures, methodology, and other tools of quality management.

2. Literature review

The work of a number of Ukrainian and international scientists – including: Stolyarchuk [1]; Yankovyi, Goncharov, Koval, and Lositska [2]; and Shulyar [4] – is devoted to the study of QMS assessment of enterprises in various fields of activity. This list also includes the work of: Levkulich [5]; Chekmasova [6]; Ravichandran and Rai [7]; Kaplan and Norton [8]; Manz and Stewart [10]; Androsyuk [11]; Bednall, Sanders, and Runhaar [13]; Fok, Fok, and Hartman [14]; Kumar, Van Der Aalst, and Verbeek [14]; Trachenko [16]; Lokhanova [18]; Levine and Toffel [19], and others. Stolyarchuk [1] emphasizes the use of the absolute and comparative forms of the rating method. Levkulich [5] developed 12 indicators of cost estimation in QMS of an enterprise manufacturing clothes which apply to its estimation. Chekmasova [6] emphasizes that when assessing the effective-

ness and adaptability of QMS today it is advisable to take into account the fact that they require the integrated application of existing mathematical, technical, organizational, managerial, and other special methods. Others [7–9] have analyzed the advantages and disadvantages of introducing a balanced system of indicators in the restaurant industry. Despite significant research, today there are no effective methodological tools for specifically assessing the QMS of enterprises in the field of engineering services.

The aim of this article is to study the existing methodological approaches to the assessment of QMS of enterprises, and to develop practical tools for their application in the field of engineering services.

3. Results and discussion

Recently, Ukrainian enterprises have been actively involved in the implementation and certification of quality management systems (QMS) in accordance with the international standards of the ISO 9000 series. The main motive is to improve the quality of enterprise management and ensure its more efficient development in domestic and international markets. After receiving its certificate, a company must maintain QMS in working order. Various inspections, evaluations, and analyses are needed to ensure its proper functioning and continuous improvement [1]. According to the ISO survey (The ISO Survey of Certifications – 2018) at the end of 2018, there were 878,664 certificates and 1,180,965 ISO 9001 certified production sites in the world. Figure 1 shows the survey data on the number of ISO 9001 certificates issued in the world from 1999 to 2018. According to the chart, there is an obvious tendency to increase the number of certified enterprises in different countries of the world. For the period of 2011–2015, their number remains almost at a constant level. However, in 2017 there is was decrease in certificates by approximately 3%, and this then increased again in 2018. The reason for this drop is related to the involvement of certification bodies and changes in the data provided by the same organizations, which led to a significant reduction in registered certificates [3].

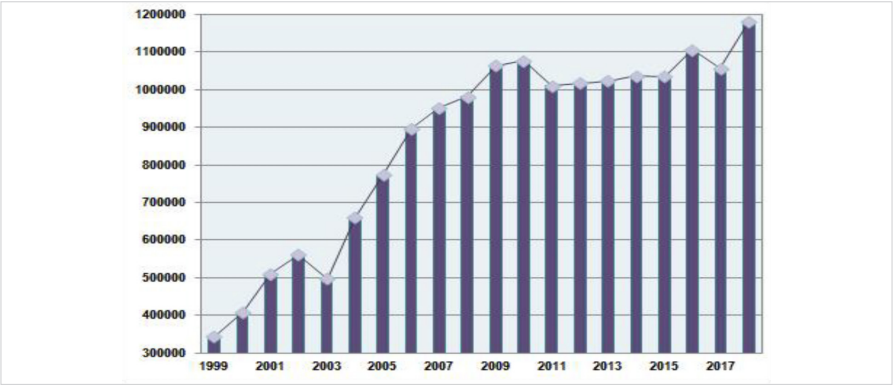

Figure 1. *Number of ISO 9001 certificates issued in the world from 1999 to 2018*
Source: compiled according to "The ISO Survey of Certifications – 2018"

It is advisable to focus on countries and industries with more certificates according to ISO 9001:2015. Table 1 shows the Top 10 countries that are certified according to ISO 9001:2015 in 2018.

Table 1. *Top 10 countries that are certified according to ISO 9001:2015 in 2018*

№	Name of the country	Number of certificates
1	China	295,703
2	Italy	87,794
3	Germany	47,482
4	Japan	34,335
5	India	31,795
6	Spain	29,562
7	Great Britain	26,434
8	United States of America	21,848
9	France	21,095
10	South Korea	14,123

Source: compiled according to "The ISO Survey of Certifications – 2018"

Unfortunately, Ukraine is not included in the top 10 certified countries according to the ISO 9001:2015 standard, which indicates a large number of problems. In the opinions of the authors, prime among these are: firstly, the decline of the country's economy (destruction of industry, oppression of small and medium-sized businesses); secondly, the low level of capacity and competence among existing enterprises to form and implement effective and efficient QMS.

It is important that, according to "The ISO Survey of Certifications – 2018," the top 5 most certified industries (by type of activity) for compliance with ISO 9001:2015 are the following: metallurgy; construction; automotive; electronics; and engineering.

Analysis of certified countries according to other ISO standards (Table 1) shows that Ukraine is not included in any top 10. However, "engineering" as a certified industry is, by all standards (Table 1), included in the top 5. The importance of certification of QMS in the field of engineering (engineering services) is obvious and indisputable, as legal requirements and participation in the World Trade Organization force this industry to carry out activities in the presence of certificates of compliance with ISO standards, the most important of which is ISO 9001:2015. At the same time, successful certification is possible due to the formation and implementation of adequate QMS in enterprises. At the same time, one of the most important principles of QMS is its constant improvement, which is only possible due to its evaluation.

Evaluating the effectiveness and efficiency of QMS is one of the most complex and important issues in enterprise quality management, in particular in the field of engineer-

ing services. Today there are various methods and recommendations for assessing the QMS of enterprises in various fields.

Existing methods for assessing the effectiveness of QMS allow for assessment in three ways: the level of economic efficiency achieved as a result of the application of the quality management system; according to the criterion of compliance of the QMS level with the established requirements; the degree of influence of individual elements of QMS on the functioning of the organization as a whole and the level of quality of its products. It should be noted that the third method of evaluating the effectiveness does not differ fundamentally from the second, and is therefore its variant. Thus, the effectiveness of QMS can be assessed on the basis of two basic methods: assessment of economic efficiency; and determination of compliance [2]. In other words, the author suggests two approaches to the assessment of QMS of economic efficiency and effectiveness, with which we agree.

Investigating methodological approaches to QMS assessment, Stolyarchuk proves the effectiveness of the absolute and comparative forms of the rating method and emphasizes that the following methods are used in the absolute form: total, arithmetic mean, sum-differential, arithmetic-differential, and weighted average. In the comparative form, one can use the basic principles of the same methods as used in determining the level of product quality [1]. According to the Stolyarchuk, it is advisable to develop a universal approach to QMS assessment which should be based on a process approach, the main purpose of which is to eliminate inconsistencies, inefficiencies, and internal conflicts in companies.

In our opinion, such an approach to the assessment of QMS of engineering services enterprises, given the fierce competition, is not rational for the following reasons: firstly, it aims to assess only the effectiveness of QMS; and secondly, it does not contain questions relating to all of the important QMS processes regulated by the requirements of the international standard ISO 9001:2015.

On the other hand, some [4] argue that the method involving theory of extreme characteristics and double exponential distributions can be used to estimate the QMS of enterprises. This method is based on applying the desirable function of E. Harrington, which allows for the identification of deviations between the distribution of smallest, largest, and average estimates. Indicators are divided, by the method of T. Saati, into hierarchies via pairwise comparisons, and the optimality of indicators is tied to the logic of their content load.

There are ways to estimate the QMS based on the costs incurred by the company in the operation of such systems, and the costs of their improper operation. In one study [5], 12 indicators were developed for assessing cost in the QMS that are used for the evaluation of a clothing production company.

Studies of quality problems in recent years contain a method based on the principles of VI Romanovsky's criterion for the formation of a generalized indicator of the quality system, criteria for nonparametric statistics, "series criterion," and ordinal statistics, with the construction of a median series of inversions to confirm the stability of processes' influences. In other words, this approach can identify and analyze the QMS which leads to the fewest failures and deviations [4].

When evaluating the effectiveness and adaptability of QMS today, it is advisable to take into account the fact that they require the integrated application of existing mathematical, technical, organizational, managerial, and other special methods [6].

The effect of the introduction or improvement of QMS can have both external and internal origins. These effects can be expressed in the following areas: an increase in enterprises' guarantees of quality of production for clients; saving money by increasing productivity; an increase in sales of the company's products on the market due to improved quality characteristics; a simplification of the procedure for checking product quality upon receipt of orders; or an opportunity to participate in national and international tenders [7].

In the latest developments and scientific works, one can identify several basic integrated approaches to QMS assessment, which should be grouped into four categories.

1. Evaluation of QMS efficiency on the basis of the technical, economic, and social effect (effects) of its formation, implementation, application, and certification according to the international standards of the ISO 9000 series.
2. Study of cause and correlation between the introduction of QMS and other indicators of the enterprise (economic, social), determining the economic effect and economic efficiency of QMS based on the ratio of results from its operation and the cost of its implementation.
3. QMS, which can be measured on the basis of consumer satisfaction indices, are more effective from their point of view. Indices are calculated in many countries, some of which are international.
4. For the management system of the enterprise (general management) it is advisable to apply the method of a balanced scorecard of Norton and Kaplan (BSC) [8]. Taking into account the interests of groups of influences and the principle of continuous development of the enterprise allows for a more objective identification of the impact of QMS on the activities of the enterprise (general management) [9].

One might consider in more detail the above approaches to QMS assessment in order to develop effective tools for companies in the field of engineering services. The first two approaches, in our opinion, are appropriate for use by enterprises in the field of engineering services for the assessment of QMS, as they indicate a synergistic effect associated with the improvement of business processes such as: design of facilities, electrical work, electrical work equipment (ETO), and commissioning. On the other hand, the synergistic effect is associated with the management processes of the enterprise, which are important for improving its QMS: staff development and training, planning and implementation of quality objectives, actions on risks and opportunities, monitoring customer satisfaction (works), and innovation processes. In our opinion, this approach to QMS assessment indicates its integration into the overall management of the enterprise in the field of engineering services, which is an essential requirement of the ISO 9001:2015 standard. Directions for assessing the implemented QMS at the enterprise in the field of engineering services are shown in Figure 2.

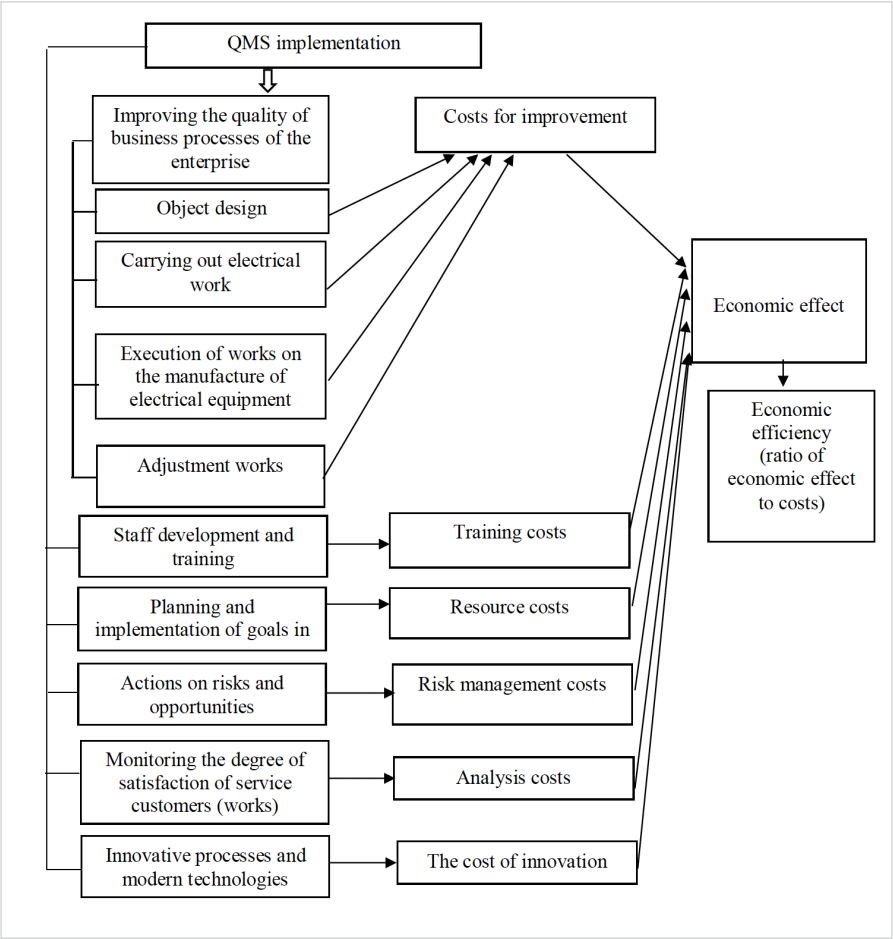

Figure 2. *Directions of QMS assessment for an enterprise in the sphere of engineering services*
Source: author's own development

Areas of assessment of the QMS of enterprises in the field of engineering services are determined taking into account the requirements of the international standard of ISO 9001:2015. The assessment of QMS in relation to this approach requires taking into account the level of development of the financial and economic condition of the enterprise in the field of engineering services at the initial stage of assessment. More objective evaluation results can be obtained by taking into account the time period of occurrence of the relevant changes and the impact of QMS on certain indicators.

QMS assessment can be internal and external, for example by being carried out independently or by independent organizations, associates, consumers, or customers,

and may include audit, analysis, or self-assessment [10]. Undoubtedly, the audit (internal or independent) allows for the assessment of the QMS for compliance with the requirements of the international standard ISO 9001:2015, to determine its adequacy and compliance with the requirements of the standard. One of the key processes of QMS is the planning and conducting of internal audits with a periodicity determined by the company, during which non-compliance of QMS with the requirements of the above standard allows the auditor to identify conclusions about its effectiveness and opportunities for improvement. One unconditional advantage of audits is systematization, or independence. The company's internal QMS audits can be attributed to the company's self-assessment. However, they provide for the mostly selective nature of inspections of the QMS processes of the enterprise, which does not ensure the completeness and objectivity of the assessment. On the other hand, the results of audits significantly depend on the competence, experience, and qualifications of auditors. Regarding third party audits (through an independent certification body), i.e., a certification audit, the shortcomings are almost the same as with internal audits, but companies receive the coveted QMS certificate for compliance with ISO 9001:2015. This provides them with a number of positives, such as: a guarantee for consumers of proper quality of products, services, and works; the opportunity to enter international markets; increasing competitiveness, etc. Certification is an external assessment of the QMS of the enterprise. In general, audits allow us to assess the effectiveness of the QMS processes of the enterprise, and there is no question of efficiency.

Regarding the analysis of the QMS of the enterprise, this approach includes, in particular, the issue of adjusting the policy and the quality objectives in the event of changing needs and expectations of stakeholders. This makes sense, however, given the fact that the purpose of assessing and analyzing the QMS of the enterprise is to improve it, and, in our opinion, they should be considered in terms of identifying problems with the functioning of system processes using certain methods. Today, enterprises in the field of engineering services do not have the methodological tools to solve these problems, so we propose to use an algorithm for the expert evaluation of QMS processes, which was developed as part of research on the adaptation of the integrated enterprise management system to international standards ISO 9001:2015, ISO 14001:2015, and ISO 45001:2018. The algorithm was developed on the basis of QMS research on 12 companies in the field of engineering services in Ukraine (Fig. 3).

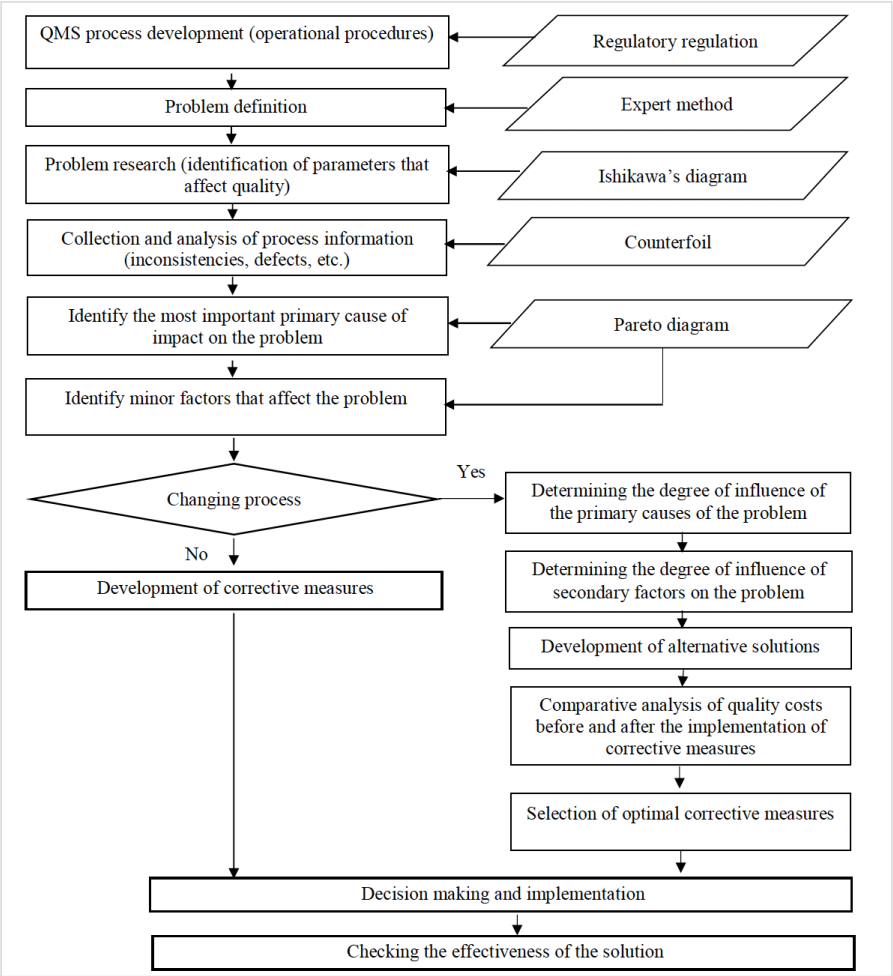

Figure 3. *Algorithm for the expert evaluation of the QMS processes of the enterprise in the field of engineering services*

Source: author's own development

The algorithm developed is an effective tool for analyzing the problems of companies, and has a wide range of applications. Its use is advisable during internal audits to assess the QMS processes in the context of ISO 9001:2015, including risk assessment and taking into account the areas shown in Fig. 2. For the effective application of the developed algorithm in the work of an enterprise in the field of engineering services, it is advisable to create a quality management department as the main body to clarify the problems

associated with the functioning and improvement of QMS processes. The responsibility of such a unit should be the collection, systematization, and processing of data on the functioning of the QMS, along with the external and internal influences on both its processes and the activities of the enterprise as a whole. An important aspect in the formation of QMS is the definition and clear regulation of its processes in accordance with the requirements of regulations. No corrective action is required if the requirements are met. If deviations from the requirements are found, their reasons should be formulated as issues that require appropriate management decisions. The functions of the quality management department are also the development of a schedule that determines the frequency of data collection, document management, and the development of forms of relevant documents.

To develop solutions to address the identified deviations, it is necessary to unite and coordinate actions, which forms part of the function of the quality management department. This body is responsible for the transfer and systematization of non-compliance (deviations) with the requirements for the operation of QMS in the enterprise, their routing, scheduling solutions, the appointment of executors, clarification of the state of problem solving, and their synchronization.

As the company's resources are limited, a chain of tools is needed to select the problems of QMS operation, the solutions to which give the company significant potential benefits. On the basis of a complete set of situations and corresponding solutions, problems are selected to which solutions already exist. If the necessary solution has already been formulated, the quality management department will find it and determine the period of its previous use in a similar situation and notify the person who raised the problem.

If such a solution does not exist, it is proposed to use the causal diagram of Ishikawa to prepare it. This method allows one to identify deviations and their causes. The outcome of the process depends on many components, between which there are cause–effect relationships. The Ishikawa diagram is a tool that allows one to display these relationships in a simple and accessible form. When creating a cause-and-effect diagram, it is necessary to select the maximum number of factors related to the characteristic that went beyond the allowable values. The most effective is a group method of analyzing the causes – brainstorming.

It was noted above that the collection and analysis of information is an important step in quality management. The guide to action is the data from which we learn the facts. Any data that is collected has a purpose and must be worked with once it has been collected. To do this, we used one of the Japanese quality management tools – a checklist.

Based on the collected and analyzed information for each primary and secondary cause affecting the problem, the most important of them are identified. The Pareto diagram is used for this purpose. It allows one to distribute efforts to solve the problems that have arisen and identify the main reasons for which to act, and also provides an opportunity to quantify the causes that affect the problem.

To find optimal solutions, it is desirable for the company to have a library equipped with the necessary literature. Leaders (not exclusively) should get acquainted with the

latest achievements in the areas that interest them. In addition, managers should be given the opportunity to attend conferences, seminars, refresher courses, and special university lectures. Managers must not only know the solutions that have been tested in practice, but also create new ones. Therefore, their desire to experiment and develop in this direction should be encouraged. Finding the optimal solution requires from the person responsible for solving the problem a huge creative return, and a degree of determination.

The effective search for and selection of optimal solutions should be carried out by changing the process conditions. This allows one to objectively determine the root causes and secondary factors that cause the problem. Having received the data under different conditions of the process, by ranking them you can determine the most important root cause of the problem and approve its priority. In this way, we get objective information on how to solve the problem.

Having identified the most important primary cause of the problem, we determine the most important secondary factor that affects it. It is for this that we make the optimal management decision. The choice of optimal solutions is always based on a set of indicators of the state of the object or phenomenon, taken from both subject and system knowledge.

Once the best of the possible solutions has been chosen, one must make a plan to implement corrective action and check on its implementation.

The reasoned decision is registered and sent to the quality management department to determine which departments of the enterprise will be affected by the proposal and what their reaction will be. Once it has been decided which departments are affected, the quality management department selects the managers with whom the proposal needs to be agreed, schedules their work, and sets a deadline by which they must communicate their views on the proposal.

Each division of the enterprise should calculate the effect that is planned to be obtained from the implementation of the proposal. It is also advisable to conduct a comparative analysis of quality costs before and after the implementation of corrective measures. If the decision is prepared and approved, the person responsible for its implementation is appointed.

There are eight principles of quality management in accordance with the international standards of the ISO series: customer focus; management; employee involvement; process approach to management; system approach to management; continuous improvement; evidence-based approach to decision-making; and a mutually beneficial relationships with suppliers. The use of a balanced scorecard can be integrated into quality strategy, thus influencing its formation and implementation in the short and long term [11].

The system of performance and efficiency evaluation indicators, built on the basis of BSC, provides an opportunity to combine the evaluation of QMS efficiency in general with the calculation of efficiency and effectiveness of business processes that are aimed at making a profit. Noting this provision, it should be highlighted that the QMS effect is by nature synergistic (i.e., the effect of enhancing interaction and coordination between the elements of this system). The objective basis for the emergence of the synergistic effect of

QMS is the real interaction and integration of its constituent processes. Hence, respectively, we can draw two methodological conclusions:

1. the effect of QMS is always greater than the algebraic sum of the effects of business processes;
2. the efficiency of QMS is directly related to determining the increase in the magnitude of the overall effect of the system in comparison with the total effect of the functioning of its individual business processes. The latter can be assessed on the basis of indicators of customer satisfaction and staff. Meanwhile, BSC allows you to see business activities in four main projections: financial prospects; prospects of customer satisfaction; prospects for the development of the organization; and prospects for innovation, learning, and growth [12].

Today, the BSC is the most successful attempt to integrate the use of financial and non-financial indicators. As practice shows, a company needs 15–20 indicators, a division approximately 7–10, and for one employee no more than 5 are required. BSC focuses evaluation on four closely related perspectives: financial results; consumers; internal organization; and training and staff development. In a typical BSC, each will contain key success factors and relative indicators that will stimulate performance in certain directions [13].

It is necessary to introduce a balanced system of indicators in stages: the first stage is preparatory; the second is a continuous cyclic process of system deployment and refinement. First, it is necessary to identify key strategic goals that will form the basis of the entire analysis, such as "finance," clients," "processes," or "development." Breaking these concepts into narrower ones, it is possible to compile a decision tree on the problem of improving the efficiency of enterprise management [14].

The stages of analysis with the help of BSC are: SWOT analysis and the determination of success factors; the definition of strategic goals and their reflection on the basis of the construction of a strategic map; the determination of indicators for each component of a balanced system of indicators and target values, and the calculation of these indicators; and a strategic action plan and the support, updating, and development of a balanced scorecard [15].

The construction of a balanced system of indicators was carried out on the basis of data obtained during the study of the 12 largest enterprises in the field of engineering services in Ukraine, in the field of energy. According to the stages defined, the analysis of a condition of internal and external environments of the enterprises by means of SWOT analysis was carried out. The SWOT analysis showed a significant number of strengths of the company's internal environment. The excess of threats over opportunities in the external environment is mainly associated with political instability, an imperfect legal framework, the wear and tear of equipment, the constant improvement of competitors' skills, and high inflation [16].

It is the assessment of its internal capabilities that allows us to identify the mechanism of causal links between the strategic goals of an engineering enterprise. All of this is clearly reflected in the strategic maps of the enterprise.

Kaplan, Norton, and Niven [17] consider strategic maps from the point of view of: the reflection of interrelations and dependences between separate purposes; the explanation of mutual effects arising in the course of the achievement of the purposes; the formation, at heads, of an understanding of the dependences and values of separate goals; and the promotion of a common understanding of the strategy. Each direction can contain several goals. Figure 4 shows a strategic map for an enterprise in the field of engineering services as an important aspect in assessing its QMS.

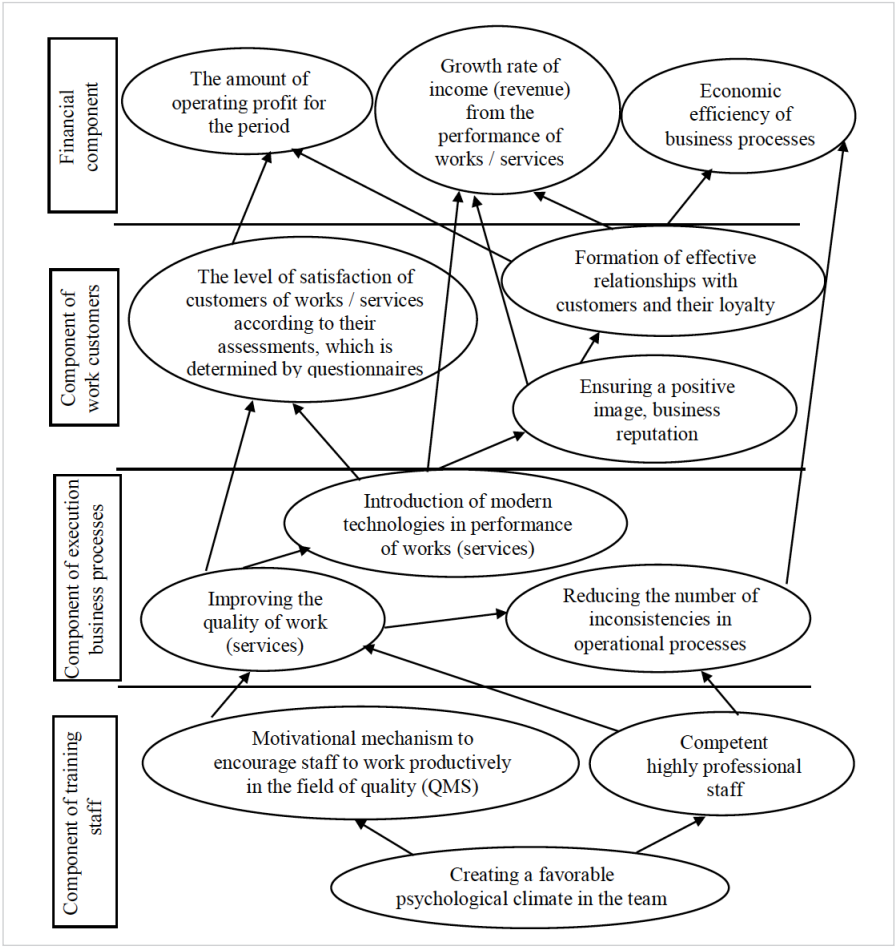

Figure 4. *Strategic map of enterprises in the field of engineering services based on a balanced scorecard for QMS assessment*

Source: constructed by the author using [18]

At the next stage of the analysis, it is necessary to select key indicators in terms of BSC directions. It is advisable to choose an equal number of indicators, namely 5 indicators from each area, and make their calculations for the period (per year). It is known that most performance appraisal systems are based on the annual budget and operational plan of the enterprise. Therefore, it should be noted that these systems focus on short-term periods and tactics, rather than strategy. Along with traditional systems, the BSC also includes financial indicators as one of the most important performance measurement criteria, but also emphasizes the importance of non-financial indicators.

An important component of the BSC is financial. Its main task is to increase the profitability of work performed (services), return on equity, net cash flow, and net profit. Financial goals are at the heart of the goal tree, but there is a close relationship with goals in marketing, internal processes, and staff development. In terms of the financial component, it is necessary to calculate the following indicators: the ratio of absolute liquidity; total liquidity; long-term borrowing; return on equity; and return on assets.

Within the client component, the company's management must identify key market segments for the implementation of engineering services (or works). This will strengthen the marketing and sales strategy and lead to an increase in financial performance in the future. To solve this problem, it is advisable to analyze such factors as market segment share, the number of regular customers and major competitors, profitability of sales, and the share of receivables.

The business process component of an engineering enterprise identifies the main processes that need improvement. The efficiency of business processes determines the value of the company's offer, which depends on the number of customers involved and the final financial result [19]. For the key business processes of an engineering company, it is necessary to determine the parameters that characterize these processes and develop performance indicators. In our case, the following indicators were determined that correspond to the business environment of the enterprise: product profitability; depreciation rate and suitability of fixed assets; turnover of current assets; and profitability of the enterprise to perform works (or services).

Staff training and development is an essential component of BSC, as staff form the key chain of successful businesses. The main performance indicators include: employee satisfaction and pride in their work; skills, awareness, competence, and high qualification; and the ability to make management decisions based on evidence. The main indicators within this component are: the coefficient of professional development; staff profitability; staff turnover; and the actual amount of assets per employee [20–25].

A balanced system of indicators of an engineering enterprise is the basis for creating a BSC for its divisions. Each unit must develop its own systems of indicators that meet the goals and strategies of the enterprise as a whole. This process is called "cascading," when a complex system of indicators is built in which lower-level indicators "work" to achieve the target values of upper-level indicators.

BSC allows one to systematically implement a company's strategic plans, transferring them to the operational level of management and monitoring the implementation of the strategy based on key performance indicators.

The approach to QMS evaluation based on determining the economic effect and economic efficiency of QMS based on the ratio of results from its operation and the cost of its implementation is noteworthy. It is known that, in accordance with the requirements of ISO 9001:2015, the QMS of the enterprise must be integrated into the business processes of the company, and the effectiveness of their implementation is a fundamental tool for their evaluation. A comparative analysis of business process costs before and after implementation was conducted to assess the QMS of the engineering enterprise. The research and calculations were carried out within the framework of the fundamental and applied research works of the Odessa National Economic University, on the topic: "Improving the design of facilities as an important component of the quality management system of Chornomorenergospetsmontazh LLC in accordance with the requirements of the international standard ISO 9001:2008."

The total cost of ensuring the quality of work (C_{qual}) at the engineering company can be determined by the formulas:

$$C_{qual} = C_{work} + C_{cons} \quad (1)$$

where C_{work} – the cost of work;
C_{cons} – the cost of correcting defects (inconsistencies) after the work of the consumer.

For an enterprise in the field of engineering services, it is clearly established which costs belong to each of these categories, as well as how and by whom they will be reproduced. The basis of calculations are the costs of performing the main business processes of the enterprise.

$$C_{qual} = C_{des} + C_{elec} + C_{el.equip} + C_{commis} + C_{cons} \quad (2)$$

where C_{des} – the cost of design work;
C_{elec} – the cost of electrical work;
$C_{el.equip}$ – the cost of work on the manufacture of electrical equipment and metal structures;
C_{commis} – the costs of commissioning;
C_{cons} – the cost of correcting defects (inconsistencies) after the work of the consumer.

By increasing or decreasing some cost groups, other groups may increase or decrease accordingly. By increasing the cost of preventive measures, it is possible to achieve a reduction in losses from defects (inconsistencies) and a reduction in control and testing.

One of the most effective ways to reduce the cost of work (or services) is to minimize costs for all groups. Therefore, when comparing changes in costs, one should choose the option that gives the greatest savings.

In modern practice, in the organization of work (or services) and cost planning for quality assurance, the largest share in the total costs is the cost of control, whereas the smallest is the cost of preventing defects (inconsistencies) [26–32]. This does not take

into account that the control at a significant cost does not in itself increase the quality, but only allows one to separate the high quality from the low quality.

In this regard, the most optimal scheme is the distribution of costs with an emphasis on costs associated with the prevention of defects (inconsistencies) in the performance of certain types of work at the engineering company.

Changing the level of quality of work (or services) performed leads to a change in the cost of their performance on the one hand, and the cost of the consumer on the other. Thus, the performance of works (or services) of another level of quality and their consumption cause the following situations:

1. The costs of the contractor (services) increase, and the costs of the consumer decrease.
2. The costs of the executor of works (or services) decrease, and the expenses of the consumer increase.
3. The costs of the contractor (services) and the consumer are reduced.
4. The costs of the contractor (services) and the consumer increase.

The components of costs are determined and their calculations are performed when performing the main business processes of Chornomorenergospetsmontazh LLC, namely:

- object design;
- electrical work;
- for the manufacture of electrical equipment and metal structures;
- commissioning works.

1. We can calculate the cost of design work for 2012 – C_{des0} (before the introduction of QMS and its certification for compliance with the requirements of the international standard ISO 9001) and 2013 – C_{des1} (after the introduction of QMS). In 2012–2013, the hryvnia exchange rate was kept at a stable level of 8 UAH / USD.

$$C_{des0} = C_{wag0} + C_{soft0} + C_{el0} + C_{pap0} + C_{exam0} + C_{post0} + C_{train0} + C_{cons0} \quad (3)$$

where C_{wag0} – wage costs;
C_{soft0} – software costs;
C_{el0} – electricity costs;
C_{pap0} – paper costs;
C_{exam0} – costs for examination of projects;
C_{post0} – the cost of posting workers to facilities;
C_{train0} – staff training costs;
C_{cons0} – the cost of correcting defects (inconsistencies) after the work of the consumer.

C_{des0} = 135,000$ +11,250$ +5,000 $ +1,250 $ +50,000 $ +33,750 $ +11,250 $ +2,500 $ =250,000 $

The cost of project work after the implementation of QMS (Exercise 1) is calculated by the formula:

$$C_{des1}=C_{wag1}+C_{soft1}+C_{el1}+C_{pap1}+C_{exam1}+C_{post1}+C_{train1}+C_{cont.proj1}+C_{tend1}+C_{exp1}+C_{mod1}+C_{cons1} \quad (4)$$

where C_{wag1} – wage costs;
C_{soft1} – software costs;
C_{el1} – electricity costs;
C_{pap1} – paper costs;
C_{exam1} – costs for examination of projects;
C_{post1} – the cost of posting workers to facilities;
C_{train1} – staff training costs;
$C_{cont.proj1}$ – costs of quality control of project implementation;
C_{tend1} – costs of tender market monitoring;
C_{exp1} – the cost of expanding jobs;
C_{mod1} – the cost of modern office equipment;
C_{cons1} – the cost of correcting defects (inconsistencies) after the work of the consumer.

$$C_{des1} = 135{,}000\ \$ + 22{,}500\ \$ + 5{,}000\ \$ + 1{,}250\ \$ + 20{,}000\ \$ + 5{,}000\ \$ + 50{,}000\ \$ + 33{,}750\ \$ + 17{,}500\ \$ + 31{,}250\ \$ + 3{,}750\ \$ + 1{,}875\ \$ = 326{,}875\$$$

Profit from design work (P_{des0}) for 2012 amounted to 265,000$
Profit from design work (P_{des1}) for 2013 amounted to 353,025$

2. The calculation of costs for electrical work before the introduction of QMS engineering enterprise (Celec) is carried out according to the formula:

$$C_{elec0} = C_{cost0} + C_{to0} + C_{prot0} + C_{equip0} + C_{lubr0} + C_{train0} + C_{post0} + C_{spec0} + C_{subcontr0} + C_{en0} + C_{instal0} + C_{cons0} \quad (5)$$

where C_{cost0} – wage costs;
C_{to0} – the cost of providing power tools;
C_{prot0} – the cost of protective equipment;
C_{equip0} – equipment maintenance costs;
C_{lubr0} – costs of fuels and lubricants;
C_{train0} – staff training costs;
C_{post0} – the cost of posting workers;
C_{spec0} – the cost of renting special equipment;
$C_{subcontr0}$ – costs of subcontractors;
C_{en0} – energy costs;
$C_{instal0}$ – costs of installation and dismantling;
C_{cons0} – the cost of correcting defects (inconsistencies) after the work of the consumer.

$$C_{elec0} = 1{,}250{,}000\ \$ + 18{,}750\ \$ + 18{,}750\ \$ + 62{,}500\ \$ + 2{,}500{,}000\ \$ + 18{,}750\ \$ + 500{,}000\ \$ + 87{,}500\ \$ + 1{,}200{,}000\ \$ + 37{,}500\ \$ + 3{,}000{,}000\ \$ + 13{,}125\ \$ = 8{,}706{,}875\ \$$$

The cost of electrical work after the introduction of QMS to the enterprise (Vem1) is calculated by the formula:

$$C_{elec1} = C_{cost1} + C_{to1} + C_{prot1} + C_{equip1} + C_{lubr1} + C_{train1} + C_{post1} + C_{spec1} + C_{subcontr1} + C_{en1} + C_{instal0}1 + + C_{cons1} \quad (6)$$

$$C_{elec1} = 1,375,000\ \$ + 15,000\ \$ + 16,250\ \$ + 56,250\ \$ + 2,250,000\ \$ + 22,500\ \$ + 475,000\ \$ + +75,000\ \$ + 1,187,500\ \$ + 35,000\ \$ + 2,625,000\ \$ + 9,375\ \$ = 8,141,875\ \$$$

The profit from electrical work before the introduction of QMS (P_{elec0}) in 2012 amounted to 9,229,287.5 $

The profit from electrical work after the introduction of QMS (P_{elec1}) in 2013 amounted to 8,793,225 $

3. We can also calculate the cost of work on the manufacture of electrical equipment and metal structures before the introduction of QMS to the engineering enterprise ($C_{el.equip0}$) by using the formula:

$$C_{el.equip0} = C_{cost0} + C_{compon0} + C_{el0} + C_{equip0} + C_{train0} + C_{prot0} + C_{cons0} \quad (7)$$

where C_{cost0} – wage costs;
$C_{compon0}$ – costs of components and materials;
C_{el0} – energy costs;
C_{equip0} – equipment maintenance costs;
C_{train0} – staff training costs;
C_{prot0} – the cost of protective equipment;
C_{cons0} – the cost of correcting defects (inconsistencies) after the work of the consumer.

$$C_{el.equip} = 135,000\ \$ + 750,000\ \$ + 17,500\ \$ + 5,000\ \$ + 2,500\ \$ + 3,750\ \$ + 1,000\ \$ = 914,750\ \$$$

The costs of performing works on the manufacture of electrical equipment and metal structures after the introduction of QMS at the engineering enterprise ($C_{el.equip1}$) are calculated by the formula:

$$C_{el.equip1} = C_{cost1} + C_{compon1} + C_{el1} + C_{equip1} + C_{train1} + C_{prot1} + C_{cons1} \quad (8)$$

$$C_{el.equip1} = 147,500\ \$ + 687,500\ \$ + 15,000\ \$ + 4,375\ \$ + 3,125\ \$ + 3,500\ \$ + 625\ \$ = 861,625\ \$$$

Profit from the performance of works on the manufacture of electrical equipment and metal structures prior to the introduction of QMS to the enterprise ($P_{el.equip0}$) amounted to 969,635 $

The profit from the performance of works on the manufacture of electrical equipment and metal structures after the introduction of QMS ($P_{el.equip1}$) amounted to 930,555 $

4. The calculation of costs for commissioning work before the introduction of QMS to the engineering enterprise ($C_{commis0}$) is carried out according to the formula:

$$C_{commis0} = C_{cost0} + C_{to0} + C_{equip0} + C_{el.lab0} + C_{lubr0} + C_{train0} + C_{post0} + C_{el0} + C_{cert0} + C_{cons0} \quad (9)$$

where C_{cost0} – wage costs;
C_{to0} – the cost of providing power tools;
C_{equip0} – the cost of protective equipment;
$C_{el.lab0}$ – the cost of maintaining electrical laboratory;

C_{lubr0} – costs of fuels and lubricants;
C_{train0} – staff training costs;
C_{post0} – the cost of posting workers;
C_{el0} – energy costs;
C_{cert0} – costs for electrical laboratory certification;
C_{cons0} – the cost of correcting defects (inconsistencies) after the work of the consumer.

$$C_{commis0} = 500{,}000\ \$ + 3{,}750\ \$ + 3{,}750\ \$ + 25{,}000\ \$ + 37{,}500\ \$ + 3{,}125\ \$ + 125{,}000\ \$ + 4{,}375\ \$ + + 5{,}000\ \$ + 1{,}875\ \$ = 709{,}375\ \$$$

The costs of commissioning after the introduction of QMS to the engineering enterprise ($C_{commis1}$) are carried out according to the formula:

$$C_{commis1} = C_{cost1} + C_{to1} + C_{equip1} + C_{el.lab1} + C_{lubr1} + C_{train1} + C_{post1} + C_{el1} + C_{cert1+} C_{cons1} \quad (10)$$

$$C_{commis1} = 525{,}000\ \$ + 3{,}125\ \$ + 3{,}125\ \$ + 25{,}000\ \$ + 31{,}250\ \$ + 3{,}500\ \$ + 100{,}000\ \$ + 3{,}750\ \$ + + 5{,}000\ \$ + 1{,}250\ \$ = 701{,}000\ \$$$

The profit from commissioning works before the implementation of QMS to the enterprise (2012) ($P_{commis0}$) amounted to 751,937.5 $

The profit from commissioning after the introduction of QMS to the enterprise (2013) ($P_{commis1}$) amounted to 757,080 $

To calculate the annual economic effect of the introduction of QMS to the enterprise, it is necessary to determine the total costs of work before and after the implementation of QMS (C_{qual0} and C_{qual1}) and the total profit of the respective periods of the enterprise – 2012 and 2013 (P_0, P_1).

$$C_{qual0} = 250{,}000\ \$ + 8{,}706{,}875\ \$ + 914{,}750\ \$ + 709{,}375\ \$ = 10{,}581{,}000\ \$$$
$$C_{qual1} = 326{,}875\ \$ + 8{,}141{,}875\ \$ + 861{,}625\ \$ + 701{,}000\ \$ = 10{,}031{,}375\ \$$$

The total profit by type of activity before the introduction of QMS (E_0), and after its implementation (E_1) is:

$$P_0 = 265{,}000\ \$ + 9{,}229{,}287.5\ \$ + 969{,}635\ \$ + 751{,}937.5\ \$ = 11{,}215{,}860\ \$$$
$$P_1 = 353{,}025\ \$ + 8{,}793{,}225\ \$ + 930{,}555\ \$ + 757{,}080\ \$ = 10{,}833{,}885\ \$$$

The economic effect for 2012 and 2013 is determined by the formulas:

$$E_0 = P_0 - C_{qual0} \quad (11)$$
$$E_1 = P_1 - C_{qual1} \quad (12)$$

$E_0 = 11{,}215{,}860\ \$ - 10{,}581{,}000\ \$ = 634{,}860\ \$$
$E_1 = 10{,}833{,}885\ \$ - 10{,}031{,}375\ \$ = 802{,}510\ \$$
$E\ implem = E_1 - E_0 = 802{,}510\ \$ - 634{,}860\ \$ = 167{,}650\ \$$

4. Conclusions

The proposed areas for the evaluation of quality management systems in enterprises in the field of engineering services can be effective means of improving the activities of companies. The algorithm for the expert evaluation of the quality management systems of engineering services is an effective tool for analyzing problems with companies. It has a wide range of applications, including internal audits, assessing QMS processes in the context of ISO 9001:2015, and risk assessment. To apply the methodology of a balanced scorecard, a strategic map of an enterprise in the field of engineering services has been developed, which focuses efforts on significant processes and indicators for evaluating the quality management system. Comparative analysis of the costs of business processes of the enterprise in the field of engineering services before and after the introduction of QMS allowed the authors to determine the economic effect, which was 167,650 $.

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FINANCIAL PROVISION FOR COMPETITIVENESS OF AGRICULTURAL ENTERPRISES

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Abstract: *An important condition for ensuring the competitiveness of an enterprise is the effective use of the innovative, financial, and information capabilities of the enterprise, which collectively constitute its potential and which should be competitive. The purpose of this article is to substantiate and develop the algorithm of the strategy of financial support for agricultural enterprises' competitiveness. Based on the calculations, the forecast of financial resources parameters of LLC Svitanok in 2019–2023 was developed, which reflects the tendency of reducing the parameters of financial resources, which itself confirms the need to improve the financial security of the enterprise. This article presents the components of the strategy for ensuring the competitiveness of agricultural enterprises in terms of financial provisions, which will enable the prediction of the main indicators of the enterprises and the adaptation of the system of attraction and use of financial resources to a changing environment. A strategy for improving financial support for agricultural enterprises' competitiveness is proposed, which suggests the choice for the agricultural enterprise of the paradigm of development among the proposed alternatives. The implementation of a paradigm of existence, equilibrium, or perfection should be combined with an increase in the level of economic and financial security and a reorientation of export activity.*

Keywords: *financial support, financial resources, competitiveness, agrarian sector.*

JEL: *G1, Q10*

1. Introduction

One of the most important modern trends in the socio-economic development of Ukraine is the growth of the competitiveness of all sectors of the national economy. The agricultural sector – which plays a leading role in shaping the country's export potential in providing food, energy, environmental safety, and economic growth, as well as social equilibrium in society – is no exception. For the active economic integration of the agrarian sector of Ukraine's economy and the adaptation of domestic agricultural enterprises to the current requirements of the world market, it is necessary to maximize the efficient use of opportunities and existing benefits, taking into account probable threats and risks. It is important to focus on financial support through the prism of the competitive development of agricultural enterprises [1–2, 8].

The development of the competitiveness of agricultural enterprises is formed at the expense of the powerful production potential and natural resources with which the country has been endowed. In an economic downturn and financial crisis, the agricultural sector in Ukraine is surely showing positive dynamics, thus sustaining the entire country's economy in a multiplier effect. Transformations of the system of economic relations caused by global and local factors give rise to the need to increase the level of competitiveness, first of all, due to the full financial support of the activity [3,7,9].

The agricultural land of Ukraine is the largest in Europe and constitutes 41.5 million hectares (70% of the country's territory), of which 32.5 million hectares are used for growing crops. Therefore, there is every reason to assert that, subject to the provision of appropriate financial support, the agrarian sector of Ukraine's economy can be competitive in foreign markets.

2. Research Results and Discussion

For the perception of agricultural enterprises it is necessary to follow a methodical tool for determining the financial support of activities and the level of competitiveness of agricultural enterprises. The need for such an approach is explained by the interdependence and coherence of these processes and the existence of causal relationships between the state of financial support and the level of competitiveness of agricultural enterprises. Using internal (belonging to the company) and external (borrowed or invested) financial resources in the process of production, agricultural enterprises must monitor financial support as it is crucial for commodity production and the development of agricultural enterprises, and also affects their competitive presentation in the market.

To determine the financial support of activities, it is necessary to identify indicators that determine the sufficiency and effectiveness of the use of financial resources by agricultural enterprises. The economic and financial performance of agricultural enterprises is determined by the availability of sources of funding and the level of use of internal and external financial resources.

The financial security of activities is formed under the influence of the following factors: natural and climatic conditions; specialization of the enterprise and seasonality of

production; legal form; stage and cycle of reproduction process; the existence of a time lag regarding the formation of costs and the receipt of financial results; and the feature and timing of the reproduction of fixed assets [4–5,10]

Methods for assessing the competitiveness of agricultural enterprises can be grouped as follows: based on the analysis of comparative advantages; based on the assessment of the financial condition of the enterprise; based on the theory of effective competition; based on the theory of product quality; matrix methods; definition of a competitive position in terms of strategic potential of the enterprise; integral method; benchmarking method; and other methods.

Each of these methods has its advantages and disadvantages, so to unequivocally allocate one of them is practically impossible.

Ukrainian scientists use different approaches and a system of performance indicators for assessing the competitiveness of an agricultural enterprise, such as profitability, mass and profit margins, labor productivity, product prices, marketability of production, its liquidity, and its creditworthiness. It is also worth analyzing the following indicators: efficiency of use of land, labor, and material resources; capital productivity; capital and energy intensity of the unit of production; and gross value created in the industry.

To ensure the efficient use of financial resources, agricultural enterprises need to develop an appropriate financial support strategy (Fig. 1).

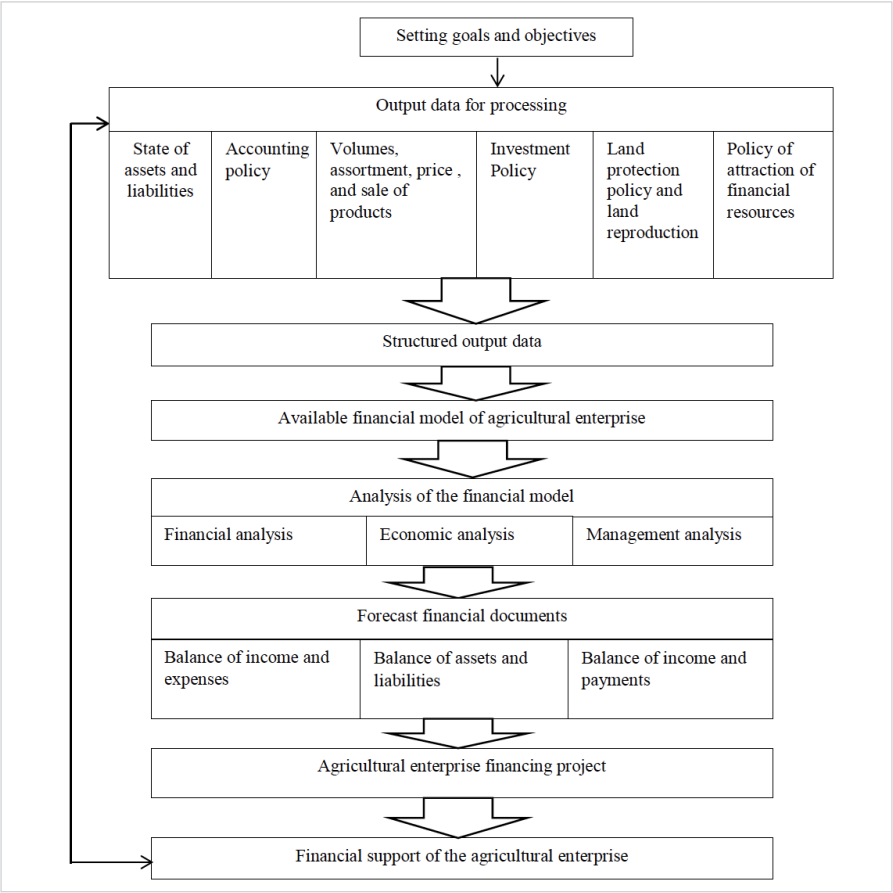

Figure 1. *An algorithm for developing a strategy for the financial support of an agricultural enterprise.*

Source: author's construction

In developing the strategy of financial support for agricultural enterprises' competitiveness, it is necessary to take into account both economic and social trends. These include: transformational economic processes; political instability; fiscal, price, or credit policy inflation; constant changes in the regulatory framework; and significant fluctuations in the national currency.

An important element of financial support for agricultural enterprises is profit, as the actual source of financial resources. To provide financial support to agricultural enterprises, it is necessary to organize the process of generation, accumulation, and transfor-

mation of profits, which enables its use in accordance within the financial policy and the existing financial strategy (Table 1).

The data in Table 1 gives grounds for talking about the ambiguity of the situation in agriculture in Ukraine. On the one hand, we see that during the period analyzed the number of active agricultural enterprises decreased by 18.5%, while the amount of gross production increased by UAH 25.9 billion, or by 8.8%. On the other hand, the estimation of the dynamics of net profit from the sale of agricultural products in agricultural enterprises in Ukraine shows that its growth almost tripled, which, in turn, makes the agrarian sector an investment-attractive branch of the economy and shows its profitability.

Table 1. *Dynamics of the main indicators of activity of enterprises of the branch Agriculture of Ukraine**

Indexes	**2013**	**2014**	**2015**	**2016**	**2017**
Number of enterprises (thousands)	56.8	52.5	45.4	47.7	45.6
Gross agricultural output, total (billions of UAH)	136.59	139.06	136.59	139.06	122.99
Labor productivity (thousands of UAH)	201.22	227.75	272.69	273.90	265.76
Operating profitability level (%)	11.7	21.4	43	33.6	23.5
Net profit, loss (billions of UAH)	14.93	21.41	101.91	89.33	78.46
Enterprises that have earned a net profit (% of the total)	80.3	84.7	88.9	88.3	86.7
financial result (billions of UAH)	26.19	51.67	127.53	102.79	92.07
Enterprises that received a net loss (% of the total)	19.7	15.3	11.1	11.7	13.3
financial result (billions of UAH)	11.26	30.25	25.61	12.68	13.29
Level of profitability of all activity (%)	8.3	9.3	30.4	25.6	18.7

Source: author's calculations [6]

The directions for increasing the competitiveness of agricultural enterprises lie in the area of improving financial security. Using the financial data of Svitanok LLC and based on the priority areas identified for improving the financial support of the company, we have developed a forecast of financial resource parameters. In order to identify the parameters of the performance indicator, which is the financial resource – z, a correlation–regression analysis has been applied and its dependence on sales proceeds (y_1), net profit (y_2), receivables (y_3), and payables (y_4) has been modelled (Table 2).

The multi-factor correlation–regression equation of the dependence of the financial resources parameters of LLC Svitanok has the form:

$$z=23.87745+0.51257y_{1}\_10.57323y_{2}\_0.72431y_{3}-0.08361y_{4} \quad (1)$$

Table 2. *Data of correlation–regression analysis of parameters dependence financial resources of LLC Svitanok, thousands of UAH.*

Index	Parameters of financial resources	Revenues from sales of products	Net profit	Receivables	Payables
	z	y_1	y_2	y_3	y_4
2010	10.3	12.5	0.7	5.0	12.7
2011	7.3	11.3	2.1	8.3	18.1
2012	7.8	27.9	1.2	9.3	17.2
2013	26.3	10.2	-3.5	11.8	23.8
2014	33.7	48.9	0.9	13.7	20.5
2015	43.7	55.6	0.4	14.3	19.2
2016	48.1	67.2	0.8	12.5	19.9
2017	48.9	68.1	0.9	12.0	19.5

Source: author's calculations

The reliability of the correlation–regression analysis can be confirmed by the coefficient of multiple correlation, which indicates a value of 96.5% depending on the effective indicator (z) from the factors whose impact is investigated. The coefficient of multiple determination reflects the dependence z on y_1 ... y_4 by 97.5%. Based on this, we can assert that the calculations performed are reliable with high probability parameters, and the correlation–regression model is significant. The estimation of the correlation matrix of the dependence of the financial resources parameters of LLC Svitanok allowed us to establish a direct correlation between the parameters of the effective indicator and the parameters: y_1 (0.8832), y_3 (0.7454), and y_4 (0.6532).

Based on our calculations, we have developed a forecast for the financial support of LLC Svitanok in 2019–2023, which shows a tendency to reduce the financial support of the investigated enterprise (Fig. 2).

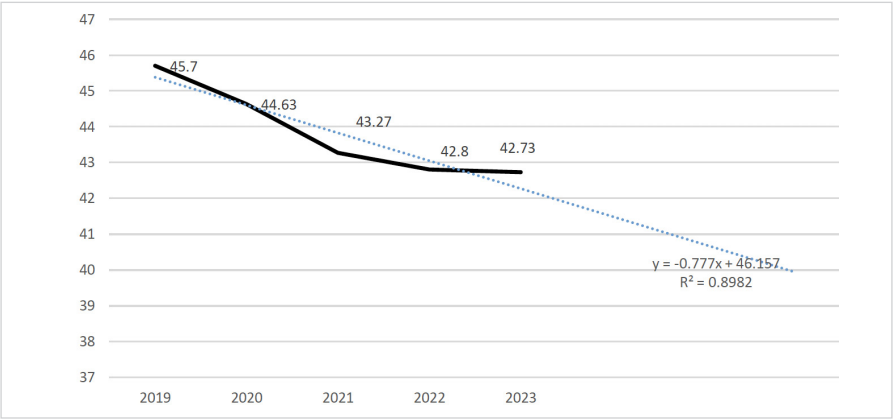

Figure 2. *The forecast of parameters of financial resources LLC Svitanok in 2019–2023.*

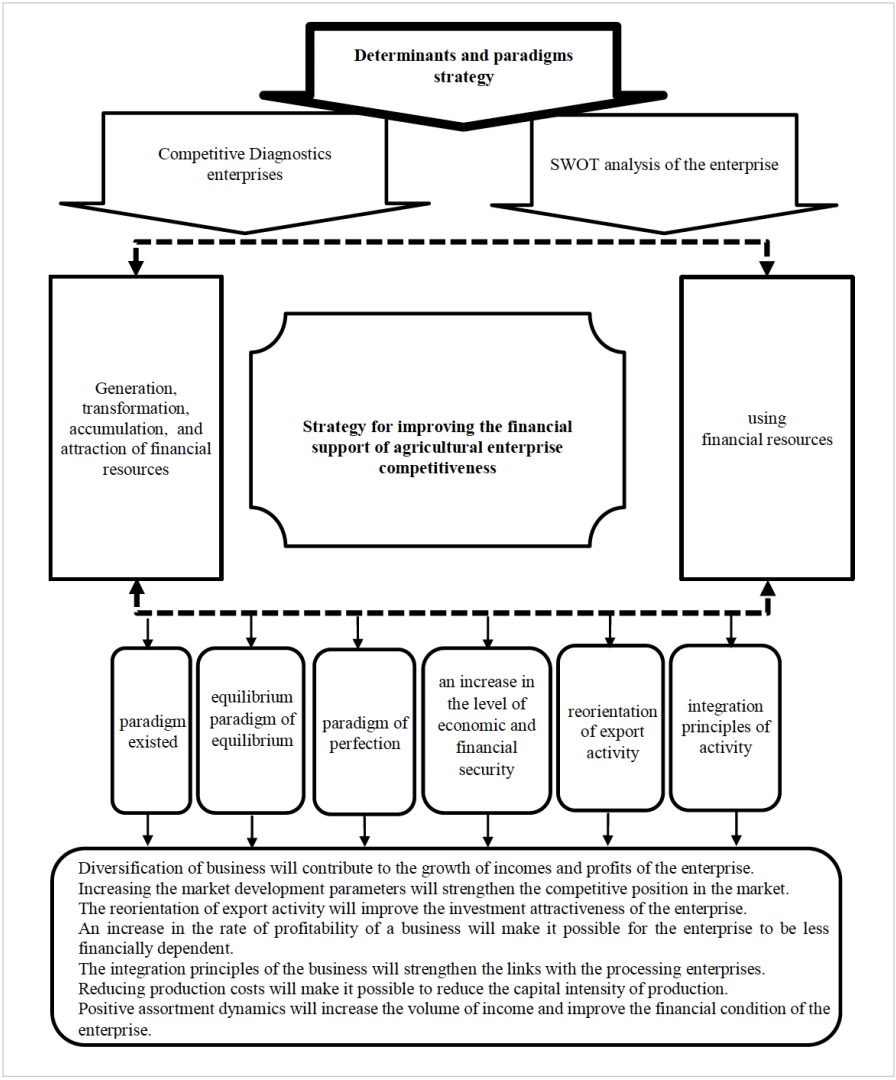

Figure 3. *Strategy to improve financial support of agricultural enterprises' competitiveness. Source: author's calculations*

Therefore, already in the current year the management of the company should take effective measures to improve the level of financial security. To this end, we propose the development of an effective strategy and the timely ongoing monitoring of the competitiveness of the enterprise (Fig. 3).

The strategy for improving the financial support of an agricultural enterprise's competitiveness (Fig. 3) suggests the choice of an agricultural enterprise for the development paradigm among the proposed alternatives. The implementation of paradigms of existence, equilibrium, or perfection should be combined with an increase in the level of economic and financial security and a reorientation of export activity.

3. Conclusions

The strategy of improving the financial support of an agricultural enterprise's competitiveness provides an agricultural enterprise with the choice of developing paradigms among the alternatives proposed. The implementation of paradigms of existence, equilibrium, or perfection should be combined with an increase in the level of economic and financial security and a reorientation of export activity.

The proposed strategy for improving the financial security of agricultural enterprises' competitiveness enables the implementation of the scenario of the competitive development of an agricultural enterprise. A system of estimation of the formation, accumulation, and utilization of the financial resources of agricultural enterprises by average local and regional indicators for typical agribusiness enterprises was developed, which makes it possible to make comparisons based on the listed indices in the regions and to identify weak and strong places of competitiveness.

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IMPACT OF ECONOMIC AFFORDABILITY OF FOOD ON THE LEVEL OF FOOD CONSUMPTION BY UKRAINIAN HOUSEHOLDS

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Abstract. *This work assesses the current level of food security in Ukrainian households according to the methodology proposed by the authors. The methodology developed includes separate indicators for monitoring SDG1 and SDG2 in Ukraine and indicators proposed by the authors. The survey identified vulnerable categories of households based on their level of food security: households located in rural areas; households with four or more persons; households with four or more children; and households with average per capita total income per month below the statutory subsistence level. The results of the study confirm the hypothesis that the level and structure of food consumption is significantly influenced by the economic affordability of products. Households in rural areas as well as households with large numbers of persons have significantly lower incomes than other household groups, and these households are characterized by the lowest quality of food.*

Keywords: *food security, economic affordability, consumption rate, household, expenses.*

JEL: *D12, R22, R51*

1. Introduction

According to the draft Law of Ukraine "On food security of Ukraine" (2011, p. 3), "The process of formation of food security should be accompanied by organized monitoring of the nature of changes, their quantitative and qualitative assessment in order to prepare appropriate recommendations and management decisions. The monitoring system should be based on a combination of economic and social indicators with indicators that reflect the performance of public authorities in addressing food security. According to the results of monitoring, the authorized bodies of the executive power must make decisions about changes in the food basket for the main social and demographic groups of the population, and the authorized executive bodies should decide on the changes and approve the food sets for the main social and demographic groups of the population".

In the context of European integration, which implies openness of internal and external food markets, the constant monitoring of household food security indicators is necessary in order to prevent social and humanitarian crises and to formulate an appropriate state policy for the protection of vulnerable groups in the context of transformational financial and economic processes.

When discussing the monitoring of food security indicators, the levels at which it is conducted should be highlighted: the interstate (global), national, and regional levels, as well as the levels of household and individual.

The methodological support for food security monitoring at global, national, and regional levels has been partially or fully developed. The Food and Agriculture Organization (FAO) monitors food security indicators at the interstate (global) level. Information on the methodology of evaluation and the direct relevance of the indicators is available on the official FAO website, which has been integrated into a single database to ensure open access to information and the creation of a comprehensive food security information system. Indicators are classified into four components of food security measurement: availability, access, use, and stability (Food security statistics, n.d.). The FAO is currently developing indicators for monitoring food security and nutrition (FAO, WFP, and IFAD 2016) as part of the new global agenda for Sustainable Development Goals 2016–2030 (GSDs-2030).

Monitoring of Ukraine's food security indicators is carried out in accordance with the Methodology for determining the main food security indicators at the national and regional levels, approved by the Cabinet of Ministers of Ukraine in the Resolution "Some issues of food security" (2007). Regarding the monitoring of Ukraine's food security indicators at the regional level, there are also suggestions by Ukrainian scientists. In "Monitoring of food security at the regional level" (Kotykova, Babych, and Semenchuk 2019), the authors developed a methodological approach to food security monitoring and evaluation at the regional level, which meets the criteria and dimensions of the GSDs-2030 and which includes a rating assessment of the food supply of the regions based on 9 indicators over the last five years (on average and in the dynamics). Appropriate calculations and proposals for solving the identified problems in the field of food security in each particular region were made.

There is no monitoring of household food safety indicators in Ukraine.

The studies of international researchers are scientifically interesting in this regard. For example, Hansen, Sorensen, and Eriksen (2018) have developed a basic model that identifies the expected links between consumer motives (health, environmental and social awareness), organic food identification, and organic eating behavior. Ortega and Wolf (2018), with the help of Becker–DeGroot–Marschak (BDM), investigated the demands of households in Michigan for livestock products from humanized technologies. Bhalla, Handa, Angeles, and Seidenfeld (2018) investigated the impact of social financial assistance on Zimbabwe's household food security. Haysom and Tawodzera (2018) developed a system of drivers and methods for assessing the food security of households living in urban areas. Botkins and Roe (2018) determined the effectiveness of local governmental food promotion programs in the United States, including farm-to-school FTS programs. Bonanno, Bimbo, Cleary, and Castellari (2018) studied the effectiveness of food labeling policies in helping consumers make informed choices about healthy foods. However, in practice it is possible to use the results of these studies in Ukraine only as an idea for conducting such research: it is quite obvious that the conclusions obtained will not be identical to those obtained in other countries.

Part of the assessment of the level of food security of households is carried out by domestic scientists. In open access (on the official site of the National Library of Ukraine named after V. I. Vernadsky), there are only seven scientific papers devoted to the study of the food security indicators of Ukrainian households. In particular, the work of Ambrosenko (2010) revealed the factors that shape consumer behavior and influence its food supply process. Works by Mostenska (2015) and Suta (2012) included studies of household food consumption by income and number of children in the household. The research of Piskunova (2016), Lysenko (2015), and Yatsiv (2014) analyzed the economic affordability of food for different income groups and examined the dynamics of differentiation in the consumption of basic food in households with different monetary incomes. At the same time, the works mentioned lack a single methodological basis for their studies, and vulnerable segments of the population are identified only among households with different numbers of members and children in their composition.

2. Methodology

The theoretical bases of this study are: the fundamental provisions of the formation of the food security system; modern economic theory, which defines the goals and patterns of sustainable development for the world and Ukraine; the scientific works of domestic and international scientists on food security; and the public administration and legislative regulation of this problem.

The methodological basis of the study is the dialectical method, and the general and special methods of scientific knowledge. In the course of this research the following methods of economic research were used: abstract-logical (involving the formation of principles, theoretical generalizations, and conclusions, as well as the substantiation of methodology and the methodology of complex research and evaluation of food security);

monograph (studying best practices in food security); systematic analysis (identifying the cause and effect of the problem of food shortages in Ukraine); elementary-theoretical analysis; and synthesis (establishment of patterns of development and determination of the current state of food security of Ukraine at different levels). Statistical methods were also used during the study, including: grouping, comparison of average and relative values, graphical, and index.

The information bases for the research were: the legislative and regulatory acts and program documents of the state bodies of Ukraine and EU countries; the official materials of the Cabinet of Ministers of Ukraine; the methodical and statistical materials of the State Statistics Service of Ukraine and relevant services and institutions of other countries; the results of studies of international organizations and the FAO; and the results of the author's personal research.

The hypothesis of the study is that there are significant disparities in the level of consumption by different categories of households, and that these imbalances impact economic affordability. Based on this thesis, it is proposed to assess the level of household food security by household category based on the major indicators of economic affordability and food consumption (Figure 1).

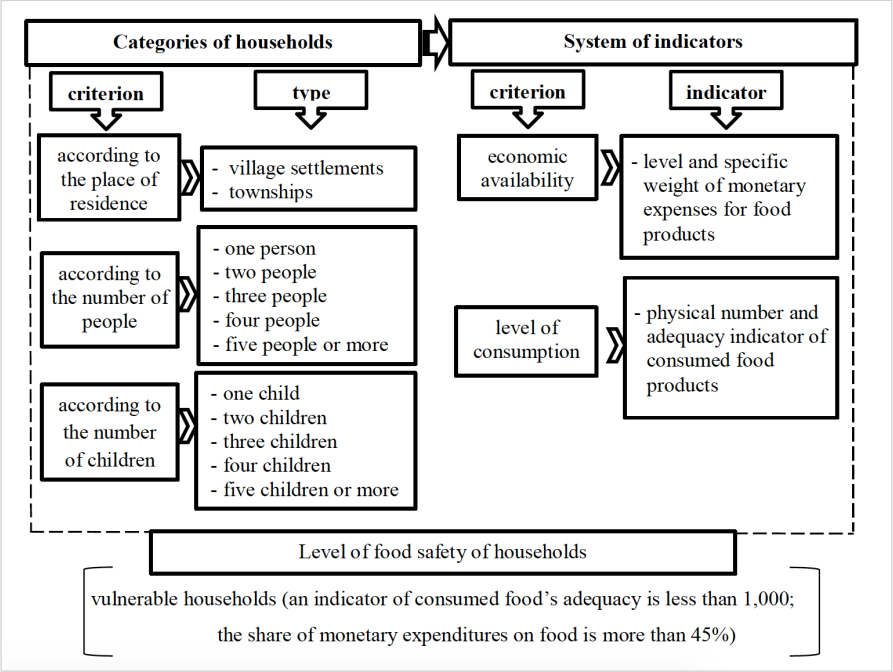

Figure 1. *Methodology for economic evaluation of the assessment system for the effective management of food security at the household level*

Sources: Author's original creation

The objective of the study is to assess the current level of food security in Ukrainian households via the proposed methodology, and to identify vulnerable categories of households based on the level of food security.

3. Results

In 2016, total household spending on food was UAH 2,367.1 per month, compared to 1,766.14 UAH in 2014. However, fluctuations in this indicator were found based on the household categories of urban and rural settlements, accounting for 49% and 45% respectively of expenses (Table 1). This situation is explained by the fact that in rural settlements most of the food products are produced by households, and they therefore do not spend money on their purchase. Further, the vast majority of the rural population tries to earn additional income through the sale of food produced by their own household. At the same time, the dynamics of rural households' spending on food and non-alcoholic beverages are increasing, while the share of spending for urban households is decreasing.

Table 1. *Household expenses on food and non-alcoholic beverages, UAH per month*

Indicator	2014	2015	2016	% change, 2014–2016
On average per household (UAH)	1,766.14	2,207.23	2,367.10	34.0
% of consumer spending	52.9	54.0	52.3	-0.6
% of expenses	47.8	49.6	47.8	0.0
In urban areas (UAH)	1,960.21	2,432.01	2,587.98	32.0
% of expenses	49.4	51.3	49.0	-0.4
In big cities (UAH)	2,093.19	2,628.29	2,787.35	33.2
% of expenses	49.1	50.9	47.8	-1.3
In small towns (UAH)	1,761.59	2,157.3	2,308.76	31.1
% of expenses	50.0	51.9	50.9	0.9
In rural areas (UAH)	1,375.64	1,747.34	1,913.65	39.1
in relation to expenses in big cities	-717.55	-880.95	-873.70	21.8
% of expenses	43.7	45.4	45.0	1.3
in relation to expenses in big cities	-5.4	-5.5	-2.8	2.6

Source: calculated by the authors based on data (Expenditure and resources of households of Ukraine: Statistical publication 2017)

Consumer aggregate costs of the population in large cities exceeded this indicator for the rural population by 873 UAH, or 31.3%, in 2016. It is worth noting that in the aggregate consumer costs the costs of foodstuffs on average in households in rural areas

are 213 UAH lower, and the share of these expenditures in the aggregate consumer expenditures is 5.3% higher in this population.

There are also significant differences in the structure of total household spending in urban settlements and rural areas. In 2016, rural households spent 45% of their total expenditures on food (including out-of-home meals), down 0.4% from 2015. In urban areas, the decrease was 2.3%, but the indicator was 4% higher compared to households in rural areas. This type of spending ceased to be dominant, since the purchase of non-food items and payment for household services were directed at the same share of their expenditures as food. Essentially, these changes are driven by an increase in the share of household expenditures spent on housing maintenance (including ongoing repairs), water, electricity, gas, and other fuels, although the dynamics of these components vary.

The cost of eating for one person in rural areas averaged 30 UAH per day, versus 43 UAH in urban settlements, while the absolute rate of increase was almost the same (Figure 2).

Changes in household structure are insignificant in the context of rural and urban households: the same dynamics of increasing or decreasing the share of food costs are observed in almost all types of food except meat and meat products (in rural areas, the share of costs is increasing, and in urban areas it is decreasing) and vegetables, including potatoes (in urban areas the cost share increases and in rural areas the dynamics have not changed).

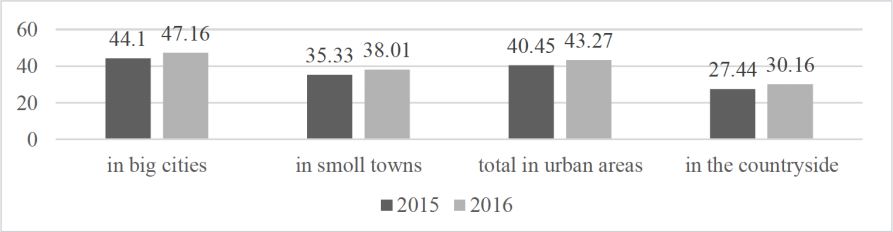

Figure 2. *The level of expenses in urban and rural households for food per person per day, UAH*

Source: calculated by the authors based on data (Expenditure and resources of households of Ukraine: Statistical publication, 2017)

On the other hand, there are significant differences in the absolute cost of household spending in rural and urban areas. Thus, the increase in expenditures on household food in rural areas amounted to UAH 166 versus UAH 156 in urban settlements. At the same time, household spending in rural areas increased significantly on types of food such as: bread and bread products; meat and meat products; fish and fish products; sugar, jam, honey, syrup, chocolate and confectionery; soft drinks and other products. Accordingly, household spending in urban areas has increased significantly on types of food such as: vegetables and potatoes; fruits; milk, cheese, and eggs, while reducing on fish and fishery products.

The significant increase in the cost of sugar, soft drinks, and other products in rural areas compared to households in urban areas can be explained by the lack of their production in the countryside, but it is difficult to make a valid argument regarding bread, meat, and fish, since the production of these products is concentrated within households. Thus, the increase in costs may be caused by an increase in consumption by this category of households. However, the consumption of these foodstuffs in rural households on average per month is less than their consumption in urban areas – meat and meat products by 0.7 kg and fish and fish products by 0.1 kg. Only the consumption of bread and bread products is higher in rural areas, on average by more than 2.1 kg. In addition, households in rural areas consume less eggs, fruits, berries, and grapes than households in urban areas.

Thus, a sufficient level of consumption in accordance with rational food consumption in households in rural and urban areas is achieved by vegetable oil, as well as by bread products in households in rural areas. The lowest consumption in accordance with the rational norms of consumption of food in households in rural and urban areas is of fruits, berries, and grapes – respectively 0.507 and 0.320 kg per month.

In addition to the place of residence, the numerical composition of households is significantly influenced by the affordability of food and its structure because of the level of income of households. Estimates show that, on average per person, depending on the number of people in one household there are different costs for food. The highest expenditure on food per person (UAH 1,370) is for households with one person (Figure 3). The lowest cost (per person) for food is in households of five or more people. For such households, expenditures per person are 38.6% lower than the level of expenditure for food in one-person households.

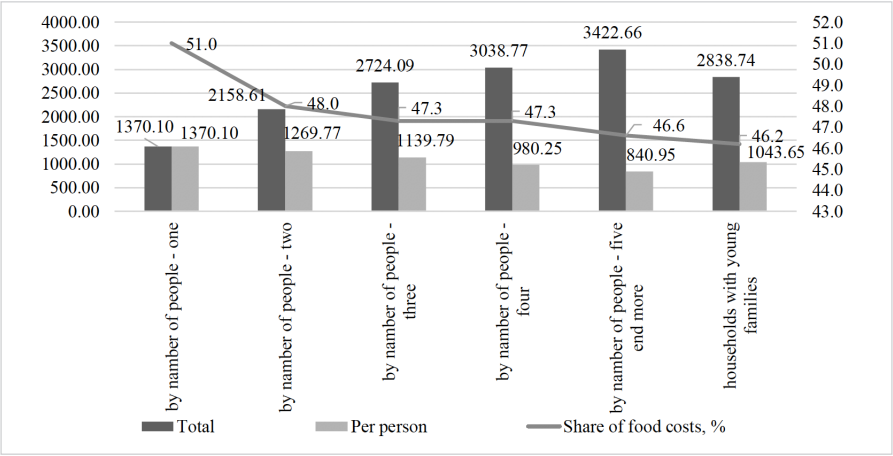

Figure 3. *The level of household expenditures on food by their average monthly composition, UAH*

Source: calculated by the authors based on data (Expenditure and resources of households of Ukraine: Statistical publication, 2017)

The cost structure of households with different numbers of people also varies significantly. The one-person household group has the highest share of oil costs, at a much lower cost than meat, fish, fruit, and sugar. Thus, single-person households consume almost twice as much oil per person as other groups. However, despite the relatively low share of costs, this group consumes more meat, fish, fruits and sugar, as well as the rest of the foods except eggs, the highest consumption of which is in two-person households.

In the two-person household group, the highest share of costs is spent on meat, fish, vegetables, milk, cheese, and eggs. For households with three people, the highest share is spent on fruits and soft drinks. Households with five people spend most on bread, sugar, and other foods. In the category of households with young families (where the average equivalent household size is 2.72 persons), the highest expenditure is on fruit and non-alcoholic beverages compared to other groups.

Levels of consumption below the average of most food products are observed in households with a population of four and five or more people. The highest percentage of households that have, on average, a cash income per capita per month that is lower than the subsistence minimum are comprised of four persons – 30.1% – and households with five persons possess the smallest share of those with average per capita cash income per month below the subsistence level – 9.5%. In four-person households, the oil consumption adequacy indicator is more than 100%, for eggs and bread it is more than 75% and 80%, for other products it is below 60%. Households with a population of five or more are most likely to deviate from the average in their consumption of animal products. Thus, the deficit in consumption of meat and meat products in households that number five or more persons is 44.5% of the normal rate, for milk and dairy products this is 46.0%, eggs 29.7%, and fish 46.0%. In this case, the compensation of calories is partly accomplished by the excess consumption of oil, while the consumption of potatoes, vegetables, fruits, and berries remains insufficient, since these products are consumed at a level much lower than rational standards. Thus, it can be argued that the level of nutrition in households of four or more people is insufficient and the level of food security has not been reached.

Vulnerable groups in terms of food security include households with children. The analysis shows that, on average per household, there are different costs for food depending on the number of children. The highest expenditure on food (UAH 1,068) is for households with one child (Figure 4).

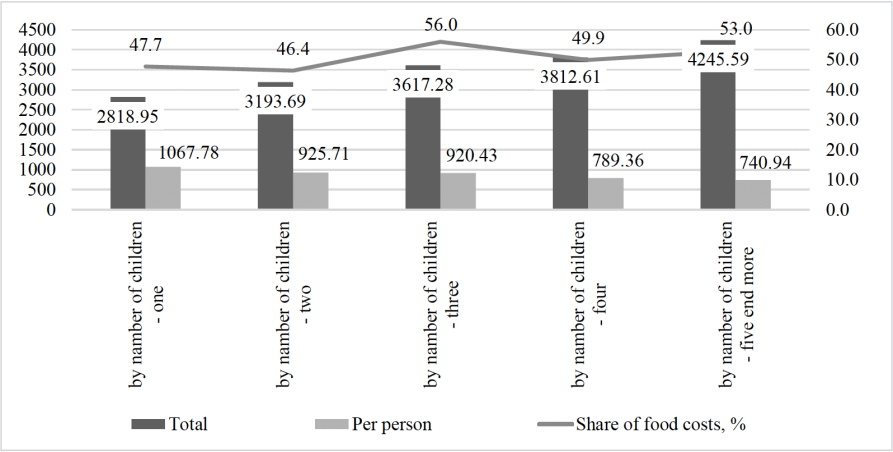

Figure 4. *The level of household expenses on food depending on the number of children, on average per month, UAH*

Source: calculated by the authors based on data (Expenditure and resources of households of Ukraine: Statistical publication 2017)

The lowest costs (per person) for meals are in households with five or more children. In such households, the cost of food is 30.6% lower than the level of expenditure on food in households with one child. The share of food expenditure in different groups ranges from 46.4% to 56.0%, but there is no clear tendency to increase or decrease the share of food expenditure depending on the number of children in the household. If, on average, households with children spend 47.6% of total expenses on foodstuffs, then for households with five or more children the share of such expenditures is already 53.0%, or 5.4% higher.

In the one-child household, the highest share of meat and vegetable costs is significantly lower than in other bread and sugar spending groups. In the group of households with two children, the highest share is spent on non-alcoholic beverages and other foodstuffs, with a much lower share of the cost on oil. In the group of households with three children, the share of spending on fish, fruit, and non-alcoholic beverages prevails; and in the group of five children with oil and sugar at the expense of less consumption of fruit, meat, milk, cheese, and eggs. In the group of five or more children in households (the average equivalent household size is 5.73 persons), the highest share of bread, meat, milk, cheese, and eggs is at the expense of other expenditures, with a lower cost share for fish, vegetables, soft drinks, and other food.

Among households with children, 30.1% of the total number are households with four children with an average per capita cash income per month below the statutory subsistence level (UAH 1,388). However, there are no significant variations in the level of food consumption among households with different numbers of children from one to three. This is indicative of the fact that parents are trying, under any circumstances, to

provide their children with the necessary food, but it is very difficult to accomplish this task under the conditions of low purchasing power. Thus, for households with four or more children, the average level of consumption of food by one person is observed only for bread and bread products (1.4%) and potatoes (12.1%). In addition, households with four or more children had the lowest consumption indices for meat and eggs (22% and 22.2%, respectively), and vegetables and fruits (22.4% and 30.3%, respectively). This indicates that households with four or more children, as in the case of households comprising four or more persons, compensate for less protein of animal origin by increased consumption of plant-derived proteins. The relatively low consumption of fruits and vegetables is explained by the high price in the winter-spring season and the low purchasing power of this category of households. Therefore, households with four or more children can also be categorized as vulnerable in terms of food security. In the latter group, where the number of children is four or more, indicators of the adequacy of food consumption by individual types of products are lower than the average, and significant deviations from the first group were found for meat and eggs (Table 2).

Table 2. *Indicator of adequacy of food consumption in households with children, depending on the number of children in their composition in 2016, on average per month per person*

Indicator	Households with number of children				
	all	one	two	three	four and more
Meat and meat products	0.615	0.645	0.555	0.630	0.480
Milk and milk products	0.543	0.553	0.524	0.518	0.502
Eggs	0.745	0.786	0.703	0.662	0.579
Fish and fish products	0.600	0.660	0.540	0.660	0.480
Sugar	0.758	0.758	0.695	0.758	0.726
Vegetable oil of all kinds	1.200	1.200	1.015	1.015	1.015
Potato	0.561	0.561	0.571	0.590	0.629
Vegetables and melons	0.566	0.604	0.492	0.529	0.440
Fruits, berries and grapes	0.440	0.453	0.400	0.413	0.307
Bread	0.832	0.855	0.784	0.891	0.844

Source: calculated by the authors based on data (Statistical Yearbook of Ukraine for 2016: Statistical publication 2017)

The defining characteristic of Ukrainian consumers is low purchasing power. Different levels of household income form the appropriate structure of household consumption. Thus, a population with an income level of up to 840 UAH per month consumes on average 1.5kg of meat and meat products per month for one person, and those with an income level over 3,720 UAH consume 5.5 kg per month, with an average consumption over all households of 4.2 kg per month. Only households where the income per person

exceeds 2,640 UAH (which is 1,252 UAH below the statutory minimum wage) have an average level of consumption of meat and meat products per person. A similar situation is observed in milk and dairy products, fish, fruits, and berries. Even for relatively inexpensive food (potatoes, bread, and baked goods), the consumption per capita is higher than the average for all households, and households with an income higher than 2,280 UAH per capita, which is 892 UAH below the statutory subsistence level, can afford an average amount of these foods. Thus, households with average total income per capita per month below the statutory subsistence level (1,388 UAH) consumed all foodstuffs below the national average in 2016, including: bread and bread products – by 14.5%; meat and meat products – by 42.9%; fish and fish products – by 41.7%; milk and cheese – by 41.4%; eggs – by 21.1%; oil – by 33.3%; fat and lard – by 40.0%; oil and other vegetable fats – by 20.0%; fruits, berries, nuts, grapes, watermelons, and melons – by 46.8%; vegetables, potatoes, mushrooms – by 29.7%; and sugar and honey – by 29.6%.

3. Conclusions

1. There are significant differences in the levels of affordability and consumption of household food. According to the research conducted, vulnerable areas of the population in terms of food security are:
   1) households located in rural areas (the expenses of such households are lower than those of urban settlements; disparities are observed in the structure of expenditures on foodstuffs, with a significant predominance of bread and sugar expenditures and lower costs of meat and milk with insufficient consumption of the latter);
   2) households with four or more persons (the level of nutrition in the households is insufficient and the level of food security is not reached);
   3) households with four or more children (households compensate for less protein of animal origin by the increased consumption of vegetable proteins).
2. The results of the study confirm the hypothesis that the level and structure of food consumption is significantly influenced by the economic affordability of products. Households in rural areas and households with a large number of persons have significantly lower incomes than other household groups, and these households are characterized by the lowest quality of food.
3. Further scientific research will focus on the formation of strategic foundations and the formation of an appropriate state policy for the protection of vulnerable groups in the context of transformational financial and economic processes.

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COMPETITION IN PUBLIC PROCUREMENT IN THE FIGHT AGAINST CORRUPTION: ANALYSIS OF AN EXAMPLE OF UKRAINE

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Abstract: *Corruption, as a social phenomenon, destroys the system of government, jeopardizes basic democratic values, delays economic development, and impedes the development of healthy competition in the economy. The increasing number of anti-corruption measures that have arisen around the world in the past few decades testify to the importance of this issue. The purpose of this paper is to investigate the anti-corruption measures that exist internationally in the field of public procurement. This paper will also research and analyze the innovations that have been adopted into Ukrainian legislation, and consider their impact on overcoming corruption in the public economy sector.*

The results of the study show that thanks to public procurement reforms, the introduction of e-procurement, transparency in the tender processes, and increased leverage on unfair bidders, there has been a tendency to make savings in public finances. At the same time, competition remains low due to imperfect legislation and low trust in the integrity of officials.

In the fight against corruption, the authors consider it necessary to increase competition in procurement by enhancing operational control of procedures, namely the development of a public procurement monitoring system.

The study presented reveals the widespread corruption schemes that have been devel-

oped in the system of public procurement in Ukraine, reveals the cause and effect of the inadequacy of the reforms carried out, and develops directions for further reforms of the system in order to overcome corruption in the public sector.

Keywords: *public procurement, corruption, tenders, sub-threshold procurement, public administration.*

JEL classification: *D73; H 57; H 50.*

1. Introduction

The share of public procurement in the GDP of every country is quite significant. According to the European Commission, the total volume of public procurement in the European Union is 14%, or approximately 2 trillion euros per year, which indicates the high economic importance of public procurement and its role as a powerful instrument for influencing market relations (European Commission 2020)

In such sectors as energy, transport, waste recycling, social protection, health, and educational services, public authorities are major buyers in the overall economic space of every country. The public sector can use procurement to stimulate jobs, growth, and investment, as well as to create an economy that is more innovative, resource- and energy-efficient, and socially inclusive. The high quality of public services depends on modern, well-managed, and efficient procurement (European Commission 2020). In every country, regardless of the level of economic development, public procurement should provide solutions to strategic and tactical challenges. The strategic policy is to support the national producer, public finance management, environmental protection, social policy, support for depressed regions, and others.

Public procurement is an important component of the anti-corruption system. Corruption destroys the democratic system of state governance, threatens law and order, endangers honesty and social justice, impedes economic development and competition in the economy, and threatens the destruction of the moral principles of society. Therefore, advanced European economies in the fight against corruption are developing multivector tools that include different standards, including those related to public procurement. The amount of literature that recognizes the importance of public procurement in the development of a country's economy is growing. Scientists consider corruption to be one of the main problems in public finance, and develop strategies to reduce the risk of its occurrence. This problem is particularly acute in developing countries. In the work of many scientists, the experience of European countries is studied and a strategy is developed taking into account national peculiarities.

The current stage of development of Ukraine's economy is characterized by processes of adaptation to the world economy, which is determined by the need to implement the provisions of international law at the national level. With the entry into force of the Law of Ukraine "On Public Procurement" of December 25, 2015, state procurements were reformed into "public procurement" (Verkhovna Rada of Ukraine 2015). In recent years,

significant organizational work has been carried out on the planning, development, and implementation of new technologies in public financial management. At each stage, analytical and methodological work was carried out by representatives of the Ministry of Finance of Ukraine, the State Treasury Service of Ukraine, the Department of Public Procurement Regulation of the Ministry of Economic Development, the Antimonopoly Committee of Ukraine, and the significant participation of international organizations. In their work, Ukrainian scholars widely study international experience of the public procurement system and the tools used in the fight against corruption as they constantly look for new mechanisms in accordance with the historical, economic, and social realities of Ukraine. But in the research of and search for new tools, scientists are limited to certain areas of the economy or explore certain methods (psychological, technical, repressive) that have a short-term effect. In our opinion, a comprehensive approach with the strengthening of the economic instruments of influence will reduce the corruption component, which at the same time will increase the efficiency of procurement. As public resources are limited, the efficiency of the procurement process is one of the components of all public procurement. An open, transparent, and non-discriminatory procurement regime is considered to be the best tool for approaching the optimal price–quality ratio, as it increases the level of competition among suppliers and reduces the risk of corruption.

In this article, the term "corruption" will involve the investigation of any method of manipulation in the conduct of public procurement procedures aimed at violating or avoiding the use of applicable legal acts. The article first examines research in the field of public procurement in Ukraine and the world, and analyzes Ukrainian legislative initiatives in the framework of integration processes. The second part of the article then deals with the methodology used for the study. In conclusion, the results of the study are summarized.

2. Literature review

Many scholars of economy, law, and sociology pay close attention to the study of corruption in public procurement. Scientists consider corruption in public procurement from a variety of aspects, investigating the issues of transparency, competition, detecting illegal schemes, and developing a strategy to combat the problem.

Locatellia et al. (2017) consider that despite the importance of the corruption component in the selection, planning, and implementation of government projects, this topic is poorly researched, especially with regard to large and unconventional procurement. The scientists investigate how corruption in government megaprojects affects cost, lead-time, and cost savings. The impact of the complexity of the public procurement object on the outcome of the auction and the level of corruption was investigated by Baldia et al. (2016). Grossi and Pianezzi (2018) examine the impact of society in the fight against corruption through the prism of the philosophical views of Rousseau, Popper, and Kant, and point to the need for democratic scrutiny and the building of social ethics for a common outcome.

Soreide (2002) bypassed economic instruments and instead paid close attention to the political aspect of combating corruption in public procurement.

In countries with a poorly developed economy, the issue of corruption during public procurement is quite acute. Researchers are trying to learn from the experience of other countries and incorporate it into their domestic economies, taking into account the political, economic, and social conditions. Watilshaka and Saidb (2015) focused their research on reducing corruption by reducing the involvement of intermediaries in bidding, and proved the effectiveness of e-procurement to promote transparency, accountability, and efficiency in procurement. Neupane et al. (2014) dedicated their research to the evaluation of the perception of potential e-procurement participants. The authors developed a theoretical model which reflects the impact of monopoly power, information asymmetry, trust, and transparency on the perception of e-procurement. Williams-Elegbe (2018) examined the causes of widespread corruption in developing countries and identified the causes of the failure of anti-corruption measures in Nepal. Sewpersadh and Mubangizi (2017) used experience of fighting corruption in Hong Kong to model anti-corruption measures for combating corruption in South Africa's public procurement system. Achua (2011) explored the reforms undertaken in the Nigerian public sector, and assessed and formulated a strategy to combat corruption in the country. Mugadza (2018) conducted an analysis of the fight against corruption in public procurement in Hong Kong, China, and South Africa, and identified four main directions for combating corruption: criminal, administrative, institutional, and civic activity. In his work, Mugadza examined two approaches to combating corruption – traditional and classic, characterized them by identifying their key features, and explored their strengths and weaknesses. Modisakeng et al. (2020) explored methods of effective supplier contract management from the perspective of local governments, and believe that the use of e-procurement will improve procurement efficiency. Issambayeva et al. (2019) also see great potential in the introduction of e-procurement as a way to increase competition and transparency, although Ukraine's experience shows that the introduction of an e-system is not a panacea for overcoming corruption. Hamzah et al. (2020) studied the mechanisms of reducing procurement prices by increasing competition among suppliers which will increase the efficiency of procurement, but do not consider it as a tool to reduce the corruption component in the economy of the state.

The global community, the EU in particular, has a well-developed public procurement system which many countries are guided by. Despite this, the EU budget loses a certain amount from corruption schemes in the field of public procurement every year. Hessami (2014) in his work used empirical data to explore the advanced economies of 29 countries, and looked at the link between political corruption and public spending structure. In his study, he argued that corruption in public procurement occurs not only in developing countries but in highly developed countries as well. Vukovic (2019) examined the relationship between corruption procurements and mayoral elections in the example of Croatian cities, and proved a hypothetical non-linear relationship between corruption and re-election. Ferwerda et al. (2017) devoted their work to identifying significant indi-

cators of corruption risks and identified indicators that could prevent corrupt practices in public procurement.

A transparent system of public procurement has also been introduced in recent years in the post-Soviet region, the main purpose of which is to ensure fair, competitive procurement. Detkova et al. (2018) analyzed the effects of corruption on the encouragement of customers to maintain fair competition among participants, and investigated weak competition in electronic trading. These problems are also relevant to Ukraine's public procurement system. Szucs (2017) analyzed the reform of public procurement policy in his work, and focused on alternative methods of public procurement during threshold purchases. He also analyzed reforms and examined the results of their influence on production in the country. Kováčiková (2019) examined the conflict of interest that arises during procurement and proposes a system of "red flags" that would indicate a conflict of interest that should help to overcome corruption, mass violations, and fraud during the procurement process. The development of a system of indicators for monitoring the procurement process in order to prevent violations is a current issue in Ukraine, and may be the source of a separate study in the future. Babica (2019) explored the shortcomings and prospects of innovation in public procurement and considers them as a tool to promote sustainable development in Latvia. Recent data suggests that the problem of systemic corruption in public procurement is common to all countries that moved to a market economy in the 1990s. Langr (2018) investigated methods of detecting falsifications in bidding. These studies, however, are aimed at identifying corruption components, and not at finding methods to prevent violations of the system.

In Ukraine, many scholars devoted their work to the study and analysis of public procurement. Research on this issue is mostly limited to studying the experience of other countries – for example, Ivanova and Sevostianova (2018) conducted a comparative description of the domestic electronic system with the European one. However, much of the research of recent years is descriptive and mostly limited to some comparisons, although further research is needed on this issue as the public procurement system in Ukraine is developing rapidly, and legislation in the technical part of tenders and monitoring is constantly improving. Altsyvanovych and Tsymbalenko (2018) studied the main approaches used to prevent corruption risks, namely psychological, technical, and repressive, and concluded with the need for an integrated approach to solving this issue, but in the process of their research overlooked the search for economic approach. Parasiy-Vergunenko (2017) proposed a methodology for analyzing public procurement which makes it possible to evaluate its effectiveness, whereby for each analytical stage a system of indicators and algorithms for their calculations were developed. Radionov (2011) investigated the problems of inefficient use of budget funds, and identified the causes and negative factors that lead to budget violations. Zdyrko and Ostapcuk (2020) considered issues of auditing the effectiveness of public procurement, and proposed the application of criteria of economy, productivity, and efficiency. However, despite the fact that there is a lot of research in the field of improving the efficiency of public procurement, researchers do not see them as tools in the fight against corruption.

The reform of the public procurement system in Ukraine began more than two years ago, and this provides a large area for research and analysis with the aim of finding new approaches to increase control over spending and budgetary savings.

The problems of corruption in the public procurement system arise in every country, therefore much attention is being paid to developing international instruments to overcome manipulation and increase transparency during procedures. Due to the spending of large amounts of public funds on public procurement in every country, and the significant negative effects of corruption schemes, international organizations pay great attention to the creation of preventive measures. Table 1 provides an overview of the EU Directives used to increase transparency and integrity in the public procurement system (*Harmonisation of public procurement system in Ukraine with EU standards: Compendium of EU public procurement directives* 2015).

Table 1. *EU Public Procurement Directives.*

Directives	Scope of application
2014/24/EU, February 26, 2014	Procurement in the public sector
2014/25/EU, February 26, 2014	Procurement in the field of housing and communal services
2014/23/EU, February 26, 2014	Conclusion of concession agreements
89/665/EEC, December 21, 1989	Regulates the use of appeals procedures for awarding contracts for the purchase of goods and work with public funds
92/13/EEC, February 12, 1992	Regulates the use of appeals procedures for awarding contracts for the purchase of goods and work with public funds by water, energy, transport and telecommunications organizations
2009/81/EU, July 13, 2009	Procurement in the defense sector
2014/55/EU, April 16, 2014	About electronic implementation in procurement

Source: compiled by the author on the basis of Harmonisation of public procurement system in Ukraine with EU standards: Compendium of EU public procurement directives (2015)

The submitted directives introduce an effective procurement process, the purpose of which is the rational use of budget funds. The directives introduced certain control measures aimed at increasing competition and reducing the risk of corruption and budget over-spending. A transparent procurement process is considered to be the main tool for the effective fight against corruption, and is being implemented by the Directives. First of all, this involves: the disclosure of public procurement rules; the timely disclosure of procurement plans; the publication of tender announcements; the disclosure of evaluation criteria; the publication of information on concluded contracts; the establishment of appropriate and timely dispute mechanisms; and the introduction of the practice of informing public officials of their involvement in the public procurement process.

Ukraine has assumed obligations under the Association Agreement, in particular Art. 148-156 on the implementation of a public procurement system in accordance with EU standards (Verkhovna Rada of Ukraine 2014). In recent years, Ukraine has been undergoing European integration processes in the management of the budget system. At the legislative level, the methods of public finance management are enshrined, which include the achievement of concrete results with their use and the efficiency of their usage at all stages of the budget process. Consistent adherence to commitments undertaken by Ukraine on the path to global integration demonstrates a clear position on strengthening control over the efficiency and use of budget funds. Budget accounting is the tool for achieving this goal in terms of financial information, and the introduction of new legislation on public procurement is the tool in terms of the effective use of budget funds. The scheme of integration processes is presented in Figure 1.

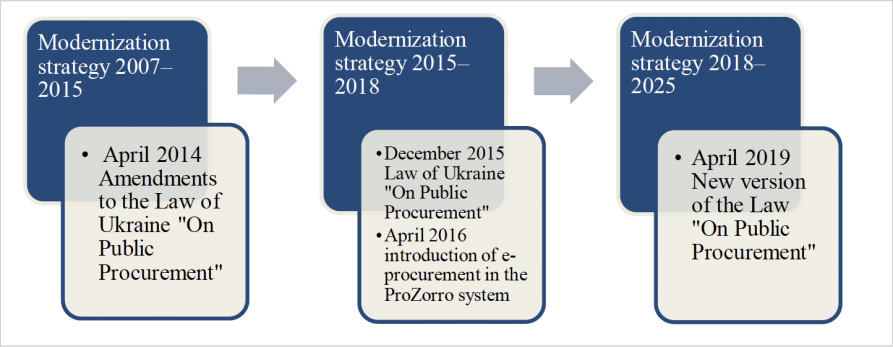

Figure 1. *Scheme of integration processes in public procurement. Compiled by the authors*

The reform in Ukraine began with the adoption of a strategy in 2007, which set the general direction of accounting reform in the public sector. The implementation of this project was intended for the period of 2007–2015, but for good reasons the implementation of the reform was postponed several times. At the end of 2015, a strategy was adopted to modernize accounting in the public sector for 2015–2018, thus confirming the inevitability of the reform. In connection with the reform of the budget system, considerable attention is paid to the management and use of public finances. This was achieved by creating a transparent regulatory framework for public procurement, an effective institutional infrastructure for public procurement, and the accountability and integrity of public authorities in the field of procurement.

Work on harmonizing public procurement procedures in Ukraine with EU standards began in 2013. In recent years, the Law on Public Procurement was amended in 2010 and, before it was replaced by a new version in 2014, has been constantly amended. A new, more progressive version of the Law of Ukraine "On Public Procurement" of April 10, 2014. № 1197-VII was adapted to EU rules in key areas. The changes were made in order to simplify the public procurement procedure, increase the level of transpar-

ency and openness, fight against corruption, and harmonize domestic legislation with EU standards. Work on improving procurement legislation has continued, in particular with the introduction of electronic bidding. The logical result of this process was the approval by the Verkhovna Rada of the new Law of Ukraine "On Public Procurement" on December 15, 2015, based on which there was a gradual transition to procurement from paper to an electronic system starting from April 1, 2016.

All reforms of the state procurement system took place in accordance with the approved Road-map, and today it is possible to evaluate definite results in the work of the new system of public procurements. For further research, it is necessary to study the European legislative content on the fight against corruption in the context of integration processes in Ukraine.

The main document in the international regulation of public procurement is the UNCITRAL Model Law, which is adopted as the basis for national legislation in many countries. The main objectives of creating a model law are to maximize the efficiency and effectiveness of procurement, expand and stimulate the participation in procurement of international suppliers and contractors, develop competition between suppliers and contractors, create a level playing field for all suppliers and contractors, promote the objectivity and fairness of the procurement process and public trust in it, and ensure the openness of procedures (UNCITRAL 2011).

The new Ukrainian legislation on public procurement is based on the main principles and approaches of the UNCITRAL Model Law, although it went beyond the accepted template primarily in the implementation of electronic procurement.

The most comprehensive anti-corruption convention is the United Nations Convention against Corruption, adopted by the United Nations General Assembly on October 31, 2003, which came into force on December 14, 2005. The articles of the Convention deal with issues of transparency in the public sector and establish a code of conduct for public officials. In order to ensure the transparency of procurement procedures and to ensure the public disclosure of information, the Convention articles require: the establishment of a proper procurement system, transparency in procurement, the application of objective criteria for decision-making, the introduction of an effective system of internal control, the integrity of public officials, and the proper preparation of documentation of a public nature (Verkhovna Rada of Ukraine 2006).

The United Nations Convention against Corruption was ratified by Ukraine on October 18, 2006, and came into force on January 1, 2010, since when it has become an integral part of national legislation and is considered superior to any provision of domestic law.

Another framework mechanism for regulating the public procurement system is the World Trade Organization (WTO) Agreement on Public Procurement, which is the legislative basis for international trade between governments. The agreement provides general rules for tender bidding and outlines responsibilities for each country. The purpose of such an agreement is to create non-discriminatory conditions for all market participants to ensure international competition in the public procurement system. The

implementation of this agreement by the participating countries should stimulate good governance and promote the rational use of budget funds.

Ukraine has been a member of the WTO since May 16, 2008, with an observer status, which has allowed it to increase the opportunities for international procurement and liberalize trade with the EU. Ukraine also joined the WTO agreement on government procurement in February 2016 (Verkhovna Rada of Ukraine 2016). Joining this agreement has opened the world public procurement market to Ukrainian companies, which is one of the most important areas of public procurement reform.

The leading body established in Europe to fight corruption is the Council of Europe, which has developed multi-functional instruments aimed at overcoming criminalization in the public sector, contributing to the increased liability of officials and aiming to minimize losses from corruption schemes.

The Council of Europe uses a comprehensive approach to combat corruption in three main areas: setting standards, monitoring compliance, and technical assistance in the implementation of projects and programs. The Council of Europe provides assistance in reforming the economic sphere to prevent corruption and money laundering to many countries, including Ukraine.

Most of the instruments created by the Council of Europe have a much larger scope than public procurement, but Resolution (97) 24, on twenty guiding principles of the fight against corruption, provides a number of measures aimed at preventing corruption in the public sector. These include: access to public information and the promotion of ethical conduct; ensuring transparency in public administration; the creation of rules which regulate the rights and duties of officials; the provision of audits of the activities of state administration bodies; ensuring the responsibility of officials for consequences arising from their participation in corruption schemes; and the provision of transparent public procurements that will foster fair competition (OECD 2017).

Another source of recommendations for anti-corruption measures is the World Bank, along with other international financial institutions. Ukraine must adhere to the general rules applicable to borrowing countries that use donor funding provided by international financial institutions. For borrowers, certain standards are set for reforming the public procurement sector, which should ensure transparency, increase competition and objectivity in the use of donor funds, and provide control over the use of such funds.

The main task of the World Bank's procurement sector is to provide support for reforms in order to improve the procurement system of borrowing countries by: creating an effective legislative framework; increasing accountability, objectivity, and transparency in the spending of budget funds; and protecting competition, efficiency, economy, and equality during bidding procedures.

The Organization for Economic Cooperation and Development (OECD) develops procurement evaluation tools and implements the principles of professional ethics in public procurement. The main tools for combating corruption during public procurements are presented in Table 2.

The Istanbul Action Plan to Combat Corruption, adopted in 2003, deals with Eastern European and Central Asian countries, including Ukraine. Ukraine takes into ac-

count the recommendations of the OECD report "Anti-corruption Reforms in Ukraine. Fourth round of monitoring of the implementation of the Istanbul Anti-Corruption Action Plan" (OECD 2017).

Ukraine is reforming its public procurement system through the introduction of new legislation and an electronic trading system. The new system was introduced almost two years ago, and there is a need for analysis to identify deficiencies and risks of corruption in the system of public procurement.

Taking into account the above, it can be said that Ukraine supports all global efforts to combat corruption during public procurement. Changes in Ukrainian public procurement legislation were also caused, in part, by political motives. After the signing of the Association Agreement with the EU, it was necessary to integrate the public procurement system in accordance with European rules and principles.

Table 2. *OECD Instrumentation on Combating Corruption in Public Procurement*

OECD tools	Date	Scope of application
Convention on the fight against bribery by foreign officials in international business operations	1999	Recommendations on the fight against corruption of officials during international business relations, methods of international influence in order to minimize corruption risks, proposed sanctions for dishonest officials.
General Principles on Professional Ethics in Public Procurement	2009	Ten principles are proposed based on fair, transparent, accountable public procurement, alongside the tools for implementing these principles.
Guidelines for combating government procurement violations	2009	Guidance materials to assist governments in creating conditions for obtaining an optimal price/quality ratio in the procurement process.
Professional ethics in public procurement: from A to Z	2007	Recommendations for assessing the risks arising during public bidding, the methodology for increasing transparency at each stage of the bidding, and the tools for increasing accountability and public control.
Bribery in public procurement: methods, subjects and actions in response	2007	Recommendations for the analysis of corruption risks in public procurement, mechanisms for identifying potential corrupt officials and corruption agreements, and methods for preventing corruption in public procurement

Source: compiled by the author based on: OECD Report, 2017

This is evidenced by the project "Harmonization of the Public Procurement System in Ukraine with EU Standards", which was started in November 2013. The project aims to promote the development of a sound and consistent public finance management system through the establishment of a transparent regulatory framework, effective institutional infrastructure, and a system of responsible and honest state administration. In addition, it is necessary to take notice of additional measures provided by other international instruments and the practical experience and recommendations from the anti-corruption approaches of the leading states.

The implementation of these principles through the introduction of new legislation and the e-procurement system should have reduced the level of corruption in Ukraine but, according to research conducted in recent years by Transparency International Ukraine, the Corruption Perception Index in Ukraine (2019) remains rather low. The index is based on a series of independent surveys involving international financial and human rights experts, including Asian and African development banks, the World Bank, and the American organization Freedom House. The index is a rating from 0 (the maximum level of corruption) to 100 (no corruption). The results of this research in Ukraine are presented in Fig. 2.

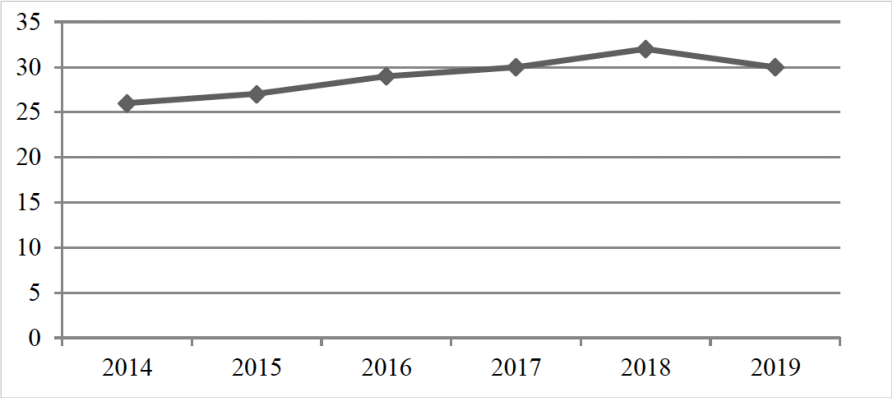

Figure 2. *Corruption Perception Index in Ukraine*

Source: compiled by the author on the basis of Transparency International Ukraine (2018)

As can be seen from the graph, Ukraine is experiencing, albeit very slow, a growth in the Corruption Perception Index (CPI). Along with other factors that help fight corruption – such as judicial reform or the introduction of electronic declarations for officials – a significant role is played by the introduction of new legislation in the field of public procurement and the introduction of the electronic procurement system.

In the worldwide rating for 2019, Ukraine did not significantly improve its position among neighboring countries, who ranked as follows: Poland – 58, Romania – 44, Hungary – 44, Belarus – 45, Moldova – 32, Slovakia – 50, and Russia – 28. Over the last year, Ukraine has reduced its position and regressed to the level of the year 2017.

Worldwide experience shows that for the stable development of a society it is necessary to reform the budget system in accordance with the strategic tasks of the socio-economic development of the country. Having chosen the path of European integration, Ukraine must adhere to the global standards of ensuring financial stability, social guarantees, and high economic activity. Therefore, the main task of fiscal policy is to modernize the budget sector of the economy, reform public expenditures, and increase the efficiency

and effectiveness of the use of budget funds. To fulfill these tasks, a public procurement reform was launched in Ukraine based on transparency, proper governance, and the prevention of misconduct; involving monitoring, accountability and control.

3. Methodology and empirical data

3.1. Analysis of the efficiency of the use of budget funds during electronic procurement

During the last decade in Ukraine, at the level of legislation governing public procurement, many reforms were undertaken to overcome the existing and potential risks of corruption. The previous system of public procurement, which ceased to function in August 2016, was considered to be corrupt. This system allowed for a conspiracy between the participants and customers, permitted the use of non-competitive procurement procedures, and lacked the possibility of conducting procurement through electronic bidding. The flaws of the old system had to be fixed due to the enactment of the Law of Ukraine "On Public Procurement," which was supposed to greatly increase transparency and competition in the procurement process and which introduced mechanisms of influence on customers and participants behaving unfairly. The new law contains key provisions for the functioning of electronic public procurement, establishes general technical and security requirements for the electronic procurement system, provides the basis for an electronic authorized site, reduces the number of procurement procedures to three, and introduces the appeals office for procurement procedures.

The electronic system combines the main electronic portal with a network of private electronic platforms. The data obtained in the process of interaction with the system is publicly available, and is used for monitoring. The implemented reform in the field of public procurement has opened access to more participants, has become noticeable to the general public, and the openness of the system has raised the level of awareness of citizens regarding public procurement. As a result of these innovations, observers' access to purchasing processes has been simplified and monitoring has become simpler and more convenient. The electronic system has simplified access to bidding for bidders and reduced administration costs, as well as speeding up the procurement process. In addition, Ukraine, as a member of the WTO Agreement on Government Procurement, has become more open to foreign participants and has itself gained access to global procurement processes. The main achievement of the introduction of the electronic procurement system is the saving of budget funds, which is constantly covered on the official website of ProZorro. The savings effect is calculated as the difference between the expected purchase price and the value of concluded contracts. The expected value of the offer is set by the customer at the time of publication of the contract, and represents the maximum amount of funds that can be spent by the customer under a particular contract. The procedure for determining the expected value is not established by law, and so is quite a subjective indicator. The actual value is set at the time of concluding the contract, and is the minimum price offer for a separate contract.

Calculation using this method does not reflect the efficiency of the use of budget funds in procurement by bidding and procurement by negotiation procedure – that is, without the use of open bidding due to the lack of an offer with the expected value. To add, according to statistical data from 2017–2019, such procedures account for almost half of all purchases, as can be seen in Table 3. Consequently, the total cost of threshold procurement and procurement conducted under the negotiation procedure amounts to half of the value of all purchases, with this trend continuing over the past years. Thus, calculation of the estimated budget savings in procurement proposed by ProZorro does not fully reflect the effectiveness of procurement.

Table 3. *Procurement analysis*

Procurement type	2017		2018		2019	
	UAH billion	%	UAH billion	%	UAH billion	%
Threshold procurements	171.101	35.6	188.643	28.7	167.61	21.0
Negotiation procedure	89.313	18.6	102.94	15.7	129.38	16.2
Open bidding	93.52	19.4	151.41	23.0	253.66	31.8
Open bidding with publication in English	110.519	23.0	194.71	29.6	230.54	28.9
Negotiation procedure for defense needs	16.43	3.4	20	3.0	16.37	2.1
Total	480.883	100	657.703	100	797.56	100

Source: compiled by the author based on: ProZorro Statistics

In order to determine the savings of public funds from the standpoint of legality, we propose the application of an operational approach, i.e. determining the savings of budget funds for each purchase. The effectiveness of each individual procurement is assessed by calculating the savings, which are determined as a percentage of the initial contract price.

The savings indicator (E) will be calculated as follows:

$$E=\frac{\Sigma beg-\Sigma end}{\Sigma beg}\times 100\% \qquad (1), \text{ where}$$

Σ beg – expected cost,

Σ end – the cost of the contract.

According to the calculation presented, an analysis of purchases among customers in Zhytomyr in 2019 was conducted. A total of 6242 purchases were investigated using the ProZorro analytical module. The results of the research were grouped by risk regarding the possibility of a corruption component (Table 4).

Table 4. Indicators of saving public funds for procurement in Zhytomyr in 2019

Savings indicator	Estimation of economy	Number of lots	% of the total number of lots	Total expected cost, thousand UAH	Total contract value, thousand UAH
E=0	There are no savings	729	12%	126792.4	126792.4
E<5	low savings	1656	26%	195911.3	187185.7
5% <E<12%	normal savings	3157	51%	513724.4	447387.0
13%<E<20%	high savings	484	8%	2269161.7	1767287.3
E>21%	speculative savings	216	3%	40365.1	28916.4
Total		6241	100%	3145954.9	2557568.8

Source: compiled by the author based on: ProZorro Statistics

According to the data presented in the table, the number of purchases with zero savings is 12%. This situation is observed in the application of negotiated procurement procedures, mainly for gas supply services, electricity supply, etc. In Ukraine, the problem of a forced monopoly exists due to the lack of competition in this market. The large percentage of low-cost purchases is due to the lack of a sufficient number of bidders. In this situation, a sufficient number of proposals for each purchase is not provided, and so the percentage reduction of the initial price is minimal. The percentage of purchases with high savings is 8% of the total, while the total cost of such purchases is the largest and exceeds all others at times. A more detailed analysis shows that the categories of "high savings" and "speculative savings" include capital construction and the overhaul of roads. Such procurements are traditionally of high value and have a high risk of corruption. The general research shows that in 2019 in Zhytomyr there was fairly low competition among participants.

3.2. Competition as a tool for ensuring the transparency of public procurement

One of the main tools for combating corruption during public procurement is the increase of competition and the introduction of the principle of non-discrimination of participants, as stipulated in Article 3 of the Law of Ukraine "On Public Procurement." The implementation of this principle is carried out through the establishment of equal conditions for participation in these procedures for participants of all forms of ownership and organizational and legal forms of activity. In this case, customers are prohibited from resorting to actions that would discriminate against potential participants. In accordance with the Law of Ukraine "On Public Procurement," the customer may establish one or several qualification criteria, including: the availability of equipment, material, and a technical basis; the availability of employees with relevant qualifications; and the documented completion of a similar contract. This rule is not always used as it is intended by the law. Customers take steps to reduce competition during the procurement

process by defining specific and overly detailed requirements for a procurement item in order to ensure that a particular participant wins, thus discriminating against the participation of other potential participants. There are cases where customers combine in one lot several types of products to be produced by different manufacturers. Because of this, producers cannot bid, and a certain intermediary firm wins. Also, to reduce competition, the delivery time specified in the contract is often too short for the manufacturer to produce and deliver the necessary quantity of product. Dishonest customers, during the disclosure of conditions, may also overstate the terms of payment for products, which reduces the number of participants willing to bid. Due to this, with today's constant inflationary processes in the economy, not all manufacturers can wait for an extended period of time to receive payment for products. As a result, the desired participant wins the tender, and after the signing of the agreement the delivery times and terms of payment for the products can be reviewed.

An analysis of the level of competition in public procurement is an important part of the research of the competitive environment, since a higher level of competition reduces corruption and creates favorable conditions for the most profitable deals, which leads to the increased efficiency of public procurements. Typically, the level of competition is calculated as the ratio of the number of participants to the number of procedures in public procurement. This technique is used when calculating the level of competition in the "ProZorro" system, and Parasiy-Vargunenko (2017) proposes to use the formula:

$$P = \frac{K}{N} \qquad (2), \text{ where}$$

P – level of competition,
K – number of participants,
N – number of procedures.

Taking into account the negative factors, and despite the simplification of the procedure for public procurement, competition among participants remains low. The dynamics of competition in the public procurement market for the period of 2016–2019 are presented in Table 4. Since the launch of an electronic public procurement system in August 2016, there has been a steady rise in the number of participants and procedures. However, the level of competition over the period of 2016–2019 remains insignificant at a level of two participants per procedure, indicating a lack of competition, an overstated price, and a guarantee of procurement by agreement. To prevent such a situation in the market of public procurement, the Law of Ukraine "On Public Procurement" provides a procedure for appeal.

Table 5. *Analysis of the level of competition*

Indicator	September 2016	September 2017	September 2018	September 2019
Number of procedures, thousands	50.8	82.69	92.54	94.29
Number of participants, thousands	118.9	185.2	211.92	236.67
The level of competition	2.34	2.24	2.29	2.51

Source: compiled by the author on the basis of ProZorro Statistics

3.3. The implementation of the principle of non-discrimination of participants during public procurement

The use of the electronic system during procurement provides access to information for potential suppliers or participants dissatisfied with the procurement process, as well as for public observers. On one hand, this leads to increased competition, promotes the transparency of work done by the government organizations, facilitates public control, and increases the likelihood of exposure for conspiracies, fraud, and the inefficient spending of budget funds. On the other hand, dissatisfied participants have access to information on the tenders that have taken place, and may contest the decision on the winning bid by appealing to the Antimonopoly Committee of Ukraine regarding the violation of the principle of non-discrimination of participants.

The ACU Board must consider the complaint in due time and make a decision regarding the violation of the principle of non-discrimination, and may oblige the customer to amend the tender documentation for which the violation was discovered or cancel the purchase entirely. However, the appeal of participants to the Antimonopoly Committee of Ukraine on violations, alongside being a means of protecting the rights of participants in procurement, can also be a means of abuse by delaying the bidding process, since according to Art. 18 of the Law of Ukraine "On Public Procurement" the consideration of a complaint can take up to 15 working days. The result of the consideration of a complaint may be a confirmation or refusal of violation in the procurement procedure. The statistical data on complaints submitted to the Antimonopoly Committee are presented in Figure 3.

As can be seen from the data, there is a sharp rise in the number of appeals, especially in the last year. This is due to the simplification of the procurement procedure and the possibility to automatically submit a complaint to the electronic cabinet of the appeals body. On one hand, this greatly enhances the possibilities of preventing unfair competition or revealing a violation of the law, and ensures the implementation of the basic principle of non-discrimination of participants in public procurement. On the other hand, this allows dishonest parties to challenge procedures without valid reasons, since the filing of a complaint is allowed even without payment. In 2017 the number of such appeals increased by 47 percent compared with 2016 (Figure 3).

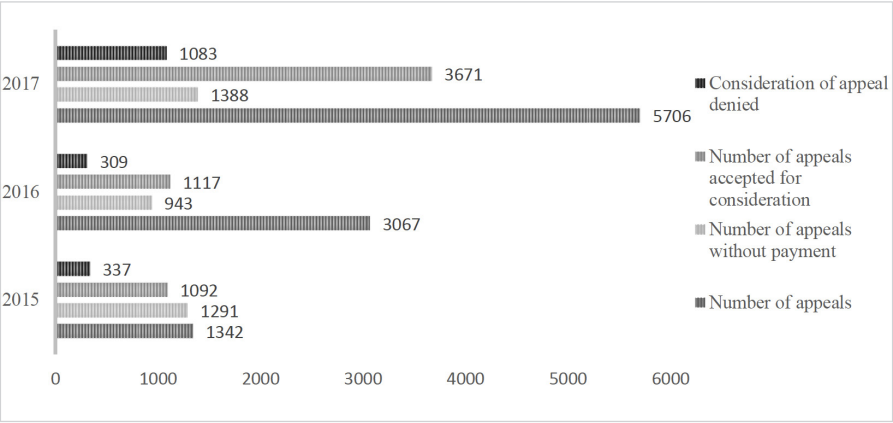

Figure 3. Dynamics of appeals to the Antimonopoly Committee of Ukraine

Source: compiled by the author on the basis of ProZorro Statistics, 2015–2017

In practice, there are cases where the procurement procedure was delayed through an automatic appeal by 120 days. In order to prevent such cases, amendments to the legislation should be introduced that would not allow the automatic suspension of the procurement procedure until the payment for the appeal is made. In addition, raising the fees for appeal procedures may reduce the number of unfounded appeals. Such an increase would be expedient and economically justified, as over the past seven years, despite the inflationary processes in the country's economy, changes in legislation, and rises in the minimum wage and the cost of living, the price for appeals has remained unchanged.

Despite the problems identified, as a result of an increase in the number of applications in 2017, the budget revenues doubled in comparison with 2016, amounting to 24.3 million UAH. With the raising of the fee for appeals, the budget revenue will increase and the number of submissions of groundless complaints will be reduced.

One of the most popular schemes to avoid open bidding is to break up one large purchase into several smaller ones. The new legislation on public procurement requires the mandatory conduct of electronic procurement if the amount of procurement exceeds the threshold of 200,000 UAH for goods and 1.5 million UAH for services. Purchases below this threshold can be entered into the system in the form of reports. To avoid public procurement procedures, customers divide one large procurement into several smaller ones and only file a report in the system upon the conclusion of a contract. This approach allows the customers to make purchases by negotiation, in violation of the principles of public procurement. According to statistics, the number of customers who the used electronic system for public procurement with the application of the provisions of the Law "On Public Procurement" in 2017 amounted to 14,620, and customers who conducted threshold purchases amounted to 25,610. At the same time, in 2017, 137,854 contracts were concluded in accordance with the rules of public procurement law, and 765,504

threshold contracts – 5.6 times more, a tendency that is repeatedly observed in the following years. The amount of threshold purchases in the total number of final agreements is also quite high, as shown in Table. 6.

Table 6. *The number of contracts concluded*

The procurement procedure type	2017 year		2018 year		2019 year	
	number of contracts	%	number of contracts	%	number of contracts	%
Threshold procurements	765,506	84.7	950,907	87.7	1,094,620	87.5
Negotiation procedure	51,340	5.7	48,866	4.5	58,746	4.7
Open bidding	76,801	8.6	78,322	7.3	89,896	7.3
Open bidding with publication in English	7,592	0.8	4789	0.4	5625	0.4
Negotiation procedure for defense needs	2,121	0.2	1359	0.1	2054	0.1
Total	903,360	100	1,084,243	100	1,250,941	100

Source: compiled by the author on the basis of ProZorro Statistics

Obviously, we must consider the preferential use of threshold procurement by customers for the purchasing of goods, work, and services. Such a situation is explained by the simplified procedure of threshold procurement, the smaller volume of necessary documentation, the possibility of avoiding competition, and ensuring the fulfillment of the contract by a particular participant. However, if we return to the procurement analysis of 2017 in Table. 3, then the total amount for threshold procurement was 110.519 billion UAH, and the total amount for contracts concluded in accordance with the rules of the law on public procurement was 370.364 billion UAH. It is clear that contracts with lesser value fall under the law, but it is inappropriate to break up contracts to avoid open bidding – a process used by unscrupulous customers.

To combat such a scheme, we consider it necessary to lower the threshold for public procurement, so that a greater number of purchases fall under the legislation. The problem in threshold procurement today is the lack of a legislative framework that would regulate this issue. Therefore, it is necessary to extend the Law on Public Procurement with the introduction of a simplified procedure for procurements with a lower threshold value.

A lack of regulation at the contract implementation phase is a major corruption risk, which is also observed in many other countries. This increases the risk of corruption in the field of public procurement since the contract price and volume often change after the contract is concluded, and contractors often fail to fulfill their contractual obligations. Due to collusion between the customer and the contractor, there are deviations from the contract agreements which lead to negative consequences. It is necessary to set up an effective system for monitoring contract implementation, and amendments to

the contract must comply with the law and provide a limit on the value of the contract. In practice, there is a tendency for the value of the contract, after the winning bid, to increase several times with the aid of additional agreements, while the legislation allows for fluctuations in price within 10%. In addition, the contractor often supplies a product of lower quality or differing specifications, or even replaces product entirely with lower quality analogues. Officials deliberately avoid proper control by collaborating with the contractor, which leads to an increase in prices due to changes to the contract. Regulation on the publication of reports on the performance of contracts exist to prevent such situations, but it is not explicitly stated in the Law "On Public Procurement," so some of customers avoid disclosing such information and ignore this requirement.

4. Results

The introduction of public procurement accountability through the electronic procurement system greatly contributed to the strengthening of the CPI in 2016. Due to the operation of the ProZorro and DoZorro systems, cases of procurement violations have become more apparent to business and the public than they were under the system of paper tenders.

The introduction of the automatic calculation of the savings percentage (1) for each purchase into the DoZorro system would allow users to quickly detect suspicious purchases with speculative savings in order to identify unscrupulous participants.

Active exposure of such tenders with the DoZorro system can significantly reduce corruption in procurement. As shown in Table 3, there is a steady increase in the number of auctions and public procurements, indicating the confidence of small and medium enterprises in the reform of public procurement and thus fulfilling the main objectives of the introduction of a new system of public procurement: transparency, competition, and ethical behavior. The increase in the number of participants in public procurements directly strengthens Ukraine's position in the determining of the CPI rating (Fig. 1), although very slowly as the level of competition among participants in recent years remains low.

The results of this study support the idea that corruption in public procurement is caused by low competition among participants in the system (Table 4). Therefore, the main way to overcome corruption risks during tenders is to increase the number of participants by implementing a number of measures at the state level that would strengthen the confidence of potential suppliers and reduce discrimination in the system. These measures include:

- the introduction of automatic monitoring for the detection of unscrupulous participants in the electronic public procurement system;
- a reduction in the marginal amount for subthreshold procurement to prevent the avoidance of competitive bidding;
- the introduction of a simplified procurement procedure for standard goods, works, and services (such as stationery or computer equipment) in order to attract more participants;

- the prevention of the automatic suspension of the procurement procedure until payment of the appeal in order to prevent fictitious complaints;
- an increase in the fee for appealing the purchase.

An important indicator that affects the level of corruption during public procurement is the efficiency of the use of public funds. Such an indicator should reflect the productivity, performance, and cost-effectiveness of budget spending. The absence of a clear, legally established principle and mechanism for the effective use of budget funds in Ukraine affects the identification of the corrupt actions of participants in the budget process. At present, it is impossible to determine the results of the use of budget funds at a legislative level, since the current system is not oriented based on their efficiency.

5. Conclusions

Public procurement is a powerful tool for influencing a country's economic market, which allows for the formation of a stable and efficient economic system. The reform of public procurement in Ukraine has allowed the public procurement system to be more open and simplified the access of participants to bidding, along with reducing the level of government spending on administration and accelerating the procurement process. Currently, a hybrid procurement system operates in Ukraine, in which state bodies are responsible for the integrity of the central database and business structures are responsible for providing trading platforms to customers and participants. This approach is rare and prevents corrupt practices within the system itself.

However, the introduction of an electronic bidding system has not been the only result of the reform. Public procurement has become more noticeable for small and medium-sized businesses, and openness has raised awareness among citizens. In addition, Ukraine, as a member of the WTO Agreement on Government Procurement, has become more open to foreign participants and itself has access to procurement abroad. The electronic system has lowered the cost of administering the procurement process and accelerated the procurement procedure.

Despite the transparency, constant public monitoring, and optimization of the process, corruption in public procurement in Ukraine remains present. It is necessary to develop a number of tools to overcome the risk of corruption in the system of public procurement, including: amending the legislation in order to increase the level of competition; reducing the number of unfounded appeals; and monitoring the implementation of contracts. It is necessary to develop and regulate, at the legislative level, a single system to analyze the indicators of the effectiveness of state funds.

Under the present system, the effect of budget savings is calculated as the difference between the expected purchase price and the actual cost of concluded contracts. Thus, the concept of "procurement savings" and the concept of "procurement effectiveness," which underlie the principles of public procurement anticipated by law, differ significantly in practice. The legislation does not clearly define what is understood by, and indeed what is the essence of, the principle of public procurement: "maximum economy and effectiveness." The expected cost of procurement is determined by the customer at

the time of the publication of the procurement notice, and is a rather subjective indicator because when the initial price of the contract is set the validity and real market value of the procurement are not taken into account. In addition, the full life-cycle of the product or service is not taken into account at all. The calculation of effectiveness should include the expiration date and the possibility of disposal after the expiration date. Taken into consideration, these indicators could be addressed, alongside a number of environmental and social issues. These provide prospects for future research.

The reform of public procurement gained considerable support among Ukrainians and from the international community, but faced considerable resistance and caused ardent debates. There are blind spots in the system which increase the risk of corruption, making it impossible to fully analyze and monitor public procurement.

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EVALUATION OF THE ADAPTABILITY OF SCIENTIFIC THEORIES FOR THE DEVELOPMENT OF ACCOUNTING INSTITUTE

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Abstract: *This study is devoted to the development of theoretical foundations and the formalization of the method for assessing the adaptability of existing scientific concepts for the purposes of developing accounting, and is based on an analysis of the advantages and disadvantages of scientific concepts when applied to research on accounting and the development of its theory. The article uses empirical analysis for assessment of the feasibility of applying a specific scientific concept, formalized in accordance with reasonable criteria. These criteria include: grouping based on the presence of common features; analyzing the principles of compliance with the principles of the concept of accounting; and empirical assessment of the impact of the concept on the methodology of accounting through predicting the negative consequences of its application.*

Research results indicate that the application of various scientific concepts and theories in the development of accounting does not always contribute to the solution of accounting problems and tasks. In order to minimize the risks of choosing a false basis for scientific research in the field of accounting, a method for evaluating the effectiveness of the concepts of scientific change has been proposed.

The novelty of the proposed approach is that, unlike the existing ones, it allows the mathematical identification of the concept's adaptability and is based on digital values. Thanks to its use, an informed choice of the most effective concept for researching and solving accounting problems is ensured, which makes it possible to avoid choosing a false basis of scientific research.

Keywords: *Scientific concept, Accounting, Accounting theory, methodology.*

JEL: *M4, M40, M41.*

1. Introduction

The modernization of accounting and the improvement of its organizational and methodological foundations require a balanced approach. The decisive role in this process is played by the scientific substantiation of the ways of solving this problem through the formation of an appropriate frame of reference. In modern conditions, there are a number of different methodological concepts, the use of which allow for the formulation of logically-systematized provisions related to the development of accounting theory and the formation of an effective system thereof. However, a critical review of the scientific literature indicates that their principles in this area are not widely applied. The description of these theories is mainly carried out with a goal that is more informational rather than being based on research, which negatively affects the results of scientific research aimed at improving the theory of accounting.

The application of various concepts in the process of the research of scientific changes, in combination with the analysis and determination of the reasons for their occurrence and the consequences of the impact on the accounting system, will allow for the identification and evaluation of possible alternatives and the building of logical models with more advanced characteristics and parameters. Thanks to the correct choice of the fundamental concept of research, it is possible to achieve the best positive results, which in modern conditions are characterized by a transition from quantitative accounting parameters to the plane of qualitative approaches. That is, the basic law of dialectics is confirmed – the transition of quantitative changes into qualitative ones. New qualitative changes are accompanied by the emergence of appropriate new quantitative parameters, which must necessarily be taken into account when modernizing accounting.

2. Literature review

In modern conditions, the assertion of a change to the position of information attributes is true. It acquires the characteristics of an independent object that can exist outside of a person and a material carrier. In line with this, there is a need to change the approaches to its formation. From the point of view of conceptual foundations, a clear definition of the problem of management needs, taking into account the possibilities of their solution in the context of the current level of development of other sciences, can serve as the basis for such a process.

The theoretical and methodological foundations for the further development of accounting in Ukraine, as Malyuga (2006) noted, taking into account international tendencies and experience, as well as national social and mental specificity, form the philosophical basis of this science. At the same time, the scientist emphasizes that, for the development of accounting theories, in order to form an accounting methodology in Ukraine, the Western positive direction is unacceptable. The main, decisive direction of development for domestic accounting, according to the scientist, should be methodological unity. In line with this, the normative nature of accounting theories should be carefully observed.

Fully supporting the first part of the Malyuga's position, it should be pointed out that the categorical nature of the further conclusion contradicts, in a certain way, the thesis about the development of the theoretical and methodological foundations of accounting in Ukraine taking into account global trends, and also sets a framework for the development of domestic accounting theory. This approach, despite the presence of firm ground (namely, strict regulation), significantly reduces the possibilities and prospects for the harmonization of accounting, especially through the use of recommendations of international standards.

Along the way, it should be noted that, compared with research on ways to improve accounting, in the modern scientific literature not enough attention is paid to the development of its theory.

Some scholars express the opinion that the complexity of developing a new accounting theory is due to a number of stereotypes that have developed and are supported by the academic community (Holov 2011).

Others, on the contrary, note that the need to single out the metatheoretical level of accounting is one of the most promising areas of development in the accounting theoretical knowledge system, and its solutions will streamline existing developments and shape the further development paths of individual accounting scientific theories (Lehenchuk 2012).

The reason for such disagreements may be the fact that scientific publications mainly state the need to develop, or at least develop accounting theory, but in fact such studies in Ukraine, with a few exceptions (Holov 2011; Lehenchuk 2010; Popper 1983), are not too common.

The problem is not only the development of the concept, but also the recognition that there is no consensus among scientists about the fundamentals of its development. On this occasion, Sokolov (2000) argued that in its essence everything that now seems to be the theory of accounting is either unnecessary scholasticism of the type "subject and method," or the inspection of regulatory documents that relate more to the field of jurisprudence than to accounting. At the same time, deep ideas, postulates, and paradoxes are taken as the bases of the theory, and are not considered at all.

Despite this, many countries, including Ukraine, have chosen such a direction as adaptation to international standards as the basis for the formation of national accounting concepts. Such an approach should not be considered sufficiently substantiated and balanced, since the practice of Ukraine shows that there is no particular take-off of economic indicators after the introduction of national accounting standards which are based on the provisions of international standards. From this position, one should consider the indicated direction of development of the scientific concept of accounting theory as insufficiently effective.

Unegbu (2014) carried out research in this direction. His research aims to follow the evolution of accounting theory – however, he concludes the opposite. Unegbu notes that it is the introduction of international standards that allows for the solving of the problem of increasing the efficiency of activity, because this is promoted by unity in the matter of generating reporting data on expenses, financial results, etc.

It is necessary to agree with the positive result of standardization in matters of accountability. Indeed, thanks to the application of uniform principles and estimates, reporting becomes understandable to a wide range of users, including foreign investors. However, this is the basis for the growth of economic efficiency – it is important that accounting standards are formed on the basis of sound research and theories.

Many other scientists devote their work to the problems of accounting theory and its development in the context of various basic principles.

Kabir (2010) examines the development of positive accounting theory (PAT) and compares it with three standard accounts of science: Popper (1959), Kun (1996), and Lakatos (1970). PAT has been one of the most influential accounting research programs during the last four decades. One important reason which Watts and Zimmerman (1986) have used to popularize and legitimize their approach is that their view of accounting theory is the same as that used in science. Thus, it is important to examine how far accounting has been successful in imitating natural science, and how the development of PAT compares with the three standard accounts of science.

Kaya (2017) is guided in his research by a positivistic theory for the formulation of conclusions about the development of the theory of accounting. Considering this, he takes as a basis three hypotheses: bonus plan hypothesis, debt hypothesis, and political cost hypothesis. These hypotheses will continue to be a rich field of empirical research and the basic questions that they raise are still relevant today.

It should be recognized that in international scientific thought, and in recent years in the publications of Ukrainian authors, more and more attention is being paid to the development of accounting theory. In Ukraine, the focus is now on institutionalism, however in different historical periods other approaches were taken as a basis.

Therefore, to determine the concept of the development of the theory of accounting, it is legitimate and expedient to analyze the history of scientific accounting thought, and those postulates that were taken as a basis by relevant groups of scientists in a given period of time. The most widespread, as the review of scientific literature shows, were theories: theories of various series of accounts; balance theories; economic and legal theory; logical-mathematical, organic, tax, macro- and microeconomic, social, scholastic, and formal theories; structural and metaphysical theories; as well as a number of others.

In general, it should be noted that each theory has both disadvantages, which have a corresponding impact on the general principles of the development of accounting theory as well as its methodological and organizational basis, and advantages. In this context, an important task that the researcher should undertake in order to obtain a positive result in their scientific research is the correct assessment of the influence of the chosen concept on the research result.

The analysis of literary sources shows that foreign and domestic scientists have made numerous attempts to research and use various kinds of scientific concepts in relation to scientific changes in accounting. In particular: the theory of falsifications of Popper (based on the ideas of F.N. Bacon); the implicit personal knowledge approach of Polanyi; the paradigmatic approach of Kun; the research programs of Lakatos; the evolutionist method of Tulmin; "epistemological anarchism" (Feyerabend 1993; Hartley 1928; Polani

1958; Popper 1959; Weber 2005; Dipiaza and Jekklz 2003; Kun 2002; Kuter 2000; Lakatos 2008; Popper 1983), and "institutional theory" (Takeda 1982).

It should be noted that even among these theories there are those that contradict or, on the contrary, organically complement each other. In particular, the theory of falsification (Popper 1959), which is based on critical rationalism (a system of methodological rules), can most likely be opposed to epistemological anarchism (Feyerabend 1993), according to which the only principle that does not hinder progress is the principle of proliferation (permissiveness). It was thanks to the latter that significant breakthroughs occurred in accounting science, in particular the development of the theory of duality, and in recent years the theory of sources of information (which, due to the computerization of accounting, can be classified as accounting).

Against the background of logical orderliness and resolution of the modern accounting system, it is possible to form completely new theoretical foundations through the use of scientific views that do not fit into the methodological rules, or that even violate them.

Among other examples, the development of paperless accounting in modern conditions should be noted, the existence of which, until the advent of the computerized form of accounting, was considered fiction. In accordance with this, the thesis of Feyerabend (1993) – that anarchism helps to achieve progress in any sense – is quite fair. It is thanks to going beyond the traditional view that a number of breakthrough theories have emerged (kinetic, relativity, dispersion, quantum, Galois (field theory), etc.).

On this basis, we can conclude that going beyond the orderliness of the system and using the principle of "everything is allowed" will allow the formation of a new accounting theory. This principle, justified Feyerabend, in its essence organically fits into the postulates of the theory of implicit personal knowledge (Polani 1958).

After all, the fact that phenomena with characteristics which go beyond the limits of well-known theories do not exist at all is not scientifically supported. Ignorance of them does not mean their absence, because the level of development of science and technology at a certain period of time does not allow them to be discovered and investigated.

From the point of view of accounting, this situation can be illustrated by the following example. In the early stages, credentials were recorded without adhering to the principle of duality, but this does not deny its presence and instead most likely indicates limited knowledge.

Accordingly, it can be argued with high probability that a breakthrough in accounting theory can be, for example, the justification of the principle of the trinity or another similar development. In general, these theories in modern conditions have great advantages compared with those based on the application of logic, the accumulation of knowledge, and the competition of programs. Such theories as the logical-methodological (Popper 1983), paradigmatic (Kun 2002), or research programs (Lakatos 2008), play an important role in scientific research of course, including those devoted to accounting issues.

The result of the application of their principles is the formation of more perfect principles, and not the achievement of a new qualitative level that meets the criteria of the invention.

The institutional theory – in our opinion – is similar, from the standpoint of the result (Semenyshena 2011). Its use for the study of the theory of accounting will also

contribute to its improvement, but can in no way lead to a fundamental change. Institutions in this area are mainly interpreted as restrictions, rules, norms, frameworks, and mechanisms of coercion in the economy (North 1981; 2000; Williamson 1996).

Therefore, it is quite logical for Zhuk (2009) to justify its influence, and it was concluded that there is an institutional theory of accounting. Zhuk defined the purpose of such a theory, along with its essence, role, and significance (Zhuk 2009).

Without going into the details of these issues, we note that the validity of the existence of such a theory is confirmed not only by modern accounting practices (international accounting standards and relevant international institutions, etc.). Evidence of the existence of this theory can be carried out even by applying the well-known theory of falsification of Popper (1959). In its context, if we take the hypothesis that there is no institutional basis for accounting, we deprive it of the fundamental basis of existence in general, which is absolutely false.

On the other hand, it is necessary to evaluate the adaptation of each specific object of scientific research (in our case, the accounting system and its theory) for the correct and effective application of the postulates of a particular theory in the process of researching any problem.

3. Methodology

This article uses empirical analysis for the assessment of the feasibility of applying a specific scientific concept formalized in accordance with reasonable criteria. This involves: grouping based on the presence of common features; analyzing the principles of compliance with the principles of the concept of accounting; and empirical assessment of the impact of the concept on the methodology of accounting through predicting the negative consequences of its application.

4. Results

The determination of the possible influence of each of the existing theories of the development of scientific knowledge on a particular branch of science requires an assessment of the effectiveness of the use of concepts. To formalize a model for such an assessment, one should: firstly, group the existing concepts, taking into account their compatibility and the possibility of integration; secondly, identify the shortcomings of the application of the principles of scientific change in the context of the object of study.

The conclusion regarding the effectiveness of the use of scientific concepts in the latter is based on the results of the evaluation, which will have a specific mathematical expression. By excluding from the list of concepts those that will not be effective, it is possible to establish the optimal list of areas of scientific change for a particular field of study.

The study identified the shortcomings of the application of basic concepts for the development of accounting fundamentals in budgetary institutions, and concluded that its basis should be based only on the effective parameters of each of them. To do this, they must be classified.

The implementation of the classification of concepts of scientific change allows for the identification of the relationship between existing authors' positions and the establishing of the relationship between their parameters. In the future, the result of the classification can be the basis for the formation of a formalized mathematical model for their assessment. To do this, it is important to characterize the main shortcomings of the concepts of change in accounting theory, since the latter should be used as the basis for establishing weights for each theory (Fig. 1).

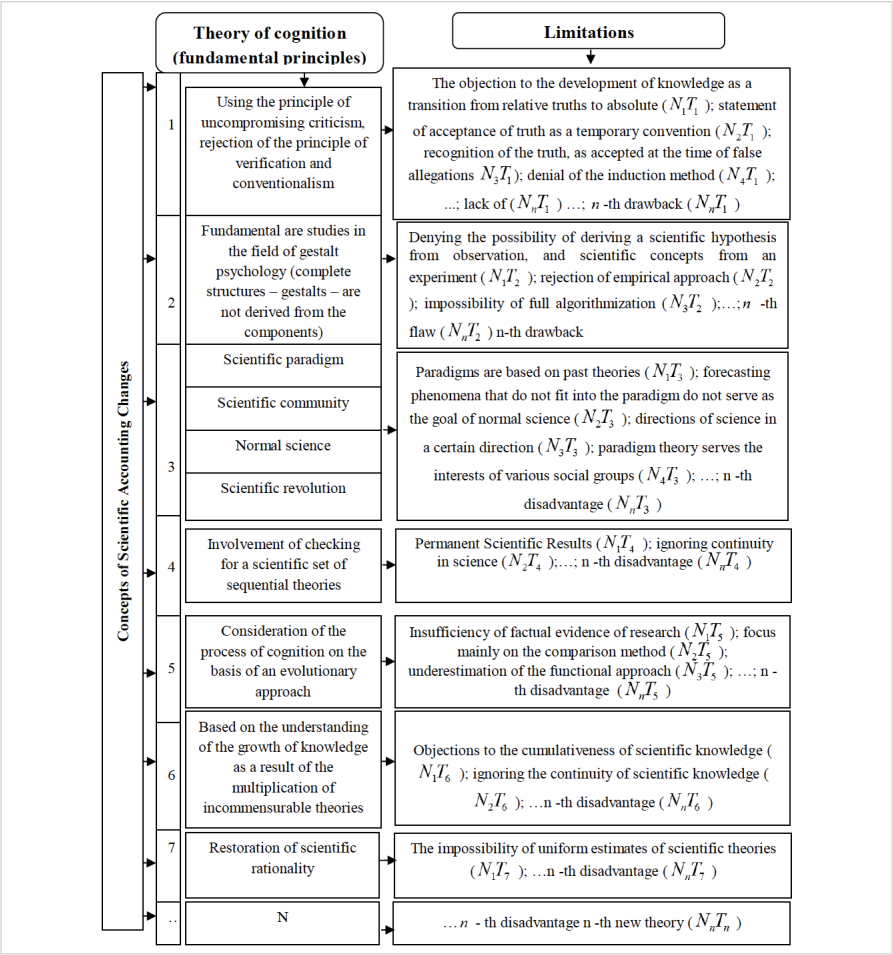

Figure 1. *Classification of concepts and basic principles of scientific accounting changes **

*Notes: * formed on the basis of [1; 2; 3; 4; 7; 8; 13]; 1 – the theory of fraud; 2 – the concept of implicit personal knowledge; 3 – paradigm theory; 4 – the concept of research programs; 5 – evolutionary concept; 6 – the concept of "epistemological anarchism"; 7 – the concept of research traditions.*

The concepts considered and illustrated (Fig. 1), like any other, are not without drawbacks. However, each of them in a certain way played (and plays) its role in the knowledge of the essence of various phenomena and processes, including those related to accounting. A formalized mathematical model for evaluating the effectiveness of the functioning of the concepts of scientific changes in accounting can be produced as follows:

$$\begin{cases} K_{ef} = \alpha_1 P_{tf} + \alpha_2 P_{ipk} + \alpha_3 P_{pt} + \alpha_4 P_{rp} + \alpha_5 P_{ea} + \alpha_6 P_{cea} + \alpha_7 P_{rt} + \ldots + \alpha_n P_n \\ \sum_{i=1}^{n} \alpha_i = 1 \\ P_{tf} = \langle C_{puc}, C_{fhnk} \rangle; P_{ipk} = \langle C_{fgp} \rangle; P_{pt} = \langle C_{sp}, C_{sc}, C_{ns}, C_{sr} \rangle; P_{rp} = \langle C_{snsct} \rangle; \\ P_{ea} = \langle C_{kbea} \rangle; P_{cea} = \langle C_{ea} \rangle; P_{rt} = \langle C_{rsr} \rangle; P_n = \langle C_n \rangle \end{cases} \quad (1)$$

Where:

P_{tf}– the concept based on the theory of fraud. The main component is the principle of uncompromising criticism C_{puc} and the fundamental hypothetical nature of knowledge C_{fhnk};

P_{ipk}– the concept of implicit personal knowledge. The development of the concept is based (C_{fgp}) on research in the field of Gestalt psychology. It is assumed that the content of scientific statements depends on the implicit context of hidden knowledge, "knowledge as," which is fundamentally of an instrumental nature;

P_{tp}– concept based on paradigm theory. This theory is built on four main elements: the scientific paradigm C_{sp} , the scientific community C_{sc} , normal science C_{ns} , and the scientific revolution C_{sr} ;

P_{rp} – the concept of research programs, which provides for the verification of the scientific nature of a set of consistent theories C_{snsct};

P_{ea} – the evolutionary concept, which provides for consideration of the process of knowledge on the basis of the evolutionary approach C_{kbea};

P_{cea} – the concept of "epistemological anarchism," which provides for consideration of the process of knowledge on the basis of the evolutionary approach C_{ea};

P_{rt} – the concept of research traditions, which provides for the restoration of scientific rationality C_{rsr};

Π_n – n-on concept. It provides C_n, that is, the characteristic that underlies the concept;

α_i – weights that determine the degree of influence of each of the concepts on the resulting value of efficiency. Determined on the basis of taking into account the shortcomings of each of the concepts:

$$\alpha_i = 1 - \sum_{i=1}^{10} N_i T_i \,, \quad (2)$$

where $N_i T_i = 0.1$

Assigning a value of 0.1 to each deficiency corresponds to the condition that their reasonable maximum amount can be 10. If the concept has more flaws, then it is inef-

ficient, and its application will have a negative effect on changing the concept of accounting development.

We can then outline the evaluation devices:

1. Theory of Falsification:

Limitations:

1. 1the denial of the development of knowledge as a transition from relative truths to absolute (N_1T_1).This has a negative effect on the development of the methodology and organization of accounting, since it limits the use of relative estimates. From the point of view of the dynamism of accounting data and its dependence, in modern conditions, on a number of factors that are taken into account through indexation and an additional evaluation, this shortcoming limits the development of the theory of accounting in the evaluation of its objects.
2. the statement regarding the acceptance of truth as a temporary convention (N_2T_1).
   a) contradicts the principle of continuity. Chronologism and consistency inherent in accounting position it as a system of continuous reflection of business operations (with minor fluctuations depending on the requirements of current legislation). The application of the concept under study would indicate the opposite;
   b) accuracy as the main requirement for accounting information cannot be temporary;
3. recognition of the truth, as taken at the time of false allegations (N_3T_1).
   a) contradicts the principle of consistency.
   b) the unacceptability of this concept through the indicated deficiency in the development of accounting theory is obvious, since the accounting system reflects the results of the business operations and processes carried out in the prescribed manner. Reporting as the final stage of accounting should contain accurate, objective data and indicators. Otherwise, it can be recognized as twisted and untruthful, for which responsible employees can be brought not only to administrative, but also to criminal liability.
4. negation of the induction method (N_4T_1).
   a) inductive research method allows for the prediction of the possible options for the development of accounting theory;
   b) taking into account existing trends contributes to more accurate forecasts;
   c) the negation of the method of induction actually deprives the research of the basic output bases.
5. naive refutation.
   a) the refutation of the basis of accounting is impossible due to the presence of mathematical sequences in the implementation of accounting operations;
   b) the rejection of accounting as such contradicts the logic of the needs of society and the individual and the availability of information about the objects;
   c) it is impossible to prove the expediency of not accounting.

Summary: As a result of evaluating the characteristics and principles of the theory of falsification, 12 flaws were identified.

The theory of falsification could probably be applied to such principles as accounting principles and functions (2 positions).

From here:

$$\alpha_i = 1 - \sum_{i=1}^{10} N_i T_i = 1 - (0.1 + 0.1 + 0.1 + 0.1 + 0.1 + 0.1 + 0.1 + 0.1 + 0.1 + 0.1 + 0.1 + 0.1) = 1 - 1.2 = -0.2$$

$$\mathrm{K}_{ef} = \sum_{i=1}^{10} (1 + 1) \cdot (-0.2) = -0.4$$

Conclusion: The theory of fraud is unsuitable for use in research problems of the theory of accounting.

2. The concept of implicit personal knowledge.

Limitations:

1. Denial of the possibility of deriving a scientific hypothesis from observation. The definition of accounting includes the period of observation (observation, measurement, registration, etc.). Its exclusion from the research process will lead to an unjustified limitation of the components of accounting.
2. Denial of the possibility of deriving scientific concepts from experiment.
   a) an experiment in the study of accounting objects is an important research method. Its use allows one to test the developed proposals. The exclusion of experiment will relieve the theory of the possibility of the practical confirmation of new concepts;
   b) denial of testing the results of the study;
3. Rejection of the empirical approach.
   a) refusal to generalize in research. This is unacceptable for accounting, since it makes it impossible to take into account positive experience;
   b) rejection of classification in research. Classification in accounting is one of the main components of its rationalization.
4. The emphasis on implicit knowledge is contrary to the accuracy of accounting, it is its key characteristic.
5. Intuition as the basis of the cognitive process does not correspond to the principle of accuracy of accounting.
6. The thesis that the skill of cognition cannot be described contradicts such a key characteristic of accounting as registration.
7. The presence of fundamental differences between implicit knowledge and current accounting practices.
8. Implicit knowledge is difficult to record because it is in a non-verbal form.
9. The impossibility of a text or other representation.

Generalization: As a result of evaluating the characteristics and principles of the concept of implicit personal knowledge, 8 shortcomings were identified.

This probability theory could be applied to develop the fundamentals of improving reporting, inventory and other accounting methods (3 items)

From here:

$$\alpha_i = 1 - \sum_{i=1}^{10} N_i T_i = 1 - (0.1 + 0.1 + 0.1 + 0.1 + 0.1 + 0.1 + 0.1 + 0.1 + 0.1 + 0.1) = 1 - 1.1 = -0.1$$

$$K_{ef} = \sum_{i=1}^{10} (1 + 1 + 1) \cdot (-0.1) = -0.3$$

Summary: As a result of evaluating the characteristics and principles of the concept of implicit personal knowledge, 8 deficiencies were identified.

This probability theory could be applied to the development of the fundamentals of improved reporting, inventory, and other accounting methods (3 positions).

$$\alpha_i = 1 - \sum_{i=1}^{10} N_i T_i = 1 - (0.1 + 0.1 + 0.1 + 0.1 + 0.1 + 0.1 + 0.1 + 0.1 + 0.1 + 0.1) = 1 - 1.1 = -0.1$$

$$K_{ef} = \sum_{i=1}^{10} (1 + 1 + 1) \cdot (-0.1) = -0.3$$

Conclusion: The theory of implicit personal knowledge is unsuitable for use in researching the problems of accounting theory.

3. Paradigm theory.

Disadvantages:

1. Denial of the new foundations and methods of research:
   a) prediction of phenomena that do not fit into the paradigm do not serve as the goal of the study and are not taken into account when using this concept;
   b) the limited use of innovative research approaches and techniques that do not fit into the existing paradigm.
2. Conclusions and the development of new principles are based only on past theories:
   a) rejection of the new foundations of the development of theory;
   b) the denial of the possibility of using the concept to study the new foundations of theoretical accounting knowledge;
3. The trajectory of science in one particular direction.
4. Limited interests:
   a) serving the interests of specific social groups;
   b) ignoring various interests.

Summary: As a result of evaluating the characteristics and principles of the concept of implicit personal knowledge, 7 shortcomings were identified.

This probability theory could be applied to the development of the accounting methodology as a whole (1 position)

From here:

$$\alpha_i = 1 - \sum_{i=1}^{10} N_i T_i = 1 - (0.1 + 0.1 + 0.1 + 0.1 + 0.1 + 0.1 + 0.1) = 1 - 0.7 = 0.3$$

$$K_{ef} = \sum_{i=1}^{10} 1 \cdot 0.3 = 0.3$$

Conclusion: paradigmatic theory is suitable for use in the study of accounting theory.

4. The concept of research programs.

Disadvantages:

1. 1. Permanence of scientific results does not meet:
   a) the principle of continuity in accounting;
   b) chronology of records;
   c) the initial conceptual basis of accounting – balance sheet equality;
   d) systematic accounting;
   e) historical and logical method of cognition.
2. 2. Ignoring continuity violates:
   a) the principle of historical value;
   b) the principle of continuity of accounting;
   c) the requirement of continuous reflection of the objects of accounting in chronological order;
   d) logical and historical method of scientific knowledge.

Summary: As a result of the evaluation of the characteristics and principles of the concept of research programs, 9 shortcomings were identified.

This theory of probability could be applied to the study of the problems of accounting for liabilities and expenses, as well as the formation of estimates and reporting (4 positions).

From here:

$$\alpha_i = 1 - \sum_{i=1}^{10} N_i T_i = 1 - (0.1 + 0.1 + 0.1 + 0.1 + 0.1 + 0.1 + 0.1 + 0.1 + 0.1) = 1 - 0.9 = 0.1$$

$$K_{ef} = \sum_{i=1}^{10} (1 + 1 + 1 + 1) \cdot 0.1 = 0.4$$

Conclusion: The concept of research programs is suitable for use in researching the problems of accounting theory.

5. The evolutionist concept.

Limitations:

1. The insufficient level of use of factual evidence does not correspond to:

a) the principle of accounting efficiency;

b) the purpose of accounting;

c) documentation as an accounting method.

2. Underestimation of the functional approach:

a) leads to the loss of real opportunities to influence future results due to insufficient use of credentials by the management system;

b) contradicts the separation of accounting by sites and objects and the subsequent construction of accounting indicators;

c) does not allow for the full combination of the functions of accounting.

3. The emphasis is mainly on the comparison method:

a) not all cases of comparison in accounting give a real picture of the state of the subject;

b) the indifference of various accounting objects limits the application of the concept.

Summary: As a result of evaluating the characteristics and principles of the evolutionist concept, 8 shortcomings were identified.

This probability theory could be applied to the study of asset and liability accounting and reporting problems (3 items)

From here:

$$\alpha_i = 1 - \sum_{i=1}^{10} N_i T_i = 1 - (0.1 + 0.1 + 0.1 + 0.1 + 0.1 + 0.1 + 0.1 + 0.1) = 1 - 0.8 = 0.2$$

$$K_{ef} = \sum_{i=1}^{10} (1 + 1 + 1) \cdot 0.2 = 0.6$$

Conclusion: The evolutionist concept is suitable for use in researching the problems of accounting theory.

6. The concept of "epistemological anarchism."

Limitations:

1. 1. Denial of the cumulativeness of scientific knowledge does not respond:
   a) the basic concept of accounting, built on balance sheet equality;
   b) a certain isolation of the accounting system within a particular subject of activity, as well as the limitations of this theory based on a number of requirements;
   c) consideration of the development of the science of accounting as a progressive process (albeit with a bearish amplitude)
2. Accidents in accounting studies play an insignificant role in comparison with other sciences.
3. Ignoring the continuity of scientific knowledge:

a) limits the use of a systematic research method;
b) denies the historical and logical methods of scientific knowledge;

Summary: As a result of evaluating the characteristics and principles of the evolutionist concept, 6 shortcomings were identified.

This probability theory could be applied to the general accounting methodology (1 position).

From here:

$$\alpha_i = 1 - \sum_{i=1}^{10} N_i T_i = 1 - (0.1 + 0.1 + 0.1 + 0.1 + 0.1 + 0.1) = 1 - 0.6 = 0.4$$

$$K_{ef} = \sum_{i=1}^{10} 1 \cdot 0.4 = 0.4$$

Conclusion: The concept of epistemological anarchism is suitable for use in the study of problems of accounting theory.

7. The concept of research traditions.

Limitations:

1. The position that no experiment is key or sufficient to refute the developed theory.
2. The basis (core) of the study should be the same for different objects.
3. The research program may be progressive or regressive, which excludes those studies that have an ascertaining character.
4. The obligation to consider phenomena and processes that do not fit into the existing paradigm. The inclusion of all such phenomena, without assessing their impact, leads to excessive detail, but not always positive outcomes for the development of the science of accounting.
5. Unconventional approaches to scientific views are the basis for the development of new concepts (contrary to the principles of historical assessment, accuracy, prudence, and some other accounting principles).
6. The objection of unified assessments of scientific theories.

Summary: As a result of evaluating the characteristics and principles of the evolutionist concept, 6 shortcomings were identified.

This probability theory could be applied to the general accounting methodology (1 position)

From here:

$$\alpha_i = 1 - \sum_{i=1}^{10} N_i T_i = 1 - (0.1 + 0.1 + 0.1 + 0.1 + 0.1 + 0.1) = 1 - 0.6 = 0.4$$

$$K_{ef} = \sum_{i=1}^{10} 1 \cdot 0.4 = 0.4$$

Conclusion: The concept of research traditions is suitable for application in the research of problems of accounting theory.

8. Institutional theory.

Limitations:

1. Contrasts with classical and neoclassical views, which in modern conditions continue to be relevant and determine the fundamental basis of accounting (a static approach corresponding to the formation of a balance sheet as a reporting form; abstract analysis method, etc.).
2. The legal framework as the basic framework (in economics and accounting, the legal framework is important, but not the only influential framework for the development of economic phenomena and processes).
3. The emphasis on the need for greater public control over business and government intervention in the economy (contrary to the widespread use of market laws for economic development).

Summary: As a result of assessing the characteristics and principles of the institutional concept, 3 shortcomings were identified.

In our opinion, this theory could be applied to the general accounting methodology (1 position)

From here:

$$\alpha_{i=}1-\sum_{i=1}^{10} N_i T_i = 1-(0.1+0.1+0.1) = 1-0.3 = 0.7$$

$$\mathrm{K}_{ef} = \sum_{i=1}^{10} 1 \cdot 0.7 = 0.7$$

Conclusion: Institutional theory (concept) is suitable for use in the study of problems of accounting theory.

An evaluation model has been developed that makes it possible to make the right choice of an initial research concept, as its final result and effectiveness depend on it. A well-grounded approach to assessing output research concepts is based on the mathematical justification of the appropriateness of their application for the development of the theoretical foundations of accounting. The assessment developed is based on the empirical determination of the shortcomings of the research concept regarding the possibilities of satisfying the tasks that are posed before. In the future, the development of scientific research in this direction should be directed towards the identification and justification of new laws for the formation of an effective modernized accounting system. This will make it possible to comprehensively solve the important problem of the development of accounting theory.

5. Conclusions

In general, the theories considered have a number of shortcomings in the accounting system; however, some of them can be used quite effectively when developing the theory of accounting. In particular, as a result of the assessment of scientific concepts in accordance with justified criteria and the proposed mathematical model, it was found that it is most advisable to use institutional (K_{ef} = 0.7) and paradigm (K_{ef} = 0.3) theory, the concept of "epistemological anarchism" (K_{ef} = 0.4), and the concept of research programs (K_{ef} = 0.4).

These concepts have minor flaws associated with the inconsistency of their principles with the essential characteristics and the accounting paradigm. Accordingly, the risk of obtaining false results from studies of accounting problems is minimal when using them.

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OPTIMIZATION OF THE MENU FOR INSTITUTIONS OF RESTAURANT INDUSTRY BASED ON MATHEMATICAL MODELLING METHODS

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Abstract: *This study is dedicated to innovative approaches to the individualization of service in institutions in the restaurant industry based on the requirements of balanced nutrition and cost optimization. The study was conducted on the materials of the existing objects of the restaurant industry in Kyiv (Ukraine), taking into account the approved norms of the energy value of the daily diet for different age groups. The solving of the problem was carried out by linear programming methods on the example of a specific category of consumers: men aged 18–29 years old. The coefficient of physical activity was set at 1.4, with which the optimization task of compiling menus from Ukrainian and Georgian cuisine was formulated. The prices of famous Kiev restaurants, the content of nutrients and energy values of dishes, and the nutrient consumption rates were established for the selected category of customers and used as the initial data. It is demonstrated that the condition for minimization of the target function (account) allows for a reduction in the cost of nutrition by up to 20%, without reducing energy value and nutrition.*

Substantiated proposals in the study for the compilation of an individual menu can be the basis for the diversification of restaurant services and increase the competitiveness of the enterprises in the industry, as they take into account the current trends in nutrition and the requirements of the organization for useful and controlled nutrition with restrictions on the content of energy and useful substances, whilst also minimizing the cost of the check. They can be implemented in restaurant establishments in the form of the introduction of an additional module in widespread information and payment systems (Fidello F&B, Micros, "Parus-Restaurant," SERVIO, 1C-Rarus: Restaurant + Bar + Cafe, Iiko, R-keeper, others.).

Keywords: *Restaurant management, menu customization, balanced eating, check minimization, linear programming, optimization.*

JEL: *L60, L66.*

1. Introduction

Increasing competition among establishments in the restaurant industry requires the orientation of enterprises towards maximizing the consideration of current trends in healthy eating, and the fulfilment of the wishes of target groups of consumers and the individual requests of visitors. The success of the restaurant business involves a creative approach to its organization, the maximum use of the facilities of the institution, and the introduction of additional channels of communication with customers. An individual approach to each client, taking into account their culinary and gastronomic preferences, becomes one of the main modern trends in the organization of catering.

There will come a time when restaurant customers will not only be able to choose dishes at their own discretion, but also to shape them independently, taking into account the peculiarities of their diet and personal tastes. In this case, individual nutrition can vary for a number of reasons, including: diets for medical indications; vegetarianism; the nationality or age of consumers; raw food diet; Ayurvedic nutrition; Fruitarianism, etc. However, any choice of nutrition should ensure a balanced consumption of energy, protein, carbohydrates, fats, vitamins, and micro-elements, taking into account the daily physiological needs of a particular person in terms of nutrients.

2. Literature review

A considerable amount of work both by international and Ukrainian researchers is devoted to determining balance in human nutrition and the factors that influence this indicator. Scientists have proposed various algorithms for the development of recipes in order to obtain the optimal ingredient composition of meals.

The normal physical needs for nutrients and energy of different population groups and reference materials characterizing the energy value of foodstuffs and their chemical composition are taken into account [2]. The importance and complexity of nutrient balance selection, depending on the tasks assigned to a particular group of consumers, is

emphasized, and balanced nutrition is associated with both personal human needs and the concentration of nutrients in foods [3].

The global introduction of mobile and online technology into the restaurant business contributes to the organization of the broadcasting by consumers of their gastronomic preferences to food companies, and aids their managers in fixing and maintaining the wishes of their regular customers. The ability to order food online, free Wi-Fi in establishments, the presence of an electronic menu – these are already common catering services for visitors. Modern restaurant information systems allow businesses to analyze the dynamics of sales to further predict them and, accordingly, to prepare a procurement plan and work schedules for line staff.

One of the technologies of restaurant service is related to the availability of terminals or tablets that include the menu at every restaurant table. This service allows customers to order meals without waiting for the waiter, make changes to the order, and visualize the meal and its value. This paper proposes the use of these technologies to make an individual menu with a specific content of energy, nutrients, micro-elements, or vitamins. The mathematical programming methods used to solve this problem are widely used in dietetics.

Already in the first publications on this topic [4; 5] we discussed the practical applications of the solution to the problem of producing the optimal diet. A review of scientific works devoted to the use of linear programming in the optimization of nutrition and compiling diets, taking into account certain limitations, was provided in the article [6]. In particular, attention was drawn to the considerable potential of linear programming techniques for finding solutions to various nutrition problems.

The works of French researchers such as Briend, Darmon, Ferguson, and Erhardt [7] emphasized that linear programming is "the ideal tool for rigorously converting precise nutrient constraints into food combinations." The studies of Dutch scientists such as van Dooren, Tyszler, Kramer, and Aiking [8], taking into account low food costs, include restrictions on the emissions of greenhouse gases into the atmosphere that accompany the cultivation of certain foods.

The research of such scholars as Parlesak et al. [9] are dedicated to the creation of low-cost consumer product baskets that take into account nutrient recommendations, dietary recommendations, and cultural acceptance. Linear programming methods were also used.

There are works, particularly those of Ukrainian scientists such as Liashenko and Shulak [10], where different approaches to the design of information subsystems for determining a balanced diet are offered.

Mathematical methods of designing diets with certain conditions on the content of ingredients are used by the Kharkov scientists Cherevko, Krutovyi, and others [11–15].

Research in the field of biotechnology also suggests the use of computer technology – for example, recipe optimization tasks can be used to develop a functional product. In this case, the formulation of the problem introduces criteria for minimizing deviations from the specified content of nutritional and biological indicators [16].

Firstly, however, we must consider that even the modern development of information systems for restaurants does not pay due attention to the interests of the customer, i.e., a focus on healthy and controlled nutrition [17]. Secondly, scientific research on nutrition optimization is mainly focused on the preparation of diets for therapeutic or

therapeutic prophylactic action. In addition, quite often the word "optimization" is used in a more general sense rather than in terms of optimization by mathematical programming methods. Finally, even in studies that are devoted to finding the best diet with the goal of minimizing its cost, a set of specific foods, not meals, is meant.

3. Purpose

The purpose of this study is to develop proposals that combine the efforts of food establishments to diversify their services, the capabilities of mathematics and information technologies, and current customer requirements for balanced and healthy eating.

The problem of the optimal cost of food and the minimization of the check in the restaurant establishment without a reduction in the daily physiological norm of energy exchange is also urgent, taking into account the realities of our country. The limitations of the linear programming problem are then related to the consumption of energy, nutrients, minerals, and vitamins, and the intended result is hindered by the cost of the check.

Accordingly, another objective of the study was to improve the service process in restaurant establishments by introducing a menu-based service that helps customers to consume nutrients and minimize cost.

4. Methods

The methods of analysis and synthesis, statistical comparisons, and the grouping and generalization of scientific data on the energy values of the products of restaurants in Ukrainian and Georgian cuisine and their cost as of April 1, 2020, were used in the study of the optimization of the process of providing food services in institutions of the restaurant industry. Linear programming methods, Excel spreadsheets, and the "Solution Search" superstructure were used to solve the research objectives.

5. Results

The development of an adequate diet is quite a challenge, the solution to which depends upon many factors. The value of energy metabolism is an indicator of the general state and physical activity of the body. The level of daily energy consumption of a person depends on sex, age, height, size of the surface area of the body, constitution, health status, intensity and duration of muscular activity, nature of nutrition, climate, meteorological factors, season of the year, and time of day. Therefore, the standard, and at first glance quite simple, problem of linear programming regarding the diet becomes the task of finding a solution without many restrictions, which often contradict each other. The economic and mathematical model of the problem is: to determine such integral values of x_1, x_2, x_3, ... x_n, at which the objective function reaches a minimum (minimization of the cost of nutrition or content in the diet of a certain substance).

$$S=c_1x_1+c_2x_2+c_3x_3+\ldots c_nx_n \rightarrow min$$

і виконуються обмеження

$$\begin{cases} a_{11}x_1+a_{21}x_2+a_{31}x_3+\ldots a_{n1}x_n \geq b_1 \\ a_{21}x_1+a_{22}x_2+a_{32}x_3+\ldots a_{n2}x_n \geq b_2 \\ a_{13}x_1+a_{23}x_2+a_{33}x_3+\ldots a_{n3}x_n \geq b_3 \\ - - - - - - - - - - - - - - - \\ a_{1m}x_1+a_{2m}x_2+a_{3m}x_3+\ldots a_{nm}x_n \geq b_m. \end{cases}$$

Typically, in studies using this model, the mix problem, the variables $X(x_1, x_2,\ldots.x_n)$ are ingredients in the formulation of certain dishes, foods in the diet of daily or single consumption, components of a "grocery basket," or food additives. In this work, it is suggested to use a set of dishes from the menu of a particular establishment as variables.

The coefficients $c_1,c_2,\ldots.c_n$ of the objective function of the problem are prices. In this case, the price of the dishes is included into the restaurant menu.

The limitations of the task can be formulated as inequalities with the signs >=, <=, or equality = depending on their content. Thus, for example, the range is indicated within which it is permissible to adjust the content of nutrients.

Coefficients $a_{11}, a_{12},\ldots..a_{mn}$ in the restriction system are the content of nutrients, energy, minerals, or vitamins in a particular dish. That is, the meaning of the coefficients in the system of inequalities can change depending on the task that is being set. Accordingly, the interpretation of the right-hand side of inequalities $b_1,b_2,\ldots.b_m$, may be different – namely, they may be restrictions on the consumption of energy, fats, proteins, carbohydrates, different minerals, and vitamins. In addition, weight restrictions on some dishes from the catering menu can be placed on the right side.

The initial data for obtaining the optimal admissible plan $X(x_1, x_2,\ldots.x_n)$ in the solution of the problem are: nutrient and energy consumption rates for a certain category of population, component prices (in our case, prices of meals in the institution's menu), and the composition of substances in components (in our case in every dish). The source of energy for the body is nutrients. There are many tables of average energy consumption for various activities that can be used to determine daily energy costs [18]. It is possible to calculate the daily need for basic nutrients and biologically active substances (proteins, fats, carbohydrates, vitamins, minerals) on the basis of the obtained value of the average energy consumption. The norms of consumption of basic nutrients by the population of Ukraine are determined depending on sex, age, and physical activity, approved by the order of the Ministry of Health of Ukraine of September 3, 2017, No. 1073 "On approval of the Norms of physiological needs of the population of Ukraine in basic nutrients and energy" [1].

This paper proposes the use of linear programming methods to obtain the optimal composition of meals from the menu of a particular institution. The first stage of this task is the formation of a template with the specified parameters of the target function, and the constraint system is solved with the help of Excel spreadsheets and the "Search for Solution" superstructure. As an example, a category of consumers was selected which could include students, young teachers, office workers without significant physical activity, and

foreign and domestic tourists – namely, men aged 18–29 years. According to the MOH order above, the daily requirement of this population in proteins, fats and carbohydrates, minerals, and vitamins is shown in Table 1.

Table 1. *Daily requirements of men (18–29 years) for energy, essential nutrients, and biologically active substances*

Group	Group The coefficient of physical activity (hereinafter – CFA) (D) Carbohydrates (D)	Energy (Kcal)	Proteins (g)		Fats (g)	Carbohydrates (G)
			everything	including animals		
I	1.4	2450	80	40	81	350
II	1.6	2800	91	45	93	400
III	1.9	3300	106	52	107	478
IV	2.2	3900	108	54	128	566
V	2.5	4100	117	58.5	154	586

Minerals								
Group	Calcium (mg)	Phosp-horus (mg)	Magnesium (mg)	Iron (mg)	Zinc (mg)	Iodine (mg)	Copper (mg)	Chrome (mcg)
I-V	1200	1200	400	15	15	150	1.0	50
Vitamins								
Group	C (мг)	A (mcg PE)	E (mg TE)	D (μg)	B_1 (mg)	B_2 (mg)	B_6 (mg)	K (μg)
I-V	80	1000	15	5	1.6	2,0	2.0	110

Source: Based on [1]

The specific indications of the units of daily requirement for vitamins, which are presented in the table, are related to the use of coefficients for the conversion of various forms of vitamin preparations. For example, vitamin A (mcg PE) is in retinol equivalent. These details are not relevant to the topic of this work and are related to the biological activity of vitamins, the study of which is engaged in vitaminology.

It should be emphasized that, for various reasons, producing an optimal diet is a difficult task and often has several options. Therefore, at the same time, to take into account the consumption of energy, fats, proteins, carbohydrates, essential micro-elements, and vitamins when solving one optimization problem is almost impossible. Additional factors that complicate this task are:

– the content of nutrients and energy in the same dish may vary, albeit slightly, depending on the quality of the ingredients or the characteristics of the preparation;

- the individual wishes of the client require additional restrictions on the presence or absence of a particular dish;

- the number of dishes offered for selection may also vary depending on the individual needs of the consumer (diet, religious beliefs, current health, etc.);
- the requirements of the consumer when forming the order (collective, individual, festive, every day, etc.)
- the type and peculiarities of business process organization in restaurant establishment.

Therefore, the limitations of the task should be less severe to allow the consumption of a substance or energy within a certain interval. The presence of an optimization task template makes it easy to change both the nomenclature of dishes and their number, as well as to adjust the rates of consumption of nutrients and energy, depending on the characteristics of the consumer (gender, age, physical activity etc.).

Therefore, the development of daily menu options for men aged 18–29 years, optimized by minimizing the cost of the check and taking into account restrictions on energy, fat, protein, and carbohydrate consumption, is proposed in this this paper. Assuming that the customer pays at each visit to the restaurant (not necessarily the hotel structure), the daily menu was divided into three parts: breakfast, lunch, and dinner. According to common recommendations, for 3 meals a day, the ratio of energy and nutrients should be as follows: 30% – 40% – 30%. It is also extremely difficult to implement this.

The national variety of cuisines offered at Kyiv food companies can satisfy almost any taste. The menu of the Ukrainian cuisine restaurant "Ukrainian dishes" was chosen for the following reasons:

- it presents the national cuisine;
- it has a fairly diverse menu;
- it is actively visited by foreign tourists;
- its menu and prices are calculated for average consumers;
- its menu does not indicate the content of nutrients and energy.

The solution to the task of preparing a breakfast menu of dishes from Ukrainian cuisine with a minimum cost for the specified institution and with a certain content of proteins, fats, carbohydrates, and energy is presented in the Table 2.

Table 2 includes:

- the names of the dishes, taken from the menu offered for selection in the establishment;
- the prices from the menu, scaled up to 1 kg of food;
- the content of nutrients and energy, scaled up to 1 kg of each dish;
- the intervals of restrictions on the content of nutrients and energy (the right part of the restrictions);
- the actual content of nutrients and energy (the left part of the restrictions);
- additional restrictions on the presence of a particular dish among the favourites;
- cells with search results, namely the weight of foods recommended for consumption and the total cost, are highlighted.

Table 2. *The optimized version of the breakfast menu at the restaurant "Ukrainian dishes" for consumers of the selected category*

	Oatmeal porridge with nuts and honey	Scrambled eggs with bacon	Pancakes with sour cream and jam	The omelette is natural	Bread	Tea	Pancakes with Cheese	Coffee with Milk	Cheesecakes			
	X1	X2	X4	X5	X6	X7	X8	X9	X10	Cost, UAH		
Food weight, kg	**0.20**	0	**0.12**	0	0	0	0	**0.20**	0	**105.84**		
Prices (UAH / kg)	190	367	482	312	75	40	505	50	680			
LIMITATION										Left part	Sign	Right part
Proteins	46	102	120	122	55	0	110	15	130	26.60	>=	20
Fat	47	275	75	184	10	0	43	18	194	22.00	>=	22
Carbohydrates	263	6	300	19	400	80	279	100	196	108.60	>=	90
Energy	1480	2130	2600	2220	1900	310	1950	500	3002	708.00	>=	700
Proteins	46	102	120	122	55	0	110	15	130	26.60	<=	27
Fat	47	275	75	184	10	0	43	18	194	22.00	<=	27
Carbohydrates	263	6	300	19	400	80	279	100	196	108.60	<=	110
Energy	1480	2130	2600	2220	1900	310	1950	500	3002	708.00	<=	1000
Bread	0	0	0	0	1	0	0	0	0	0.00	=	0
Pancakes	0	0	1	0	0	0	0	0	0	0.12	>=	0.12

Source: Authors' calculation

Similarly, the task of compiling an optimal Ukrainian lunch and dinner menu for the selected consumer category was prepared and solved (Table 3).

Thus, consumption rates are exceeded by all indicators (energy, protein, fats, and carbohydrates); the main excess was consumed during lunch.

Table 3. *Calculation of the amount of energy, proteins, fats, and carbohydrates in the Ukrainian version of the menu of consumers of the selected category*

Men, 18–29 years old, KFA 1.4	Energy (kcal)	Proteins (g)	Fat (g)	Carbohydrates (g)
Norms	2450	80	81	350
Breakfast	708	26.6	22	196
Lunch	1182	44	54	129
Dinner	797.2	21	31.6	65.9
Realistically applied	2687.2	91.6	107.6	390.9
Difference	237.2	11.6	26.6	40.9
Difference, %	9.68%	14.50%	32.84%	11.69%

Source: Authors' calculation

The largest excess is in terms of fats. Accordingly, there can be two recommendations:

- to increase the coefficient of physical activity;
- to reduce energy, protein, fat, and carbohydrate intake in the coming days.

In recent years, many food establishments have opened in Ukraine, and in particular in Kyiv, offering Georgian cuisine. Among them are highly professional specialists – Georgians, whose cuisine is popular with both Ukrainians and foreign tourists. Therefore, it was decided as a second example to use the menu from the Georgian restaurant "Gogi," in Kiev. Accordingly, the names of the dishes and their prices were taken from the menu of this restaurant. The results of solving the problem of optimizing the breakfast menu with minimal cost and restrictions on the protein, fat, carbohydrate, and energy content are presented in the Table 4.

Table 4. *The optimized version of the breakfast menu for consumers of the restaurant "Gogi" of the selected category*

	Khachapuri	Ajaxon Dali	Dolma	Lobio	Kubdari	Tea	Coffee with Milk			
	X1	X2	X4	X5	X6	X7	X8		Cost, UAH	
Food weight, kg	**0.21**	0	0	**0.12**	0	0	**0.15**		**148.36**	
Prices (UAH / kg)	320	360	547	316	335	82	280			
LIMITATION								Left part	Sign	Right part
Proteins	122.3	75	80	53	78	0	15	34.74	>=	25
Fat	111	67	200	5	106	0	18	27.00	>=	22
Carbohydrates	276.3	82	110	133	270	80	100	90.00	>=	90
Energy	2590	1230	2560	800	2340	310	500	724.26	>=	600
Proteins	122.3	75	80	53	78	0	15	34.74	<=	35
Fat	111	67	200	5	106	0	18	27.00	<=	27
Carbohydrates	276.3	82	110	133	270	80	100	90.00	<=	110
Energy	2590	1230	2560	800	2340	310	500	724.26	<=	800
Kubdari	0	0	0	0	1	0	0	0.00	=	0

Source: Authors' calculation

According to the results of the Georgian version of the menu for men aged 18–29 years with a coefficient of physical activity of 1.4, we calculate the total amount of nutrients (proteins, fats, and carbohydrates) and energy consumed during the day (Table 5).

Table 5. *Calculation of the amount of energy, proteins, fats, and carbohydrates in the Georgian version of the menu of consumers of the selected category*

Men, 18–29 years old, KFA 1.4	Energy (kcal)	Proteins (g)	Fat (g)	Carbohydrates (g)
Norms	2450	80	81	350
Breakfast	724	34,74	27	90
Lunch	1257,4	52,7	53,2	133,25
Dinner	613,5	16,2	11,31	100
Realistically applied	2594,9	103,64	91,51	323,25
Difference	144,9	23,64	10,51	–26,75
Difference, %	5,91%	29,55%	12,98%	–7,64%

Source: Authors' calculation

Thus, exceeding the norms of consumption of nutrients and energy is accomplished by the following indicators: energy – by 5.91%; proteins – almost 30%; fat – almost 13%. The intake of carbohydrates is 7.64% below the norm.

A significant exaggeration of the norms of protein consumption is related to the specificity of Georgian cuisine – namely, a large number of meat dishes.

By giving the customer an invoice, the restaurant informs them only of the amount of money spent. If, at the same time, energy, fats, proteins and carbohydrates consumed during the diet were included in the bill, subsequent meals may be adjusted.

We emphasize that dieting is a rather difficult task, the peculiarities of which are conditioned not only by the basic principles of rational nutrition, but also by the characteristics of each person in a certain population group – not only by age and gender, working and living conditions, but also by health, deviations in the mode of life, and other reasons. Therefore, even the norms of the use of nutrients and energy differ according to various researchers. If, after drawing up a daily diet and calculating its chemical composition for proteins, fats, and carbohydrates, the obtained results deviate from the normative by more than 5%, then the diet is considered insufficiently balanced and the meals included in the menu should be revisited.

The effectiveness of including the cost minimization condition can be estimated by comparing the total checks received with the lowest possible score, and without taking into account this condition (Table 6).

Table 6. *Efficiency of optimization of a diet on condition of minimization of cost*

	Ukrainian cuisine restaurant check		Georgian cuisine restaurant check	
	min	max	min	max
Breakfast	105.84	109.32	148.36	164.96
Lunch	205.75	213.1	234.36	281.35
Dinner	135	137.02	248.98	319.24
Total	446.59	459.44	631.7	765.55
Cost increase		3%		21%

Source: Authors' calculation

It should be noted that some well-known restaurant companies operating in Ukraine are already paying attention to the need for energy balance when choosing an order, by giving information about the energy and nutritional value of dishes on the menu. At the website of the restaurant chain "Puzata Hata," one can find information about the energy, protein, fat, and carbohydrate content of the dish that the customer chooses. The restaurant chain "McDonalds" places this information not only on their website, but also in print promotional items and in fiscal checks.

The authors suggestions for the development of templates for finding the optimal content and energy of a menu, while minimizing its cost, can be used to improve and individualize the services of restaurants, the development of complex menus for individual visitors and organized contingents of consumers, and the development of an additional module of information systems at the enterprise providing food services.

It should be noted that the specialized information systems used in the institutions of the restaurant industry can significantly simplify and accelerate all business processes, in particular by determining the cost of ingredients for each dish, calculating the required number and cost of restaurant products, and creating a menu for the dining hall and the bar price list. Due to the introduction of additional modules in the software systems, the formation of individual checks is simplified, taking into account certain criteria.

For the functioning of a module that implements this method of offering a menu, only information about the available energy value of dishes is sufficient, that is, sufficient access to the database in which this information is available is required. Therefore, this module can be implemented in several variants.

1. The implementation of this module can be implemented as an additional one in the relevant software system (Fidello F&B, Micros, Software complex "Parus-Restaurant," software complex SERVIO, 1C-Rarus: Restaurant + Bar + Cafe, software complex Iiko, R-keeper and others). This module can extend the functionality of existing programs and allow restaurants to offer menus according to the specified criteria.
2. This module can also be implemented as a separate program that uses data from an existing database, and that uses the appropriate program to select menus with the corresponding energy value.
3. It can be implemented in the form of a web-application, which will allow it to be integrated into the website of the respective catering facility, and provide the possibility of selecting menus from the available dishes based on the set criteria.
4. The implementation of the module in the form of a Telegram bot is promising. Telegram provides an open ARI for developing custom versions of bots. This implementation option will allow for a restricted Internet connection by sending a request to get a response – a menu.

6. Conclusions

This article proposes templates for solving the task of optimizing the menu of a restaurant establishment with restrictions on the content of energy and useful substances, and minimizing the cost of the check. The possibility of changing the initial data in ac-

cordance with the individual requirements of the consumer and the features of the food enterprise is substantiated.

The approaches explored in the article can be extended for different categories of consumers and implemented in restaurants of different types of service in order to organize a balanced healthy diet, maintaining regular customers and the aiding the formation of a highly competitive position.

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BULGARIAN MUNICIPALITIES: KEY PLAYERS IN THE PROCESS OF THE IMPLEMENTATION OF EU FUNDS AT THE NATIONAL LEVEL

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Abstract: *The role of Bulgarian municipalities in the processes of programs that implement EU funds is absolutely undeniable. They are direct or potential beneficiaries of the major part of the operational programs – both in the previous and current programming period. More so, they are the beneficiaries of so-called "big projects" (according to the European legislation, projects with budgets over €50 million), which are key infrastructure projects in priority sectors such as transport and water infrastructure. This paper is devoted to these municipalities and their attitudes towards European funds in the context of the overall development of the municipalities. The study is based on empirical research among representatives (n = 73) of the Bulgarian municipalities, and their perceptions on the importance of EU funds and programs for the municipalities' development.*

Keywords: *European funds, Bulgarian municipalities, EU projects, local policies.*

JEL: *F59, H70, O22*

1. Introduction

Bulgarian municipalities are key beneficiaries at the national level of a major part of the programs financed by the European Structural and Investment Funds. It could be said that their role and importance for the overall process of the implementation of these programs was underestimated during the previous programming period (2007–2014), which was Bulgaria's first programming period as a regular member-state of the European Union. Currently we are almost at the end of the present programming period, and lessons have to be learnt including with the provision of a special centralized governmental policy, and measures that support the administrative capacity of the Bulgarian

municipalities as key beneficiaries. Therefore, the progress of implementation projects by municipalities, especially those concerning infrastructure, could be interpreted as indicators for their readiness and project capacities in this important field. For a national economy such as the Bulgarian one, European funds are absolutely crucial for the development of society in almost all essential aspects, both at the national and regional levels.

On the other hand, the municipal authority is the closest public structure to the everyday life of their citizens. The importance and role of the municipality is undisputable in modern democracy, which proclaims independent (from the centralized authority) local government. Local authorities are responsible for the overall development of the region, ensuring that the prosperity of citizens is provided by different policies and measures. For this major purpose local governments possess, as general rule, two basic sources of finance: from one side – the revenues according to local taxes and fees; and from the other – European funds. The present paper primarily explores European funds and their role in the development of Bulgarian municipalities in priority sectors, but also presents the bidirectionality of these relations (municipalities are just as important for the overall implementation of the operational programs as the resources provided by the programs are important for the local development of the concrete municipalities).

2. Literature overview

The role of European Funds and Programs and their impact on the European, regional, and national economy is a subject that is explored in depth, and involves many different authors` points of view. One of the major scientific foci in the sphere of European funds, logically, is the impact that EU funds have on the economy, and more specifically on the SMEs which are usually described as a backbone of the national and the European economy. For instance, Bostan et al. [6] present the impact of these funds on the competitiveness of SMEs in the specific geographic area of the Danube Delta. They conclude that the Structural Funds have made a major contribution to achieving this goal, being aimed mainly at meeting European standards on the environmental protection and economic development of the area, while respecting its biodiversity and the inhabitants' general interest in improving the quality of life in the Danube Delta [6]. The interest of another study is again focused on the role of EU funds in SMEs at the national level, this time in Hungary [4]. After a profound analysis, the scholars concluded: "According to our results, economic development funds had a significant positive effect on the number of employees, sales revenue, gross value added and, in some cases, operating profit. However, the labor productivity of enterprises was not significantly affected by any of the support schemes. Furthermore, by explicitly comparing non-refundable subsidies (grants) and refundable assistance (financial instruments), we find that there is no significant difference in the effectiveness of the two types of subsidy" [4]. The survival rate of the enterprises of four relatively new EU member states (from the EU wave enlargement of 2004 – Czech Republic, Poland, Slovakia, and Hungary) are explored in detail in another survey. Using and analyzing data from an impressive sample of almost 42,000 companies, Baumöhl, Iwasaki, and Kočenda [5] claim that large shareholders, solvency,

and more board directors are preventive factors; foreign ownership and higher ROA also increase survival rates; and larger firms and those hiring international auditors have lower survival chances. Further research is dedicated to the field of SMEs and specific instruments supporting their activities, this time in the specific context of open innovation (OI). After a comprehensive analysis especially focused on the companies operating in digital sectors, the authors found that the SMEs awarded the grants are less engaged in the challenging dimensions of Open Innovation than companies that did not receive any funding. This is contrary to the intended goals of the grants. They also provided policy and methodological implications relevant for the design of better OI-informed policy and the more effective evaluation of companies participating in the SME Instrument [9].

Kalfova has provided a multifactor analysis on regional policy in Bulgaria with a focus on the implementation of EU funds. The author claims that structural funds are the main tool of EU Regional policy, and the level of absorption is accepted as a substantial indicator of the successful implementation of Regional policy [14]. An interesting approach is proposed by Kiryluk-Dryjska and Beba [15] in the process of identifying the budget and its allocation for rural areas within the Common agriculture policy of the EU. The authors propose a method for the region-specific budgeting of European Union rural development funds, based on objectively measured indexes of rural development. The indexes are calculated based on statistical data with the use of factor analysis, and the results demonstrate that the proposed approach allocates the funds according to an assumed logic that supports the weaker and underdeveloped regions and features of agriculture. In the field of ensuring sustainable development through the landscape in the context of the European Union, Mann et al. [19] have provided a special comprehensive study. The authors identify three major conflict zones: "(1) agricultural production versus nature conservation, (2) urban sprawl and rural land abandonment versus landscape integrity, and (3) renewable energy generation versus landscape aesthetics." On this basis, they have proposed measures to improve European landscape policy through Integrated Landscape Management that combines and fosters collaboration between all stakeholders. Again in the field of agriculture is another study, this time dedicated to special policy on agroforestry, which is considered by the authors to be one of the active tools for achieving sustainability of land management. The scholars explore European policy in the field of agroforestry and conclude that agroforestry was poorly adopted in the CAP 2007–2013, having better success in the CAP 2014–2020 due to the recognition of woody vegetation and the compensation of 5 years given for maintenance once agroforestry is established. However, policy rules ensuring Pillar I payment when agroforestry measures are adopted, such as a management plans ensuring that maximum tree density (100 trees per hectare) is not reached, should be pursued. [22]

The subject of the public system responsible for EU management and its possible improvements as well as proposals in terms of policy and procedures for beneficiaries are the focus of many scholarly works. In this regard, a plethora of scientific analysis can be outlined – for instance Anguelov [1,2] and Dobrovolskienė, and Tamošiūnienė [10].

The work of public authorities (including municipalities and centralized institutions) as beneficiaries under different EU funds and programmes is not so well explored, espe-

cially in comparison with the interaction between SME-EU funds. On the other hand, a large majority of recent research is focused on very specific aspects of the work of public authorities. For instance, Olanubi, Osode, and Adegboye [20] have explored the efficiency of the public sector in a very specific time period. On the basis of their analysis, the scholars concluded that their results reveal large-scale inefficiencies in the use of funds allocated to the scheme during the great recession and euro area sovereign debt crisis that followed, with member states wasting on average 34.6% of funds allocated to it.

Naterer, Žižek, and Lavrič have explored the urban strategies prepared by the municipalities and their accordance with the general strategy at the EU level – Europe 2020 – a strategy for smart, sustainable, and inclusive growth. The scholars explored a number of new integrated urban strategies (IUSs) prepared by the Slovenian municipalities, and considered that their results show that the IUSs of Slovenian cities are generally of low quality and that they conform to the Europe 2020 strategy poorly, but rather more to national guidelines defined by the Slovenian government [19]. New research on urban development sheds more light on the modern practices of cities (and of their government in local municipalities) in the context of entrepreneurship. After a profound comparative analysis covering 60 EU cities, it was noted that in the contemporary global economy, cities are essentially competing with each other in terms of attracting investments, businesses, inhabitants, tourists, as well as improving citizen satisfaction. Cities use different tools to compete: strategic planning, marketing strategies, or city branding, for example… "Our results confirm that the top cities are located in Northern Countries" [21].

The requirements of sustainability that are characteristic of all EU funded projects are extremely important in terms of community development due to the fact that through sustainability there is a guarantee that public money is spent towards a visible purpose. In this regard, interesting analysis has been conducted by Dobrovolskienė, Tvaronavičienė, and Tamošiūnienė [11]. On the other hand, the role of EU funds both in the public and private sectors in Lithuania is described elsewhere [23].

The role of municipalities in the field of waste management and related services and their implementation by different stakeholders are the subject of vivid scientific interest by different authors within the countries of the European Union. For instance, Chamizo-González, Cano-Montero, and Muñoz-Colomina [7] have explore the type of management and taxes in this field. After their comprehensive analysis they concluded that their results reveal, first, that the most widely-used solution at local government level is the easiest to apply—namely, a flat rate per household or a step-variable flat rate covering on average 59.03% of the cost (in 2012); and, second, that Madrid's waste step-flat rate cannot be considered a PAYT system, despite the fact that it covers up to 70% of the cost (in 2012) [7]. Another piece of research dedicated to the subject of the role of municipalities in the field of solid-waste recycling and the correspondence of practice to the guidelines of Europe 2020 has been developed by two Spanish authors. Expósito and Vlasko have explored, in depth, the experience of Spanish municipalities, and have provided on this basis a comprehensive regional efficiency analysis at the national level. In conclusion, the scholars claim that their results confirm that Catalonia, Navarre, and Madrid function as benchmark regions to be emulated by the remaining inefficient re-

gions. The necessary regional investments and output projections to reach an efficient development of the recycling sector are also estimated. Additionally, it is found that per capita income and population density significantly explain differences in regional efficiencies [13].

On the other hand, different types of public institutions predetermine the role of the process of the implementation of EU funds. For instance, Higher Education Institutions, which also are potential beneficiaries under EU programs managed at the national level, are essentially placed under very different conditions than municipalities in their role as potential beneficiaries. Unlike municipalities, Higher Education Institutions are not direct beneficiaries of any operational programmes. More information on the role of Higher Education Institutions in the process of the implementation of EU funds has been developed by other scholars [3].

In summarizing the literature overview, it is clear that the role of modern municipalities is complex, dynamic, and difficult, and covers different aspects of modern life, including economic, social, culture, urban etc. Therefore, scientific interest is absolutely logical when taking into account the fact that local authorities are the closest public institutions to their citizens. In the present paper we will explore the role of Bulgarian municipalities as key stakeholders in the process of the implementation of EU funds at the national level, and their assessment of the central management of EU funds.

3. Methodology

For the purpose of our current research a special questionnaire was developed, devoted to the different aspects of the overall process of the implementation of EU funds and focused on the municipalities and their role as potential and direct beneficiaries of operational programs. The questionnaire included 35 questions, aiming to understand self-assessment from two sides. Firstly, from the perspective of the activities of concrete municipalities in the field of the preparation and implementation of EU projects; and secondly from the perspective of the assessment of representatives of the local authorities on the overall work of central administration in managing EU funds in Bulgaria. These two types of assessment are desperately needed, especially taking into consideration the final timing of project implementation during the current programming period (2014–2020).

The questionnaire developed consisted of 3 types of questions. The first type of question involved closed questions, where the respondents had to choose among different options of predefined answers. The second type of question was open, and respondents were asked to give their own original answers. The third and final type of question was designed using the rating scale, where the respondents were asked to evaluate, using the scale presented, different key elements of the overall project cycle – from the project preparation phase to the process of submission, evaluation, implementation, reporting and monitoring, final evaluation, and sustainability.

The questionnaire was sent to all 265 Bulgarian municipalities via e-mail in two major phases: the first period saw it distributed among big municipalities, which are also district centers and of which there are 27; and then in the second period it was distributed

to the remainder of all Bulgarian municipalities. In order to facilitate access to the questionnaire for the different representatives of the Bulgarian municipalities, as well as to simplify the process of its fulfillment, we used the online platform Google Forms.

Due to the specifics of the information provided by the questionnaire, as well as in order to ensure reliable and quality primary information, our respondents are anonymous. We collected information only on the name of the municipality and the role of the representative in terms of EU implementation projects. We have not yet noted the limitation of one municipality: only one answer was received, and therefore we have several municipalities where different experts have completed the questionnaire. For the purposes of this research, this fact only brings more clarity and gives more reliable information to the situation of the respective municipality in its specific role as a potential or direct beneficiary of EU funds through operational programs. On the other hand, despite targeting every Bulgarian municipality, we received 112 responses from 73 municipalities.

4. Results and Discussions

The profile of our respondents covers essential information such as sex, age, level of education, and their position within the municipality. In terms of sex, the demographics are clear – there is a dominance of female respondents, with almost 77% (76.7%) of respondents being female and 22.3% male (Figure 1). This finding in fact repeats the reality of Bulgarian administration, where the predominant number of employees are women.

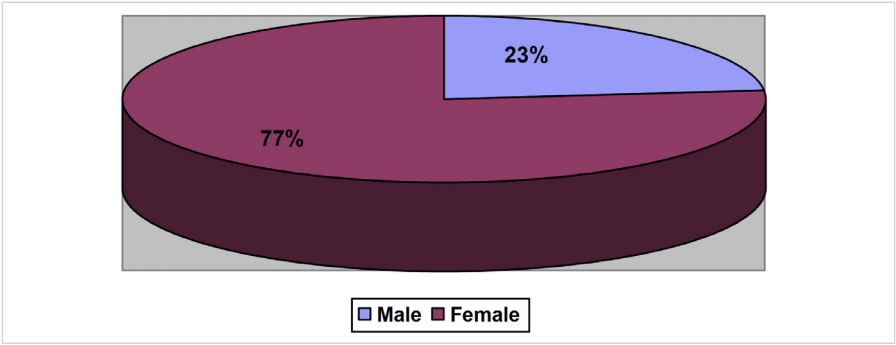

Figure 1. *Sex of respondents*

The second question concerning the profile of respondents is regarding their age. These results are presented in Figure 2. As can be seen from the figure, the majority of respondents are in the age group of between 41 and 50 years old. This fact could be considered as positive in terms of the level of experience of employees of municipalities, including in the field of project preparation and implementation. The next group according to their number consists of people aged 31–40, followed by the group of respondents aged 51–60. This finding again could be considered to be a strength of the municipalities – it

could ensure the succession between different generations of employees and the transfer of knowledge, specifically knowledge achieved on the basis of experience and sufficient practice in team work between different age groups. Young people in the local authorities among our respondents form a share of 12%. Therefore, our sample has representatives from all age groups – a prerequisite for the quality of the primary information collected from the survey.

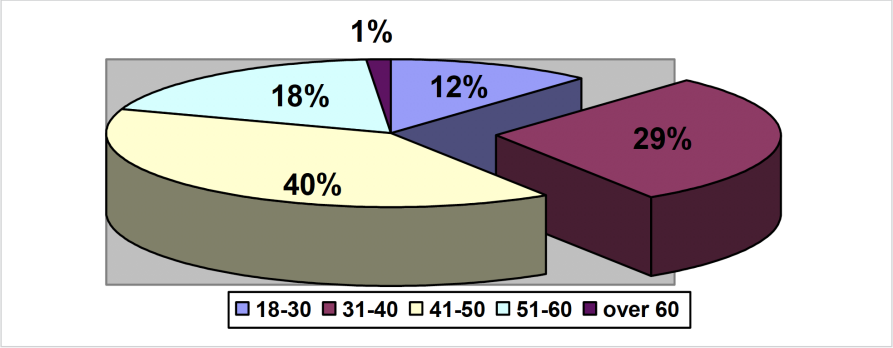

Figure 2. *Respondents' ages*

The next question on the profile of respondents is regarding their educational level. Our findings here categorically identify that all respondents have tertiary education, and one among the 112 respondents has a PhD degree. It is interesting to note that this holder of a PhD is a representative of a big municipality administration, in a district center with many universities.

The next question collected information on the positions of the respondents. These results are presented in Figure 3. For the specific purposes of our survey, we predefined four answers and the respondents were asked to choose which best represented their position in implementing EU funded projects from four options: Manager of the administration (i.e., the mayor and deputy mayors); EU Project Team Manager; EU Project Team Member; or Final beneficiary of EU funded project.

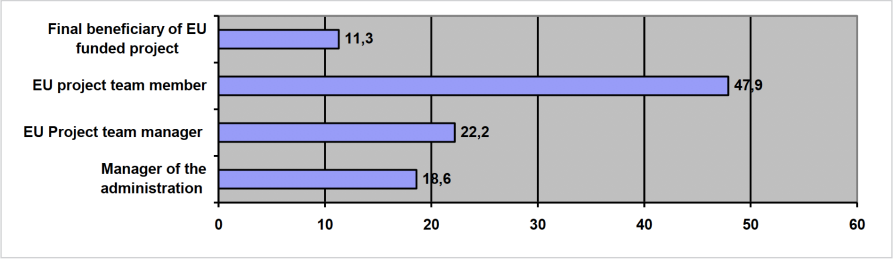

Figure 3. *Distribution of respondents according to their position in the municipal administration, %*

As can be seen from Figure 3, the largest share of respondents was formed by EU Project Team members – almost 50%, or one half of respondents – followed by the group of EU Project Team managers (22.2%). Our third most represented group of respondents are managers of the overall local authority, which means that 18.6% of the respondents are mayors or deputy mayors in the different types of municipalities. The smallest group includes respondents who are the final beneficiaries of the EU funded projects, and work in local administration. This group's size suggests the overall quality of the collected information and ensures its reliability. This structure to our respondents is absolutely sufficient in terms of their competence, experience, and position within municipalities.

The respondents were asked to compare the changes made by the managing authorities and National Coordination Unit within the Council of Ministers Administration, between the two programming periods of Bulgaria as a regular member state of the European Union. The results are presented in the Figure 4. The question through which we collected information on this topic was as follows: "According to your personal opinion, compared to the previous programming period, in general, the procedures related to preparation and monitoring processes are…." The respondents were again given predefined answers and the option to choose only one response among five different assessments (two positive, two negative, and one neutral). According a significant majority of our respondents, the changes between the two programming periods initiated by the central authorities are considered in a positive light. 38.6% of our respondents declared that the changes made by the managing authorities significantly improved upon the initial situation, and at the same time another 42.8% of respondents were positive but more moderate, claiming that there was an improvement but it could have been better. These findings reveal that, in total, 81.4% of respondents positively assessed the changes made by the managing authorities in the application and monitoring phase. For 14% of respondents there were no significant changes, and the remaining 4.5% of the total evaluated the changes negatively.

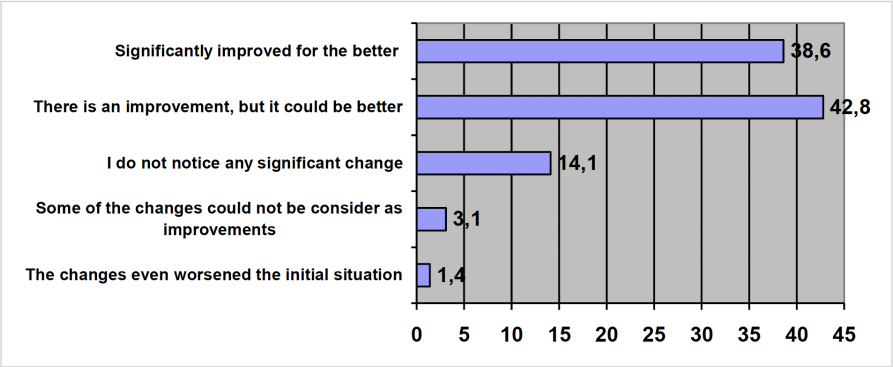

Figure 4. *Assessments of the respondents on the changes made by Managing Authorities in the preparation and monitoring phases, %*

This impressive support by the representatives of local authorities for the decisions of the central administration responsible for EU funds in Bulgaria is, in fact, mainly due to the electronic procedures for project application submission, as well as monitoring reports introduced with the beginning of this programming period by the Central Coordination Unit within the Council of Ministers' administration. The Unified Managing Information System (UMIS) operates at the national level, and this programming period was developed through new functionalities so that we now have electronic procedures for the submission of project application forms and the monitoring of the funded project. These huge changes, especially in comparison to the previous programming period, were accepted with enthusiasm by all types of beneficiaries, including enterprises, non-governmental organizations, and different types of public institutions which are potential beneficiaries. On the other hand, the municipalities, which are some of the biggest beneficiaries including of big (over €50 million) infrastructure projects, for instance in the field of the environment (for different types of waste infrastructure etc.), have enormous documentation for reporting that has to be included in one interim request for payment sent to the Managing Authority of the responding programmes. If we imagine the very real situation that one municipality can be a beneficiary of three or four projects at the same time under different operational programmes, then the volume of documentation that has to be sent to the Managing Authorities accumulates drastically. Here we do not even consider the situation that each Managing Authority could ask for the same type of document. All of these problems have, in fact, been overcome by the usage of the new functionalities of the UMIS 2020. They are undoubtedly in favor of the beneficiaries, but are also in favor of the Managing Authorities and audit institutions as well.

These conclusions are supported by the answers received to the special questions dedicated to the new functionalities of UMIS 2020. All of the respondents were asked to evaluate the new functionalities of UMIS with the following question: "Do you think that the electronic submission of project proposal launched, as well as the electronic monitoring of an implemented project, support the preparation and project implementation processes?" Evaluation was executed through a ranking system from 1 to 7, where 1 indicated a "very slight benefit" and 7 a "very strong benefit." The results are visualized in Figure 5, and form a very clear evaluation of the municipalities as beneficiaries of EU funded projects. As we can see from the data, approximately half of the respondents (almost 51%) indisputably evaluated the new functionalities of the system with the highest score. This result could be considered, with great confidence, to indicate that these changes are broadly accepted by the experts of the municipalities responsible for the preparation and implementation of EU funded projects.

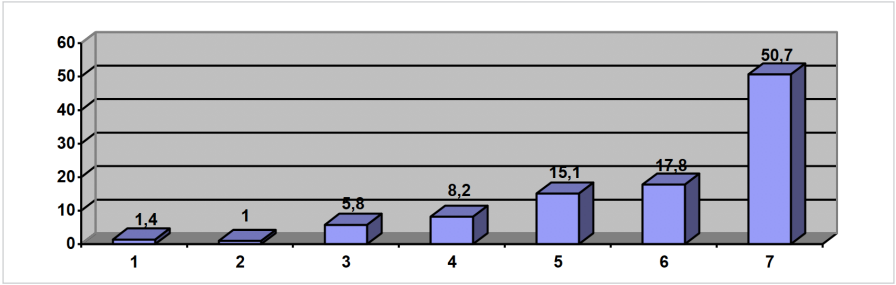

Figure 5. *Results of the evaluation of the new functionalities of the UMIS 2020 (1 to 7), %*

The next assessment asked the representatives of municipalities the following question: "According to your personal opinion, what would be the effect of shortening the deadlines for the evaluation and approval of project proposals?" Again, the respondents were asked to evaluate this effect through the 7-degree scale, where 7 indicated a "very strong effect."

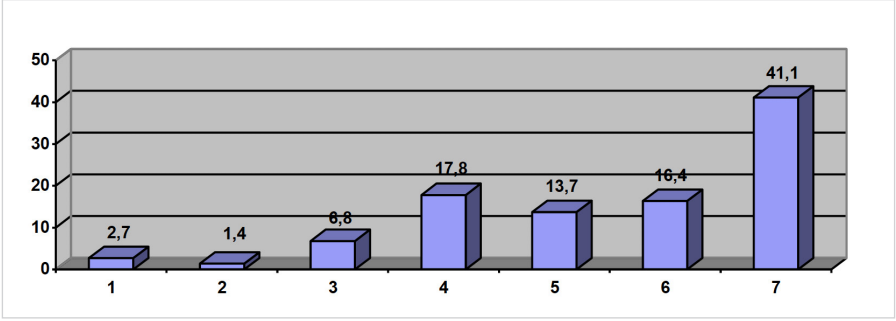

Figure 6. *Results of the evaluation of potential shortening of the deadlines for the evaluation and approval of project proposals (1 to 7), %*

Our results (Figure 6) again indicate positive assessments – 41% of our respondents evaluated the potential effect from the shortening of deadlines in the procedures of evaluation and approval of project proposals from the Managing Authorities as potentially having a very strongly positive effect for beneficiaries. In fact, the relatively long deadlines for approval are one of the most common criticisms from enterprises aimed at the work of the Managing Authorities. This is logical, having in mind the strong competition and the speed of business, for instance in an open call for innovations in a project proposal. As far as the municipalities are concerned, we can again see their opinion on the potential effect of shortening the timing for project proposal approval.

The next question for which evaluation was requested through the same system is the following: "According to your personal opinion, what would be the effect on beneficiaries if the requirements of all operational programmes were standardized?"

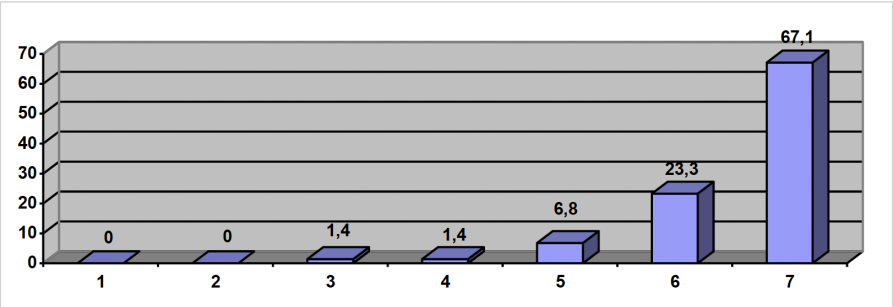

Figure 7. *Results of the evaluation of the potential standardization of all requirements on beneficiaries from Managing Authorities (1 to 7), %*

The results in Figure 7 show the most categorically expressed opinion on the potential for eventual change thus far. One frequent criticism during the previous programming period was connected to the fact that each Managing Authority has its own procedures, rules, and requirements of the beneficiaries that can differ drastically from one to the other. In practice, this leads to confusion among beneficiaries that have many projects under different operational programmes (and all municipalities are guilty of this), resulting in the making of frequent mistakes due primarily to these different rules.

The next possible change put to our respondents for evaluation was the following question: "In your personal opinion, what would be the effect if the amount of advance payment to municipalities was further increased?"

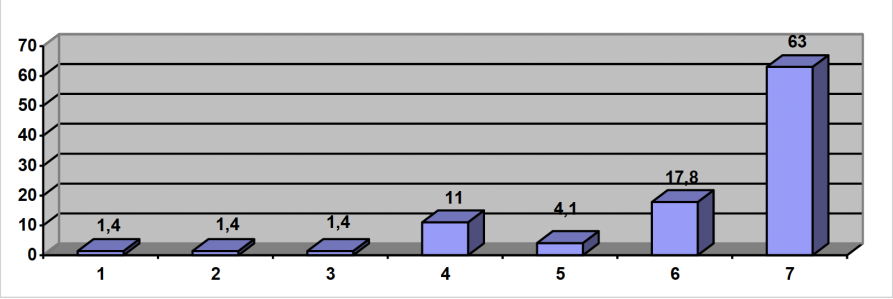

Figure 8. *Results of the evaluation of a potential increase in the amount of advance payment for municipalities (1 to 7), %*

The support expressed in the assessment scores is again very clear – the representatives of municipalities that responded to the questionnaire found this eventual change to be very positive (Figure 8). In fact, in the previous programming period this was one of the most common recommendations to the Managing Authorities. The problem usually arises for big infrastructure projects, where the necessity of operational financial resource is strongest. Now, however, the municipalities already have good experiences of and collaboration with the FLAG fund, which is designed especially for the needs of local governments and local authorities.

The next evaluation was again connected to payments, but this time it concerned the final payment. The respondents were asked to evaluate the effect of reducing the time for final payment. The question was phrased: "According to your personal opinion, what would be the effect if the deadline for the final payment was reduced to 30 calendar days?"

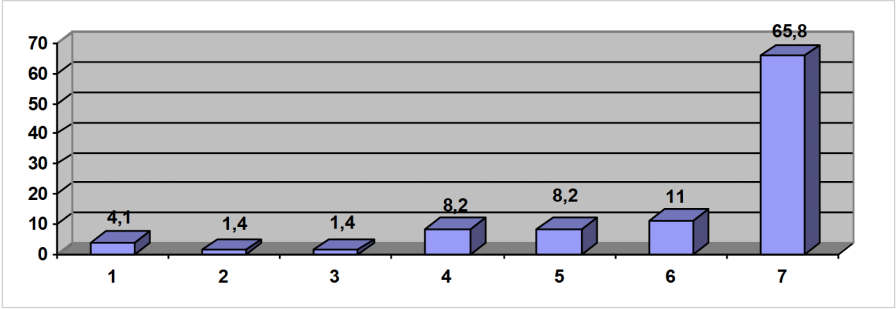

Figure 9. *Results of the evaluation of reducing the potential time of the final payment (1 to 7), %*

This potential measure in the vein of supporting beneficiaries is commented on and offered by all types of beneficiaries – they share the same opinion on the deadlines needed by the Managing Authorities to make final decisions on the concrete project and to proceed to the final payment (Figure 9). It is common practice by all Managing Authorities, in order to ensure and to secure public resources, to unnecessarily complicate the procedures that lead to the final payment. Therefore, a reasonable solution that is accepted by both sides has to be developed. For instance, for problematic projects the overall final procedure should be absolutely obligatory, and for the rests of the projects – another principle should be developed that guarantees the required level of risk.

The next evaluation is on the very sensitive subject of the implementation of Public Procurement legislation as the major tool for spending public money by different types of public authorities and institutions. One of the major burdens related to the delays, and often to the impossibility of executing some of the initial planned project activities, is the difficulty of the procedures of the Public Procurement Law. Over the years there have been different changes to the Bulgarian Public Procurement Law, but in fact these changes have not led to better procedures and implementations. The question that was

posed for evaluation by our respondents was: "According to your personal opinion, what would be the effect of improving the procedures under Public Procurement Law?" The results of this evaluation are presented in Figure 10.

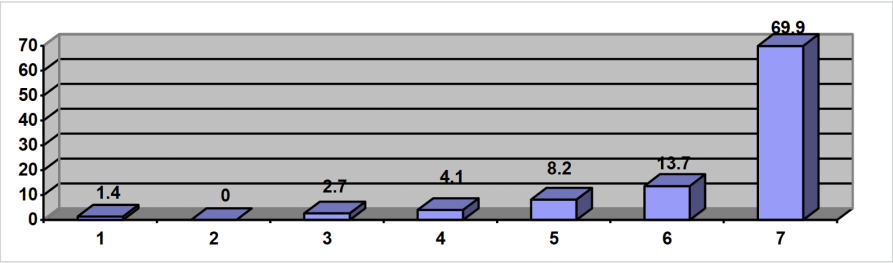

Figure 10. *Results of the evaluation of potential improvements to the procedures of Public Procurement Law (1 to 7), %*

During the previous programming period, and indeed during the current one, the municipalities have rich experiences in the different procedures under Public Procurement Law. Some of the Managing Authorities execute *ex-ante* control of the overall documentation of concrete procedures prepared by beneficiaries, but there are two absolutely opposite opinions on this practice. From one side, *ex-ante* control is perceived as some kind of initial insurance on the public procurement procedure. From the other side, *ex-ante* control usually takes extra time than the beneficiary has planned. Perhaps the most common criticism of *ex-ante* control is the fact that there is no shared responsibility. Once one procedure has approval from the Managing Authority's *ex-ante* control, there is no guarantee that any of the responsible audit institutions impose financial corrections due to imperfections in the same procedure that has passed the *ex-ante* control of the Managing Authorities. Therefore, this impressive level of approval of the potential improvements to the Public Procurement Law is no surprise.

The final evaluation of potential change is connected to the major subject of sustainability, which is another field in the process of implementing EU funds on which Managing Authorities have differing interpretations. The question used to collect the distributions of opinions is the following: "In your personal opinion, what would be the effect if the institutions responsible for the control of the sustainability of the projects unified their requirements?" The results achieved from this question are presented in Figure 11, and reveal the most categorically clear picture made across all of the evaluations.

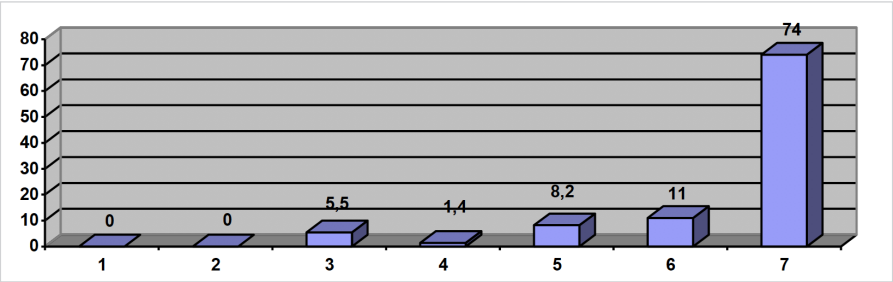

Figure 11. *Results of the evaluation of the potential unification of the requirements of all controlling institutions in terms of sustainability (1 to 7), %*

In comparing all of the evaluations, the results categorically indicate that, according to the representatives of the municipalities, the most desirable change is the unification of sustainability requirements. This finding in fact corresponds to the recent practice and financial corrections of the projects of the municipalities that have already been implemented which, however, fail on the issue of sustainability. One of the possible solutions here is connected to the centralized guidelines approved by the deputy-ministers of the EU funds in Bulgaria, which are compulsory for all institutions at the national level. These guidelines have to be in accordance with the European and national legislation in the field, and approved by the majority of stakeholders in a broad public discussion.

5. Conclusion

Local municipalities and local governments have key roles in the overall process of programs for the implementation of EU funds at the national level. Their opinions are very important as they already have rich experiences, and lessons have to be learnt in order to improve the environment, applicable legislation, and procedures.

The findings from our research indicate that the representatives of municipalities have very clear understandings of the specific requirements that have to be achieved in preparing, implementing, and reporting a project financed by the European Structural and Investment funds. However, there must be an intersection between the requirements of the Managing Authorities in terms of securing the legitimacy of every public euro spent on a project, and the proposals of municipalities as one of the major players in the field of EU funded projects at the national level. Representatives of the different municipalities declare their clear appreciation for the changes that have already been made to procedures, especially those on e-project submission and e-monitoring. On the other hand, they also point out the need for significant improvement in terms of clarifying unified practice on the sustainability of projects, and the specific requirements therein for beneficiaries.

The present research is an attempt to collect, analyze, and offer the opinions of representatives of municipalities on changes that have the potential to drastically improve the overall national system of the management of EU funds.

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RESPONSIBLE ENVIRONMENTAL MANAGEMENT AS A TOOL FOR ACHIEVING THE SUSTAINABILE DEVELOPMENT OF EUROPEAN COUNTRIES

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Abstract: *The trend of the last decade is to achieve sustainable development of society. The reasons of the development of this tendency are the global processes of industrial growth, the level of consumption of products, urbanization, and the development of globalization processes, the formation of the impact of non-profit organizations in the fight against environmental problems. The problems of environmental responsibility are urgent for many researchers, as they represent a way to solve complex environmental and economic problems facing the representatives of modern business, society and the state. The article deals with the analysis of the environmental component of social responsibility and its impact on the sustainable development of European countries. The article focuses on prioritizing sustainable development goals, namely Partnership for Sustainable Development. The factors that most influence on the environmental sustainability of European countries (Lithuania, Hungary, Slovakia, France, and Ukraine) were analyzed. The correlation between GDP changes, populations and the level of environmental pollution has been proved. The definition of the concept of responsible consumption is considered and recommendations of reducing the level of influence of the agricultural sector on the environmental component were proposed. The necessity to increase environmental social responsibility in order to prevent a negative impact on the economy of European countries is substantiated.*

Keywords: *responsible consumption, ecological responsibility, sustainable development, globalization, environmental*

JEL Classification codes: *Q01, Q52, M14*

1. Introduction

The increasing importance of the country's development, at the present stage, enhances the interaction between society and nature – with the attraction and use of large quantities of raw materials, energy, and fuels – and influences the change of directions in the crucial role of natural resources and ecology through increasing human influence.

Increasingly, there is an exacerbation of the environmental problems of the world, which in turn affects the environment, resulting in the pollution of land, water, and air, the deterioration of public health, a reduction life expectancy, and an inequality of access to resources, which creates negative trends in the socio-economic development of each country. The consequence of such actions is a violation of the balance of the nature-economy-society balanced, that is, the global concept of sustainable development.

In accordance with the new Resolution "Transformation of Our World: The 2030 Agenda for Sustainability," 17 Sustainable Development Goals have been developed with 169 targets. A list of goals has been established. The set of objectives covers a wide range of areas as it addresses the interrelated elements of sustainable development: economic growth; social integration; and environmental protection. Sustainable Development Goals are spreading across the world, both in rich and poor areas. That is why the current conditions of development of the countries of the world demand from society a reduction in the consumption of resources, an increase in the use of alternative types of materials and renewable sources of energy, and the introduction of resource-efficient, low-waste, and cleaner technologies.

Summarizing these issues and their possible solutions in line with the Sustainable Development Goals, this study considers Objective 13: Take urgent action to tackle climate change and its implications, and Objective 17: Strengthen sustainable development and enhance the work of the Global Partnership Mechanisms. In the interest of sustainable development, it is an objective necessity to study the relationship between the ecological system and the sustainable development of the country's economy.

2. Literature review

Theoretical and practical aspects of environmental issues and the sustainable development of the economy were described in the works of such scientists as Hoffman (1998), Meadows, Randers, and Meadows (2007), Reimers (1990), and others. Analyses of environmental pollution were reflected in the articles of Golyan (2007), Burkinsky (2006), Khlobistov and Zharova (2010), and others.

Sustainable development has been explored by leading scholars such as Zgurovsky and Gwishiani (2008), Dolishniy, Melnyk, Rudenko and Lisovsky (2005), and others.

International institutions at the global level are studying the environmental component of sustainable development. These institutions include: the International Council for Science (ICSU, n.d.); the World Center for Geoinformatics and Sustainable Development (WDC); the Club of Rome (n.d.); the International Institute for Applied Systems Analysis (IIASA, n.d.); and the International Federation global problems.

Despite the considerable amount of scientific work devoted to the environmental problem and the sustainable development of the economy, it is necessary to study the relationship between them.

The aim of this study is to investigate the relationship between the state of the environment and the sustainable development of the economy.

3. Methodology

For this study an inductive approach was used, which involved the development of a theory as a result of the observation of data (Saunders, Lewis, and Thornhill 2009; Figure 1). A sample of subjects was studied for establishing the theory by working with quantitative data from France, Hungary, Lithuania, Poland, Slovakia, and Ukraine.

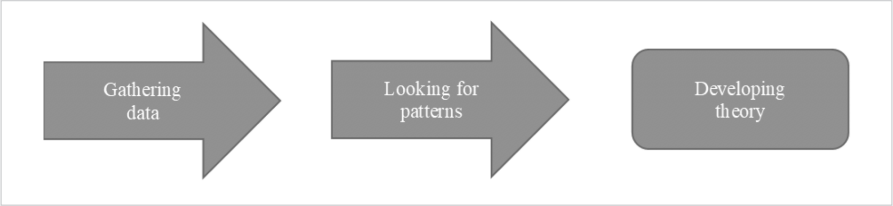


Figure 1. *Main steps in the inductive approach*

Source: Authors' compilation based on Saunders, Lewis, and Thornhill (2009)

For answering the research questions of the study, secondary data was used. Analyses of correlation between GDP, population, and pollutant emissions, as well as dependence of value added, pollutant emissions, and use of organic fertilizers, were performed based on the secondary data of World-Statistics and CITEPA for the abovementioned countries. World-Statistics provides data from international organizations, such as the World Bank, the United Nations, and Eurostat, while CITEPA is a Technical Reference Center for Air Pollution and Climate Change, reporting atmospheric emissions data.

A grounded theory approach (Strauss and Corbin 2008), involving the inductive building of theory, was adopted for data analysis. Potential bias in this method can arise from the researcher's worldview, and pre-understanding can also influence the achievement of "pure" grounded theory (Gummesson 2000). In this research, some level of pre-understanding was acknowledged and minimized through reflection.

4. Results and discussion

4. 1. Theoretical and practical aspects of the sustainable development process

Seventeen Global goals of Sustainable Development were documented in "Transforming our world: A 2030 agenda for sustainable development." The event was part of the 70th session of the UN General Assembly, held in New York in September 2015.

As a result of all consultations, taking into account national specificities, the first, third, fourth, sixth, eighth, ninth, and eleventh goals were identified as priority targets for the sustainable development for Ukraine and its regions. In general, this choice is typical of a transition country. It is worth pointing out that the environmental component was completely ignored when choosing targets, even though environmental issues are quite acute in some regions. Over four years, Ukraine has been focused on achieving the chosen goals, albeit slowly (UNDP to Ukraine 2016, 2018).

When explaining the impact of international projects on achieving the sustainable development goals, one can draw a comparison between such measures and benchmarking processes. This type of marketing aims to study the positive experience of leading companies and implement the results obtained in their work. International projects aim to achieve similar goals. Any international cooperation is accompanied by the acquisition of new experience and useful skills that are often used in economic, social, or environmental fields (Loginova 2016).

Ukraine, as a country with a transitional and rather volatile economy, should focus on such measures, and use opportunities to borrow foreign experience in full. In spite of this, the Sustainable Development Goal No. 17, entitled "Partnership for Sustainable Development," was not selected as a priority for the country.

It is necessary to understand the importance of Goal No. 17 in its entirety. Sustainable development partnerships in the form of international projects and communications will always influence other goals, giving the experience of more progressive countries to those less progressive in the areas of economic development, social issues, and environmental security. A potential international partnership can affect the development of all areas of sustainable development, and this is a significant advantage.

Despite the lack of prioritization of international projects, the process of regional experience exchange has been much more intensive since the harmonization of sustainable development goals. It is important to understand that without significant impact from international projects, such development is very limited and usually ends in national trends.

The definition of sustainable development characterizes it as the development of the present generation, which does not conflict with the interests of future generations. Its essence is to create the conditions for the lives of future generations so that they can meet their needs in full. Moreover, it is about providing resources and living standards which should be no worse than the current ones (Sustainable Business Magazine, n.d.).

By stepping up international cooperation, countries and regions are creating the same concept of sustainable development as was discussed in the 2015 document (i.e., development that is global in nature and is characterized by comprehensive international cooperation).

The Sustainable Development Trends, formed by the New York Summit four years ago, have already become a benchmark for most countries. Only the pace of activity that countries implement in achieving the Sustainable Development Goals differs. It is important to note that the result of international projects is not only the borrowed experience

of more developed countries, but also the generation of new solutions to existing global problems, which is certainly one of the key factors for sustainable development.

Among the goals of sustainable development, in terms of environmental security the most global from both the long-term perspective and in terms of current needs is Climate Action Goal No. 13. A great deal of research and publications are devoted to the impact of climate change on different countries and regions.

The Oxford Dictionary defines climate change as a change in global or regional climate patterns, in particular mid-to-late twentieth-century changes that are largely related to increasing levels of carbon dioxide in the atmosphere produced by fossil fuels (Hodulova 2017). From the point of view of the concept of sustainable development, climate change can be characterized as a disruption of natural weather cycles through human activity, which affects the planet as a whole and can lead to various consequences in different countries. In 2015, the research organization Our World in Data conducted a study on carbon dioxide emissions in the regions of our planet. It is worth noting that the chronology of the study covers the period from 1751 to the year of the analysis (Ritchie and Roser 2017).

The progressive increase in emissions began in the 1850s, when the Industrial Revolution from England was spreading to other countries in Europe and the United States. At that time, emissions did not even total one billion tons. In 100 years, this figure was six billion tons; it had increased by more than 6-fold. The graph in Figure 2 shows that, since the 1930s, carbon dioxide emissions have increased by approximately 1.5 times every 20 years, which is already a significant upward trend. The most significant centers of atmospheric pollution are the United States, Europe, and China. In addition, as a whole, the entire Asian region produces approximately 44% of the world's total carbon dioxide emissions (Figure 2; Ritchie and Roser 2017).

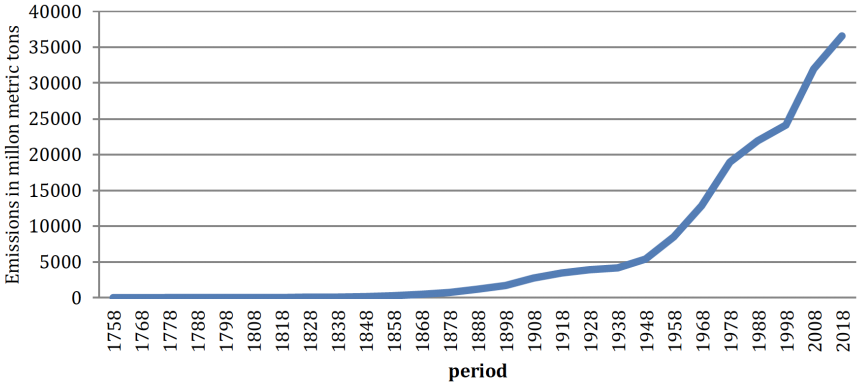


Figure 2. *Global emissions of carbon dioxide by world regions from 1758 to 2018*

Source: Authors' compilation based on Ritchie and Roser (2017)

Carbon dioxide emissions have been increasing at a very low rate in recent years, despite many environmental reduction programs. Such a qualitative suspension of carbon dioxide emissions gives us hope for further positive changes on this issue globally.

Given the anthropogenic nature of the vast majority of adverse climate change, it is crucial to give people a full and clear understanding of what is happening and what the consequences can be. In this case, the maximum effect on human perception can be achieved by having an understanding of the effects of climate change on human health.

The impact factors can be divided into 4 groups, depending on the nature of the causes and their potential consequences (Centers for Disease Control and Prevention, n.d.):

- Temperature rise (in particular extreme heat, which will manifest in heat and cardiovascular diseases, as well as the opposite situation which is accompanied by injuries and fatal cases of hypothermia);
- Sharper change in weather conditions (in particular air pollution, which will increase the incidence of respiratory diseases. Another consequence is the change in the ecology vector, which causes an increase in the incidence of malaria, rocky fever, and other insect-borne diseases);
- Sea level rise (in particular an increase in the number of allergens, which causes an increase in the frequency of respiratory allergy diseases. Another, equally significant consequence of the sea level rise is its impact on the quality of water, which is accompanied by an increase in the incidence of cholera, cryptosporidiosis, etc.);
- Increase in atmospheric carbon dioxide (increased atmospheric CO_2 content is largely due to lower nitrogen concentration in plants and lower nutrient content in crops if soil nitrogen level is suboptimal. As a result, the vast majority of people will be eating poorly, and the incidence of diarrheal disease will increase many times over. Another very negative consequence in this case is environmental degradation, which will cause migration to accelerate, which in turn will lead to conflict among citizens and other side effects; Centers for Disease Control and Prevention, n.d.).

It should be understood that in the context of one particular person, the above consequences may not be as significant as they may seem. But we have a population of 7.5 billion people on Earth, and it is on this scale that we should evaluate the possible negative consequences.

4. 2. Current issues of climate change which impact on European countries; development: a comparative analysis

The authors' research dedicated to the Sustainable Development Goals and the impact of climate change was explored in accordance with Climate Action Goal No. 13. The study was conducted on the basis of information from five European countries. All five countries are representatives of Europe, so this study demonstrates the different nature of climate change impacts across a single continent.

Weather anomalies recorded in Ukraine in recent years confirm negative climate change in the country. These changes involve increasing drought, increasing the dura-

tion of hot periods (the so-called heat waves), as well as the frequency and intensity of thunderstorms, hailstorms, and storms that have caused great harm to people living in a certain area. Climate change is also affecting Ukraine's export structure – agriculture will have to adapt to the new seasonality and the new rainfall regime. According to an almost general trend, there is extreme heat in the country, and the frequency of days with maximum summer temperatures of 35–40°C in Ukraine has almost doubled in the last few years.

Exploring the issue of climate change in France, it is worth noting that the country has become much warmer in the last ten years, and its ecology has changed as a result. The Giec study, conducted by an intergovernmental panel of climate change experts in March 2014, shows interesting results. At present, all regions of the world suffer from human-induced warming. In some countries, this is being reflected in the disappearance of plant and animal species, and the problem of a lack of drinking water is present in most African countries because of extreme heat. In France, however, there are problems with the migration of birds. In addition, the country sometimes introduces restrictions on water usage, which is a consequence of the reducing amount of this resource and the increasing of its need. France's rail network has also experienced negative climate change because of the sensitivity of the rails to heat damage (Idele 2017).

France's GHG emissions fell by around 11% between 1990 and 2018, but there are great differences between the sectors. For example, transport, housing, and waste increased by 12%, 11%, and 14% respectively. In this case, high growth rates were offset by reductions in emissions from industry (-40%), energy (-27%), and agriculture (-6%), as demonstrated in Figure 3 (Idele 2017; Georgieva 2019; World Data Atlas).

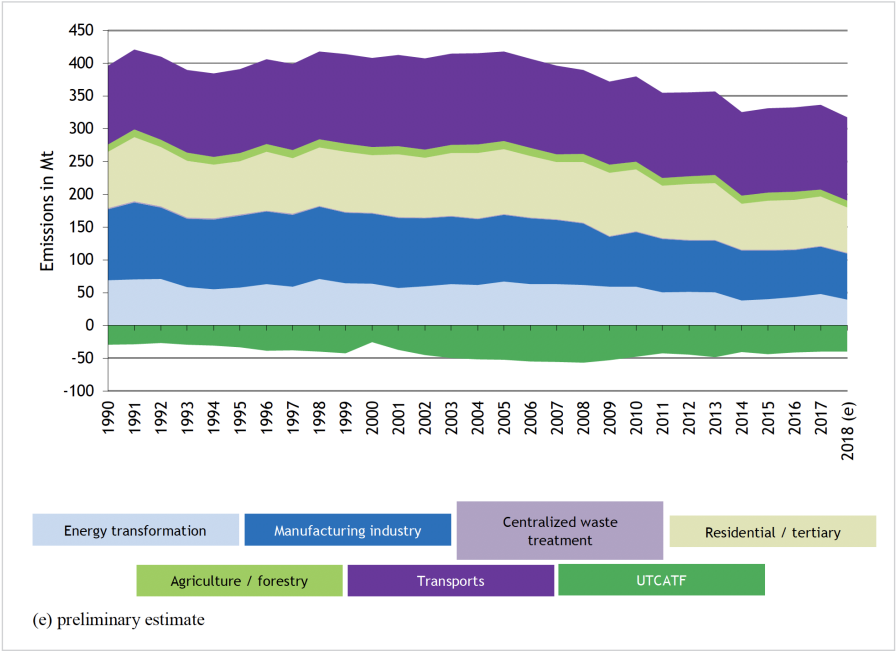


Figure 3. *Evolution of CO_2 emissions in air in mainland France since 1990*
Source: CITEPA/format SECTEN (April 2019)

Agriculture, where the lack of water will lead to higher prices for products, will be a great issue for Slovakia with increasing climate change. In Slovakia over the past 100 years, the average annual temperature has risen by 1.1°C.

As part of the new Greener Slovakia Environmental Strategy, the country has made a number of environmental decisions on specific problems of environmental safety. The strategy covers three of them, including water protection and biodiversity, climate change and air protection, and the green economy. In addition, the strategy proposes improvements in the protection of national parks and forests (by 2030, 75% of territorial national parks will face urgent conditions without human involvement). The strategy also envisages environmental public procurement, which is expected to increase by 70% by 2030. Another area of this strategy is environmental education, which should become an important part of formal education (Georgieva 2019).

"Dirty" vehicles generate around 90% of harmful emissions in Lithuania. Emissions from cars make up the largest share – 57%. Lithuania should reduce greenhouse gas emissions by 9% in the period of 2021–2030, while not exceeding the quota of 126.6 tons. If the country goes beyond the agreed limits, then it will have to cover this deficit with an appropriate amount in loans. According to forecasts, greenhouse gas emissions in 2021–2030 in Lithuania will reach 140 million tons. According to preliminary estimates,

covering the surplus will cost €348 million. Covering greenhouse gas emission quotas in the transport sector alone will require approximately €243 million, as transport is a major source of particulate matter and nitric oxide pollution in large cities. One of the main problems is that diesel vehicles emit significantly more of these pollutants than other types of fuel. Under a new bill, "vehicles with diesel pollution" will recognize vehicles with diesel engines whose carbon dioxide emissions exceed 115 grams per kilometer, as well as vehicles with petrol or gas engines whose carbon dioxide emissions exceed 130 grams per kilometer. For diesel, petrol, and gas engines exceeding the emission standards, a newly imposed tax will start from €80, €40, and €36 per year, respectively.

In Hungary, the PM 2.5 level is 19.4 micrograms per cubic meter, which is higher than the OECD average of 13.9 micrograms per cubic meter and well above the annual maximum of 10 micrograms per cubic meter set by the World Health Organization. PM 2.5, a fine particulate matter capable of reaching even the deepest part of the lung, is monitored in OECD countries, as these particles can be harmful to human health and shorten life spans.

Access to clean water is a fundamental factor in human well-being. Despite the significant progress OECD countries have made in reducing water pollution, improving the quality of freshwater is not always easy to determine. In Hungary, 77% of the population is satisfied with water quality, which is below the OECD average of 81%.

Therefore, a country's sustainable development can only be achieved by delimiting economic growth from the use of natural resources and environmental impact. This distinction can be explored by comparing the dynamics of economic growth with the use of natural resources.

The demarcation will be confirmed when growth rates or environmental impacts are lower than economic growth. But the real goal must be a complete demarcation when the environmental impact is stable or diminishing and the economy grows (BIO Intelligence Service, Institute for Social Ecology, and Sustainable Europe Research Institute 2012).

Decoupling (decoupling and delimitation are used as synonyms) is a separation of parameters. The EC Communication to the European Council and Parliament (European Commission 2011) identifies two types of delimitation: economic growth from resource use; and economic growth from environmental impact.

In one way or another, the theory and methodology of the concept have been used in a number of strategies and programming documents of the EU, the UN, and a number of countries around the world. In particular, the main documents are: the EU's "Thematic Strategy on the Sustainable Use of Natural Resources" (2005); "Roadmap to a Resource Efficient Europe" (2011); "Strategy for the Sustainable Development of the European Union – Europe 2020"; "Assessment of resource efficiency indicators and targets, Final report" (2012); "UN-UNEP Annual Report"; Organization for Economic Co-operation and Development (OECD); Global Environmental Forum Environment (Global Forum on Environment, focusing on sustainable materials management 2011); publications of the European Environment Agency; as well as a number of individual sustainable development strategies of EU countries, including Germany, Austria, France, Norway, Sweden, and others.

Differentiating between environmental impact and economic growth means two things:

1. The economy is growing faster than the rate of use of natural resources, but the absolute value of resources is used more;
2. The economy is growing, and resources are being used at the same or smaller levels.

These different degrees of delimitation are commonly referred to as relative and absolute delimitation. Similarly, decoupling environmental impact from economic growth means an economy growing at a faster rate than environmental impact (relative delimitation) or stabilizing or reducing environmental impact (absolute delimitation; European Commission 2011).

We compared the dynamics of the main indicators of economic growth and its impact on the environment in Ukraine, France, and Slovakia.

Figures 4, 5, 6, 7, and 8 show the dynamics of the economic growth indicator (GDP), the population, and the amount of pollutant emissions into the atmosphere in each country.

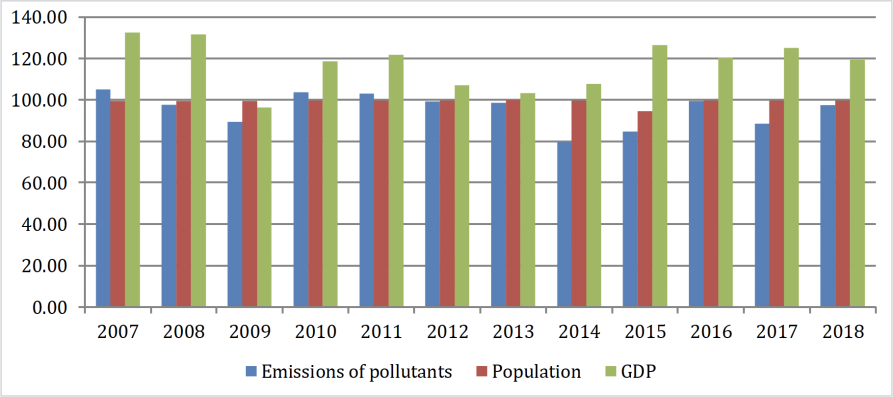


Figure 4. *Correlation between GDP, population, and pollutant emissions in Ukraine*
Source: Authors' compilation based on World-Statistics, CITEPA data (2020)

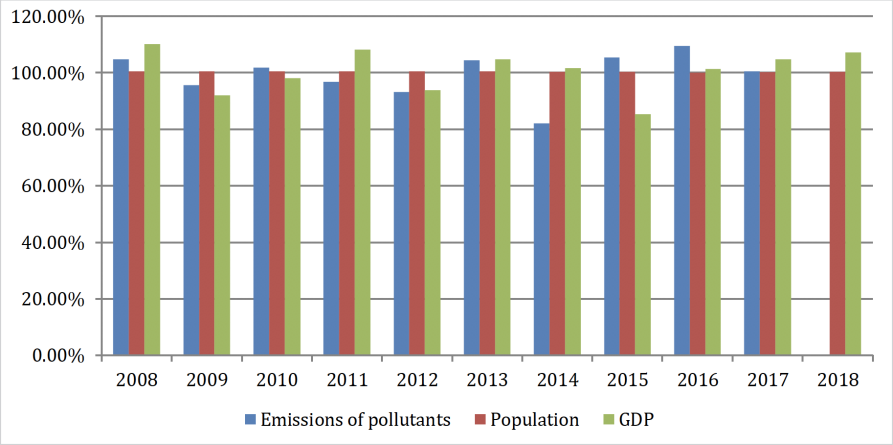


Figure 5. *Correlation between GDP, population, and pollutant emissions in France*
Source: Authors' compilation based on World-Statistics, CITEPA data (2020)

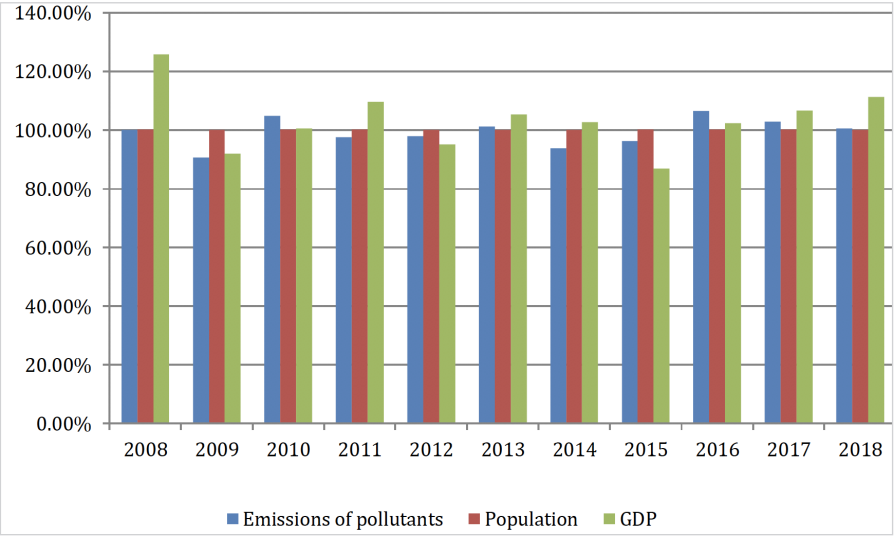


Figure 6. *Correlation between GDP, population, and pollutant emissions in Slovakia*
Source: Authors' compilation based on World-Statistics, CITEPA data (2020)

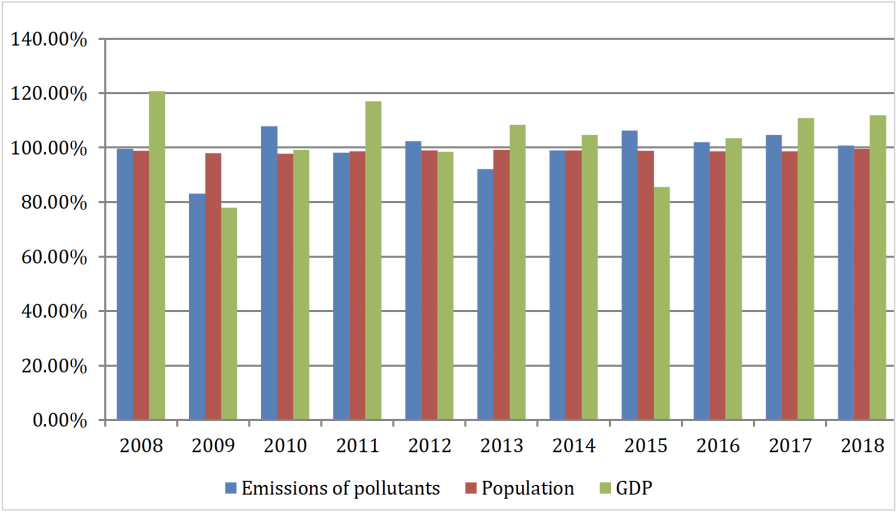


Figure 7. *Correlation between GDP, population, and pollutant emissions in Lithuania*
Source: Authors' compilation based on World-Statistics, CITEPA data (2020)

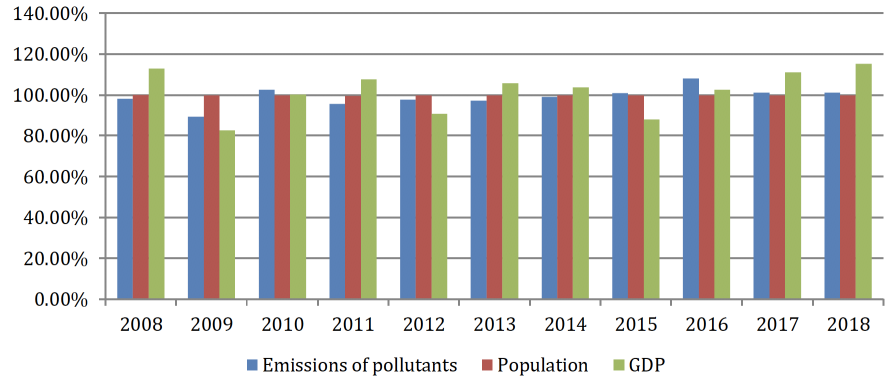


Figure 8. *Correlation between GDP, population, and pollutant emissions in Hungary*
Source: Authors' compilation based on World-Statistics, CITEPA data (2020)

The analysis shows that GDP growth rates are much higher than similar emission figures but overall the emission trend remains positive, indicating a relative distinction between these indicators, although in some cases the opposite situation is observed in a relatively minor manner. Agriculture is one of the largest sources of greenhouse gas emissions, and the proper use of its potential can help to limit global warming to 2°C by the end of the century. OECD experts assessed the impact of agriculture on global warming and analyzed the policies of developed and developing countries on the subject.

Agriculture contributes to an increase in carbon dioxide emissions, an increase land use, and a decrease in CO_2 absorption mechanisms such as forests or organic soils. Direct and indirect land-related agricultural emissions are accounted for in the AFOLU (Agriculture, Forestry, and Other Land Use) sector. In total, emissions in the AFOLU sector include agricultural greenhouse gases (CO_2-free), net CO_2 emissions from agricultural soils, and net CO_2 emissions from deforestation and other land uses (FOLU).

Agriculture is a major source of greenhouse gas emissions. It releases large quantities of carbon dioxide through the burning of biomass, mainly in areas of deforestation and grassland.

Agriculture is also responsible for up to half of all methane emissions. Though it persists for a shorter time in the atmosphere, methane is approximately 20 times more powerful than carbon dioxide in its warming action and is therefore a major short-term contributor to global warming. Current annual anthropogenic emissions are around 540 million tones, and are growing by around 5% per year (CITEPA 1990; Batini 2019a).

Livestock alone accounts for approximately one quarter of methane emissions, by way of gut fermentation and the decay of excreta. As livestock numbers grow, and as livestock rearing becomes increasingly industrial, the production of manure is projected to rise by approximately 60% by 2030. Methane emissions from livestock are likely to increase by the same proportion.

Irrigated rice farming is the other main agricultural source of methane, accounting for approximately one fifth of total anthropogenic emissions. The area used for irrigated rice is projected to increase by approximately 10% by 2030. However, emissions may increase more slowly because an increasing amount of rice will be grown with better controlled irrigation and nutrient management, and rice varieties which emit less methane may be used.

Agriculture is a key source of another important greenhouse gas: nitrous oxide. This is generated by natural processes, but is boosted by leaching, by the volatilization and runoff of nitrogen fertilizers, and by the breakdown of crop residues and animal wastes. Livestock accounts for approximately half of all anthropogenic emissions. Annual nitrous oxide emissions from agriculture are projected to grow by 50% by 2030.

Farming can also be a sink for carbon. However, it is generally believed that soils, like other biological sinks (e.g., vegetation), have an inherent upper limit for storage. The total amount that can be stored is crop and location-specific, and the rate of sequestration declines after a few years of growth before eventually reaching this limit. In 1997–1999, an estimated 590 to 1,180 million tonnes of carbon were locked up in cropland soils alone, in the form of soil organic matter from crop residues and manure. Projections of increased crop production imply that by 2030 this total could rise by 50%.

Other changes could boost the total even further. If only 2 million of the current 126 million ha of saline soils were restored each year, they could account for an extra 13 million tonnes of carbon annually. In developed countries, land that is permanently set-aside can sequester large amounts of carbon if it is left unmanaged, or reforested.

Depending on agroclimatic conditions, NT/CA can lock up 0.1 to 1 tonne of carbon per ha per year, in addition to cutting carbon dioxide emissions by over 50 percent

through the reduced use of fossil fuel in plowing. The growth potential for NT/CA is considerable. If another 150 million ha of rainfed cropland is converted to NT/CA by 2030 and the average sequestration rate on land managed in this way is 0.2 to 0.4 tonne per ha per year, a further 30 to 60 million tonnes of carbon could be soaked up annually during the first few years after conversion.

Should any of these practices be discontinued, the sequestered carbon would be released over a period of a few years. Agricultural carbon sinks of this kind are needed to "buy time" in which to cope with carbon dioxide emissions at source (Batini 2019b).

Greenhouse gas emissions from the livestock sector make up 18% of all human-related emissions. This is larger than the entire transport sector of the planet (Figure 9).

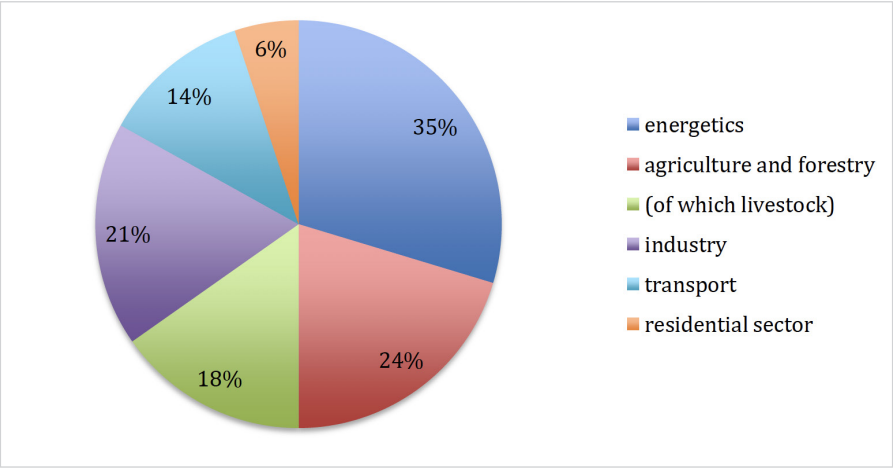


Figure 9. *The average value of atmospheric emissions in 2018*

Source: Authors' compilation based on Chatham House and CITEPA data (2020)

Industrial livestock is a source of three greenhouse gases: methane, nitrogen dioxide, and carbon dioxide. According to Chatham House, animal husbandry emits 39% of all methane and 65% of all nitrogen dioxide. Methane is produced during animal digestion and by the large amount of manure that accumulates on farms.

This sector is causing carbon dioxide emissions whilst the rainforests of Brazil and Southeast Asia are being destroyed in search of new pastures. Forests are also cleared into fields for growing animal feed.

The greenhouse gas emissions are extremely large: the world's 20 largest meat and dairy companies produce more greenhouse gases than all of Germany. Industrial livestock facilities cause enormous damage to the environment. Their emissions lead to the formation of atmospheric aerosol and acid rain, increasing the concentrations of greenhouse gases.

For meat and dairy production, a quarter of all industrial water is used annually, making AIC the largest consumer of water in the world. The vast majority of this water, due to the lack of treatment plants, returns to the environment in the form of liquid manure, suspensions, and sewage.

The Food and Agriculture Organization (FAO) report said that the environment is also contaminated with nitrates, substances, and pathogens that reduce oxygen, heavy metals, antibiotics, hormones, and residues of other medicines. Water contamination also occurs through the use of pesticides when growing feed. According to the FAO, in recent years in many countries, including Ukraine, there has been a significant increase of 50% in pesticide use.

Groundwater is also polluted. In the United States, of the 1,600 wells near farms 34% were contaminated with nitrates, with 10% exceeding normal levels. Another cause of water pollution is antibiotics, half of which are used in livestock.

Thus, it is possible to generalize the impact of the agro-complex in environmental pollution (Figure 10)

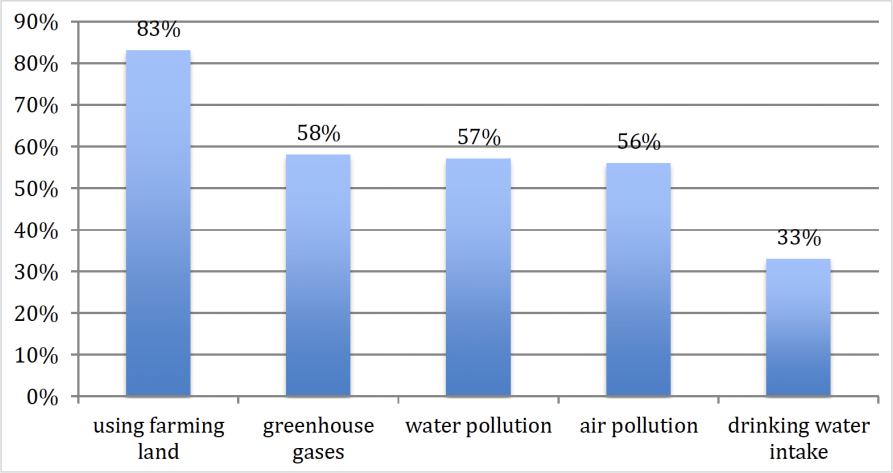


Figure 10. *The impact of the agro-complex in environmental pollution in 2018*

Source: Authors' compilation based on CITEPA and FAO data (2020)

As the world's population grows and the number of people consuming animal products grows, it will be more difficult to achieve climate change targets.

Helen Harvatt of Harvard University estimates that if action is not taken, then by 2030 livestock alone could account for 37% of the allowable emissions to keep warming below 2°C, and 49% if the goal is to limit warming 1.5°C. Besides the fact that the agri-food sector has a direct impact on climate change, it consumes large amounts of the planet's resources, in particular about half of the world's lands that are not covered by ice and deserts, and three quarters of its fresh water. Agriculture depletes these resources

due to the systematic emission of pollutants such as pesticides, synthetic fertilizers, and manure; discharges of genetically modified organisms and their deposits in surface and ground waters; loss of topsoil; as well as the salinization and waterlogging of irrigated lands. It has been established that the applied agricultural methods cause soil degradation at rates more than 100 times higher than the rates at which new soils are formed. Agriculture is also the main cause of the current mass extinction of species on Earth, according to the United Nations Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (2019).

Worst of all, existing food systems have not met expectations for providing humanity with food. While a third of all food produced goes to more than 70 billion animals that are annually farmed only on land, in 2018 over 820 million people worldwide were starving, according to FAO. At the same time, 650 million people were classified as obese and approximately 2 billion overweight due to eating too much of the wrong types of food.

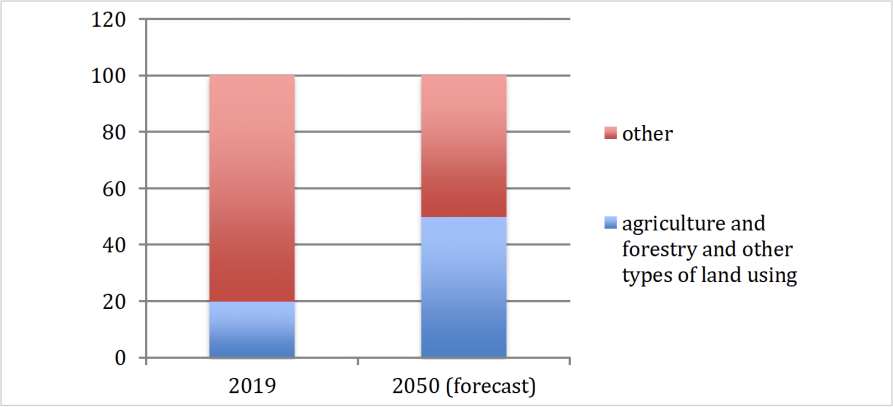
Making food systems sustainable for a growing world population is technologically possible, but this requires an in-depth review of production and consumption – namely, the Great Food Transformations. In the supply area, three changes are needed.

Firstly, the global production and consumption of red meat (especially beef) and dairy products should be reduced by about 50% by replacing them with vegetable proteins. The adoption of urgent measures by the three leading producers of beef – the USA, Brazil, and the European Union – and dairy products – the USA, India, and China – is of the utmost importance (IPCC 2019).

Secondly, a large-scale transition is required from traditional monocultural agriculture to practices that promote biodiversity, such as organic farming and the combination of farming with livestock, sustainable soil cultivation, and ecosystem restoration. Denmark and the Netherlands were among the first countries to announce bold plans for the transition to organic agriculture. Soil restoration using regenerative farming methods (for example, planting cover and perennial crops and stopping monoculture cultivation) will help to keep up to 60 tons of carbon per acre in the soil and green spaces, and thus reduce carbon dioxide emissions into the atmosphere. As one leading soil scientist, Rattan Lell of Ohio State University, calculated: "an increase in carbon content in the soils of the planet by only 2 percent can compensate for 100 percent of all greenhouse gas emissions." Regenerative mariculture will help both to absorb carbon and restore ecosystems. According to the World Bank, breeding algae and mollusks in the oceans in an area equivalent to 5% of US territorial waters would allow the production of protein equivalent to 2.3 trillion hamburgers, and absorb an amount of carbon equal to the emissions of 20 million cars. Mariculture covering less than 10% of the world's oceans would help to absorb all of the carbon produced in a year on the planet, and produce enough biofuels to meet the world's energy needs, according to Tim Flannery of the University of Melbourne (Harwatt 2018; Hedenus, Persson, and Sprei 2016).

Thirdly, an integral part of limiting climate change will be improving land use – for example, in the form of forest planting and reducing deforestation, as pristine forests absorb twice as much carbon as monoculture plantings. The proposed Covenant, in addition to the Paris Agreement (Global Deal on Nature Conservation), aims to ensure

that by 2030, 30% of the Earth is formally protected and another 20% are considered stabilization zones to limit global temperature increases to less than 1.5°C. Provided that these three changes are large-scale and coordinated, in combination they can drastically reduce emissions, increase carbon sequestration from arable land, free up land for crops and forests, stop the loss of biodiversity and pollinators, and restore global fresh water reserves. Changes in supply and land use should be accompanied by changes in diets and a shift to increasingly diverse plant-based products, such as coarse grains, legumes, and vegetables, as well as nuts and seeds. A study published in 2018 in *Nature* magazine concluded that if slightly more meat and dairy products would benefit malnourished people, then the average citizen of the world should eat them 50% less according to the catchy rule: "breakfast or lunch without animal products." Mostly plant-based diets are crucial not only for the planet (Figure 11), but also for people, because they reduce the risk of cancer, cardiovascular disease, type 2 diabetes, and obesity.



Note. Excluding greenhouse gases from food and non-food transformations.

Figure 11. *Share of greenhouse gases from the agri-food sector*

Source: Intergovernmental Panel on Climate Change (2019); Willet et al. (2019)

Thus, by 2050 the share of greenhouse gas emissions from the agri-food sector is expected to increase to half of total emissions compared with one quarter at present. (Percentage of greenhouse gases from agriculture, fisheries, and land use in total greenhouse gases).

Therefore, it is precisely due to the increase in agricultural exports that the exploitation of land is increasing, which requires the use of organic fertilizers – themselves also factors of soil and air pollution. The authors conducted a study on agriculture based on the value added, the amount of pollutant emissions, and the use of organic fertilizers in Ukraine, Hungary, Slovakia, France, and Lithuania, presented in Figures 12–16.

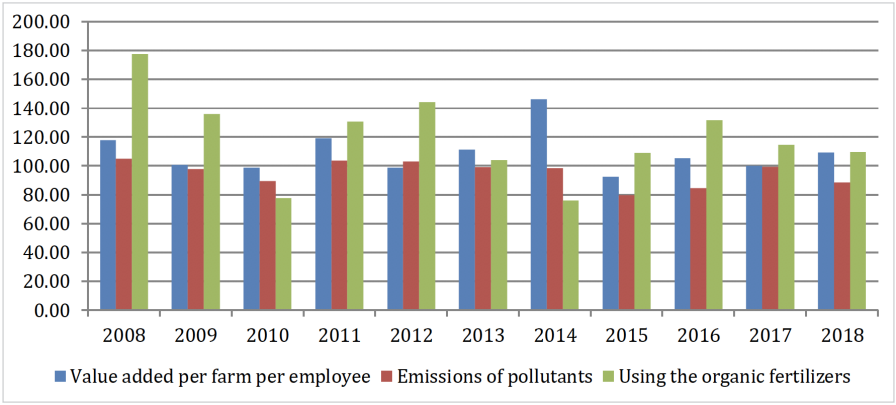


Figure 12. *Dependence of value added, pollutant emissions, and use of organic fertilizers in Ukraine (growth rate)*

Source: Authors' compilation based on World-Statistics and CITEPA (2020)

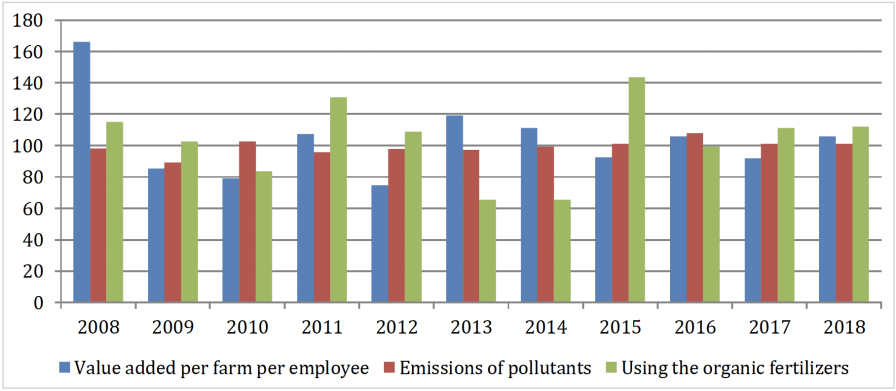


Figure 13. *Dependence of value added, pollutant emissions, and use of organic fertilizers in Hungary (growth rate)*

Source: Authors' compilation based on World-Statistics and CITEPA data (2020)

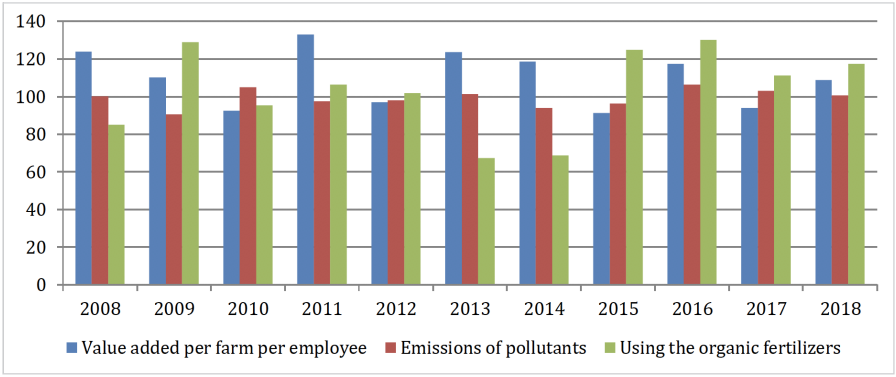


Figure 14. *Dependence of value added, pollutant emissions, and use of organic fertilizers in Slovakia (growth rate)*

Source: Authors' compilation based on World-Statistics and CITEPA data (2020)

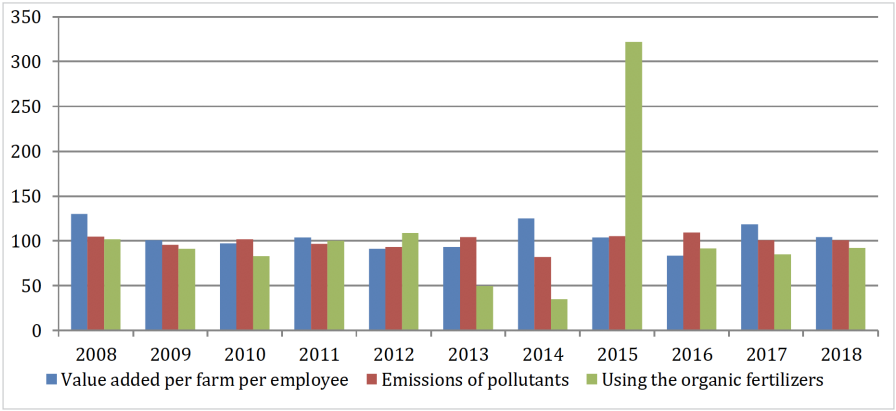


Figure 15. *Dependence of value added, pollutant emissions, and use of organic fertilizers in France (growth rate)*

Source: Authors' compilation based on World-Statistics and CITEPA data (2020)

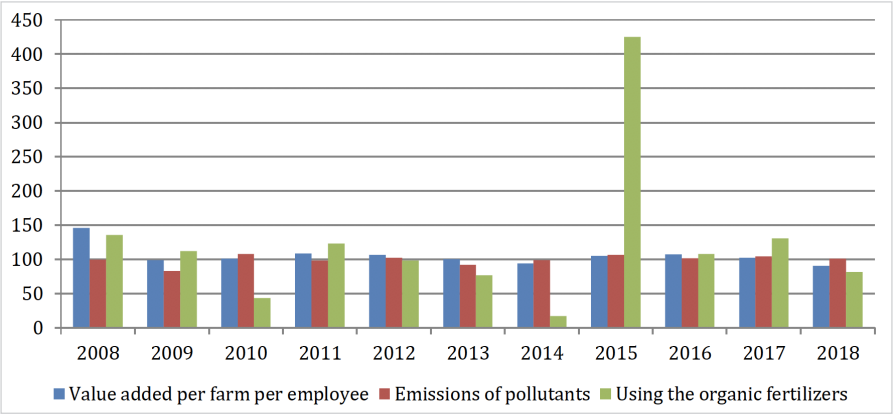


Figure 16. *Dependence of value added, pollutant emissions, and use of organic fertilizers in Lithuania (growth rate)*

Source: Authors' compilation based on World-Statistics and CITEPA data (2020)

Thus, it is observed that the use of organic fertilizers in most cases affects the added value of agriculture and worsens the climatic conditions of countries. This further reflects the efficiency of land use, which tends to decrease without reducing the use of fertilizers and demarcation of indicators. However, there is a reduction in the differences between indicators, so we can note a positive correlation between them, again demonstrating that the processes of land analysis for certain components of fertilizers make it possible to reduce pollution and the inefficient use of land resources.

5. Conclusion

Sustainable development of the economy and the population growth of the country can be ensured by reducing the negative impact of entrepreneurial activity on nature and reducing the level of nature and resource intensity of the economy. Movement along the trajectory of sustainable development is impossible when the intensity of use of natural resources and the amount of pollution per unit of output are increasing. Achieving decoupling requires significant changes in government policy, an increase in the pace of scientific and technological progress, and structural changes in the economy. The key role in these processes should be played by the modernization and gradual replacement of the obsolete fixed assets of industry with advanced technologies, the widespread use of cleaner production, the introduction of resource-saving, low- and non-waste technologies, and other innovations.

Summarizing the experience of the four countries on the effects of climate change and how to address them, there are several factors that can improve the environmental situation and its impact on anthropogenic factors at the global level:

- Construction of green infrastructure;

- Increasing the amount of low emission transport;
- Flood protection;
- Gradual increases in garbage collection fee;
- Improving energy efficiency;
- Improving public awareness of energy projects and energy;
- Introducing environmental education into formal education;
- Ensuring effective control of logging;
- Control of water consumption;
- Increasing responsible consumption;
- Analysis of the chemical composition of land resources, etc.

Regarding solutions, the day-to-day reduction of agricultural pollution is proposed to be achieved by reducing meat consumption. Brigitte Alarcon, sustainable food policy officer at WWF, noted that: "We can cut a quarter of our climate emissions from the European food supply chain by eating more pulses, fruit and vegetables and by reducing our meat consumption. National governments should improve food education to encourage healthy eating habits and environmental sustainability as a first step."

However, in most countries – such as Ukraine, Hungary, and Poland – the opposite is the case. According to the Eurostat, the FAO, and CITEPA, in ten years the consumption of meat has increased by 15% to 3.2 million tonnes. The consumption of poultry meat increased the most. The second direction for improvement is to use waste as an energy resource. Livestock waste requires special conditions for its disposal. Unfortunately, companies do not always approach this in good faith, but at the same time the great potential of this waste for renewable energy remains.

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- Inovacijos ir investicijų valdymas.
- Žinių ekonomika.
- Tvari ekonomikos plėtra ir socialinės technologijos.
- Informacinių ir ryšio technologijų ekonomika.
- Žmogiškųjų išteklių vadyba.
- Ekonominių sistemų efektyvus valdymas.
- Gyventojų gyvenimo kokybės tyrimai.

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- Mokslo ar kitos institucijos, kuriai autorius (-iai) atstovauja, pavadinimas, adresas, telefonas, elektroninio pašto adresas.
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