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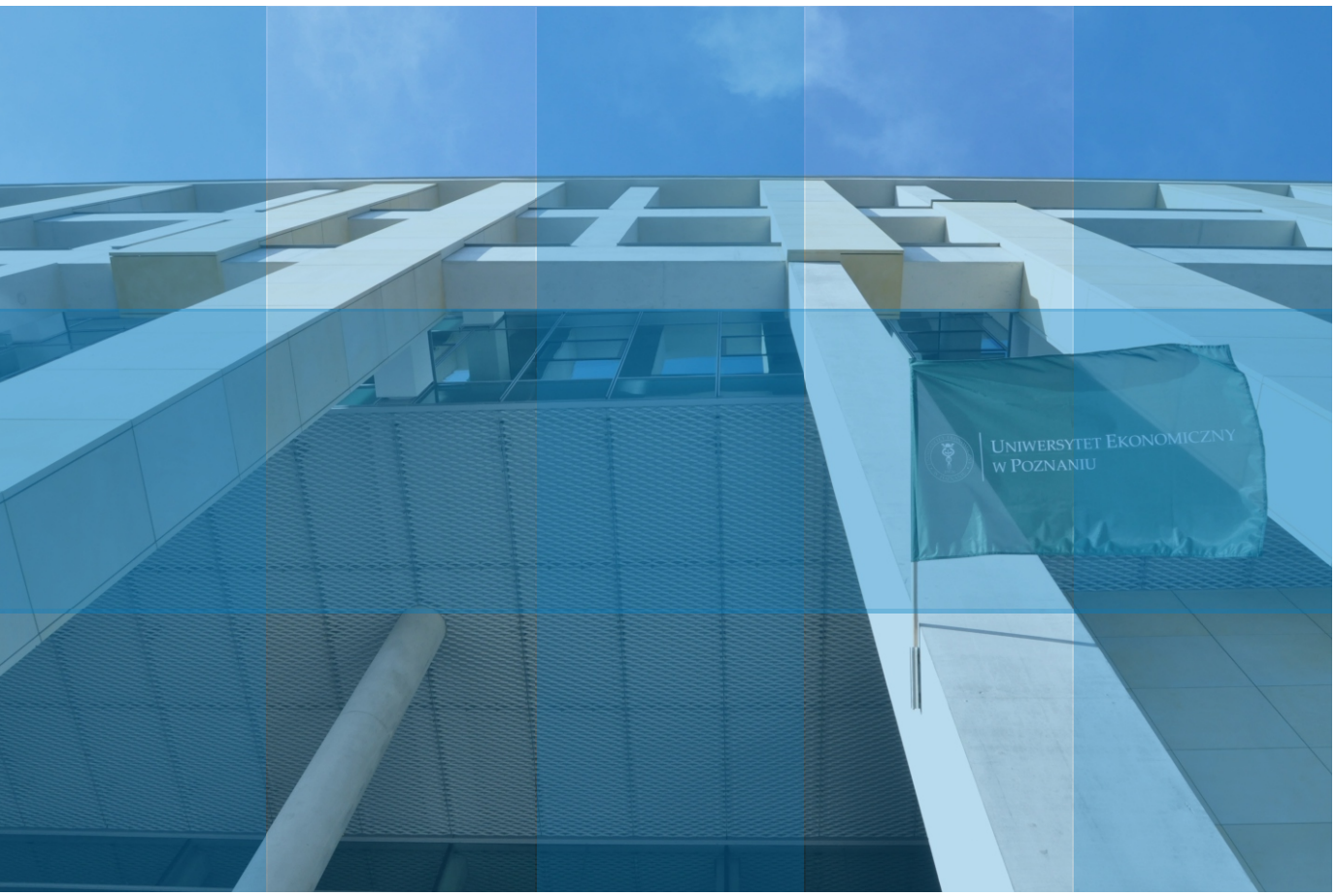

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PREFACE

Dear Readers,

We have the unique pleasure to present the latest issue of the REF journal. These scientific papers are predominated by the complexity of economic system. The authors offer a multidimensional view on dealing, measuring and concluding the complexity and cohesiveness of the problems. The works included in this issue depict the authors' interest in the area of agriculture, finance market, industry and energy supply. What is most interesting and worth recommending is the authors' approach. The problems as not depicted in isolation, but grounded in the system, being part of it.

The first article refers to the mechanism for assessing the competitiveness of an industrial enterprise in the information economy. It brings up the instrumental approach on how to measure competitiveness of an industrial company involved in technological progress and market competition. The paper presents a comparative evaluation model adapted to the industrial area of business, especially focused on the Ukrainian economy.

The next work focuses on complexity and deals with a multilevel model of AHP being non-subjective and reducing the uncertainty instrument. The author aims here to answer the question of whether the balance between economic viability, social responsibility and environmental sustainability serves the purpose of balanced development of an enterprise. The paper includes decomposition driven by hierarchic understanding of the concept and structure of balanced development.

This issue of the journal also presents an insight into the mechanism of public-private partnership implementation to coal mining enterprises in Ukraine. The syndicate form of this business branch and producers-consumers relationships are considered as well. The authors focus on the effectiveness of sales management policy in a body of this partnership and suggest extending amendments to the current laws and regulations.

Another work discusses the issue of an agricultural chain of production. The article entitled "Development of an Agro-Food complex on the basis of economic integration" includes qualitative and quantitative associations of determinants serving a way to understand complexity of the economic system. Conclusions are driven mostly by the unstable energy supply and ecological crises on the planet, having previously addressed arguments on agro-food complex development for energy production.

Last but not least, the next article is widely associated with the energy problem and focuses on investing in building the energy cluster in Ukraine. However, the authors have been far more concerned with exploring this issue by the financial aspect laid in attracting funds mostly in the form of municipal bonds and compensatory financing on the basis of tax.

These five articles give a set of explorations mostly referring to multileveled problematic interpretation and have the dimensions of measurement and comparison. For the methods utilized and the scope of the issues discussed, we hope this publication will be beneficial to your future developments.

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Yours faithfully,

Agnieszka Ziomek
– Member of the Editorial Committee

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RESEARCH PAPERS
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Mechanism for assessing the competitiveness of an industrial enterprise in the information economy

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ABSTRACT

The article establishes that the development of an industrial enterprise in the conditions of the information economy requires an assessment of the competitiveness of the enterprise. To solve this problem, a mechanism for assessing the competitiveness of an industrial enterprise in the information economy is developed, which is based on a complex of models for assessing the components of the competitiveness of an industrial enterprise and comparing them with the indicators of the competitive environment. Using the developed mechanism in the activity of an industrial enterprise makes it possible to assess its state in the aspect of adaptability to the information economy and provides the basis for developing solutions for further development of the enterprise.

Keywords: mechanism; evaluation; competitiveness; industrial enterprise; information economy; model; development.

1. Introduction

The development of an industrial enterprise in any context requires comparisons with other enterprises and the determination of the place of an enterprise in the environment. That is, it is necessary to assess the competitiveness of an industrial enterprise, its ability to meet the conditions of the modern world. Today, the global economy is increasingly gaining ground in the information economy.

Traditionally, in the information economy, there are three main areas: a) manufacture of equipment and electronic equipment for collecting, storing, processing, transmitting and displaying information, b) information activity of enterprises and organizations in the process of production and sale of goods and services, c) provision of services for the collection, storage, processing, transmission and display of information.

In the context of the development of an industrial enterprise, the first two areas deserve special attention. The third area of service provision is not the main thing for industrial enterprises, whose feature is the processing of raw materials and materials for the purpose of creating a new product. Although the share of the first sphere is increasing in the conditions of the information economy, but not all industrial enterprises carry out the production of equipment and electronic-technical means for working with information. At the same time, all industrial enterprises are in need of information activities in the production and sale of goods. The information economy is characterized by the emergence of new, innovative mechanisms for the implementation of information activities, which significantly expands the capabilities of the industrial enterprise in the performance of its functions.

Industrial enterprises, which lag behind with the introduction of innovative mechanisms of information activity, cease to meet the requirements of the economic environment, which is modernized in accordance with the development of the information economy, and lose in the competition to more innovative enterprises. Thus, for the development of an industrial enterprise in the conditions of the infor-

mation economy, it is necessary to evaluate its competitiveness in terms of compliance with innovative approaches to the implementation of information activities.

2. Literature review

The peculiarity of the information economy is its rapid development, in which every few years there are technologies that bring changes in the economy of almost all countries and change the universe (Aumann & Heifetz, 2002), (Chodera et al., 2013), (Gulati et al., 2013), (Kwilinski, 2017, 2018a, 2018b), Lippman & McCall, 2015), (Lakhno et al., 2018), (Lis & Mazurkiewicz, 2018), (Marston, 2011), (Mycielski, 1992), (Oishi, 2013), (Pająk et al., 2016), (Sun et al., 2017), (Vietor & Weinzierl, 2012), (Yakubovskiy et al., 2016), (Zhang et al., 2012), (Zhang, 2013). The trends of recent years are the development of high-speed wireless Internet, mobile devices with significant computing power, the coverage of most consumers with social networks, the accumulation of significant amounts of information on consumer behavior, the development of methods for processing information using methodologies of Big Data, BlockChain, ect. Due to the variability of the information economy, there are no classical approaches adopted by the whole scientific community to assess the competitiveness of an industrial enterprise in the information economy (Kwilinski, 2017, 2018a, 2018b), (Zhang, 2013). The research of approaches to assessing the competitiveness of an industrial enterprise in the information economy was carried out by many researchers who have solved some of the components of this multifaceted problem.

N. V. Valkova (2015) investigated the role of the information component in the competitive advantages of an enterprise that functions in the conditions of the information economy. At the same time, Kwilinski (2017, 2018a, 2018b) considered the main groups of methods for assessing competitiveness under various classification features and proposed SWOT-analysis of competitive advantages of the enterprise in the conditions of the information economy. As the main evaluation criteria, Valkova proposes to assess the availability of its own site, e-store, participation in electronic auctions and social networks, etc. Among the shortcomings of this approach is the lack of formalized methods for assessing competitiveness in the information economy. In addition, the listed factors to be taken into account in the assessment of competitiveness cover only the marketing aspects of the enterprise, ignoring the need to evaluate internal information flows.

T. Halimon (2016) considers information technology as a platform for managing the competitiveness of the enterprise and proposes the principles of constructing information and organizational design as solutions to the problem of the management of competitiveness. Thanks to using these principles or the dominants, T. Halimon proposes to provide accurate information on the passage of production processes, the coordination of internal activities, the dissemination of messages, as well as the use of system analysis in the operational management of the middle and lower levels of the enterprise. The disadvantage of the approach is to identify domains only in the form of declarative directions, without strict formalization, which would enable to simulate the competitiveness of the enterprise and compare the achieved competitive advantages with the indicators of other enterprises operating in the same industry and region.

A. V. Shmatko and N. G. Fonta (2015) offer to evaluate the competitiveness by calculating the continuous monitoring of the information system of the ratio of total profit to the enterprise costs and comparing the obtained indicator with the standard. The competitiveness indicator is calculated not only on the actual but also on the forecast, which is obtained by extrapolating existing trends. Due to extrapolation, the authors propose to identify problem situations and carry out their automated analysis with the use of computer-based functional diagnostics using hierarchy and SWOT-analysis methods. The main disadvantage of the approach is the choice of an indicator that characterizes competitiveness, since profits and costs are only the consequences of other factors that characterize the existing competitive advantages. An enterprise can have low competitiveness, but it will affect its profit only after some time. In addition, profit and expense may depend on factors other than competitiveness.

O. G. Dzeba and O. P. Romanko (2014) investigated the use of modern information technologies in machine-building enterprises in the aspect of increasing their competitiveness in the conditions of the scientific and technological revolution and the globalization of economic processes. Increasing competitiveness (Dzeba & Romanko, 2014) is offered through the introduction of continuous information support of the product life cycle, comprehensive automation of production and the integration of various information systems into a single enterprise management complex. These measures are promising and effective, but researchers remain out of the question how competitiveness should be assessed in comparison

with other enterprises and how information economy requirements should be taken into account. In addition, the features of domestic industrial enterprises, including machine-building, which have their peculiarities in production and marketing processes that make it impossible to copy western mechanisms, are not taken into account.

A. Reva and A. Smirnov (2010) propose to increase the competitiveness of the enterprise through the introduction of information systems and technologies taking into account the peculiarities of the life cycle. Reva and Smirnov draw the conclusion that information systems are rapidly evolving, and therefore their importance for the scientific, technical and economic development of society is expected to grow. At the same time, the study (Reva & Smirnov, 2010) lacks formalized methods that would link the development of information systems of an enterprise with its competitiveness.

A. V. Zhytkevych and A.O. Azarova (2015) have analyzed the software tools that can be used to calculate the assessments of the level of competitiveness of enterprises. Due to the identified shortcomings and benefits of the software under consideration, the most relevant tools for assessing competitiveness can be identified for each type of enterprise. Zhytkevych and Azarova use information and analytical technologies, decision support systems as well as global telecommunication technologies as tools for evaluating competitiveness (Zhytkevych & Azarova, 2015). However, without denying the promise of the conclusions reached, it should be noted that considering the software products does not provide the opportunity to compare the competitive environment of enterprises and to obtain a quantitative characteristic of the competitiveness of each of the enterprises.

3. Methodology

The existing research on the problem of assessing the competitiveness of an industrial enterprise in the conditions of the information economy has solved some of the components of this problem, but still many tasks remain unsolved. Among them, the main ones are: a) formalization of the methods of obtaining an integrated quantitative assessment of competitiveness, b) taking into account the constant emergence of new technologies caused by the development of the information economy, c) taking into account in the assessment of the competitiveness of domestic enterprises the technological gap between the Ukrainian industry and developed countries around the world, d) construction of a holistic mechanism for assessing the competitiveness of an industrial enterprise in the information economy.

Under the mechanism for assessing the competitiveness of an industrial enterprise in the information economy, we mean a set of interacting elements and integral tools for collecting and processing information, the purpose of which is to obtain estimates of the competitiveness of an industrial enterprise in its operation in the conditions of the information economy. This mechanism should address the above-mentioned tasks and provide the management system of the industrial enterprise with the bases for developing measures for its development in the conditions of the information economy taking into account the existing and potential competitiveness of the enterprise.

4. Results and Discussion

It is proposed to build a mechanism for assessing the competitiveness of an industrial enterprise in the information economy based on three models. The first one is a model of comparative evaluation of the competitiveness of an industrial enterprise, which makes it possible to compare the company with competitors or with world leaders. The second one is a model for assessing the capacity of an industrial enterprise to introduce new technologies that are constantly emerging in the information economy. The third component is the integrated quantitative assessment of competitiveness, which allows comparing such complex and multi-element characteristics of the enterprise as the competitiveness of different enterprises. A model for comparative assessment of the competitiveness of an industrial enterprise provides an opportunity to calculate indicators that characterize the competitive advantages or disadvantages of an industrial enterprise in the aspect of functioning in the information economy and compare them with other enterprises, competitors in the industry and the region where the enterprises operate or enterprises that are world leaders this area (Fig. 1).

The comparative evaluation is carried out in two stages. First, indicators are calculated, characterising the adaptability of the industrial enterprise to its functioning in the conditions of the information economy. Such indicators are offered: the degree of automation of production, the degree of informatization of business processes and the degree of representation of the enterprise in the information space.

The indicator of the degree of automation of production characterizes which percentage of production and technological processes is au-

tomated, that is, the implementation of which is carried out without human involvement or with human intervention only for the adoption of responsible and unstructured solutions (Borodin, 2006; Bryukhanov et al., 2005).

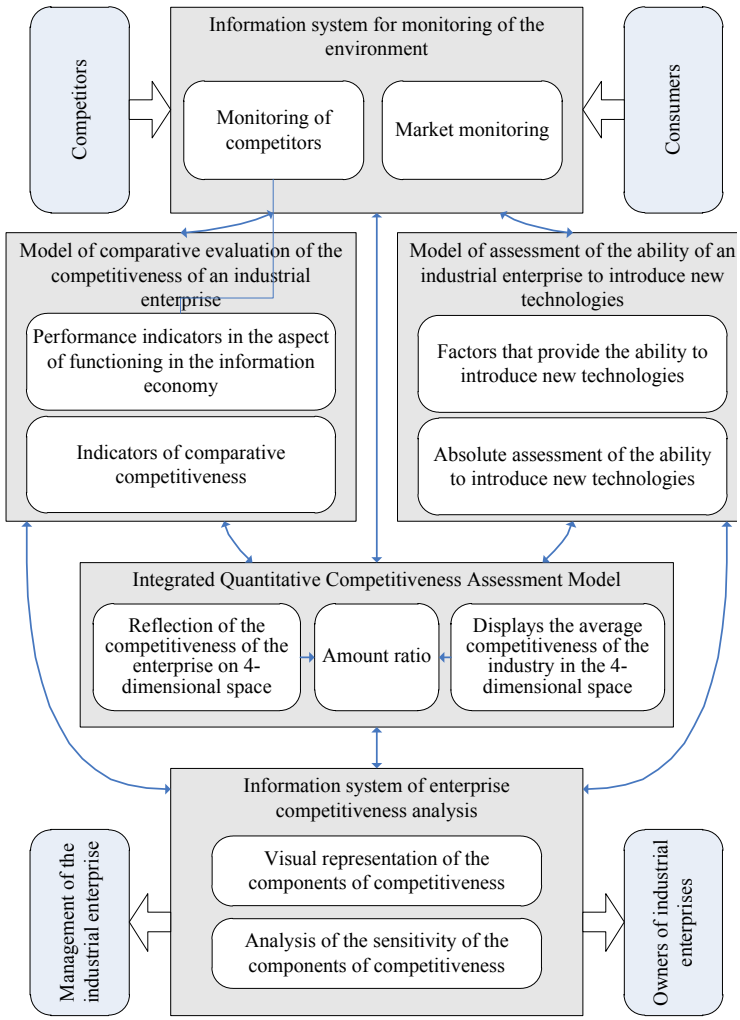

Figure 1. Mechanism for estimating the competitiveness of an industrial enterprise in the information economy
Source: own study

Calculation of the index of the degree of automation of production is proposed to take into account the contribution of each technological process to the final value of manufactured products and the importance of these products for the enterprise. This will take into account the importance of each of the technological processes in terms of the value added it provides and its impact on the financial result of the enterprise. The formula for calculating the degree of automation of production has the following form (formula 1-2):

$$S^a = \sum_{p=1}^{P} \left(w_p \cdot O_p^a \right), \tag{1}$$

$$w_p = \sum_{g=1}^{G} \left(\frac{V_g}{V} \cdot \frac{\varpi_{g,p}}{\Omega_g} \right), \tag{2}$$

where:
S^a – the degree of automation of production;
w_p – the weight of the p-th technological process;
O^a_p – evaluation of automation of the p-th technological process;
V_g – sales volumes of g-th products;
V^g – total volume of sales of the enterprise;
$\varpi_{g,p}$ – the added value provided by units of g-th products is the p-th technological process;
Ω_g – unit cost of g-th products;
P^g – number of technological processes used by the industrial enterprise;
G – number of types of products manufactured by an industrial enterprise.

Estimating the automation of the technological process is carried out in the range from 0 to 1 and has the criteria of formation, shown in Table 1. Full automation refersto a transfer of all functions of control over the execution and management of equipment or technical means. Partial automation is automation of individual operations, machines (Borodin, 2006; Bryukhanov et al., 2005). In addition, the stages of the formulation of the production task and its technological process, the direct execution of the technological process and the correctness of the implementation of the production task are considered separately.

Table 1: Estimating automation of the technological process

Elements of automation of the technological process	Quantitative evaluation of automation			
	Complete	Partial, more than 70% of operations	Partial, from 30% to 70% of operations	Partial automation of some individual operations
Achievement of production tasks	0.20	0.15	0.10	0.05
Performance of production tasks	0.40	0.30	0.20	0.10
Control over performance of production tasks	0.40	0.30	0.20	0.10

Source: calculated by the authors.

The indicator of the degree of informatization of business processes reflects the percentage of business processes of the industrial enterprise formalized and translated into an electronic form. Under business processes, it means a set of related actions whose purpose is to create a product or service, or to ensure that such actions are performed (Repin, 2013). That is, business processes can be operational – which directly creates the product, management – that provides a coordinated operation of the enterprise and business support processes (Repin, 2013).

In the conditions of the information economy not all three types of business processes are important, only the operational ones and only the production business processes that are fundamental to the industrial enterprise but also business processes of other areas of the company's activity – marketing, personnel management, accounting and management accounting, ect. Informatization of business processes means that the business process has a formal description in the form of a job description and there is a reflection of the execution of this business process in the information system of the industrial enterprise.

The calculation of the degree of informatization of business processes of an industrial enterprise is proposed to be carried out according to formula 3.

$$S^i = \frac{\sum_{b=1}^{B} O^i_b}{B}, \quad (3)$$

where:
S^i – the degree of informatization of business processes;
O^i_b – the sum of evaluations of information of the b-th business process according to all the component criteria;
B – the number of business processes in the industrial enterprise.

For each business process, informatization can be complete when the entire business process is formalized and translated into an electronic form, or partially. The criteria for assessing the informatization of business processes are presented in Table 2.

Table 2: Estimation of informatization of business processes

Coverage of business processes by informatization	Quantitative assessment
Availability of a formal description of the business process	0.2
The presence of an accompanying business process of electronic document flow	0.2
Depiction of the state of the business process execution	0.3
Reflection of responsible for the execution of the business process	0.2
The presence of an automated system of alerts on deviations from the schedule of execution of business processes	0.1

Source: calculated by the authors.

An indicator of the degree of an enterprise in the information space reflects how an industrial company uses information communications and how much information is proven to its actual and potential counterparts. In the modern world, it is very important that information about business is easy to find, in addition, the active use of information communications over the Internet allows you to save time and significantly accelerate the interaction. It is very important to have a full range of products on the site and API (application programming interface, application interface) for working with contractors. This enables contractors to quickly find the goods and services they need, and also to execute orders and control their execution. That is, it is an important competitive advantage provided by the information environment.

The calculation of the indicator of the degree of representation of an enterprise in the information space is carried out by drawing up estimates of the availability of each of the possible competitive advantages in the area of information space, taking into account the expert assessment of the quality of implementation of this advantage (formula 4).

$$S^p = \sum_k e_k \cdot O_k^p, \tag{4}$$

where:

S^p – the degree of informatization of business processes;

e_k – expert assessment of the quality of the implementation of the p-th competitive advantage in the field of representation of the industrial enterprise in the information space;

$O^p{}_k$ – evaluation of the p-th competitive advantage in the field of representation of the industrial enterprise in the information space.

An expert assessment of the quality of the implementation of a competitive advantage in the field of representation of an industrial enterprise in the information space should take into account the quality of implementation in comparison with competitors, when the best implementation is considered to be 100%, while others are compared with it. The importance of each competitive advantage is estimated according to the data presented in Table 3.

Table 3: Assessment of enterprise representation in the information space

Competitive Advantages	Quantitative assessment
The presence of your site on the Internet	0.10
Permanent site update	0.10
Availability of a full range of products on the site	0.20
Availability of API for work with contractors	0.20
Regular participation in exhibitions	0.20
Participation in public tenders through the system Prozorro	0.10
Interaction with state authorities through Internet communication	0.10

Source: calculated by the authors.

$$S^E_{min} = \sqrt{\left(S^a - S^a_{min}\right)^2 + \left(S^i - S^i_{min}\right)^2 + \left(S^p - S^p_{min}\right)^2}, \quad (5)$$

$$S^E_{max} = \sqrt{\left(S^a - S^a_{max}\right)^2 + \left(S^i - S^i_{max}\right)^2 + \left(S^p - S^p_{max}\right)^2}, \quad (6)$$

$$S^E_{avg} = \sqrt{\left(S^a - S^a_{avg}\right)^2 + \left(S^i - S^i_{avg}\right)^2 + \left(S^p - S^p_{avg}\right)^2}, \quad (7)$$

where:

S^E_{min} – the degree of informatization of business processes;
S^a – the degree of automation of production of an industrial enterprise;
S^a_{min} – the degree of automation of the first quartile of competitors;
S^i – the degree of informatization of business processes of an industrial enterprise;
S^i_{min} – the degree of informatization of business processes of the first quartile of competitors;
S^p – the degree of representation of the enterprise in the information space;
S^p_{min} – the degree of presentation in the information space of the first quartile of competitors;
S^E_{max} – competitiveness compared with industry leaders;
S^a_{max} – the degree of automation of the last quartile of competitors;
S^i_{max} – the degree of informatization of business processes of the last quartile of competitors;
S^p_{max} – the degree of presentation in the information space of the last quartile of competitors;
S^E_{avg} – competitiveness compared to industry average values;
S^a_{avg} – the degree of automation of production in the industry average;
S^i_{avg} – the degree of informatization of business processes in the industry average;
S^p_{avg} – the degree of representation in the information space in the industry average.

The obtained comparative indices give an opportunity to estimate the competitive position of the industrial enterprise, depending on the ratio of distance to outsiders, leaders and average values. If $S^E_{max} < S^E_{min}$ and $S^E_{max} < S^E_{avg}$, then we can conclude that the industrial enterprises are close to the leaders of the industry. If $S^E_{min} < S^E_{max}$ and $S^E_{min} < S^E_{avg}$, then the company is an outsider. In the case when $S^E_{avg} < S^E_{max}$ and $S^E_{avg} < S^E_{min}$, the company has a competitive, close to medium-sized industry.

The next component of the mechanism for assessing the competitiveness of an industrial enterprise in the information economy is a model for assessing the ability of an industrial enterprise to introduce new technologies that are constantly emerging in the information economy. The research on domestic and world successful machine-building enterprises makes it possible to conclude that the ability to implement new technologies depends on many factors, some of which may be considered key. Among them: a) availability of highly skilled personnel capable of adapting and implementing the latest technologies, b) sufficient qualification of the majority of personnel in the field of information technology use, c) availability of financial resources for implementation or the ability to attract them from the outside. Calculation of the absolute assessment of the ability of the industrial enterprise to introduce new technologies A^v are proposed to be carried out by drawing up all the received marks. The evaluation of these factors is suggested by analyzing relevant indicators (Table 4). Such a factor as the availability of highly skilled personnel capable of adapting and implementing the latest technology is considered to be the most important and can have a maximum value of 0.5, when all the units that can implement modern information technologies are present in the enterprise. The factor of sufficient qualification of the majority of personnel in the field of information technology may have a maximum of 0.25, at the same time only one of the listed options may be selected. Finally, the availability of financial resources also has a maximum value of 0.25, but consists of the sum of all the listed criteria.

In the case where the absolute assessment of the ability of an industrial enterprise to introduce new technologies is equal to one, this enterprise can be considered as fully adapted to the use of modern tools and technologies provided by the information economy.

The last element of the modeling mechanism for assessing the competitiveness of an industrial enterprise in the information economy is the integrated quantitative assessment of competitiveness. It is suggested, when calculating the integrated quantification, to use the indicators of the previous two models, namely: the degree of automation of production; the degree of informatization of business processes; the degree of representation of the enterprise in the information space; an absolute assessment of the ability to introduce new technologies. These four indicators are displayed in a four-dimensional space and form the corresponding figure.

Also in this space is a figure that consists of estimates of these indicators in the industry average. The integrated quantitative score in the result is the ratio of volumes of these two figures (Fig. 2).

Table 4: Assessment of the ability of the industrial enterprise to introduce new technologies

Factors of the ability to introduce new information technologies	Presence of a factor	Quantitative assessment
Highly skilled staff capable of adapting and implementing the latest technology	There is a research department	0.20
	There is a design bureau	0.20
	There is an IT department capable of self-development	0.10
Sufficient qualification of most personnel in the field of information technology use	More than 90% of the staff are confident users of computer technology	0.25
	From 50% to 90% of the staff are confident users of computer technology	0.15
	From 10% to 50% of the staff are confident users of computer technology	0.10
Availability of financial resources for implementation or the ability to attract them from the outside	There are sufficient amounts of undistributed profits of the enterprise	0.10
	There are own resources from the owners	0.10
	The enterprise has characteristics that provide it with cheap loans	0.05

Source: calculated by the authors.

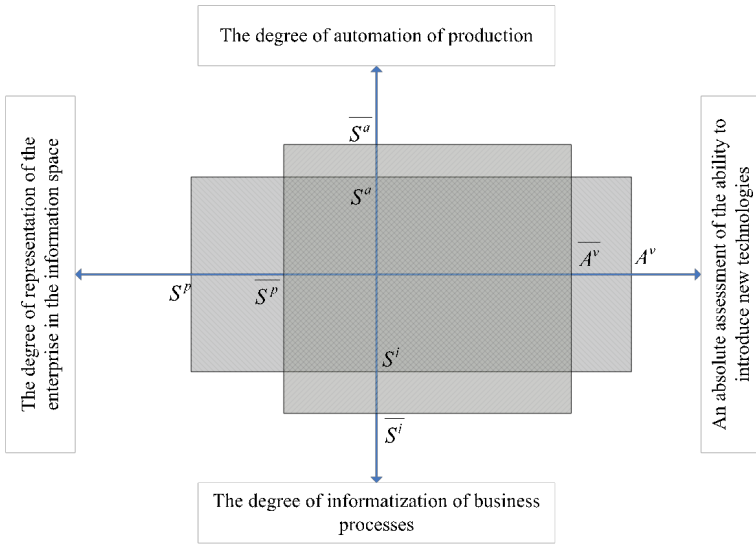

Figure 2. Representation of competitiveness of industrial enterprise and industry in projection
Source: own study

In addition to the model support, the mechanism for evaluating the competitiveness of an industrial enterprise in the information economy includes information support, which consists of an information system for monitoring the environment and an information system for analyzing the competitiveness of the enterprise. The first information system provides the collection and aggregation of data, which necessary for the assessment of competitiveness. The second provides the presentation of the results of the assessment of competitiveness in the form convenient for owners and managers, and also provides opportunities for analyzing the sensitivity of the components of competitiveness, their response to the change of individual factors.

Thus, a mechanism for assessing the competitiveness of an industrial enterprise in the information economy has been developed, which implies a set of interacting elements and constitutes a holistic tool for collecting and processing information aimed at obtaining estimates of the competitiveness of an industrial enterprise in its operation in the conditions of the information economy. This mechanism provides the control system of the industrial enterprise on the basis of developing measures for its development in the conditions of the information economy, taking into account the existing and potential competitiveness of the enterprise.

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Decomposition of the problem of ensuring balanced development of a modern enterprise in the stakeholder theory context

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ABSTRACT

The paper deals with urgent problems of enterprise's sustainable development in terms of finding balance between social responsibility, ecological sustainability and economic viability. A modern organization operates in a complicated environment, being characterized with higher degree of social accountability and strict ecological limits. According to this, complexity and multitasking of ensuring balanced development of an enterprise are stressed in the article. A hidden connection between sustainable development and interests balance of company's stakeholders is highlighted. Based on the advantages of T. Saaty's AHP approach for solving complicated problems, a five-level hierarchy is formed. The presented decomposition gives the hierarchic understanding, concept and structure of process of ensuring balanced development of an enterprise. A mathematical and graphic description of the impact of each of the separated levels of the problem focus is made.

Keywords: corporate social responsibility, stakeholders' balance of interests, sustainability, balanced development, hierarchy, decomposition of complexity.

1. Introduction

Modern enterprise constitutes socioeconomic, reproductive, sectoral, territorial, infrastructural integrity, which is characterized with complexity of connections, specified structure and main proportions. Nowadays, it is forced to act as an open system which accounts for its own activities and for achieving a justified balance of its stakeholders. According to this, the living space of society is considered as a direct bridgehead for the functioning and development of a contemporary enterprise, a substantial horizon of questions connected with balanced model-building of business and social relationships.

2. State of research

It took about 70 years for Bowen's innovative ideas about necessity of ethical carriage of affairs by businessmen who submitted their own policy, decision-making methods and behavior line to society's expectations and values (Bowen, 1953, p. 6) evolved to an entire conception of business' social responsibility for providing sustainable development and prosperity of future generations. Forming a modern social responsible organization concept occurred under the conditions of interactions and competitions of Friedman's (Friedman, 1971) and Levitt's (Levitt, 1973) 'corporate egoism'; Bowie's (Bowie, 1988) and Donaldson's (Donaldson, 1982) 'smart egoism'; Baumol's (Baumol, 1970) 'corporate altruism'; De Freeman's (Freeman, 1984) 'stakeholders' theory'; Carroll's 'pyramid of corporate social responsibility' with its four accountability levels: economic, legal, ethical, philanthropic (Carroll, 1991); of last thirty years concepts, such as 'corporate social receptivity', 'corporate social activity', 'corporate citizenship'.

Such transformation of the corporate's social function, from Friedman's thesis that 'profit is all that matters' (Crowther and Aras, 2008, p. 12) to understanding that benefit has compa-

rative and momentary character, considerably heightened the degree of social responsibility and liabilities of business toward society. Now, the triune formula of economic efficiency, ecologic security and social equity, fixed by the international community in well-known management standards, such as ISO 14000 'Ecologic management', ISO 9000 'Quality management systems', ISO 45001 'Occupational health and safety management systems', ISO 26000 'Social Responsibility', gradually comes into the organization's usual performance: from huge multinational corporations to small ventures, and transforms into an essential part of their high business image, routines and base for strategic initiatives. Cooperation between business, society and environment transforms into the crucial factor of its ability to keep functioning efficiently (Amosha et al., 2016; De Gooyert et al., 2017; Kharazishvili et al., 2016; Lakhno et al., 2018; Sarman et al., 2015; Theodoulidis et al., 2017; Tullberg, 2013). Today it is common to speak about integrated sustainable environmental, social and economic development (ISO 26000).

Therefore, a modern organization during its own activity is exposed to huge pressure of a wide circle of stakeholders, whose interests have as a rule a multidirectional character, sometimes strange to direct economic profit. In these conditions, the necessity of ensuring balanced development in sociopolitical, economic, scientific, technical and ecological perspectives becomes one of the powerful instruments for resistance to threats of external environment (Kwilinski, 2017, 2018a, 2018b). The achievement of the above-noted three constituents as special conditions for balanced development, when social responsibility does not become a great pressure, but transforms into complementary competitive advantage of an enterprise, is considered to be a current and perspective question of theoretical and practical importance.

The aim of this work is to create an effective basis and prerequisites for solving the problems of ensuring balanced development of the enterprise through their profound specification without loss of holistic representations and focus, through the formal assessment and further regulation of their complexity. The following tasks are conductive to attain the above-formulated aim:

— forming the notion of balanced development of a socially accountable enterprise,

— defining the degree of the impact of multidirectional interests of stakeholders on balanced development,

— making a hierarchic presentation of the problem of ensuring balanced development of an enterprise through its decomposition with separation of the problem's focus, forces which have an effect on the general purpose, actors or stakeholders with their own interests and expectations, scenarios which define the probability of achieving the set goal.

According to the high level of complexity and multifactor character of solving the matter, special methods and procedures have to be used. The decomposition of the problem into compound parts, defining their interconnections, calculating the degree of their impact on the problem's focus through priority vector and its presentation in the form of detailed levels' ordering by means of hierarchy analysis are supposed to be the most relevant.

3. Methodological research

3.1. Balanced development of an enterprise as the answer to social expectations

Deepening the working hypothesis that balanced development is a special form of realizing the enterprise's internal and external processes, which, primarily, complies with social expectations, allows to accomplish the decomposition of the analyzed question and to discover hidden connections between mutual satisfaction with the results of realizing by the enterprise its own social responsibility and ensuring its balanced development.

The unexpected crisis, which encompassed the world economy in 2008-2009, became another indicator of the actuality and acuteness of the problems of economic growth. These circumstances made it obvious that 'the pursuit of growth' had been the single most important policy goal across the world (Jackson, 2009, p. 5). Growth that was only based on constant acceleration of the consumption speed became the imperative, being formed by the specific architecture of the economy. According to Booth, 'society is hooked on growth' (D. Booth, 2004, p. 153). In addition, a belief in economic growth as a function of prosperity transformed into a myth despite the impending statistics. A fivefold increase of the economy (1950-2000) was accompanied by the estimated sixty-percent degradation of the world's ecosystem, with near two billion people living below the poverty line (Pajak et al., 2016, pp. 204-217), and global carbon emissions rising by 40% since 1990; the Kyoto Protocol 'base year' (T. Jackson, 2009, pp. 5-6). Main cautions, reported in

the known 'Limits to growth' by Meadows (Meadows, 1972), who already in 1970s began to raise the question of the price paid by society for such growth, were realized then.

During the unfolding of the next world's crisis, Tim Jackson – Economics Commissioner on the Sustainable Development Commission, underlined in his report of March 2009 that the 'myth of economic growth has failed, spectacularly, in its own terms, to provide economic stability and secure people's livelihoods' (Jackson, 2009, p. 7). Based on the depletion of ecology and sustainable social injustice, prosperity for several is not a foundation for the development of a civilized modern society.

Cooperating with other international and regional organizations, corporate business UN continued functioning actively in the context of ensuring balanced development, involving all levels of potential impact during the last decade. Popularization of the formulated Seventy aims of Sustainable Development, the Paris Agreement on climate change, adopted in December 2015, giving reasons for corporations to use special estimated indexes such as the Dow Jones Sustainability Index, stimulating social responsible investing are extremely noted. Owing to that, great efforts, directed to involve one of the crucial and influential players in the sphere of ensuring balanced development and maintaining business, meet in the vector of corporate social responsibility, the implementation of which becomes a key characteristic of any modern organization, irrespective of its pattern of ownership, sphere of value added and scale of functioning.

Things change as economies grow (Jackson, 2009, p.76). That is why the principles of egoistic behavior, i.e.: "there is one and only one social responsibility of business – to use its resources and engage in activities designed to increase its profits so long as it stays within the rules of the game, which is to say, engages in open and free competition without deception or fraud" (Friedman 1970), stop operating efficiently and giving profit to business in the long-term perspective. Today, corporate social responsibility as a sustainable management system, based on constant dialogue with society, becomes the key business ideology.

At the same time, compliance of the principles of accountability, transparency, ethical behavior, respect for stakeholders' interests, respect for the rule of law, respect for international norms of behavior, respect for human rights, fixed by international standards SA 8000 and ISO 26000 (Henriques, 2012, p.12), means not only automatically getting profits from open connections and understanding social needs, as well as from controlling the environmental impact. Usually, it demands from business big efforts, special internal organization and additional resources: human, temporal and financial; relevant decisions and policies, which not all the time bring by themselves a direct profit or income.

Furthermore, it should be noted that 'the aim of sustainable development consists in achieving sustainability of the society as a whole and a planet. It does not refer to the sustainability or continuation of a life-cycle of a given company. Sustainability of one organization both is or is not able to correlate to the sustainability of the society which is provided with solving economic, ecological and social problems in terms of integrated approach.' (ISO 26000: 2010, p.11).

The need to harmonically work in such a complicated context of socio-oriented existence leaves the modern enterprise alone with differences in direction, intensity of influence, time efficiency processes, and requires from it looking for certain equilibrium in a combination of social, economic and ecological components in balanced development. Balance serves as a united, qualitative and fundamental characteristic, which provides for the homeostasis (functional reproduction) of any system, including the socioeconomic one. Balance becomes the base and source of such characteristics important for the development of the system as sustainability, harmony, proportionality and others, as shown in fig. 1. Just an enterprise with a balanced internal environment has an opportunity to meet social expectations and act effectively within the ecological constrains.

Balanced development describes qualitative and proportional changes which ensure the system's stability and viability through the creation of required grouping and proportions both between the system and the external environment and within the system itself. Balanced development of an enterprise as an open complicated adaptive system can be depicted with the existence of two multidirectional vectors: the actions of the external environment and counteracting the internal environment. Thus, equilibrium development is a compound synergetic process of qualitative and proportional transformation of its vital functional systems, being directed at achieving sustainable socio-economic efficiency through the long-term perspective (internal forces). Along with this, providing balanced development as the key goal of the existence of an enterprise meets with the multidirectional aims of stockholders,

CEOs and top-management, staff, government, social organizations, which are both directly or indirectly interested and act with some impact on the realization of the main purpose (external forces).

Thus, in short, supplying the high-performance social accountable function and development requires finding balance in achieving its own interests, interests of society and natural environment needs by an enterprise.

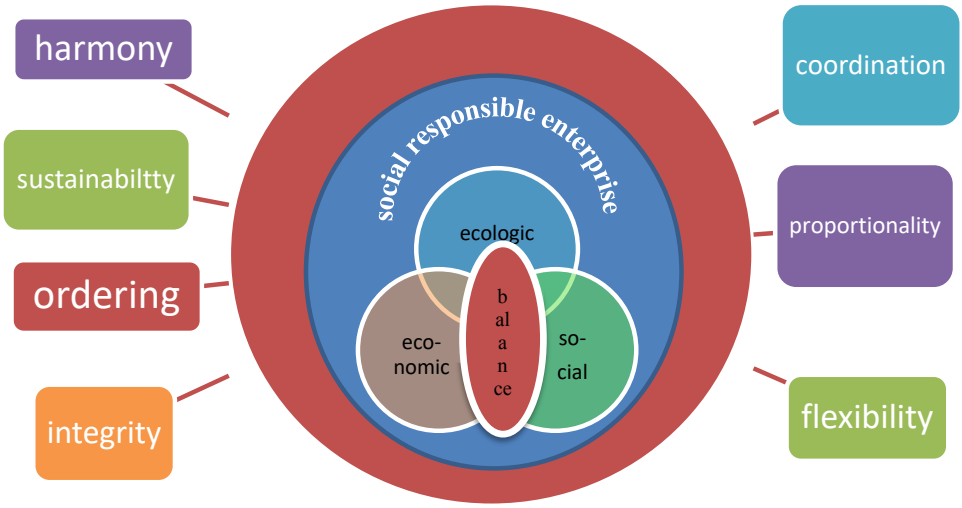

Figure 1. Balance as the basis of social responsible functioning of an enterprise
Source: authors' own analysis

3.2 Multiplicity of interests under ensuring balanced development

The above-defined key connection between social responsible behavior of an organization, in other words – performance of the 'social contract', and the importance of ensuring its balanced development highlights the existence of a wide field of stakeholders, being able to influence the solution to this problem. Establishing and interacting with stakeholders are the fundamental practices of implementing social responsibility of a modern organization (ISO 26000:2010, p. 16). These processes are most exactly pictured by the scholar H. Jonson: "A socially responsible firm is one whose managerial staff balances a multiplicity of interests. Instead of striving only for larger profits for its stockholders, a responsible enterprise also takes into account employees, suppliers, dealers, local communities, and the nation" (Jonson, 1971, p. 50). There he implicitly gives a definition of a social responsible organization through the stakeholders' concept and highlights the necessity of balancing their multidirectional interests. As a rule, different stakeholders have different, very often competitive interests which are considered to be general source of complexity of ensuring balanced development (ISO 26000: 2010, p. 20). Therefore, as noted above, it confirms the necessity of further decomposition.

According to ISO 26000, any organization at the present stage of development, functioning and realizing its own potential, enters or feels three fundamental interrelations which exist regardless of the organization's awareness of them, as shown in figure 2.

Just these interrelations influence the ability to exist and be efficient of a contemporary company. It is obvious that identification and subsequent specification of such components as 'stakeholders', 'society' and 'natural environment' will exponentially extend the quantity and qualitatively differentiate interests and expectations presented to a company for fulfilling and taking into account during its life-time. A balance of interests provides for the above-highlighted requirements to harmonize with such a target-setting of a company.

Since the mid-1980s, many different methods of defining and accounting for the stakeholders' effect on a company have been created, such as Mitchel's model of 'Power-Legacy-Urgency', Savage's identification of significance by the parameters of 'Threats-Interconnection', OMG's method of defining the rate of stakeholders' involvement, and others. Thus, taking

into account the character of the problem of ensuring balanced development and accumulated experience within social responsibility acceptation gives an opportunity to make the decomposition of the above-defined problem by creating its hierarchic presentation and observing the balance of interests of all stakeholders (Saaty 1980).

Figure 2. Interconnections between an organization, stakeholders and society
Source: ISO 26000: 2010 'Social responsibility'

3.3 Using the Analytic Hierarchy Process for the disintegration of the problem of ensuring balanced development of a modern enterprise

It is evident that the investigated economic reality has complicated, multifactorial and systematic character and contributes relevantly to analyzing methods and approaches. Using the elements of Saaty's Analytic Hierarchy Process (AHP), presented by him in the 1980s, is considered to be effective for detection and structuration of complicated and unclearly formulated problems characterized with complexity and huge amount of interconnections.

AHP is a systemic procedure of a hierarchic presentation of elements, defining the essence of the problem. It establishes powers and intensity of their impact to achieving the main goal (solving the general problem) – the peak of hierarchy. AHP consists of procedures of synthesis of different assessments, getting criteria priority and finding alternative decisions (Saaty 1993, 2001). Advanced problem detailing, establishing a hierarchy of its components, stakeholders and their rate-impact to its solving are regarded to be the main advantages of this approach.

The applied character of AHP (Perez and others 2017) makes it useful for the decomposition of the problem of ensuring balanced development of an enterprise. Following the logic of this approach gives a hierarchic presentation of the analyzed problem. Its decomposition gives an opportunity to answer the question of which components of balanced development of an enterprise (manufacturing, financial, marketing, social, ecological) is most influenced at the moment (which of them requires developing first). For achieving the general goal including the influence of external and internal forces (social, economic, ecologic), actors influencing these forces (investors, top-management, personnel, society, government), and the actor's aims (paying ability, taxes, dividends, saving work places) determining the directions and methods of achieving the general goal, as shown in fig. 3.

The decomposition presented in figure 3 gives the hierarchic understanding, concept and structure of the process of ensuring balanced development of an enterprise. The problem under analysis consists of five correlated levels, each of which is hierarchically interconnected. Thus, the peak of the formed hierarchy means the focus of the problem under analysis, namely: ensuring balanced development. At the second level, forces are defined, providing the achievement of the general goal, with a different degree of pressure. Thus, balance of the enterprise's development attains in terms of ensuring financial sustainability, ecologic safety, growth of prosperity, lasting technological renovations and increase of market value. The third hierarchic stage is presented by actors – participants of internal and external surroundings, who have a direct (personnel, management, partners) or implicit (state institutes, society organizations, investors) influence on the solution to the general problem. Each of the defined actors has some interest and degree of impact on attaining the established goal and acts through the realization of its own purposes, which are presented at fourth level of the hierarchy.

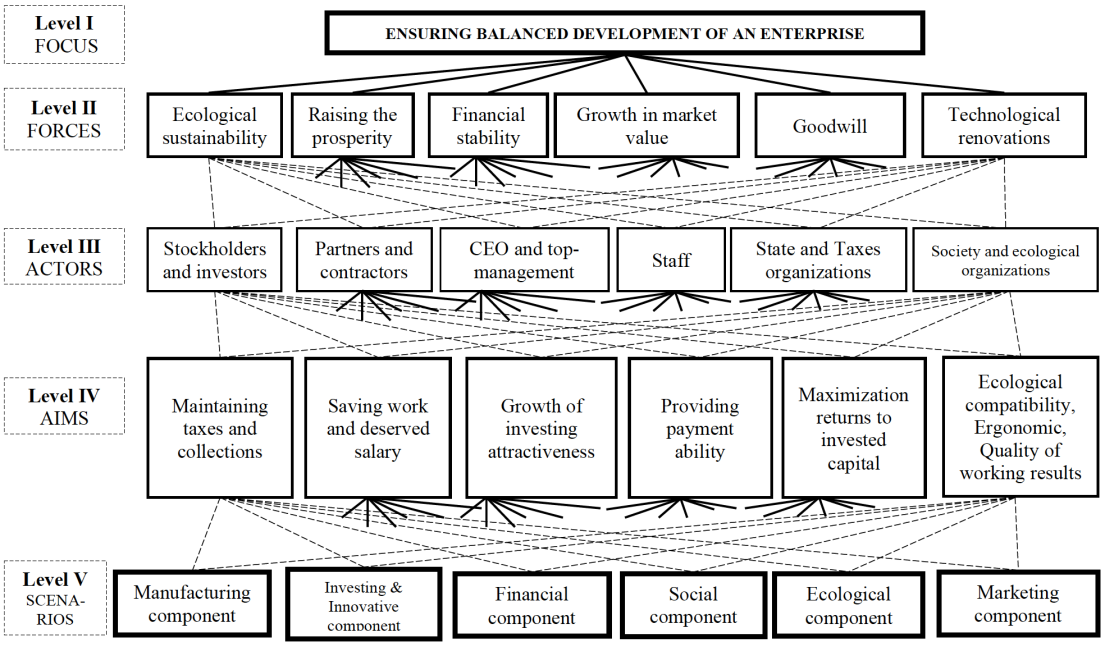

Figure 3. Decomposition of the problem of ensuring balanced development of an enterprise
Source: authors' own analysis

The fifth level is formed with relative components (manufacturing, financial, investment and innovation, marketing, social, ecological) which ensure balanced development of a company and which are aimed with actors' activities in this hierarchy. The last level of this hierarchy is the scenarios of establishing the constituents of balanced development.

Focusing on the advantages of AHP for solving the above-noted problem, the five-level hierarchy may be simplified to a three-level one, as shown in figure 4.

Accordingly, the created hierarchy shows that ensuring balanced development of an enterprise depends on achieving a balance between economic viability, social responsibility and environmental sustainability. Realizing this condition, in turn, requires a certain priority of the specified manufacturing or investment-innovation components of balanced development, as it shown in fig. 4.

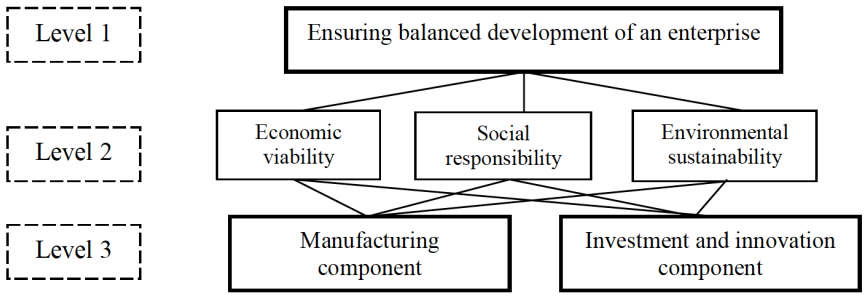

Figure 4. Three-level hierarchy of ensuring balanced development of an enterprise
Source: authors' own analysis

In terms of Saaty's statistical scale of assessments, pairwise comparisons of specified hierarchic levels are made in tables 1-2. The importance rate of each force for achieving the general goal is defined in table 1. Mark '1' is given when the objects compared have an equal impact on the attainment of the main aim; mark '3' means that object 1 is slightly more important than object 2; mark '5' is given in a situation when object 1 is significantly more important than object 2; mark '7' means that object 1 is obviously more important than object 2; mark '9' is assigned when object 1 is absolutely the most important object. Marks '2, 4, 6, 8' serve as a compromise of the above-analyzed assessments.

It is important to note that in this case marks are assigned based on the fact that the enterprise works on the principles of sustainable development and relies upon its socio-ecological component.

Table 1: Pairwise assessments of the second hierarchy level

Ensuring balanced development	Economic viability	Social responsibility	Environmental sustainability	Normalized priority vector, (NV)
Economic viability	1	1/5	4	0.28
Social responsibility	5	1	6	0.64
Environmental sustainability	1/4	1/6	1	0.08

Source: authors' development.

Table 2: Pairwise assessments of the second hierarchy level

Economic viability	Manufacturing component	Investment and innovation component	NV
Manufacturing component	1	3	0.75
Investment and innovation component	1/3	1	0.25
Social responsibility	Manufacturing component	Investment and innovation component	NV
Manufacturing component	1	1/5	0.17
Investment and innovation component	5	1	0.83
Environmental sustainability	Manufacturing component	Investment and innovation component	NV
Manufacturing component	1	7	0.88
Investment and innovation component	1/7	1	0.12

Source: authors' own analysis.

Two matrixes of priorities are formed, on the basis of tables 1 and 2 (formula 1). Matrix A shows priorities of two components of balanced development (matrix's lines) in achieving economic viability, social responsibility and environmental sustainability (matrix's columns) accordingly. Matrix B characterizes the priority economic, social and ecological factors in achieving balanced development as a whole.

$$A = \begin{bmatrix} 0{,}75 & 0{,}17 & 0{,}88 \\ 0{,}25 & 0{,}83 & 0{,}12 \end{bmatrix} \text{ and } B = \begin{bmatrix} 0{,}28 \\ 0{,}64 \\ 0{,}08 \end{bmatrix} \quad (1)$$

As a result of multiplying these two matrixes, a required priority vector (C) is formed (formula 2).

$$C = [0.39\ 0.61] \quad (2)$$

It defines the priority of the investment and innovation component, with its sixty-one-percent impact on ensuring balanced development, in comparison with the thirty-nine-percent impact of the manufacturing component.

4. Conclusions

In sum, the obtained results have applied character and make it possible to structure and arrange hierarchically compound and complex problems of ensuring balanced development. This reduces the rate of uncertainty and subjectivity of decisions for their solution.

During the research it has been established that the basis of ensuring balanced development is the problem of a socio-economic interconnection between the enterprise, society and environment. Analyzing the organization in terms of preserving its integrity, stability of

operation and dynamic development, highlights the importance of holding balance as a principle to act. Following this principle gives an opportunity to reduce low manageability and bankruptcy risks because of the disintegrated burden of social responsibility, ecological limits and expenditures. It is proven that in terms of the concept realization of corporate social responsibility and sustainable development, this may be realized thanks to the balance of stakeholders, who usually include in their group the society and natural environment. Thanks to implementing AHP, a five-level hierarchy is formed. Its focus means such conditions when balanced development is realized. Due to general forces which influence resolving the problem, actors with their own aims and components, ensuring balanced development is separated. The intensity and impact rate of each level of the problem's focus are formalized and estimated.

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Mechanism for the implementation of public-private partnership during management of marketing activity of enterprises in the coal mining industry

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ABSTRACT

Performance features of coal mining enterprises in terms of organization of the marketing activity have been studied, including: constant fluctuations of the market of coal products; economic sensitivity to the irregular demand for coal (surplus or deficit), influence of seasonal factors on the formation of the material flow of coal products; uneven development of consumption and production of coal in Ukraine; reduction of volumes of marketable and sold coal products, increase of coal in stock in the national coal mining enterprises; differentiation of consumers by different categories; direct supply of coal products is the best distribution channel; change of contractual relations between the enterprise and consumers of coal products; debts for the sold coal products; restriction of financial resources of national coal enterprises. The mechanism of implementation of public-private partnership is improved during management of marketing activity of coal mining enterprises of different forms of ownership based on a syndicate as a form of business, which shall contribute to a prompt response to changes in demand for coal, distribution of risks between coal enterprises of public and private sectors and their minimization, organization of continuous supply and secured channels of distribution of coal products for national coal-mining enterprises.

Keywords: coal-mining enterprise, marketing activity, organization, irregular demand, syndicate, public-private partnership.

1. Introduction

As the world economic practice shows, public-private partnership (PPP) is one of the most effective forms of cooperation between the state, public and private sectors in different spheres of economic activity. The use of this form will contribute to the effect by combining financial resources; improving the efficiency and quality of service compared to the public sector; attracting additional investment; access to innovative technologies to ensure sustainable development of national economies of developed countries.

At present, the issues of improving the efficiency of sales management in various industries are of paramount importance, since a well-organized policy of bringing the finished product to the end user allows strengthening the competitive position of business entities and ensuring reduction of their costs. These problems are particularly relevant for the coal industry in a number of coal-mining countries of the world due to the fact that, perhaps, no other type of economic activity is not so dependent on a variety of contractors and consumers.

In modern conditions of unstable economic development, coal companies are faced with the problem of finding the most effective ways to sell coal. This derives from unstable demand for coal products, which leads to such negative developments as deficit and surplus. And this, in turn, negatively influences the establishment of sales for coal mining enterprises due to political, institutional, engineering, market, financial, economic, marketing and informational factors.

Therefore, the necessary level of organization of sales activity is the basis of stable functioning of coal enterprises in conditions of uncertainty of external and internal environment. In this regard, there was an objective need for the introduction of an appropriate mechanism of PPP in the management of sales activities of coal companies of various forms of ownership in the coal-producing states.

2. Literature review and problem statement

Today leading scientists are in a scientific debate about the forms of public-private partnerships in different spheres of economic activity (Davies, Fairbrother 2003; Delmon 2009; Akintoye, Beck 2009; Horsley et al. 2015; Kumar, Kumar 2016; Maximov 2010; Shylepnytskiy 2011; Gaffney, Pollock, Price, Shaoul 2013; Zapatrina, 2013; Yescombe 2015; Grigorieva, Karpova 2015; Smoliński, Pichlak 2009; Tkachenko 2015; Kharazishvili 2016; Pajak 2016; Ivanov 2016; Melnyk, Podgaets 2017). Basically, scientists refer to the public-private partnership in the coal industry concession and corporate development of the mining field:
1. "The corporate development of the mining field is a hybrid form of industrial organization, or rather an economic network that unites the state mine and an entrepreneurial coal mining company..." (Tryfonova, Kravets 2014, p. 134).
2. It is defined that: "Joint activity on development of fields according to the formula of corporate development of a mining field, namely: the private firm equipment on own mountain branch that is contained within the field of the state mine, extracts coal, and the state enterprise provides it (firm) with paid services from lifting, water drainage, transport, ventilation, power supply, etc. – by no means it is impossible to consider public-private partnership...". "Classic corporate development of the mining field is a form of economic activity, which is carried out by agents (partners) together, without creating a legal entity to achieve a specific goal" (Cherevatskiy, Fokina 2016, p. 20, 21).
3. A model of public-private consortium as an organizational and legal form is proposed, which predetermines the principles of private capital participation in the framework of projects for the liquidation of coal mining enterprises; the peculiarity of this model is the use of internal mining resource as a means of payment for the services of private participants of the consortium, resulting in the effect of minimizing public spending in the field of liquidation of coal mining enterprises (Serdiuk 2016, p. 87).
4. Corporate development of the mining field as one of the forms of interaction between the state and business on the principles of public--private partnership is studied; it is proved that the corporate development of reserves of public mines by the private sector is a promising scheme of relationships that will improve the level of management and attract private investment of state enterprises of the coal industry (Zaloznova, Petrova 2017, pp. 32-33).

On the basis of the analysis of scientific publications, the main provisions of scientists and specialists in the reform of the coal industry have been summarized:
– a scheme of building a rational production structure on the example of an integrated company in the energy industry is proposed (Levshova 2013, p. 177);
– it is specified that "... Ukraine in ensuring the needs of the economy in the corner should choose the path of optimal combination of own production and the diversification of imports; at the same time optimization should be performed according to the criterion of the minimum social cost (with respect to the amount of state support and investment in production) on coal production" (Lyashenko 2014, p. 110);
– it is proved that the ratio of public sector enterprises of the coal industry and their counterparts – energy generating companies and metallurgical corporations should be organized on the principles of economic networks (Starychenko, Cherevatskiy, Zaloznova et al. 2016, p. 97).

Despite a wide range of scientific research and developments on the use of public-private partnership in the coal mining industry, the problem of sales development of the coal-mining enterprises on the basis of public-private partnership with due account for current trends of development of institutional environment is rather neglected. Considering the special urgent character of such a problem under modern conditions of managing coal-mining enterprises, it requires further scientific research. All of this considerably determined the choice of the topic of this research and its objective.

Given this, **the purpose of the study** is to develop scientific and methodological provisions and develop practical recommendations for improving the management of sales activities of coal enterprises of various forms of ownership on the principles of public-private partnership.

3. Research results

Studies show that coal remains a strategically important resource for energy security in most countries of the world. For example, Poland is a major coal producer in Europe. More than 80% of the country's electricity is produced by coal-fired power plants. At the same time, Poland seeks to increase the production of coal products by investing in new mines, expand existing and build new coal thermal power plants with the involvement of private sources of financing. The state program of support for the coal industry predicts that by 2050 coal generation will account for 50% of all generating capacity in Poland. The US and China are among the major coal powers in the world, where 60% of coal production is concentrated (12% in the US and 48% in China). The United States has 27% of the world's coal reserves.

However, recently in the world there is a tendency to reduce the level of coal production--an average of 3-4% per year. In the US the fall is 8-10% per year, in Australia – 3-4%, in China – 2-2.5%. The share of coal products in power generation has decreased from 40 to 29% in the US. A lot of American companies for the extraction of coal have gone bankrupt, among them Arch Coal, Alpha Natural Resources, Patriot Coal and Walter Energy. This is due to the global economic crisis – a slowdown in the development of world economic drivers and stagnation of industrial production in a number of developed countries.

According to the program of closure of inefficient production in China by 2020, it is planned to eliminate 800 million tons of obsolete capacity and put into operation 500 million tons. It is projected that in 2020 coal production will amount to 3.9 billion tons per year.

The Ukrainian coal industry is characterized by specific features of the organization of sales processes, such as:

– *reduction of coal consumption and production in Ukraine* – as the analysis of statistical data shows, the volume of coal consumption decreased in 2007-2016 by 39.2% (from 71 to 43.2 million tons), and production – by 49.9 % (from 58.9 to 29.5 million tons);

– *the increase in the level of consumption over production*, that is the deficit of coal (mainly coking and anthracite); if in 2007 this figure was 1.21, in 2015 – 1.52, in 2016 – 1.46 ;

– *the surplus of coal production* is mainly gas--grade coal. Thus, the volume of coal residues in the warehouses of state enterprises in 2007-2016 increased by 69.4%, that is from 1.19 to 2.01 million tons;

– *increase in the level of loss of coal production in Ukraine*. If the loss ratio of state coal-mining enterprises in 2007 was 33.1%, in 2015 – of 39.8%, and in 2016 – 46,5%;

– *inefficient implementation of export-import operations for coal sales* – the volume of coal exports for 2007-2016 decreased by 86.5% (from 3.7 to 0.5 million tons) and the volume of imports increased by 18.2% (from 13.2 to 15.6 million tons). At the same time, there is an excess of imports over coal exports. If in 2007 the value of this indicator was 3.6, in 2016 – 31.2 times. That is, the balance of export-import operations for the sale of coal is negative.

It should be noted that this leads to an imbalance – the growth of coal supplies not provided for in the energy balance of Ukraine, as well as the outflow of financial resources from the state budget for the purchase of imported coal due to the high level of prices (including transportation costs). Thus, if the average price of 1 ton of Ukrainian commercial coal products in 2016 amounted to 48 dollars USA (in 2015 – 51), the Russian coal – 85 dollars USA, Polish – 99, Canadian – 106, Australian – 109, American – 112 dollars USA.

The results of the research allowed to determine the disadvantages of sales management of the Ukrainian coal mining enterprises (as a rule, state enterprises being part of management of the Ministry of Energy and Coal Mining of Ukraine). Confirmation is also the analysis of statistical data on the example of SE "Lvivvugillya". Thus, production of coal reduced over 2007-2016 by 67%, finished coal goods – by 76.7%, marketable – by 77.7%, sold products – by 78.2%. At the same time there is a tendency of significant growth of the amount of coal in stock – by 3.91 times (Table 1).

Table 1: Dynamics of the production volume and sales of coal products of SE "Lvivvugillya"

Year	Parameters				
	Production of coal, th. tons	Finished coal goods, th. tons	Marketable coal products, th. tons	Sold coal products, th. tons	Coal products in stock, th. tons
2007	2805.6	1994.8	1935.5	1944.8	43.8
2008	2852.3	1467.2	1409.8	1414.9	171.1
2009	2503.2	1361.8	1314.1	1296.0	98.5
2010	2332.6	1085.5	1042.3	1039.9	228.0
2011	2069.4	783.8	740.9	741.1	93.6
2012	1780.0	622.9	579.3	573.3	255.0
2013	1341.2	755.0	712.3	704.9	230.9
2014	1185.9	642.1	603.0	595.2	209.0
2015	1048.6	546.1	510.4	502.6	189.2
2016	927.1	464.5	432.1	424.4	171.3

Source: Completed according to information materials of the Ministry of Energy and Coal Mining of Ukraine and SE "Lvivvugillya".

The loss ratio of coal production of SE "Lvivvugillya" in 2016 was 24.6% (in 2007 – 33.9%, in 2012 – 30.7%, in 2015 – 30.4%). The share of expenses on sales in net cost of 1 t of marketable coal goods increased over 2007-2016 by 1.2% – from 0.5 to 1.7% (Table 2).

In addition to that, as shown in the analysis, the amount of coal products sold at PJSC "Colliery Group Pokrovske" increased over 2007-2016 by 80.7%. Profit earning capacity of coal production increased by 27.4%, which means that there appears to be a tendency of increase in price net cost relation of 1 t of marketable coal products (Table 3).

Table 2: Dynamics of economic factor of work of SE «Lvivvugillya»

Year	Parameters			
	Net cost of 1 t of coal products, UAH	Cost of 1t of coal products, UAH	Loss ratio of coal production, %	Marketing cost of 1t of marketable coal products, UAH
2007	286.2	189.3	33.9	1.37
2008	532.5	320.7	39.8	4.21
2009	651.9	447.0	31.4	5.13
2010	708.2	487.2	31.2	9.38
2011	769.9	559.5	29.8	10.14
2012	881.7	610.7	30.7	11.64
2013	965.9	642.0	33.5	12.23
2014	1134.8	786.9	30.7	16.40
2015	1386.6	964.5	30.4	18.90
2016	1568.1	1182.2	24.6	26.24

Source: Complete according to information materials of the Ministry of Energy and Coal Mining of Ukraine and SE "Lvivvugillya".

Table 3: Dynamics of basic parameters of sales at PJSC "Colliery Group Pokrovske"

Year	Parameters			
	Volume of sold coal products, th. tons	Net cost of 1t of coal products, UAH	Price of 1t of coal products, UAH	Profit earning capacity of coal production, %
2007	6132.9	190.57	205.22	+7.69
2008	5084.3	326.13	320.79	–1.64
2009	5394.4	347.51	329.26	–5.25
2010	4760.0	467.66	483.89	+3.47
2011	6899.3	468.20	524.74	+12.08
2012	8345.5	540.86	629.27	+16.35
2013	8958.9	624.81	754.62	+20.78
2014	9617.4	721.78	904.94	+25.38
2015	10324.2	833.80	1085.20	+30.15
2016	11083.1	963.20	1301.40	+35.11

Source: Complete according to the materials of the Ministry of Energy and Coal Mining of Ukraine and PJSC "Colliery Group Pokrovske".

Over 2007-2016 the amount of coal production of DTEK grew by 97,9%. Over 2010-2016 export turnover on coal trading decreased by 32%, and import – by 83,1%. The balance of export-import transactions on coal trading had positive value: in 2016 – 1110,9 thousand tons (in 2010 – 648 thousand tons). That is, the value of this parameter increased for this period by 56% (Table 4).

Therefore, in the public sector of the coal mining industry there exist sales problems of coal products. Earlier SE "Coal of Ukraine" (created as per order No. 669 of the Ministry of Fuel and Energy of Ukraine dated 14.11.2003) performed the purpose of improving economic mechanisms of sales of coal products, and decided what region and in what amount shall coal be supplied to the energy-generating companies. However this state enterprise is being liquidated in accordance with the order No. 591-r of the Cabinet of Ministers of Ukraine as of 04.06.2015.

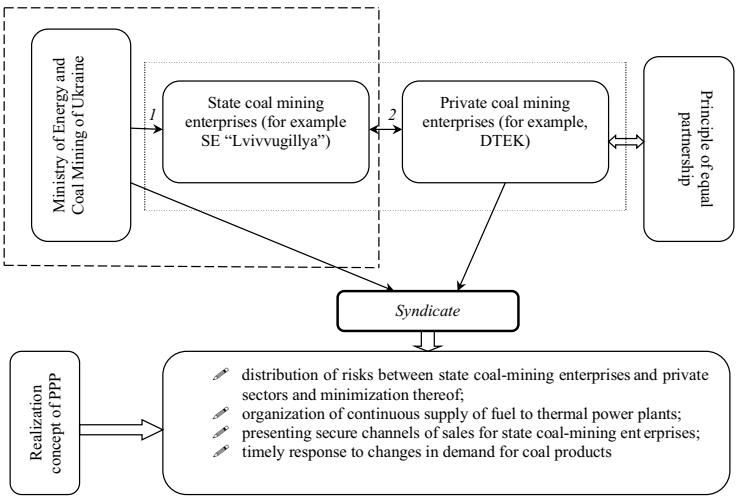
Therefore, as of today there is no convenient organizational structure of sales management of state coal mining enterprises under control of the Ministry of Energy and Coal Mining of Ukraine. Whereas, according to the Regulations on the Ministry of Fuel and Energy of Ukraine approved by a decision No. 208 of the Cabinet of Ministers of Ukraine dated 29.03.2017, the main functions of the Ministry of Energy and Coal Mining of Ukraine include: rating of priorities for the development of fuel and energy complex; development of forecast balance of coal and coal products; approval of strategic plans of the state enterprises and business entities where corporate laws of the state are exercised; development and implementation of measures on stable functioning of enterprises during special period, etc.

With that in mind, there is a necessity to create based on arrangement of coal mining enterprises of different forms of ownership (for example, SE "Lvivvugillya" and DTEK) (fig. 1).

Table 4: Dynamics of sales parameters of DTEK

Parameters	Year				
	2007	2010	2014	2015	2016
Coal production. th. tons	15789.7	22180.0	37122.0	28692.0	31250.6
Export of coal. th. tons	–	1961.0	4057.1	1387.1	1333.1
Import of coal. th. tons	–	1313.0	1687.0	404.1	222.2

Source: Completed according to information analysis content of DTEK.



Notes: 1 – agreement on estate administration; 2 – joint venture agreement

Figure 1. Mechanism of implementation of public-private partnership during control over sales of coal-mining enterprises entities on the basis of a syndicate as business legal structure
Source: authors' own analysis

Within public-private partnership in the field of mining industry and development of pits, syndicate shall be an effective form of partnership between large vertically integrated companies which at the same time act as producers and consumers of coal products, and state coal-mining enterprises for the purpose of organization, control and regulation of joint sales. It does not contradict current legislation of Ukraine where possibility of merging of enterprises by the industry principle is pointed out.

Considering that SE "Lvivvugillya" is under the management of the Ministry of Energy and Coal Mining of Ukraine, the relations between them shall be governed by the agreement on estate administration. It complies with the Regulations on the Ministry of Fuel and Energy of Ukraine, Art. 1029 of the Civil code of Ukraine, Art. 5 of the Law of Ukraine "On public-private partnership".

According to the Article 1029 of the Civil code of Ukraine under the agreement on estate administration one party (administrator – in this case the Ministry of Energy and Coal Mining of Ukraine) transfers to the other party (to the executive manager of the created coal syndicate with the participation of DTEK) the management of estate of SE "Lvivvugillya" for a definite period, and the second party shall provide management of this estate at a charge in its own name for the benefit of the trustor or indicated person (beneficiary).

The basic principles of implementation of PPP is the "congruence of interests of the state and private partners for the purpose of mutual benefit; providing high efficiency of activity, rather than carry out such activities by a state partner without resorting to private partners; equitable distribution of risks connected with agreement performance between state and private partners ...".

According to the Article 5 of the Law of Ukraine "On public-private partnership", income shall be distributed between the participants of the syndicate under the terms of a joint venture agreement. In Article 1130 of chapter 77 of the Civil code of Ukraine it is agreed that that under the joint venture agreement the parties (participants) undertake to work jointly without creating a legal entity in the furtherance of the goal. In this case (through the example of a syndicate),without consolidating the deposits of participants for the purpose of the organizing joint sales. The terms of a joint venture agreement, including coordination of the working partnership of the participants, coverings of expenses and loss thereof, contribution to the results of joint venture and so on are specified in the agreement between the parties.

Under public-private partnership of a syndicate control function over sales of state and private enterprises is passed (fig. 2).

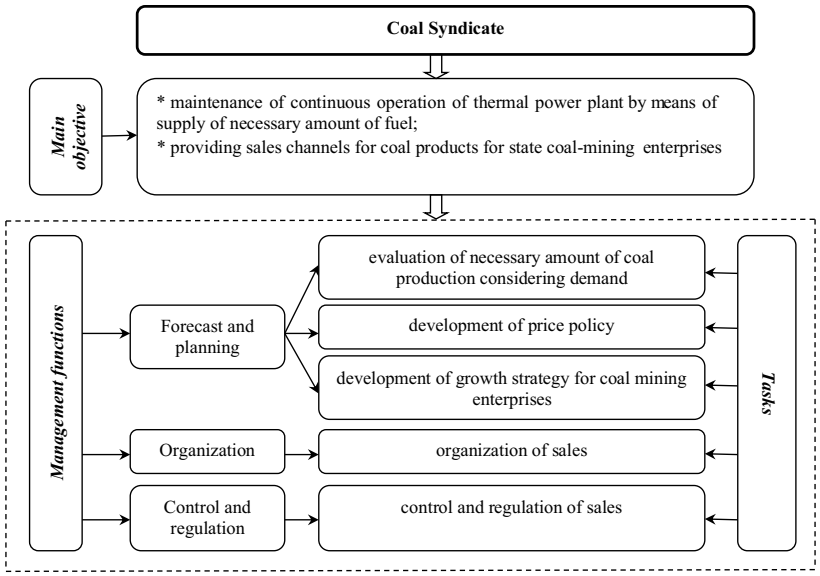


Figure 2. Functional design of coal syndicate activity
Source: authors' own analysis

4. Conclusions

In sum, on the basis of the analysis of the dynamics of parameters of sales of national coal-mining enterprises there were specified current problems of coal product sale in the public sector of coal mining industry. Practical use of organization of syndicate as a form of partnership between large vertically integrated companies which are both producers and consumers of coal products, and state coal-mining enterprises for the purpose of organization, control and regulation of sales is proved. A functional design of coal syndicate operation is offered, including functions and responsibilities for control over sales of enterprises of coal industry.

For the purpose of legal regulation of effective operation of coal syndicate in Ukraine on the principles of public-private partnership it is reasonable to make amendments to the current laws and regulations:

Article 20 of the Commercial code of Ukraine – expand the list of forms of business entity via the example of a syndicate which shall be considered as "an organizational form of variety of the cartel agreement providing sales of products manufactured by participants of the union via a joint sales agency or sales network of one of the participants of the syndicate. Such a form of union is specific for enterprises producing homogenous goods»;

Article 1 of the Law of Ukraine "On coal market" (draft) – includes the definition of a syndicate as an organizational form that unites the coal-mining enterprises for organization and regulation of joint sales on the principles of public-private partnership and also state legal platforms for syndicate operation;

Energy strategy of Ukraine through 2035 – expand the objective of "Development of the energy markets" by such phrasing: "organization and operation of a syndicate as an implementation instrument of the market functioning model of energy markets and satisfaction of needs of national economy with coal products of domestic production to the extent required with the involvement of the private sector;

Article 4 of the Law on Mining of Ukraine – include such objects of mining relations as organization, control and regulation of sales of coal mining enterprises;

Concept of the State target economic program on reforming of the coal industry for the period through 2020 – includes a set of measures on control over sales of coal-mining enterprises on the principles of public-private partnership.

Implementation of the above mentioned proposals will allow to create favorable conditions for economic management of the participants of the coal market, to provide the national economy with own-produced coal of different grades in sufficient amounts at reasonable price and also to increase the level and quality of service for consumers of coal products.

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Development of an Agro-Food complex on the basis of economic integration

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ABSTRACT

The agro-food complex combines agriculture, food-processing industry and agricultural trade. It has been established that integration is an effective tool for formation and functioning of this complex. However, due to the unstable political and economic situation in recent years, there is a decrease in production of certain types of food in Ukraine. A vertically integrated structure which looks like a two-tier hierarchical structure has been studied. The purpose of its functioning is profit maximization at the expense of the synergetic effect, resource saving, etc. Under strict vertical integration, profit distribution can be made on the basis of distribution mechanisms of scarce resources, using priorities where expenses of enterprises can be considered a priority. The problem of formation of an effective vertically integrated structure can be brought to solving the issue of the smallest covering of a set. It has been proved that a boundary value of an index of vertical integration is determined by a share of energy resources in the process of production and the potential of their production. In Ukraine, the use of biogas complexes can provide growth of the mentioned index to 0.25. This corresponds to the ratio of energy resources in the crop production cost structure.

Keywords: development, agro-food complex, intergration, model, biogas.

1. Introduction

The agro-food complex combines agriculture, food-processing industry and agricultural trade. Therefore, the role of this complex in life sustenance of people is unique. In addition to the economic function (food production and distribution, forming a share of the state and local budgets), the agro-food complex also plays a social function (development of rural territories, formation of ecologically safe 'green' energy, etc.).

Formation and functioning of the agro-food complex is carried out on the basis of integration and cooperation. In other words, by means of vertical integration, there is combination of efforts put forth by, firstly, producers of agricultural raw materials (grains, seeds of oilplants, sugar beets, etc.), secondly, their processors (in particular, grain processing, oil and fat, sugar industries, food production), thirdly, food product wholesalers and retailers. Consequently, an agro-food chain is formed: from an agricultural raw materials producer (agrarian enterprises, farm enterprises and peasant farms) to a specific consumer.

It should be noted that due to biological properties of agricultural waste, plant remains, animal and poultry keeping, products can be used for biogas production on the integration basis.

The article aims at justifying the directions of economic development of the agro-food complex on the basis of integration. In particular, the authors clarify the trends of social and economic development of the Ukrainian agro-food complex, as well as highlight methodological approaches to modelling of agro-industrial integration and economic integration in the „green" energy sector.

2. Literature review and problem statement

The essence of agroindustrial integration determines its potentials as a tool for improving efficiency of agroindustrial production (Kovalenko 2012).

A vertical integration is considered as an extension of activities and/or control of a company along its technological distributional marketing chain: at the preliminary stage (up to raw materials production) or at the next one (up to sales of products to an ultimate consumer). The vertical integration is intended to replace market transactions with other forms of contacts (internal operations and processes, long-term contracts, etc.) (Kuts 2012).

The vertical integration is also defined as a set of enterprises interconnected and integrated on the technological basis in order to achieve common goals. We propose to interpret a vertically integrated structure as a complex, dynamic organizational form of business that is a result of the vertical integration. Such a structure is an officially registered (or established on the basis of contracts and agreements) association of business units (enterprises, firms, companies, organizations and institutions) or technologically independent stages of production. As a rule, they form a complete cycle. Their task is joint activities in order to obtain a synergistic effect (Nusinov, Kolesnikov 2013; Pająk, et al., 2016, 214-217; Lakhno et al. 2018, 1802–1812).

Such an association takes place around a central production line including raw materials processing and end production (Shumeiko 2008), and independent enterprises are its structural elements (Bespalov 2006).

Agro-industrial integration combining agricultural and industrial production, including agricultural service cooperatives dealing with processing, procuring, marketing, distribution or supply activities, is quite common (Ivanov, Rohoza, Verhal 2016).

It is proved that the logistic concept of food supply involves formation of an agro-food complex which has four blocks: resource support and technological maintenance; agricultural production; storage and processing of agricultural products; food trade (Perebyynis V., Perebyynis O. 2006, p. 116).

Both cooperation and integration in the agrarian sector of the economy create benefits of such approaches to others through: accumulation of labour, financial and other resources; shortening production lead time; economies of scale; synergistic effect; possibility of access to new knowledge; wider dissemination of knowledge and information; streamlining information flows; greater opportunities for social development of a region; creating new jobs; increase in revenues to the local budget; creating better conditions for combining their members' personal interests with interests of all participants in the production process; protection of an association members from monopolistic manifestations of suppliers, sales, banking and other structures (Skopenko 2010).

Development of the agro-food complex implies improving production relations on the basis of cooperation and vertical integration of agricultural and processing enterprises (Ivanov, Perebyynis, Oleksenko, Svitlychna 2016), development of internal and external markets of food products (Rohoza, Verhal 2015), as well as rural territories (Ivanov, Rohoza , Perebyynis 2016).

Issues of integration in a 'green' energy sector, as well as in biogas production and use, are analyzed, in particular, in publications (Perebyynis V., Havrysh, Perebyynis Y. 2016), (Kalinichenko, Havrysh, Perebyynis 2016, 2017).

Thus, increasing the efficiency of functioning of the agro-food complex, being interested in the formation of inter-farm associations, we need to clarify the existing models and mechanisms of functioning of vertically-integrated structures, development of "green" energy production on the basis of economic integration.

3. Economic integration as the basis for development of an agro-food complex

3.1. Tendencies of social and economic development of the agro-food complex of Ukraine

The agro-food complex plays a leading role in forming the state's food security. Thus, in Ukraine in 2016, the level of self-sufficiency with the main types of food (production for domestic consumption within the state) amounted to: grain – 290.5%; eggs – 114.0%; meat and meat products – 105.4%; milk and dairy products – 103.6%; potatoes, vegetables and food gourds – 101.6%; berries and grapes - 84.6% (Agriculture of Ukraine – 2016, p.220).

According to the Ministry of Agrarian Policy and Food, in 2015, Ukrainian commodity producers turned to Asia ($7.4 billion), the EU ($5.9 billion) and Africa ($2.2 billion). The main types of exported food are crops ($13.8 billion) including cereals, as well as sunflower oil, oilseeds, sugar and tobacco. Exports of livestock products amounted to $1.0 billion (meat and by-products, dairy products, ready-to-eat or canned meat products, etc.). However, the food industry development is characterized with unstable tendencies (Table 1).

Table 1: Production of some types of food in Ukraine, million tons

Production	2014	2015	2016
Oil	4.4	3.7	4.4
Sugar	2.1	1.5	2.0
Milk	1.1	1.0	1.0

Source: (Ukraine in figures – 2016, p. 112).

Development of plant growing is also characterized with multi-vector tendencies. During 2014-2016, production of sunflower seeds increased by 34.7%, grain – by 3.4%, but there was a decrease in production of sugar beets, potatoes and vegetables (Table 2).

The period under analysis was characterized with a certain increase in crop yields (except for 2015 with worse weather and climatic conditions). This was promoted, in particular, by the high efficiency of production and commercial activity of large agrarian enterprises developing modern agrotechnologies (Table 3).

Low paying capacity of the public in Ukraine limits development of the internal food market. Certain difficulties in selling livestock products on foreign markets and other reasons led to a decrease in production of meat, milk and eggs (Table 4).

Table 2: Production of plant products in Ukraine, million tons

Production	2014	2015	2016
Cereals	63.9	60.0	66.1
Sugar beets (industrial)	15.7	10.3	14.0
Sunflower seeds	10.1	11.2	13.6
Potatoes	23.7	20.8	21.7
Vegetables	9.6	9.2	9.4

Source: (Agriculture of Ukraine – 2016, p. 94).

Table 3: Crop yields in Ukraine, c/ha

Production	2014	2015	2016
Crops	43.7	41.1	46.1
Sugar beets (industrial)	476.5	433.8	481.5
Sunflowers	19.4	21.6	22.4
Potatoes	176.4	161.4	165.8
Vegetables	207.8	206.1	210.5

Source: (Agriculture of Ukraine – 2016, p. 102).

Table 4: Production of the main types of livestock products in Ukraine

Production	2014	2015	2016
Meat (slaughter weight), mln. t	2.4	2.3	2.3
Milk, mln. t	11.1	10.6	10.4
Eggs, bln.	19.6	16.8	15.1

Source: (Ukraine in figures – 2016, p. 150).

The developed world under the influence of urbanization is characterized with a tendency to dwindling rural population. Ukraine also did not avoid it. As of January 1, 2017, the country's rural population was 13.2 million people (31.1% of the total population). In agriculture, forestry and fisheries, in 2016, 2.8 million people were employed (17.6% of the total employed population). The world-wide pattern of a decrease in agricultural employment is observed, which has been shown in the reduction of this category of employees by 7.3% in comparison with 2014 and decrease in the number of employees from 530.9 thousand to 509.5 thousand people (Agriculture of Ukraine – 2016, pp. 19-20). There is a positive tendency in the growth of labour productivity (output per one agricultural worker, at constant prices in 2010) from 227.8 thousand UAH in 2014 up to 277.3 thousand UAH in 2016 (by 21.7%).

Another positive tendency (for agricultural commodity producers) is the growth of average sales prices of one ton of products for the period under analysis. In particular, during this period, purchasing prices of crops at agricultural enterprises increased from 1,801 to 3,414 UAH (in 1.9 times), oilseeds seeds - from 4,063 to 8,656 UAH (in 2.1 times), industrial sugar

beet - from 494 to 849 UAH (in 1.7 times), farm animals (in live weight) - from 15,737 UAH to 22,468 UAH (in 1.4 times), milk - from 3,588 to 5,462 UAH (in 1.5 times) (Agriculture of Ukraine – 2016, p. 58, 186).

Along with the increase in the volume of food sales, the indicated tendencies have become the basis for increasing the wage fund. Therefore, it is no coincidence that in the agriculture during 2014-2016, average monthly nominal wages of full-time employees increased from 2,476 to 3,916 UAH (by 58.2%) (Agriculture of Ukraine – 2016, p. 22).

For modern Ukraine, a gap in wages between peasants and those working in cities is a tradition derived from the former Soviet Union and the Russian Empire. In this context, in recent years, there is a positive tendency of reducing a pay gap between rural and urban workers. Thus, whereas in 2014 the wages of workers employed in agriculture, hunting, forestry amounted to 71.2% of the average wage in Ukraine, in 2016 it grew to 75.6% (Agriculture of Ukraine – 2016, p. 22).

However, a share of labour costs in the structure of the cost of agricultural production in Ukraine (as opposed to economically developed countries) remains low and even decreases. In particular, whereas this indicator made up 7.1% in agricultural enterprises in 2014, it was only 5.4% in 2016, including agricultural enterprises where it decreased from 5.6% to 4.0%. Accordingly, in agricultural enterprises, deductions for social measures declined from 2.7% to 1.2%, and in agricultural enterprises – from 2.1% to 0.9% (Agriculture of Ukraine – 2016, pp. 183-184).

In spite of the complex socio-political situation, during the last years housing construction in rural areas continues. In particular, 3,096 thousand m^2 of the total area of housing were commissioned in 2014, 3,579 thousand m^2 in 2015, 2,864 thousand m^2 in 2016. The number of built apartments was respectively 28,000 m^2, 31,000 m^2 and 28,000 m^2. However, according to these indicators, rural areas lag behind urban ones, where 222 m^2 of housing per 1,000 inhabitants (in rural areas – 217 m^2), 2.9 apartments (in rural areas – 2.1) were constructed in 2016 (Agriculture of Ukraine – 2016, p. 159).

In addition to housing, social and cultural facilities are commissioned in rural areas. Thus, pre-school educational establishments for 1,918 seats, general educational institutions for 1.3 thousand pupils' seats, hospitals for 100 seats, outpatient clinics for 342 visits per shift, club facilities for 850 seats were commissioned in 2016. However, commissioning of residential homes for elderly people has been stopped since 2014, (Ukraine in figures – 2016, p. 163).

Consequently, integration is an effective tool for formation and functioning of the agro-food complex. However, due to the unstable political and economic situation in recent years, there is a decrease in production of certain types of food in Ukraine. One of the methodological tools for development of the agro-food complex is the modelling of vertically-integrated structures.

3.2. Modeling agro-industrial integration

In the simplest version, a vertically-integrated structure is a two-level hierarchical structure consisting of n functionally dependent subsystems and Pm business processes, the input of which results from the previous parts of the hierarchy. At the same time, all subsystems have the right to make decisions concerning the organization of relevant business processes within the limits defined by the managing system. The hierarchical location of subsystems (a multi-tiered structure) is determined by the fact that some processes are influenced or directed (partially/completely) by the managing system.

Let us consider a vertically integrated system consisting of one coordinating subsystem (a higher level of the hierarchy B_0) and n managing subsystems of a lower level being subordinate to a subsystem of a higher level (Fig. 1).

At the first level, the subsystem B_0, which acts as a management center for united enterprises, is represented. At the second level, there are functionally dependent subsystems represented by a finite aggregate of heterogeneous agents B_1, … B_n, where $n \geq 2$ is an aggregate of enterprises that are a part of the integrated association and interact with the management center. In addition to that, each agent is responsible for separate stages of the production and sales process vertical and can be represented both as one enterprise or a group of independent enterprises.

Given that a vertically integrated organization is formed on the basis of the subordination of the adjacent links of commodity promotion to one of the channel participants (Bespalov 2006) prevailing in it, a role of the coordinating subsystem is performed by one of the enterprises with the greatest economic potential.

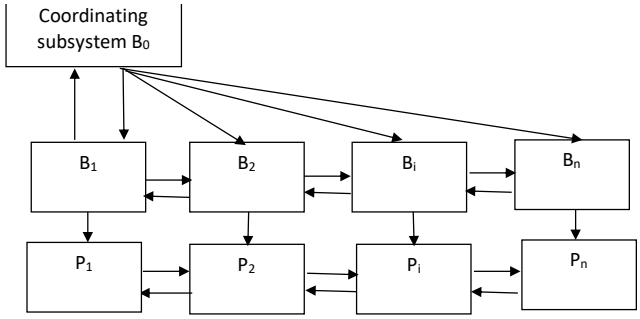

Figure 1. A vertically integrated structure as a hierarchical structure
Source: own study

That is, for a set of agents $B = (B_1, B_2, ..., B_n)$ included in the vertically integrated structure, the necessary condition for a managing subsystem selection can be described as follows:

$$\forall B_i \in B, \exists B_0, B_0 = \left\{ B_i \in B : R_{B_i} = \max_n \left(R_{B_1}, R_{B_2}, ..., R_{B_n} \right), i = 1, .., n \right\} \quad (1)$$

where R is the potential of individual enterprises being part of the integrated structure, B_0 is the coordinating subsystem of the vertically integrated structure, n is the number of enterprises being a part of the integrated structure.

Taking into account that functioning of the vertically integrated structure is mainly aimed at profit maximization due to the synergistic effect, resource savings, etc., it is important to outline mechanisms of profit distribution by the coordinating system among the subsystems of the second level. Under the strict vertical integration, profit distribution can be made on the basis of mechanisms for scarce resources allocation using priorities, where expenses of enterprises can be considered a priority (Burkov 1997; Veres 2010):

$$p_i(s) = \begin{cases} s_i, if \sum_{j=1}^{n} s_j \le P \\ \min\{s_i, \gamma\eta_i(s_i)\}, if \sum_{j=1}^{n} s_j > P' \end{cases} \quad (2)$$

where n is the number of enterprises being a part of the integrated structure, s_i is their claims for the expected profit, x_i is the distributed profit of a separate enterprise, P is the profit of the integrated structure to be distributed, $\eta_i(s_i)$ is the function of a distribution priority, $\min\{s_i, \gamma\eta_i(s_i)\}$ indicates that an enterprise receives a resource in an amount not bigger than the declared value, γ is the parameter that plays a rate setting role and is selected given budget constraints, i.e. profit P is fully distributed given claims and priority functions:

$$\sum_{i=1}^{n} \min\{s_i, \gamma\eta_i(s_i)\} = P \quad (3)$$

Let us consider the features of interaction of a couple of agents of the vertically integrated structure (Fig. 2).

Such interaction is based on satisfying the needs of integration participants, forming goals of integration of enterprises as well as their interconnection, in which an output of one system is an input for another one (outputs of one enterprise create resource conditions for the functioning of another enterprise). Meeting other needs may result in the involvement of intermediaries or expansion of the integrated structure by involving other integration participants. Therefore, the condition for expansion of the integrated structure due to external agents is the following dependence:

$$B^* = B \cup A_i \left\{ f(B, A_i) < f(B^*) \mid \forall A_i \in A, i = 1, ..., n \right\} \quad (4)$$

where $f(B, A_i)$ is the function of an enterprise's effectiveness in cooperation with an intermediary, $f(B^*)$ is the function of an enterprise's efficiency when involving an intermediary into the integrated structure, A is an external agent.

Obviously, the problem of forming an effective vertically integrated structure can be reduced to solving the problem of the smallest covering of a set (Christofides 1978, pp. 53-54), which provides maximum efficiency of the integrated structure and determines expediency of the association expansion due to integration of an intermediary agent.

Let's assume that $R = \{r_1, ..., r_m\}$ is a set of requirements imposed to an enterprise being

a part of the vertically integrated structure, $B=\{B_1,...,B_m\}$ are enterprises of the vertically integrated structures. Herewith, there is fulfillment of a condition where each enterprise B_i from a set of B is assigned a subset of requirements Rj ⊆ R where j = 1, ..., m. Herewith, an enterprise B_i either fully meets the requirements of a coordinating subsystem, or does it partially, fulfilling a function of the set R_j with a certain quality being a cover set R, if $R_i \cup R_j = R$.

Let's assume that c_j are expenses related to the functioning of an enterprise being a part of the vertically integrated structure. Therefore, a problem of the optimally vertically integrated structure is of the form:

$$F(x) \to \sum_{j=1}^{n} c_j x_j \to \min \quad (5)$$

$$\sum_{j=1}^{n} a_{ij} x_j \geq 1 \quad (6)$$

$$a_{ij} = \begin{cases} 1, \text{ if an enterprise } x_i \text{ is able to meet requirements} \\ \text{with certain efficiency } R_j \\ 0, \text{ otherwise.} \end{cases} \quad (7)$$

$$x \in 0,1$$

Thus, the analysed vertically integrated structure looks like a two-tier hierarchical structure. Its functioning is aimed at profit maximization at the expense of the synergetic effect, resource saving, etc. In response to the unstable energy supply and ecological crisis on the planet, the issue of using the opportunities of the agro-food complex for energy production is pressing.

3.3. Integration in the 'green' energy sector

Global energy consumption is constantly increasing. It leads to a reduction in stocks of fossil carbohydrate fuels. Therefore, in recent decades, the issue of utilization of renewable energy sources has become even more urgent. Biogas takes a proud place among them. It is used for production of thermal and electrical energy, as well as substitution of natural gas and traditional motor fuel. Business practice has proved that the success of production and commercial activity largely depends on the effectiveness of vertical coordination. In this context, the question that has to be answered concerns the role of biogas complexes in the formation of vertically integrated structures. Biogas complexes perform the following functions: processing and disinfection of industrial and municipal waste, bioconversion of plant material, production of energy resources (biogas, biomethane, electric and thermal energy), production of biofertilizers and other products (e.g., carbon dioxide). A vertically integrated structure including a biogas complex enjoys such advantages: expenses of integrated production are reduced, its competitiveness increases (Eriksson, Olsson 2007; Nolm-Nielsen 2000). Vertical integration can be directed both 'up' and 'down'. If biomethane, electric and/or thermal energy is sold to external consumers (in grid system or in main pipelines), there is integration that is directed 'up. Such a scheme is widely used, for example, in Germany. In this case, electrical energy is sold at a 'green' rate (Schulz, Coop, Hohhi, Fulton, Parson, Rebok, Ilchuk 2012). Having its own biogas plant, an agrarian or processing enterprise can fully or partially meet its own needs for motor fuel, electrical and thermal energy, biofertilizers. This will reduce the use of external flows of material resources. Introduction of a biogas complex by an agrarian enterprise allows to change an index of vertical integration. It is measured as a proportion of monetary (material) flows between structural divisions of a firm to the total flow (Bhuyan 2005; Caves, Bradburd 1988; Davies, Morris 1995). This index varies from 0 to 1.

The value of the index of vertical integration should be determined by the following formula:

$$FVI = \frac{Ee + Et + Ef + Eb + Ec}{MRN} \quad (8)$$

where *FVI* is the index of vertical integration, *Ee* is the cost of electrical energy produced by a biogas complex, *Et* is the cost of thermal energy produced by a biogas complex, *Ef* is the cost of motor fuel substituted by biogas produced by a biogas complex, *Eb* is the cost of biofertilizers produced by a biogas complex, *Ec* is the cost of carbon dioxide (by-product of biogas upgrading), *BMP* is the cost of material resources necessary for operating an agrarian enterprise (fuel, electrical and thermal energy, mineral and organic fertilizers, seeds and planting material, plant protection products, etc.).

The existing processing enterprises of Ukraine have already had similar experiences. Thus, at Hlobyne Sugar Refinery, biogas covers 50% of energy requirements; as for its oil extraction plant – 100 % (ASTARTA 2017). Boundary value of the index of vertical integration is determined by a share of energy resources in the production process and potential of their production. According to estimates (Havrysh, Perebyynis 2015), the use of biogas complexes in Ukraine can provide an increase of this index to 0.25. This corresponds to the share of energy resources in the crop production cost structure.

4. Conclusions

The agro-food complex combines agriculture, food-processing industry and agricultural trade. It is established that integration is an effective tool for the formation and functioning of this complex. However, due to the unstable political and economic situation in recent years, there is a decrease in production of certain types of food in Ukraine. In comparison with Poland, other EU countries, the wage remains low, causing intensive labor migration.

The analysed vertically integrated structure looks like a two-tier hierarchical structure. Its functioning aims at profit maximization at the expense of the synergetic effect, resource saving, etc. Under strict vertical integration, profit distribution can be made on the basis of scarce resources distribution mechanisms using priorities, where the expenses of enterprises can be considered a priority. The problem of formation of an effective vertically integrated structure can be brought to solving the issue of the smallest covering of a set.

In response to the unstable energy supply and ecological crisis on the planet, the issue of using the opportunities of the agro-food complex for energy production is pressing. It is proved that a boundary value of an index of vertical integration is determined by a share of energy resources in the process of production and the potential of their production. In Ukraine, the use of biogas complexes can provide growth of the mentioned index to 0.25. This corresponds to the ratio of energy resources in the crop production cost structure.

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Compensatory financing of energy saving projects in construction: modification of „TIF"

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ABSTRACT

The purpose of the article is to create a mechanism for making investments by enterprises and institutional participants in the building energy cluster. The authors explore the possibility of attracting additional financial resources for implementing energy saving measures through issuance of municipal bonds and compensatory financing on the basis of tax deductions (Tax Increment Financing – TIF). The study of the practice of local borrowing in Ukraine has demonstrated the fragmented nature of the existing system. However, provided the appropriate regulatory and legal framework and the experience of other countries are taken into account, the development of the local borrowing market can be a source of financial resources for the implementation of energy saving projects. According to the results of the study of the financial compensatory technology „Tax Increment Financing" (TIF), proposals for the formation of a mechanism for making investments by enterprises and institutional participants in the building energy cluster are provided, where its structure identifies the levers, tools, methods of funding energy-saving measures, the coordination center of the energy cluster has been determined and participants of this integration formation are proposed.

Keywords: energy saving, municipal bonds, investments, emission, building energy cluster.

1. Introduction

During the last decade there has been an increase in the rate of investment in fixed assets, with the priority being energy-efficient projects in the economy of most countries, which are among the most important directions of development of the economic potential of society, but is problematic in terms of funding, due to their scale, high cost, complexity of implementation and duration of payback. The search for effective compensatory type tools for the cost of business entities related to the re-equipment of the factors of reproduction and introduction of new energy-efficient technologies, as well as the formation of an effective system of energy saving management – the problem is complicated due to the allowed gaps and fragmentary management decisions in the process of attraction of investments, both on the macro and micro levels. One of the most promising forms of compensatory financing for energy conservation projects within the framework of cluster interaction is the use of the Tax Increment Financing (TIF) mechanism.

The purpose of the article is to create a mechanism for making investments by enterprises and institutional participants in the construction energy cluster on the principles of TIF, which will explore the possibility of attracting additional financial resources for implementing energy saving measures through the issue of municipal bonds and the implementation of financial compensating technology, „Tax Increment Financing" (TIF).

2. Literature review

The presented issue updates the study of using the Tax Increment Financing (TIF) mechanism in the process of financing energy saving projects. Thus, D. Huddleston describes the application of the TIF method to the Wisconsin example, focusing on the change in the structure of taxes received additionally from other budgets (Huddleston 1986, pp. 11-17). In their study, D. Williams and R. Blende tried to identify the circumstances under which the TIF project would be an effective means of developing municipal economies (Williams, Blende 1989, pp. 123). T. Stinson and D. Huddlston calculated the financial sustainability of individual projects, based on the expected growth rates of property value (Huddleston 1986, pp. 194-198; Stinson 1992 pp. 241-248). J. Klemański, along with financial aspects, assessed the effects of TIF in the political and legal plane (Klemanski 1990, pp. 23-28). J. Mean and M. Rosentraub analyzed the relationship between the increase in the value of property and the adoption of TIF (Mean, Rosentraub 1994, pp. 23-26). The overwhelming majority of scientists investigate the critical factors when applying the TIF method and discuss the possible impact of different variables on the probability of project success. The application of the TIF mechanism in the field of financing infrastructure projects abroad (Dmitrieva et al., 2016) makes it expedient to study the prospects of incorporation of this financial compensatory technology in domestic practice of implementing energy-efficient measures. The economic justification for the use of the TIF mechanism and its practical application under the fiscal system will make it possible to identify new vectors for the growth of the national economy, among which investment of energy saving projects can be considered (Karpenko et al., 2018; Lakhno et al., 2018, pp. 1802–1812; Mazurkiewicz et al., 2015, pp. 11-20; Melnychenko et al., 2017, pp. 66-80; Pająk et al., 2016, pp. 204-217; Pająk et al., 2017, pp. 122-138).

3. Methodology

The theoretical, scientific and methodological bases of the study were the methods of scientific knowledge, general scientific principles and work experience in the field of energy saving management of enterprises. The following scientific methods are used in solving the tasks: theoretical generalization, comparison, conceptual positions of „Passive House", „Triple Zero", „Green Lease".

4. Results and Discussion

The essence of TIF is to provide the investor with compensation through special funds replenished at the expense of tax revenues from created incomes and infrastructure objects put into operation (Dmitrieva, Bazhenova 2016, p. 23). The basis of this mechanism is redevelopment, which is financed by an investor who invests in construction and reimburses his expenses from the special fund, which accumulates taxes paid by the owners of new consolidated facilities.

That is, TIF is a mechanism that involves covering the investor's expenses on the implementation of energy-efficient projects from the budget at the expense of taxes paid to the budgets of all levels coming from the implementation of the investment project upon completion of the construction and commissioning of infrastructure objects. In essence, this is one of the variants of regional application of compensatory tax models for the decision of investment tasks. After all, TIF assumes that the investor's costs invested in the investment project will be offset by the tax exemption calculated in the future.

We propose to introduce the mechanism of TIF in the implementation of energy saving projects in the framework of the building energy cluster, since clustering is becoming the most popular form of organization of production and commercial activity, which is conditioned by trends and challenges in the real sector of the economy. As the authors point out, globalization and the potential symbiosis associated with it are an expression of benefits and opportunities that can be gained as a result of pooling of forces and the competitive advantages of collaborating actors. Confirmation of the above hypothesis is the results of studies conducted by S. Fabiani and J. Pelligrini in 1998, which show that enterprises operating in isolation, that is, outside the clusters operating in close proximity to them, receive up to 40% less revenues (Fabiani, Pellegrini 1998, pp. 23).

In Ukraine, according to the forecast of experts in the baseline scenario, the total consumption of heat energy by 2030 will increase to 271 million Gcal, or slightly more than 15% compared to the base year. In order to meet the forecasted demand, based on current realities in any scenario, the main direction of development of the systems of generation, transport and distribution of heat should be the reduction of levels of consumption of natural gas through increased efficiency of its use, the development of heat supply systems on the basis of renewable energy sources. Taking into account that 59.3% of natural gas in

Ukraine is consumed for heating of buildings, implementation of the research and applied results of financing of energy saving projects will allow optimizing the energy consumption of the building by 50-55% from the initial level of expenses at the design stage for residential and public buildings (Dmitrieva, Bazhenova 2016, pp. 23).

The main functions of the organizational structures of management and provision of energy saving projects using the TIF mechanism within the building energy cluster are:
– multilateral consultations with stakeholders (municipalities, public organizations, investors, developers);
– drawing up a plan for the implementation of the energy saving project and assessing its compliance with the regional development strategy;
– reflection in the plan of the energy saving project using financial compensating technology „TIF" costs of its implementation and organization of the management system.

We conducted a thorough study of international practices of financing energy saving projects by the leading countries of the world in terms of adaptation of modern management and regulatory technologies to the conditions of operation of construction enterprises of Ukraine, which made it possible to identify applied vectors that can be implemented in the real sector of our country's economy:
– introduction of non-traditional and renewable energy sources;
– modernization of housing stock on the basis of energy efficient technologies;
– effective management of financing energy saving measures;
– effective regulatory regulation of energy consumption;
– integration of financial resources (clustering);
– realization of conceptual foundations "Passive House", "Triple Zero", "Green Lease" (Klymchuk 2016, p. 65). Based on these studies, there was a need to study the advantages and disadvantages of financing energy saving projects through the issue of municipal bonds and the use of TIF (Tax Increment Financing) in the context of financing energy saving projects.

The mechanism of investment of enterprises-institutional participants in the construction energy cluster on the basis of TIF is a set of methods, forms, tools and levers of financial support for the process of functioning of the building energy cluster, taking into account the implementation of measures on energy conservation and energy efficiency, as well as state (municipal) regulation of these processes (Fig. 1).

In the presented mechanism, the methods of financing are identified – methods and techniques that help to substantiate and control specific management decisions related to the search for sources of financing, the construction of their rational structure and use: the issue of municipal energy bonds, as well as the introduction of financial compensatory technology based on deferred tax payments (Tax Increment Financing – TIF).

According to the current legislation, local authorities can attract local borrowing following certain requirements:
– the total amount of borrowings to the local budget can not exceed the amount of budget deficit for the local budget for the relevant year;
– funds from the placement of bonds received by the issuer are attracted to financing only the budget of development of the corresponding local budget;
– expenditures for servicing the debt of local budgets can not exceed annually 10% of expenditures from the general fund of the corresponding local budget during any budget period, when the debt service is planned;
– violation of the schedule of repayment of the principal amount and payments for its servicing due to the guilty borrower, depriving the relevant council to carry out new borrowing in the next 5 years (Ivashchuk 2007, p. 70).

Identify the benefits of financing TIF-based projects: the distribution of risks between the members of the construction energy cluster; protection against default of other assets and increase of level of financial and credit obligations of project owners; growth of the coefficient of financial leverage, that is, the ratio of debt capital of the enterprise to its own funds, which leads to an increase in the profitability of shareholder capital and reduce its value in the aggregate capital.

In addition to the benefits, the basic mechanism of risk realization of deferred payments include:
– low level of motivation of private investors to finance energy saving projects at their own expense;
– withdrawal of private investors' capital from economic turnover, which leads to losses and inability to generate profit;
– increase in the cost of debt sources for investment, which is conditioned by market conditions, inflation processes;
– low quality of forecasting of additional revenues from the implementation of the energy saving project, and hence uncertainty of the parameters of the project payback.

Potentially, these risks can lead to an increase in the timing of returning invested funds

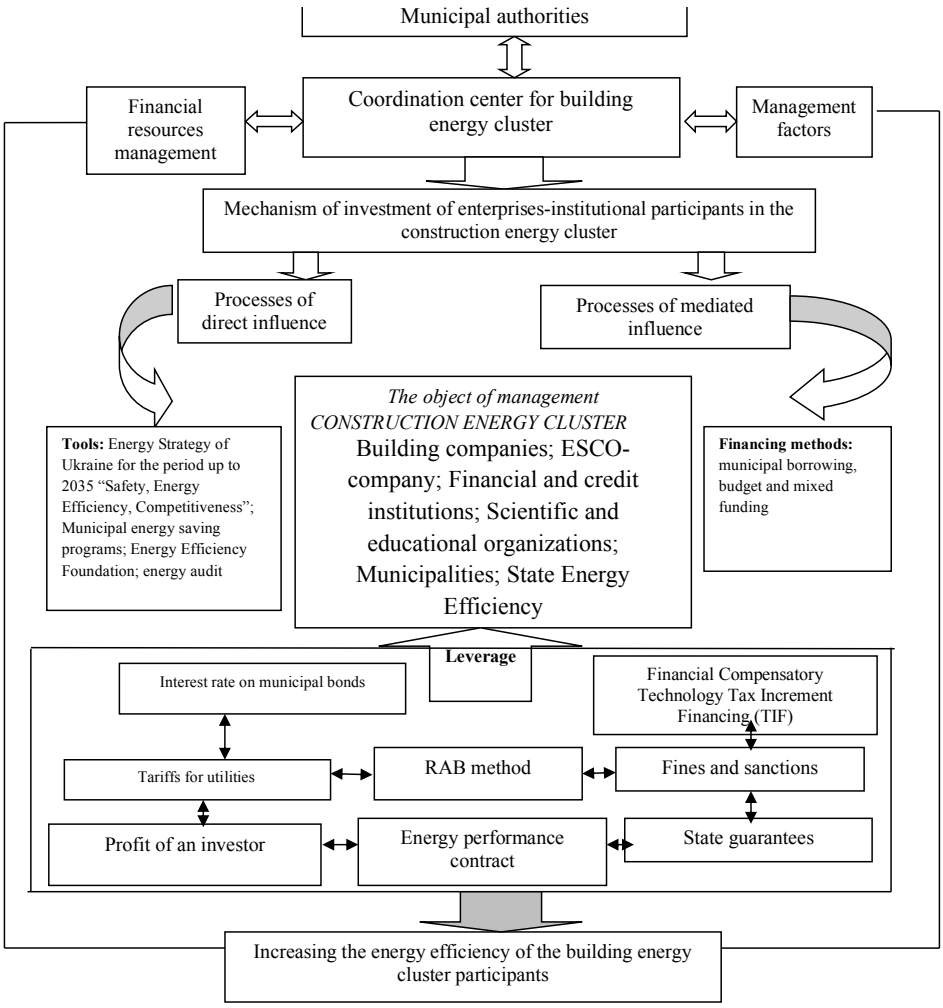

Figure 1. The mechanism of investment of enterprises-institutional participants in the construction energy cluster on the principles of TIF
Source: own study

to the energy saving project, and to change the current tax conditions, reducing the return on investment. In this regard, stability is an important condition for the success of the TIF mechanism state tax policy that increases the quality of forecasting. Most often, TIF bonds are used, which are provided with additional revenues of the TIF zone. For three years, when revenue from taxes in the TIF zone is insignificant, interest on such bonds is usually capitalized. Upon achievement of the stabilization of income, payment of interest and servicing of the principal debt are carried out.

The attractiveness of this funding scheme for local authorities is that investors are taking the risks of project implementation and revenue in a sufficient amount and with a certain periodicity of income. And TIF bonds are not assigned a rating, which makes them more profitable, but at the same time more risky financial asset.

If it is not possible to place bonds on the market at the initial stage of the implementation of an infrastructure project (for example, private investors do not want to buy bonds, the nominal amount of financing below the required one, etc.), the pay-as-you-go mechanism, which can be financed through programs of reconstruction or modernization in the territory of the TIF zone or through issuance of

securities, including bills of exchange, is used. In some cases, bonds may be issued in amounts that exceed the amount of debt. The reason for such a release is the expectation of income from tax payments in connection with the commissioning of new infrastructure.

In general, it should be noted that the TIF construction energy cluster plays an important role in the development of energy-efficient technologies, as under the budget constraints, by attracting funding from extra-budgetary sources, additional opportunities are used to increase investment in productive and social infrastructure.

A comprehensive approach to financing energy conservation projects and improving energy efficiency will provide an opportunity to create conditions for improving the quality of life of the population, economic development and social areas of the city, increase environmental security area, improve the functioning of energy infrastructure and increased improvement of urban areas, improving the management of state property.

The advantage of bonds is also the fact that they are a kind of a long-term loan for the issuer, in which nobody can restrict its independence, as is the case of a bank loan. At the same time, it is an instrument for increasing the return on equity of the issuer, provided that the rate of return on the investment funded by the bonds will be higher than the interest rate on the bonds. In this case, the return on capital will increase. Income from municipal bonds in most foreign countries is exempt, provided that they are issued for the purpose of financing social rather than private activities (Ivashchuk 2007, p. 70).

5. Conclusions

In our opinion, the incorporation of foreign experience in the implementation of projects based on TIF in Ukrainian reality requires some adaptation processes, taking into account the problems of finding sources of funding, including the interest of private investors in long-term capital investment, the risks of using the mechanism of deferred tax payments, as well as the weakness of the financial base of most regions. The international financing models of infrastructure projects and risk insurance used in international practice should be adapted to the specifics of our economy development formats.

The study of the practice of local borrowing in Ukraine has demonstrated a fragmented nature of the existing system. Yet, provided the appropriate regulatory and legal framework and taking into account the experience of other countries, the development of the local borrowing market can be a source of financial resources for implementing energy saving projects through compensatory financing on the principles of TIF. According to the results of the study, proposals for the formation of a mechanism for making investment by enterprises and institutional participants in the construction energy cluster on the principles of TIF, in which the structure, levers, tools, methods of funding energy-saving measures are identified, the coordination center of the energy cluster has been determined and the participants of this integration formation have been proposed.

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