Monitoring the integration of environmentally friendly technologies in business structures in the context of climate security

IRYNA KONOVALYUK, VASYL BRYCH, OLENA BORYSIAK, KAROLINA MUCHA-KUS, NATALIIA PAVLENCHYK, ANATOLII PAVLENCHYK, YAROSLAVA MOSKVYAK, GRZEGORZ KINELSKI

Abstract

Introduction to the topic under investigation. The risks of climate change have brought about the consolidation of business structures with the aim of reducing greenhouse gas emissions. In such conditions, ensuring the transition to a low-carbon economy requires the application of a comprehensive approach to monitoring goals for the integration of environmentally friendly technologies in business structures. In particular, it involves defining environmentally friendly hierarchical and causal relationships between goals in business structures in the context of climate security. Purpose. The purpose of the study is to develop a methodological approach to monitoring the integration of environmentally friendly technologies in business structures in the context of climate security, based on the analysis of building a model for monitoring the business structure activities of enterprises, systematising the goals of business structures and the sources of information. Methodology. In order to develop a methodological approach to monitoring the integration of environmentally friendly technologies in business structures in the context of climate security, it is necessary to determine the environmentally friendly hierarchical and cause-and-effect relationships between goals in business structures. The development of a system for monitoring the marketing environment is based on the goals of hierarchy and causality This approach will be the basis for the formation of a monitoring system for the introduction of environmentally friendly technologies at enterprises (according to the types of economic activity). Main results. The study has revealed that the types of goals are interrelated ac-

Iryna Konovalyuk
e-mail: iryna.v.konovaliuk@lpnu.ua
Lviv Polytechnic National University,
Lviv, Ukraine

Vasyl Brych
e-mail: v.brych@wunu.edu.ua
West Ukrainian National University,
Ternopil, Ukraine

Olena Borysiak[1]
e-mail: o.borysiak@wunu.edu.ua
West Ukrainian National University,
Ternopil, Ukraine

Karolina Mucha-Kus
e-mail: kmucha-kus@wsb.edu.pl
WSB University, Dabrowa Gornicza,
Poland

Nataliia Pavlenchyk
e-mail: pavlinova75@gmail.com
Ivan Boberskyj Lviv State University of
Physical Culture, Lviv, Ukraine

[1] Corresponding author

cording to similar environmentally friendly characteristics in the context of climate security, and together they form an integral system. Another important aspect of the relationship between the goals is that the set of goals for the integration of environmentally friendly technologies is the source code for the intersection of sets; that is, the goals of management entities in the business structure management system are formed after the goals for certain types of business structure activities are formed. The study has considered the goals of monitoring business structure activities, sources of information, monitoring methods and information obtained as the output of the monitoring system of integrating environmentally friendly technologies through the prism of topological and metric spaces, which makes it possible to have a certain morphological projection of input data to the output. A model for monitoring business structure activity for the integration of environmentally friendly technologies through the prism of topological and metric spaces was proposed. In the context of the study, the topological space is considered a continuum and a system of subsets. The theoretical contribution. The innovative scientific added value of the study is the improvement of the methodological approach to forming a system for monitoring the activities of business structures in the conditions of integrating environmentally friendly technologies. This approach is based on modelling through the prism of metric and topological spaces. The methodological approach makes it possible to achieve a high level of information content and timely monitoring for the integration of environmentally friendly technologies into business structures in the context of climate security. Practical implications. The practical value of the proposed model lies in the possibility of using it to strengthen climate change resilience in business and the transition to a low-carbon economy. The practical implications of the study are to develop the resilience of business structures in the implementation of low-carbon economy transition strategies and plans by integrating environmentally friendly technologies, in particular, the diversification of energy supply channels, recycling renewable resources, testing and implementing innovative solutions for the prevention of climate change, and so on.

Key words

climate change, low-carbon economy, eco-innovations, environmentally friendly technologies, climate security, clean energy, environmental management, marketing environment, business structure.

Anatolii Pavlenchyk
e-mail: pavlinov74@gmail.com
Ivan Boberskyj Lviv State University of
Physical Culture, Lviv, Ukraine

Yaroslava Moskvyak
e-mail: slavakohanec1201@gmail.com
Lviv Polytechnic National University,
Lviv, Ukraine

Grzegorz Kinelski
e-mail:gkinelski@wsb.edu.pl
WSB University, Dabrowa Gornicza,
Poland

Introduction

Climate change requires the introduction of solutions for the reduction of greenhouse gas emissions by developing a low-carbon economy and strengthening the monitoring of environmentally friendly technologies in business structures. The climate security of enterprises is ensured due to the transition to the production of green goods, the circular use of resources, etc.

Accordingly, the European strategic goals for the transition to a low-carbon economy includes the following green benchmarks: the development of carbon markets; circular cities; the energy efficiency of buildings; renewable energy; increasing the climate resilience of the agriculture and forestry sector, etc. Since 2019, in the countries of the European Union, the National Energy and Climate Plans (NECPs) have been in force with the goal of increasing the resilience of European climate security. These were proposed by means of an action plan for the EU countries for the period 2021–2030 aimed at the reduction of greenhouse gas emissions. Such plans aim to coordinate the goals of all government departments and plan for activities that promote the attraction and implementation of public and private investments (The national energy and climate plans, 2018).

A challenge commonly faced by business structures is planning for the transition to a low-carbon economy. With this in mind, the development of a monitoring system for integrating environmentally friendly technologies in business structures is an issue of the utmost urgency.

1. Literature review

Forming a system for monitoring the environmentally friendly technologies of enterprises is based on the goals of said monitoring. A summary of the references (Curry, 2019; Sumets et al., 2021; Tun et al., 2016; Zadorozhnyi and Muravskyi, 2021; Koetter and Kochanowski, 2012; Kucher et al., 2021; Dyvak et al., 2018; Maj and Kubiciel-Lodzińska, 2020; Popova et al., 2021; Borysiak and Brych, 2022; Goomas et al., 2011; Mihi-Ramirez et al., 2019; Pryimak et al., 2020; Draghici et al., 2014) provides grounds to claim that, in general, the purpose of monitoring the activity around business structures is to identify the state of the implementation of the established goals of business structures, to find the relevance of the established goals of the business structures, and to identify the need for regulatory decisions. The implementation of these goals usually takes place in an algorithmised form.

The prevention and mitigation of, and adaptation to, climate change requires enterprises to strengthen their environmental, climate and energy management (Darmorost et al., 2019; Brych et al., 2023; Borysiak et al., 2022). The implementation of eco-innovation is positioned as a target for organisations to be more sustainable in order to reduce negative externalities in the developed countries (García-Granero et al., 2018; David Ferreira Lopes Santos et al., 2019).

The business structure goals are the initial primary data on the basis of which a system for monitoring the business structure activities is formed. In the scientific literature on management issues, including issues of information management (Bueno and Gallego, 2017; Altındağ and Öngel, 2021; Voitseshyn et al., 2020; Martyniuk et al., 2020; Borysiak et al., 2022, Saifi et al., 2016; Pryimak et al., 2020; Kucher et al., 2021; Brych et al., 2022; Popova et al., 2019; Zamecnik and Rajnoha, 2015; Kniaz et al., 2021; Shkvaryliuk et al., 2021), a significant number of authors lay out the approaches to classifying and systematising the goals of enterprises according to the types of activity.

Barriga Medina et al. (2022) used a structural equation model to analyse the positive effect of eco-innovation on the financial

and environmental performance of business structures. On the other hand, a proactive environmental strategy does not directly affect firm performance, but technological eco-innovation reduces the environmental impact (Ryszko, 2016).

Accordingly, the urgent goal of energy enterprises is to develop climate management through diversification of renewable resources (Borysiak et al., 2022). Madaleno et al. (2020) investigate whether eco-innovations positively affect turnover and employment.

Critical analysis of the authors' approaches has shown the need to improve a universal classification of business structure goals based on the integration of environmentally friendly technologies and the resilience of climate security. Given this, when classifying the business structure goals, it is vital to take only those classification features and types of goals that are universal to all business structures into account.

The purpose of the study is to develop a methodological approach to monitoring the integration of environmentally friendly technologies in business structures in the context of climate security, based on the analysis of building a model for monitoring the business structure activities of enterprises, systematising the goals of business structures and the sources of information.

2. Methodology

The research hypothesis is that ensuring the transition to a low-carbon economy requires the application of a comprehensive approach to monitoring goals for the integration of environmentally friendly technologies in business structures. In particular, it involves defining environmentally friendly hierarchical and causal relationships between goals in business structures. The hierarchy and causality goals underlie the development of a system for monitoring the marketing environment. This approach will be the basis for forming a monitoring system for the introduction of environmentally friendly technologies at enterprises (according to the types of economic activity).

The research was conducted according to the following classification of business structures goals: by scale; by the level of coverage; by the respective goals of divisions of business entities; by the level of management; by management subjects; and by type of activity. In this classification, the types of goals are interrelated according to similar environmentally friendly characteristics, and together they form an integral system. In a formalised form, the relationship between business structure goals by scale and level is written as follows:

$$
\left.
\begin{aligned}
&\bigcup_{i=1}^{3} C_{b_i} \supset \bigcup_{j=1}^{n} C_{k_j} \supset \bigcup_{t=1}^{r} C_{m_t} \Leftrightarrow \bigcup_{\alpha=1}^{\gamma} C_{\alpha}; \\
&C_s \Rightarrow C_t \Rightarrow C_o \subset \bigcup_{i=1}^{3} C_{b_i}; \\
&C_{k_1} \cup \ldots \cup C_{k_n} \subset \bigcup_{j=1}^{n} C_{k_j}; \\
&C_{m_1} \cup \ldots \cup C_{m_n} \subset \bigcup_{t=1}^{r} C_{m_t},
\end{aligned}
\right\} \quad (1)
$$

where C_s – strategic goals of business structures; C_t – tactical goals of business structures; C_o – operational goals of business structures; $Ck_1 \ldots Ck_n$ – goals of the components (business entities) from which business structures are formed; $Cm_1 \ldots Cm_n$ – goals of business structure component divisions.

The business structure goals of integrating environmentally friendly technologies form a boolean $\bigcup\limits_{\alpha=1}^{\gamma} c_{\alpha}$.

Strategic goals of integrating environmentally friendly technologies are the starting point for tactical goals, and the tactical goals determine the operational ones. The set of strategic, tactical and operational objectives $\bigcup\limits_{i=1}^{3} c_{b_i}$ is the basis for a set of objectives of the business structure component $\bigcup\limits_{j=1}^{n} c_{k_j}$

and the set of objectives of the units of the business structure component $\bigcup\limits_{t=1}^{r} c_{m_t}$.

The nature of the relationships between the sets of business structure goals of integrating environmentally friendly technologies by management level is captured in the formula $\bigcup\limits_{\beta=1}^{2} c_{\beta}$, management entities – $\bigcup\limits_{\chi=1}^{3} c_{\chi}$ and types of activities – $\bigcup\limits_{\delta=1}^{3} c_{\delta}$. A special feature of the relationships between the sets of these goals is the occurrence of an intersection of sets, namely $\bigcap\limits_{\varphi=1}^{\phi} c_{\varphi}$:

$$
\left.
\begin{aligned}
&C_k \cup C_p \Leftrightarrow \bigcup_{\beta=1}^{2} C_{\beta}; C_v \Rightarrow C_c \Rightarrow C_n \Leftrightarrow \bigcup_{\chi=1}^{3} C_{\chi}; \\
&C_q \cup C_f \cup C_i \Leftrightarrow \bigcup_{\delta=1}^{3} C_{\delta}. \\
&\bigcap_{\varphi=1}^{\phi} C_{\varphi} \Leftrightarrow \bigcup_{\beta=1}^{2} C_{\beta} \cap \bigcup_{\chi=1}^{3} C_{\chi}; \\
&\bigcup_{\beta=1}^{2} C_{\beta} \cap \bigcup_{\chi=1}^{3} C_{\chi} = \left\{ \varepsilon \mid \varepsilon \in \bigcup_{\beta=1}^{2} C_{\beta} \wedge \varepsilon \in \bigcup_{\chi=1}^{3} C_{\chi} \right\},
\end{aligned}
\right\} \quad (2)
$$

where C_k – the goals of the management subsystem; C_p – the goals of the managed business structure management subsystem; C_v – the goals of top-level management entities; C_c – the goals of mid-level management entities; C_n – the goals of grassroots management entities; C_q – the objectives of the business structure operating activities; C_f – the objectives of the business structure financial activities; C_i – the goals of business structure investment activity; and ε – the goals of management entities in the business structure management system.

As seen above, it is precisely for management entities that the business structure management system intersects the goals of integrating environmentally friendly technologies for management subsystems and management levels.

Another important aspect of the relationship between the goals is that the set of goals for the integration of environmentally friendly technologies $\bigcup\limits_{\delta=1}^{3} c_{\delta}$ is the source code for the intersection of sets $\bigcap\limits_{\varphi=1}^{\phi} c_{\varphi}$, that is, the goals of management entities in the business structure management system are formed after the goals for certain types of business structure activities are formed:

$$
\bigcup_{\delta=1}^{3} C_{\delta} \Rightarrow \bigcap_{\varphi=1}^{\phi} C_{\varphi}. \quad (3)
$$

It should also be emphasised that sets $\bigcup_{\delta=1}^{3} C_\delta$ and $\bigcup_{\alpha=1}^{\gamma} C_\alpha$ are not identical:

$$\bigcup_{\alpha=1}^{\gamma} C_\alpha \setminus \bigcup_{\delta=1}^{3} C_\delta \Leftrightarrow \bigcup_{\eta=1}^{\iota} C_\eta ; \bigcup_{\eta=1}^{\iota} C_\eta \Rightarrow \bigcup_{\delta=1}^{3} C_\delta. \quad (4)$$

where $\bigcup_{\eta=1}^{\iota} C_\eta$ – business structure goals defined by the business structure mission and vision.

The set $\bigcup_{\eta=1}^{\iota} C_\eta$ transforms into the set $\bigcup_{\delta=1}^{3} C_\delta$ and, as a result, subordinates the sets $\bigcup_{\alpha=1}^{\gamma} C_\alpha, \bigcup_{\beta=1}^{2} C_\beta$ and $\bigcup_{\chi=1}^{3} C_\chi$ to itself.

As a result, the logic of relationships between the business structure goals of integrating environmentally friendly technologies is as follows:

$$\left. \begin{array}{l} \bigcup_{\alpha=1}^{\gamma} C_\alpha \equiv \bigcup_{\delta=1}^{3} C_\delta \cup \bigcup_{\eta=1}^{\iota} C_\eta ; \\[2em] \bigcup_{\eta=1}^{\iota} C_\eta \Rightarrow \bigcup_{\delta=1}^{3} C_\delta \Rightarrow \left[\bigcup_{\beta=1}^{2} C_\beta \wedge \bigcup_{\chi=1}^{3} C_\chi \right]. \end{array} \right\} \quad (5)$$

3. Research results

An important stage in forming and using a system for monitoring the business structure activity of integrating environmentally friendly technologies is the choice of information sources and monitoring methods. Despite the variety of information sources obtained by business structure management entities, first of all, it is the alternative sources that are of practical value. This is because objective information is usually considered to have a documentary basis or is confirmed by several sources. Given this, it is important to consider alternative information sources when creating a system for monitoring the business structure activities of integrating environmentally friendly technologies, especially in the context of automation and algorithmisation.

The first step to this task is to build a classification of sources of receiving information pertaining to the management of integrating environmentally friendly processes: by content (sources of direct information, sources of indirect information); by source (internal and external sources of receiving information); or by nature (sources of planning, regulatory and forecast information, sources of actual information). Among the wide variety of approaches to constructing a classification of information sources necessary to form a system for monitoring the business system activities of integrating environmentally friendly processes, only those classification features and types of information sources that may have practical significance should be distinguished.

Figure 1 shows the results of the expert survey, which showed that the most frequently used monitoring methods are the comparison method (25%), the index method (13%), the expert assessment method (9%) and the observation method (7%). In total, these methods are used by 54% of respondents. The content analysis method (6%), the systematisation method (6%), the induction (4%) and deduction methods (4%), and the generalisation method (3%) are also used, albeit not as frequently.

Figure 1. Results of the expert survey on the frequency of monitoring methods used
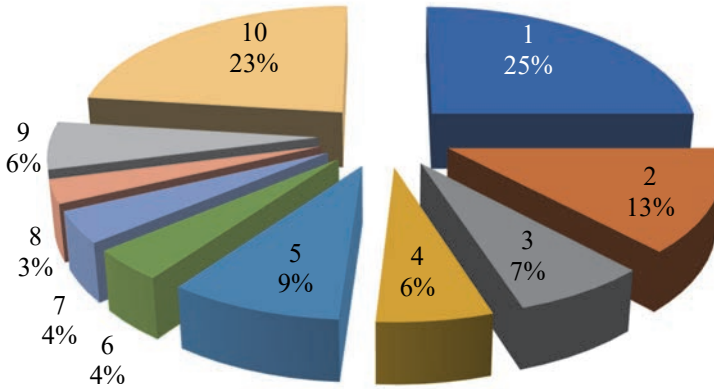
Note: 1 – comparison method; 2 – index method; 3 – observation method; 4 – content analysis method; 5 – expert evaluation method; 6 – induction method; 7 – deduction method; 8 – generalisation method; 9 – systematisation method; 10 – other methods.

Source: own elaboration

A systematised set of information sources and monitoring methods is a prerequisite for the practical application of the monitoring system of integrating environmentally friendly technologies. Despite this, it should be recognised that the monitoring object determines the requirements for the monitoring system. One of these is automation, and as a result, the algorithmisation of monitoring. This is due to the breadth of the list of parameters that characterise the monitoring object and the large number of factors that affect these values. Given this, it is advisable to consider the goals of monitoring the business structure activity, information sources, monitoring methods and information obtained as the output of the monitoring system of integrating environmentally friendly technologies through the prism of topological and metric spaces, which makes it possible to have a certain morphological projection of input data into the output:

$$
\left.
\begin{aligned}
&\bigcup_{\alpha=1}^{\gamma} C_\alpha \supset \bigcup_{\kappa=1}^{\lambda} D_\kappa \equiv \Lambda_{1\ldots n}; \bigcup_{\kappa=1}^{\lambda} D_\kappa \supset \kappa_1\ldots\kappa_n; \\
&\Lambda_{1\ldots n} \equiv \left\{ \bigcup_{\alpha=1}^{\gamma} C_\alpha \,\middle|\, \bigcup_{\alpha=1}^{\gamma} C_\alpha \bigcup_{\kappa=1}^{\lambda} D_\kappa \cap \left\{ \bigcup_{\mu=1}^{\nu} M_\mu \supset \mu_1\ldots\mu_n \right\} \in \bigcup_{\alpha=1}^{\gamma} C_\alpha \right\} \\
&I_n^1 \Leftrightarrow r; I_n \wedge I_n^1 \equiv I_n^0 \in X \,|\, d(I_n^1, I_n^0) \prec I_n^1,
\end{aligned}
\right\} \quad (6)
$$

where $\bigcup_{\kappa=1}^{\lambda} D_\kappa$ – multiple sources of information $(\kappa_1\ldots\kappa_n)$ in the system of monitoring the activities of the business structure (integrating environmentally friendly technologies); $\Lambda_{1\ldots n}$ – topology $\bigcup_{\alpha=1}^{\gamma} C_\alpha$ on $\bigcup_{\kappa=1}^{\lambda} D_\kappa$; r – ball radius; d – the distance between the elements of the set.

In the context of the study, the topological space (Figure 2) is considered a continuum and a system of subsets.

In turn, metric space is considered a pair of a certain set and a distance defined for any pair of elements of this set; that is,

indicators and possible values by which they may be acquired.

4. Discussion

In order to strengthen the resilience of climate security, companies in the European Union are introducing low-carbon actions through the development of the mandatory carbon market and the voluntary carbon market (Report on international voluntary and compulsory carbon markets with special emphasis to mechanisms applied in case of carbon farming and potential opportunities for Ukrainian developers, 2022). Taking into account the fact that one of the principles of forming a system for monitoring the activities of business structures in the conditions of low-carbon transition is to focus on meeting the information needs of business structure managers for the integration of environmentally friendly technologies, the key task in the creation of a monitoring system is to choose information sources and monitoring methods. Performing this task is important for all types of monitoring systems, but in the context of increasing competition and increasing the level of informatisation in business, the information needs of management entities are rapidly changing.

Figure 1. Model for monitoring business structure activity for the integration of environmentally friendly technologies through the prism of topological and metric spaces
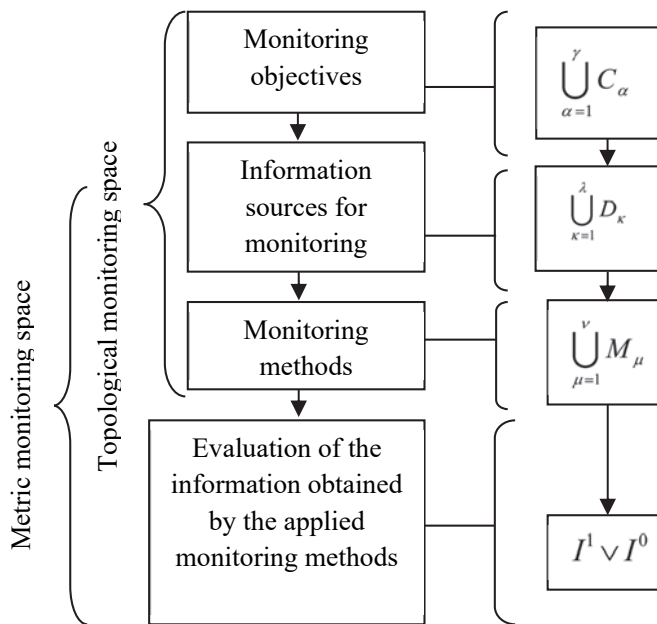
Source: own elaboration

As a result, the requirements for objectivity in choosing information sources and monitoring methods are growing. This requires modelling the monitoring of the business structure activities through the prism of topological and metric spaces, which makes it possible to permanently update the compliance of the monitoring components with the information needs of management entities.

The goals of integrating environmentally friendly technologies of business structures

are complementary to the objectives of regional, national or international initiatives towards energy efficiency, renewable energy, or the modernisation of energy supply systems based on the transition to the low-carbon economy at the local and regional levels. With this in mind, verifying the relevance of the business structure and establishing the needs of regulatory decisions, as well as modelling the totality of goals of the business structure to low-carbon transition is one of the most important prerequisites for the formation of a system for monitoring the environmentally friendly technologies of business structures. Integrating the monitoring objectives with the objectives of the business structure requires the coordination of these objectives with the objectives of the components of the business structure, the objectives of the divisions of these components, the objectives of management entities, as well as the objectives of the activities of the business structure.

The research hypothesis is that ensuring the transition to a low-carbon economy requires the application of a comprehensive approach to monitoring goals for the integration of environmentally friendly technologies in business structures. In particular, it involves defining environmentally friendly hierarchical and causal relationships between goals in business structures. The development of a system for monitoring the marketing environment is based on the goals of hierarchy and causality. This approach will be the basis for the formation of a monitoring system for the introduction of environmentally friendly technologies at enterprises (according to the types of economic activity).

As a result of the study, it is proven that the essence of coordinating objectives for the integration of environmentally friendly technologies is to avoid contradictions. Implementing this task within enterprises (according to the types of economic activities) indicates the need to formalise

objectives of all types and levels, determine the sequence of forming objectives and specify the cause-and-effect relationships between them.

Forming business structure monitoring activities for the integration of environmentally friendly technologies through the prism of topological and metric spaces, in particular in terms of formalising monitoring goals, sources of management information and monitoring methods, is important given the qualitative monitoring parameters of business structure activities in the context of the transition to a low-carbon economy. The practical value of the proposed model lies in the possibility of using it to strengthen climate change resilience in business and the transition to a low-carbon economy.

Topological and metric spaces make it possible to transform the conditions for high-quality monitoring at the input into the monitoring system to the results of applying this system. As a consequence, topological and metric spaces, by means of their information and analytical nature, are a morphological structure in which all the components are connected by causal relationships, in particular through factors affecting each of the levels of decomposition.

Conclusions

In order to build a system for monitoring the marketing environment in the context of climate security, it is proposed that the study take the goals of hierarchy and causality. This approach will be the basis for the formation of a monitoring system for the introduction of environmentally friendly technologies at enterprises (according to the types of economic activity).

The contribution of this paper to the science lies in improving the methodological approach to monitoring the environmentally friendly activities of business structures in the context of climate security. This approach is based on modelling through the

prism of metric and topological spaces and involves the use of tools for the set theory. The methodological approach makes it possible to achieve a high level of information content and timely monitoring for the integration of environmentally friendly processes into business structures. Additionally, a model for monitoring the business structure activity for the integration of environmentally friendly technologies through the prism of topological and metric spaces was proposed. In the context of the study, the topological space is considered a continuum and a system of subsets.

The practical value of the proposed model lies in the possibility of using it to strengthen climate change resilience in business and the transition to a low-carbon economy. The practical implications of the study and the directions of future research are to build resilience in business structures to implement low-carbon economy transition strategies and plans through integrating environmentally friendly technologies, in particular, diversifying energy supply channels, recycling renewable resources, testing and implementing innovative solutions for the prevention of climate change, and so on.

References

Altındağ, O., Öngel, V. (2021), Information Management, Organizational Intelligence and Innovation Performance Triangle: Empirical Research on Turkish IT Firms, SAGE Open, 11, 215824402110525. DOI: https://doi.org/10.1177/21582440211052550.

Barriga Medina, H.R., Guevara, R., Campoverde, R.E., Paredes-Aguirre, M.I. (2022), Eco-Innovation and Firm Performance: Evidence from South America, *Sustainability, 14*, 9579. DOI: https://doi.org/10.3390/su14159579.

Borysiak, O., Brych, V. (2022), Post-COVID-19 Revitalisation and Prospects for Climate Neutral Energy Security Technologies, Problemy Ekorozwoju, 17(2), 31-38. DOI: https://doi.org/10.35784/pe.2022.2.04.

Borysiak, O., Mucha-Kuś, K., Brych, V., Kinelski, G. Toward the Climate-Neutral Management of Innovation and Energy Security in Smart World; Logos Verlag Berlin: Berlin, Germany, 2022, ISBN 3832555447.

Borysiak, O., Skowron, Ł., Brych, V., Manzhula, V., Dluhopolskyi, O., Sak-Skowron, M., Wołowiec, T. (2022), Towards Climate Management of District Heating Enterprises' Innovative Resources, *Energies*, 15(21), 7841. DOI: https://doi.org/10.3390/en15217841.

Borysiak, O., Wołowiec, T., Gliszczyński, G., Brych, V., Dluhopolskyi, O. (2022), Smart transition to climate management of the green energy transmission chain, Sustainability, *14*(18), 11449. DOI: https://doi.org/10.3390/su141811449.

Brych, V., Borysiak, O., Halysh, N., Liakhovych, G., Kupchak, V., Vakun, O. (2023), Impact of international climate policy on the supply management of enterprises producing green energy, Lecture Notes in Networks and Systems, 485, 649–661. DOI: https://doi.org/10.1007/978-3-031-08093-7_43.

Brych, V., Skrynkovskyy, R., Shkvarchuk, L., Liakhovych, G., Slav'yuk, R., Borysiak, O. (2022), Portfolio Optimization of Equity Funds, *2022 12th International Conference on Advanced Computer Information Technologies (ACIT)*, Spišská Kapitula, Slovakia, 207-210. DOI: https://doi.org/10.1109/ACIT54803.2022.9913202.

Bueno, S., Gallego, M. D. (2017), Managing top management support in complex information systems projects: An end-user empirical study. Journal of Systems and Information Technology, 19(1/2), 151-164. DOI: https://doi.org/10.1108/JSIT-06-2017-0043.

Curry, D. W. (2019), Perspectives on Monitoring and Evaluation, American Journal of Evaluation, 40, 147–150. DOI: https://doi.org/10.1177/1098214018775845.

Darmorost, I., Dyvak, M., Porplytsya, N., Shynkaryk, T., Martsenyuk, Y., Brych, V. (2019), Convergence estimation of a structure identification method for discrete interval models of atmospheric pollution by nitrogen dioxide, 9th International Conference on Advanced Computer Information Technologies (ACIT), 117–120. DOI: https://doi.org/10.1109/ACITT.2019.8779981.

David Ferreira Lopes Santos, Maitê Dubugras Valente Rezende, Leonardo Fernando Cruz Basso (2019), Eco-innovation and business performance in emerging and developed economies, Journal of Cleaner Production, 237. DOI: https://doi.org/10.1016/j.jclepro.2019.117674.

Draghici, A., Popescu, A.-D., Gogan, L. M. (2014), A Proposed Model for Monitoring Organizational Performance. Procedia-Social and Behavioral Sciences, 124, 544-551. DOI: https://doi.org/10.1016/j.sbspro.2014.02.518.

Dyvak, M., Brych, V., Spivak, I., Honchar, L., Melnyk, N. (2018), Discrete Dynamic Model of Retail Trade Market of Computer Equipment in Ukraine, CEUR Workshop Proceeding, 2300, 50-53.

García-Granero, E.M., Piedra-Muñoz, L., Galdeano-Gómez, E. (2018), Eco-innovation measurement: A review of firm performance indicators, Journal of Cleaner Production, 191, 304-317. DOI: https://doi.org/10.1016/j.jclepro.2018.04.215.

Goomas, D. T., Smith, S. M., Ludwig, T. D. (2011), Business Activity Monitoring: Real-Time Group Goals and Feedback Using an Overhead Scoreboard in a Distribution Center, Journal of Organizational Behavior Management, 31(3), 196-209. DOI: https://doi.org/10.1080/01608061.2011.589715.

Kniaz, S., Kosovska, V., Shayda, O., Novosad, Z., Yaremko, L., Fedyuk, V. (2021), Method of Selection of Indicators in the Context of Information and Analytical Support of Evaluation of Development of Foreign Economic Activity of Enterprises, *2021 11th International Conference on Advanced Computer Information Technologies (ACIT)*, 389-392. DOI: https://doi.org/10.1109/ACIT52158.2021.9548613.

Koetter, F., Kochanowski, M. (2012), Goal-Oriented Model-Driven Business Process Monitoring Using ProGoalM, Lecture Notes in Business Information, 117. DOI: https://doi.org/10.1007/978-3-642-30359-3_7.

Kucher, L., Kniaz, S., Pavlenko, O., Holovina, O., Shayda, O., Franiv, I., Dzvonyk, V. (2021), Development of Entrepreneurial Initiatives in Agricultural Business: A Methodological Approach, EJSD, 10(2), 321-335. DOI: https://doi.org/10.14207/ejsd.2021.v10n2p321.

Kucher, L., Kniaz, S., Pavlenko, O., Yavorska, N., Dzvonyk, V., Rozmaryna, A., Yuzva, I. (2021), State and Prospects of Ukraine's Implementation of HACCP to Implement EU Directives on Food Safety, EJSD, 10(3), 316-331. URL: http://ecsdev.org/ojs/index.php/ejsd/article/view/1284.

Madaleno, M., Robaina, M., Dias, M. F., Meireles, M. (2020), Eco-innovation and firm performance in European highly energy consumers and polluting sectors, *2020 17th International Conference on the European Energy Market (EEM)*, Stockholm, Sweden, 1-6. DOI: https://doi.org/10.1109/EEM49802.2020.9221990.

Maj, J., Kubiciel-Lodzińska, S. (2020), Entrepreneurial tendencies of migrants working in the care sector in Poland, *Entrepreneurial Business and Economics Review*, 8(3), 27-46. DOI: https://doi.org/10.15678/EBER.2020.080302.

Martyniuk, V., Dluhopolskyi, O., Kniaz, S., Podolchak, N., Muravska, Y., Martyniuk, B. (2020), The Fiscal Policy Impact on Indicators of the State's Economic Growth, *2020 10th International Conference on Advanced Computer Information Technologies (ACIT)*, 695-698. DOI: https://doi.org/10.1109/ACIT49673.2020.9208903.

Mihi-Ramirez, A., Arteaga-Ortíz, J., Ojeda-González, S. (2019), The International Movements of Capital and Labour: A Study of Foreign Direct Investment and Migration Flows, *Entrepreneurial Business and Economics Review*, 7(3), 143-160. DOI: https://doi.org/10.15678/EBER.2019.070308.

Popova, N., Kataiev, A., Nevertii, A., Kryvoruchko, O., Skrynkovskyy, R. (2021), Marketing Aspects of Innovative Development of Business Organizations in the Sphere of Production, Trade, Transport, and Logistics in VUCA Conditions, Studies of Applied Economics, 38(4). DOI: https://doi.org/10.25115/eea.v38i4.3962.

Popova, N., Kataiev, A., Skrynkovskyy, R., Nevertii, A. (2019), Development of trust marketing in the digital society, Economic Annals-XXI, 3–4, 13–25. DOI: https://doi.org/10.21003/ea.V176-02.

Pryimak, V., Melnyk, B., Holubnyk, O., Kostyshyna, T., Brych, V. (2020), A Fuzzy Assessment of the Development of the National Labor Market of Ukraine, 2020 10th International Conference on Advanced Computer Information Technologies (ACIT), 682-686. DOI: https://doi.org/10.1109/ACIT49673.2020.9208915.

Report on international voluntary and compulsory carbon markets with special emphasis to mechanisms applied in case of carbon farming and potential opportunities for Ukrainian developers (2022), A part of the Supporting Green Recovery in Ukraine project by the United Nations Development Programme (UNDP) office in Ukraine (16 May 2022). International Consultant, Fortunato COSTANTINO. URL: https://www.undp.org/ukraine/publications/report-international-voluntary-and-compulsory-carbon-markets-special-emphasis-mechanisms-applied-case-carbon-farming-and.

Ryszko, A. (2016), Proactive Environmental Strategy, Technological Eco-Innovation and Firm Performance – Case of Poland, *Sustainability*, 8, 156. DOI: https://doi.org/10.3390/su8020156.

Saifi, A. L. S., Dillon, S., McQueen, R. (2016), The Relationship between Management Support and Knowledge Sharing: An Exploratory Study of Manufacturing Firms, Know. Process Mgmt., 23, 124-135. DOI: https://doi.org/10.1002/kpm.1506.

Shkvaryliuk, M. V., Horal, L. T., Khvostina, I. M., Yashcheritsyna, N. I., Shiyko, I. V. (2021), The use of genetic algorithms for multicriteria optimization of the oil and gas enterprises financial stability, CEUR Workshop Proceedings, 3048, 199–210. DOI: https://doi.org/10.37394/232015.2021.17.53.

Sumets, A., Kniaz, I., Heorhiadi, N., Farat, O., Skrynkovskyy, R., Martyniuk, V. (2021), Methodical approach to the selection of options for ensuring the competitiveness of enterprises in the system of development of agricultural clusters, Agricultural and Resource Economics, 7(1), 192-210. DOI: https://doi.org/10.51599/are.2021.07.01.10.

The national energy and climate plans (NECPs), 2018. URL: https://ec.europa.eu/info/energy-climate-change-environment/implementation-eu-countries/energy-and-climate-governance-and-reporting/national-energy-and-climate-plans_en.

Tun, H. T., Katayama, T., Yamamori, K., Oo, K. K. (2016), Business goals monitoring and control measures in CMMI, *2016 IEEE 5th Global Conference on Consumer Electronics*, 1-2. DOI: https://doi.org/10.1109/GCCE.2016.7800449.

Voitseshyn, V., Desyatnyuk, O., Shevchuk, O. (2020), Expediency of Reducing and Cancellation of Customs Duty's Level on Exports in Ukraine and in the World, *2020 10th International Conference on Advanced Computer Information Technologies (ACIT)*, 687-690. DOI: https://doi.org/10.1109/ACIT49673.2020.9208981.

Zadorozhnyi, Z.-M., Muravskyi, V. (2021), Combined Outsourcing of Accounting and Cybersecurity Authorities, *2021 11th International Conference on Advanced Computer Information Technologies (ACIT)*, 544-547. DOI: https://doi.org/10.1109/ACIT52158.2021.9548649.

Zamecnik, R., Rajnoha, R. (2015), Strategic Business Performance Management on the Base of Controlling and Managerial Information Support, Procedia Economics and Finance, 26, 769-776. DOI: https://doi.org/10.1016/S2212-5671(15)00843-6.

Iryna Konovalyuk – Department Entrepreneurship and Environmental Examination of Goods, Lviv Polytechnic National University. Postgraduate. The field of scientific interests is the monitoring of the activity of business structures. ORCID no. 0000-0003-2143-9621.

Vasyl Brych – Doctor of Economics, Professor, Honored Economist of Ukraine, expert on the energy efficiency technologies and innovative business processes' implementation for adaptation to climate change in energy. Head of the Educational and Research Institute of Innovation, Nature Management and Infrastructure, West Ukrainian National University (Ternopil, Ukraine). Head of projects on the sustainable development of the energy sector, development of environmentally friendly entrepreneurship, climate innovation and "green" economy, innovative development of energy enterprises. ORCID no. 0000-0002-4277-5213.

Olena Borysiak – PhD in Economics, expert on the organizational support for the implementation of the adaptation measures to climate change in energy policy, the peculiarities of personnel management and marketing at green energy, energy service companies, agriculture and transport. Head of the Educational and Research Center of Innovative Development and Training at the Educational and Research Institute of Innovation, Nature Management and Infrastructure, West Ukrainian National University (Ternopil, Ukraine). Postdoctoral study on Management, West Ukrainian National University. Coordinator of projects on the climate management, energy security under the Programme Erasmus+. ORCID no. 0000-0003-4818-8068.

Karolina Mucha-Kus – PhD in Economics, Assistant professor at the Department of Management at WSB University. A graduate of doctoral studies at the University of Economics in Katowice and post-graduate studies at the AGH University of Science and Technology in Kraków in the fields of Gas Market and Nuclear Power Industry. Her doctoral thesis was awarded in the international PROGRES3 competition for the best PhD dissertation VSB – Technicka Univerzita Ostrava, Czech Republic. Experience in Project Management – acting as Steering Committee Member, Project Manager, Project Team Member. Fields of scientific interests: strategic management, coopetition, project management, public administration management, new mobility, electricity and gas market. ORCID no. 0000-0002-7806-8916.

Nataliia Pavlenchyk holds a doctorate in economics. Professor and head of the Department of Economics and Management at Ivan Boberskyi Lviv State University of Physical Culture. She is responsible for the Management PhD curriculum and also works as an academic lecturer. Her scientific interests are mainly focused in the field of management, functioning of business structures, cooperation, functioning of the agricultural market. She is the author of more than 170 scientific works and works as a reviewer for several scientific journals indexed by WOS and SCOPUS. Member of the Ukrainian Association for the Development of Management and Business Education. ORCID no. 0000-0001-6164-5644.

Anatolii Pavlenchyk – Ph.D., Associate Professor of the Department of Informatics and Kinesiology of Ivan Boberskyi Lviv State University of Physical Culture. Works as a teacher. The author of more than 100 scientific works in the field of economics, the functioning of the agricultural market, the efficiency of enterprises, statistics, and management. Member of the Ukrainian Association for the Development of Management and Business Education. ORCID no. 0000-0002-2205-1883.

Yaroslava Moskvyak – PhD in Economics, Associate Professor of the Department of Tourism, the Lviv Polytechnic National University. Her scientific interests are mainly focused in the field of tourism business, hotel and restaurant business. ORCID no. 0000-0003-3147-0251.

Grzegorz Kinelski – PhD in Economics, Assistant professor at the Department of Management at WSB University. MBA, M.Sc., Dipl.-eng. Master of Company Management, Electrical Engineer, Master of Project Management. He is the author over 50 scientific publications in the field of economics and management. He conducts didactic classes at the Poznan University of Economy and WSB University in the field of management sciences and economics. Professional in Energy market holding high managerial positions in the leading Energy companies in Poland. Fields of scientific interests: Area I: Management of sustainable development in the digital economy, including the transfer of knowledge in the idea of Industry 4.0, Smart City and changes in the efficiency and competitiveness of energy enterprises. Area II: Management of an Energy Enterprise with the use of cognitive technologies in relation to the circular economy, in enterprises of the electricity subsector. ORCID no. 0000-0002-5768-463X.