DOI: 10.55643/fcaptp.1.54.2024.4227

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Received: 26/10/2023
Accepted: 11/01/2024
Published: 29/02/2024

FORMALIZATION OF THE INFLUENCE OF EXOGENOUS AND ENDOGENOUS PROCESSES ON THE FINANCIAL ACTIVITIES OF AGRIBUSINESS ENTERPRISES

ABSTRACT

The functioning of business structures in the agricultural sector has recently become significantly more complicated. In today's conditions, it is becoming more and more difficult to develop security strategies for agribusiness enterprises, because factors that have arisen relatively recently, especially of an external nature, have a significant negative impact on the financial activities of enterprises. In order to make optimal financial decisions, the entire toolkit, developed and tested by many years of business experience in the agricultural sector both abroad and in the middle of our country, should be used. One of these methods is economic descriptive cognitive modeling, which allows to analyze external and internal factors influencing the activities of enterprises, evaluate the strength of their interaction, and graphically display cause-and-effect relationships in a dynamic system. The method of cognitive modeling was studied in order to formalize the influence of exogenous and endogenous processes on the financial activity of agribusiness enterprises. As a result of the research, the components of the development of enterprises in the agricultural sector were analyzed from the standpoint of ensuring the efficiency of their financial activities using cognitive modeling. A matrix of causality and a cognitive map of the influence of a number of factors on the target component "financial activity of the agribusiness enterprises" were built. Impulse modeling of the influence of given concepts was carried out. The results of the conducted cognitive modeling of the influence of factors can be used to develop a safe strategy for the sustainable development of enterprises of other industries in the conditions of dynamic changes. The application of the cognitive approach made it possible to foresee various processes of development of situations in this system that may arise in it under the expected influence of various factors, as well as the influence of regulatory and control systems.

Keywords: financial activity, agribusiness, complex system, cognitive modeling, components, data verification, management decision

JEL Classification: G32, D81, C53

INTRODUCTION

Doing business in modern conditions has become much more complicated, which leads to the deterioration of the financial performance of the vast majority of enterprises and a decrease in their competitiveness. The effectiveness of the activity of any enterprise is determined by a number of external and internal factors, the possibilities of business structures to take into account their influence, and make reasonable management decisions. This requires high-quality information and analytical support. The activities of domestic companies are characterized by significant inconsistencies between economic development and socio-ecological requirements, which determines their significant social and man-made burden on employees and the surrounding natural environment. Currently, the business environment is weakly structured, where the parameters and patterns of enterprise development are mostly described by qualitative characteristics, and the dynamics of changes in the conditions of the situation are difficult to predict in terms of the parameters of its internal structure.

Managerial decisions in the absence of reliable quantitative information are made by analysts thanks to experience and intuition. As a model of a dynamic situation for decision-making, a subjective model is used, which is based on expert assessments, that is, on knowledge and practical competencies. The inconsistency of the modern operating conditions of agribusiness enterprises requires the use of methods that allow identifying strategic directions of financial activity, reducing the level of uncertainty in the development of events, conducting scenario forecasting of the development of a problematic situation with an appropriate set of interdependent factors, and adequately formulating target guidelines Combining theoretical and scientific knowledge with the experience of qualified experts in the field of financial activity, as well as the creative potential of decision-making managers, allows a cognitive approach, which is at the heart of the construction of such research methods.

LITERATURE REVIEW

The system-situational approach is actively used by scientists and analysts in the study of the financial activity of agribusiness enterprises, the influence of factors on production and economic processes, economic and environmental phenomena, and management problems at the level of independent economic entities. According to the system approach, there are opportunities to carry out a comprehensive study of the business structure as a complex object, considering it as a single integrated system. The cognitive approach is a sequential multi-stage algorithm in which three main stages are distinguished. The first of them is the development and display of the system structure in the form of a cognitive model of the appropriate complexity. As an example, we can cite the mathematically simplest model – a cognitive map in the form of a sign-oriented graph. The second stage consists of the analysis of connectivity, complexity, and stability, that is, the properties of the cognitive model. In the third stage, a scientific prediction of the possible future of the system takes place. This includes the modeling of possible scenarios of the development of processes in the system based on a cognitive model.

Therefore, the use of cognitive simulation modeling of complex systems provides an opportunity to use a set of methods for activating the processes of thinking, cognition, perception, explanation, and understanding when solving management tasks.

Axelrod, R. (1976) proposed the methodology of using a cognitive approach in the management of weakly structured systems, scenario modeling, and decision-making in difficult-to-predict situations. In his opinion, fuzzy cognitive maps, in contrast to ordinary cognitive maps, integrate the power of fuzzy logic into their structure. FCMs have proven to be a good tool for modeling complex systems due to their addressability uncertainty and increase the accuracy of the data set.

The connection between the definition of the standard differential equation dynamic system and multifaceted dynamic installation is studied in detail in the works of scientists (Atkin, R. & Casti, JL. 1977). They demonstrate that the complex associated with the linear system provides a very vivid paradigm within which new interpretations are opened and closed control laws are possible.

The process of systems thinking, that is, consciously organized thinking using system ideas, is very relevant to the problems of work in the MIS field. Some problems encountered and solved during the development of systems thinking itself (Checkland, P. 1981). He formalized separate definitions of hard and soft systems to develop systems thinking about complex processes, naming his scientific approach and his own concept as "Soft Systems Methodology" (SSM).

Systems thinking as a set of relevant knowledge first arose in biological research. Later, it spread to other fields, such as physics, cybernetics, information technologies, psychology, community development, and management. Currently, some scientists consider cognitive modelling as a form of "soft operational research" (soft OR). Often this approach is better known as the "problem structuring method" or PSM. Both approaches used to deal with complex (e.g., messy) situations (Eden, C. 1988).

Richmond (1997) states that there are seven critical skills that are essential for a systems thinker. He refers to them as dynamic thinking, closed-loop thinking, generic thinking, structural thinking, operational thinking, continuum thinking, and scientific thinking.

Kosko, B. (1986) proposed an approach that was based on the use of fuzzy cognitive maps and a soft computing technique based on human reasoning. Fuzzy cognitive maps (FCMs) can structure virtual worlds that change with time. FCM relates causal events, values, goals, and trends in a dynamic system with fuzzy feedback. In such models, knowledge of common sense is connected with the geometry of the state space. FCM connects fuzzy rules or causal flow paths that link events. Complex FCMs can create virtual worlds with "novel" or chaotic equilibrium behavior. Simple FCMs create virtual worlds with periodic behavior (Dickerson, J. & Kosko, B., 1998).

There are different ways of thinking about systems (Checkland, P. 2000). He argues that "Soft" systems tend to contain defined and identifiable elements, such as processes, strategies, outcomes, or other characteristics, about which there is a non-agreed position of stakeholders. "Hard" systems should be considered organized systems with a set of elements and goals, regarding which the position of interested parties is agreed upon.

Therefore, the features and unique characteristics of systems thinking have been studied in various settings for a long time (Davidz, H.L., & Nightingale, D.J., 2008; Frank, M., 2010).

In Ukraine, scientific studies of complex systems using systems thinking and cognitive approaches to their analysis are based mainly on foreign developments and widely available FCM software packages, and are related to the development of the theory and practice of evaluating complex decision-making systems (Kyzym M.O., Pylypenko A.A. & Zinchenko V.A., 2007; Yaldin, I., 2011; Tkachenko, O., 2019) and software packages (Rumyk, I., 2021), in particular, in long-term forecasting of the situation by modeling methods in the digital economy (Tkalenko, S., Sukurova, N. & Honcharova, A., 2020; Mihus, I., Denysenko, M., Rumyk, I., Pletenetska, S., Laptiev, M. & Kupriichuk, V., 2021; Pylypenko, O., Matviienko, H., Putintsev, A., Vlasenko, I. & Onyshchuk, N., 2022); in the agricultural sector (Patyka, N., Khodakivska, O., Pronko, L., Kolesnyk, T., Klymchuk, O., Kamenschuk, B. & Zayed, N.M., 2021; Seheda, S., 2020). At the same time, it should be noted that there are practically no Ukrainian software complexes available in the public domain, they are in demo versions or are available only for special institutions. This means the impossibility of their wide application, because paid access significantly rejects interesting scientific research in various fields. Despite such a significant drawback in the presence of a significant number of specialized IT specialists, cognitive situational modeling is a good tool open to specialists and experts in various fields of science, which allows for building models, the research results of which are quite simply interpreted in practice. With the help of systems thinking approaches, it is possible to create structural-systemic and simulation modeling.

Therefore, the use of cognitive approaches allows for identifying and reconciling contradictions that objectively exist between the perspectives of a complex system. The basis of this process is the cognitive-target structuring of knowledge, which includes information about the system, its external and internal environment, architecture, and interaction parameters of incoming participants. System thinking and structuring of knowledge make it possible to ensure a balance between conflicting goals and target values of indicators, to bring scenario measures to specific performers.

AIMS AND OBJECTIVES

The purpose of the article is to study the methodology of cognitive modeling of weakly structured complex economic systems to formalize the influence of exogenous and endogenous processes on the financial activities of agribusiness enterprises in order to choose optimal management solutions.

METHODS

The methodological basis of the study was a cognitive modeling method based on the Fuzzy-logic Cognitive Mapping (FCM) software package, which allowed for determining the factors affecting the system, the connections between them, and building a predictive model in the form of a cognitive map.

The methodology for constructing clear models of cognitive maps implies a weighted directed graph $Q = (V, G)$, where $V = \{1, 2, \ldots j \ldots, v\}$ is the set of vertices that is a set of concepts (factors) that describe the state of the simulated situation or the system under study. In the process of taking on various management tasks, impulse influences when analyzing cognitive maps can be divided into simple and complex. Simple influences - the initial impulse is set for only one concept, complex influences - the initial impulses are set for several concepts. Changes in controlled concepts most often serve as impulses for the cognitive model (Roberts, F. 1976).

The methodology for constructing fuzzy models of cognitive maps also implies a weighted oriented graph $Q = (K, G)$, where $K = \{1, 2, \ldots, k\}$ is a set of vertices, which is a set of concepts (factors) describing the state of the simulated situation or system under study. The values of concepts K_i, $i = 1, \ldots, k$ and concepts K_j, $j = 1, \ldots, k$, are represented by fuzzy sets $\sim Ki$ and $\sim K_j$ as collections of ordered pairs. The set of arcs $G \subseteq K \times K$ reflects the cause-and-effect relationships between concepts (factors) and their influence on each other. The set of influence relations between all concepts of fuzzy cognitive maps is given by a matrix of fuzzy binary relations (Roberts, F. 1976).

In our work, the research design (methodology) involves the following four main stages:

DOI: 10.55643/fcaptp.1.54.2024.4227

1. *First:* development and display of the structure of the system (formulation of research goals and objectives; study of financial support of agro-industrial complex enterprises as a socio-economic system; formation of an information base, analysis, and systematization of collected data).
2. *Second:* construction and analysis of the correspondence matrix (analysis of external and internal components of influence on the target indicator and their mutual influence on each other).
3. *Third:* analysis of cognitive model properties and implementation of the computer model (selection of an instrumental modeling environment, creating a model in a computer environment, data entry, conducting a computer experiment, and checking the adequacy of the model).
4. *Fourth:* modeling of possible scenarios of the development of processes in the system based on a cognitive model (scientific prediction of a possible future system).

RESULTS

Structuring of knowledge about the object of research and the external environment

When structuring is carried out, identification of the most essential (basic) factors - concepts that characterize the interaction of the object and the external environment, and the identification of qualitative cause-and-effect relationships between them, namely, what interactions take place between concepts in the process of their change. Factors that meaningfully fill the complex system and describe the investigated situation, financial support of enterprise activities, are entered into the research algorithm using a set of factors - F={fi}.

The algorithm for carrying out the cognitive-target structuring of knowledge about the object and the external environment is detailed in works Rumyk, I. (2020) and Pylypenko, O. & Rumyk, I. (2022).

In the first stage of research, we will provide a system of concepts selected by us based on the application of the method of expert evaluations of enterprise development concepts from the standpoint of ensuring its financial activity. Twelve elements of the model base, which have a multidirectional impact on the general state of the system and on each other, have been selected from a multitude of factors to ensure the effective development and profitability of agribusiness enterprises (Table 1).

Table 1. The system of components of enterprise development from the standpoint of ensuring its financial activity.

Conventional designation of the component	Component name	The value of the component in ensuring the financial activity of the agribusiness enterprise
External factors		
X1	The presence of a brand (local, regional, global) and a positive image	Stable development and the availability of prerequisites for increasing the production of goods and providing services for updating the assortment and increasing sales volumes
X2	Availability of infrastructure and a developed institutional environment	Ensuring rapid development, modernization of production, and improvement of activity efficiency
X3	Development of the labor market	Creation of new jobs
X4	Development of the transport and logistics network	Opportunities to reduce sales costs and increase profitability
X5	Percentage of budget expenditures for infrastructure development	Ability to maintain and develop infrastructure at a given level
X6	The level of bureaucracy and corruption	The presence of obstacles to the implementation of management tasks
X7	Favorable investment climate and innovation	Attracting significant financial resources using modern high-performance and low-cost technologies
Internal factors		
X8	Availability of diversified sources of financing	Provision of financial resources in sufficient volumes for the implementation of entrepreneurial activities
X9	The price of goods and the cost of services for consumers	Availability of quality goods and services to the vast majority of consumers
X10	Competitiveness	Financial stability and profitability
X11	Availability of developed sales channels	Ensuring the quick sale of goods and services and satisfaction of consumer needs
X12	Risks of doing business	Financial stability and security of business activity

The analyzed components of external and internal influence on the financial activity of the agribusiness enterprise and their influence on the general state of the system and on each other are predictive. Exogenous and endogenous processes are not stable; they are constantly in dynamics (Bondarenko, V., Martynova, L., Chorna, N., Sukhorebra, T. & Seheda, S. 2019; Tkalenko, S., Melnyk, T. & Kudyrko, L., 2021). Therefore, it should be concluded that the choice of concepts-factors and their interpretation regarding the influence on the financial activity of agribusiness enterprises may differ depending on the position of the expert who chooses them, evaluates them, and conducts a study of the effect of cause-and-effect relationships on the selected weakly structured complex system.

Based on the creation of models of the subject area and the corresponding structuring of existing knowledge, as well as his own understanding of the model basis, the expert forms a preliminary idea of the investigated situation about the object of research or its interaction with the environment. When making decisions in unstructured situations, the analyst can determine the most influential factors and establish cause-and-effect relationships between them, ensure balance between all conflicting goals and target values of relevant indicators.

Building the adjacency matrix and establishing relationships between the selected components

Checking the structural properties of the cognitive model and the properties of its stability showed that the model is consistent with the real system. An experimental plan for constructing an adjacency matrix was developed and a study was conducted to model the influence of twelve different external and internal components on the development of the situation in this model (process propagation of the disturbance along the graph with known initial values X(0) at all vertices). Rumyk, I. (2020) recommended to compensate the subjectivity of the approach to the selection of components of impact on the system and its overall assessment through a repeated verification procedure based on the principle of multiple generation of cases.

The cases were modeled using the given model of impulse processes when disturbances were introduced - positive $w_i = +1$ or negative $w_i = -1$ impulses into one, two or more vertices; the set of disturbance impulses (disturbance vector) in each scenario is defined as $W = \{w_1, w_i, w_n\}$. The number of modeling steps n in a computational experiment is not limited; Pulse modeling can continue until the nature of the change trends (constant value, increase, decrease, oscillation) appears at all vertices.

Table 2 shows the results of research on the influence of the selected twelve components on the financial activity of agribusiness enterprises, as well as the cause-and-effect relationships between them. When composing the elements of the matrix, the reversibility of the influence of factors was taken into account, the positive value of which can have a positive effect in some situations, and a negative effect in others. In any case, the target indicator of the system should be to increase the financial activity of agribusiness enterprises.

Table 2. Matrix of causality and directions of influence of the components of the model on the financial activity of the agribusiness enterprise.

Vertex-elements	Components that affect	Exposed components											
		External factors						Internal factors					
		X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12
External factors													
X1	The presence of a brand (local, regional, global) and a positive image	X	+1	+1	+1	-1	-1	+1	0	-1	+1	+1	-1
X2	Availability of infrastructure and a developed institutional environment	0	X	+1	+1	0	0	+1	0	-1	+1	+1	-1
X3	Development of the labor market	0	0	X	0	0	0	-1	0	+1	0	0	+1
X4	Development of the transport and logistics network	0	+1	0	X	0	-1	+1	0	-1	+1	+1	-1
X5	Percentage of budget expenditures for infrastructure development	0	+1	0	+1	X	0	+1	0	-1	+1	+1	-1
X6	The level of bureaucracy and corruption	-1	0	0	0	0	X	-1	0	0	-1	-1	0
X7	Favorable investment climate and innovation	0	0	0	0	0	0	X	+1	-1	+1	+1	-1

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DOI: 10.55643/fcaptp.1.54.2024.4227

Table 2. Continued

Vertex-elements	Components that affect	Exposed components											
		External factors						Internal factors					
		X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12
Internal factors													
X8	Availability of diversified sources of financing	0	0	0	0	0	-1	+1	X	-1	+1	+1	-1
X9	The price of goods and the cost of services for consumers	0	0	0	0	0	0	0	+1	X	-1	-1	+1
X10	Competitiveness	0	0	0	0	0	0	+1	+1	-1	X	+1	-1
X11	Availability of developed sales channels	0	0	0	0	0	0	0	+1	-1	+1	X	-1
X12	Risks of doing business	0	0	0	0	0	+1	-1	-1	+1	-1	0	X

Table 2 proves that the elements of the model base determine the peculiarities of the structuring of a complex system. However, any integrated structure must have life goals (formalized mission and vision), coordinated with its architectural structure. First of all, by characterizing the elements of the system, note that since the main driving force of development is the presence of contradictions, it is necessary to have a toolkit for identifying and solving such contradictions. Defined in Table 2, components of the proposed model base are focused specifically on defining approaches to the reconciliation of contradictions, with the search for the most optimal scenario from the point of view of achieving goals.

The matrix of interrelationships of the model parameters is represented by the adjacency matrix of the system of financial activity of the enterprise, where +1 is an increase (decrease) in the value of factor Xi, which causes an increase (decrease) in the value of factor Xj; -1 – an increase (decrease) in the value of factor Xi leads to a decrease (increase) in the value of factor Xj; 0 – the connection between factors Xi and Xj is absent or weak.

Construction of a hypothetical cognitive map

The creation of a visual mapping with the establishment of maximum and minimum boundaries between external and internal concepts was performed on the basis of data obtained from the adjacency matrix. The constructed hypothetical graphical cognitive map of the influence of components on the target component "financial activity of enterprises" within the framework of the methodology of "soft" system analysis was performed using a mixed approach and is able to most likely explain the dynamics of its development (Figure 1).

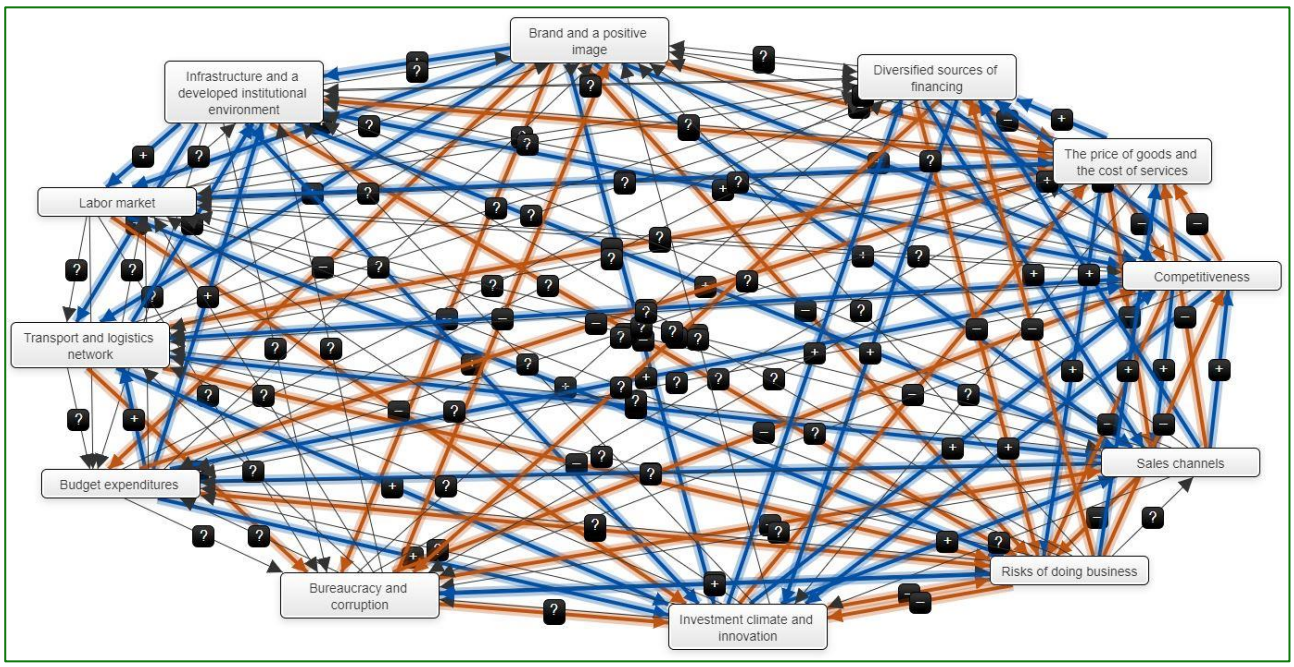

Figure 1. Cognitive map of modeling the financial activity of the enterprises. *(Source: authors' development based on FCM software)*

The essence of the mixed approach to building a cognitive map is that the expert exercises partial control over the process, there is the possibility of changing and supplementing the data manually. However, it provides the possibility of processing a large amount of data, the mathematical validity of the map elements is present, constant updating of information, and availability of various data sources.

Factors that actively affect the system can be represented by the role of their influence. The most significant external factors affecting the "financial activity of the enterprises" system of the cognitive map are X1 – the presence of a brand (local, regional, global) and a positive image, X2 – the presence of infrastructure and a developed institutional environment, X5 – the percentage of budget expenditures for infrastructure development (See Table 2). Among the internal factors affecting the "financial activity of the enterprise" system of the cognitive map are X8 – the presence of diversified sources of financing, X10 – competitiveness (See Table 2).

After the hypothetical cognitive map is built, you can proceed to the next stage - to solving scenario analysis problems. Scenarios make it possible to analyze and plan non-standard situations, make it possible to understand under what conditions a favorable or unfavorable situation may arise, and help to evaluate how it is necessary to influence the processes. Scenario modeling helps to characterize the data situation in the present time, show the behavior of processes. Defining trends and changes in the state of financial activity of agribusiness enterprises will allow to study the processes of development as the system as a whole, as well as by its individual components.

Carrying out scenario modeling

Yatsukh, O. (2018) noted that the magnitude of the momentum at the top of Xi at time t is described by the function:

$$U_i (t+1) = U_i (t) + \sum f (V_j, V_i)\, p_j (t) \quad (1)$$

where $p_j(t)$ depends on the sign of the arc connecting x_i and x_j and is equal to 1; $Ui(t+1)$ and $U_i(t)$ – the value of the i-th factor at the moment of time t+1 and t, respectively, $p_j(t)$ – the change in the vertex x_j at the moment of time t (increment), the numerical value of the vertex is equal to 1;

$n = 1 \div 12$, $f (V_j, V_i)$ – weight of influence of factor x_j on x_i;

$j \in I$, I_i is the number of factors that directly affect factor x_i.

We will obtain the results of the simulation of the impulse process of the corresponding scenario of introducing disturbances to the received levers.

Active vertices mean factors – potential levers of influence on the system: external – X1 (the presence of a brand (local, regional, global) and a positive image), X2 (the presence of infrastructure and a developed institutional environment) and X5 (the percentage of budget costs for infrastructure development); internal – X8 (the presence of diversified sources of financing) and X10 (competitiveness) (see Figure 1).

We will conduct a step-by-step scenario analysis of the growth of five selected external and internal components that have the greatest impact on the model under study, under the condition of their maximum growth to $f_i \in +1$.

The results of the influence of the external component X1 – "the presence of a brand (local, regional, global) and a positive image" on the target element "financial activity of the enterprises" are shown in Figure 2.

DOI: 10.55643/fcaptp.1.54.2024.4227

	Component	+/-	Pre-ferred State	Actual State
□	Brand and a positive image	1		
■	Infrastructure and a developed institu-tional environment			Increase
■	Labor market			Increase
■	Transport and logis-tics network			Increase
■	Budget expenditures			Decrease
■	Bureaucracy and cor-ruption			Decrease
■	Investment climate and innovation			Increase
■	Diversified sources of financing			
■	The price of goods and the cost of ser-vices			
■	Competitiveness			
■	Sales channels			
■	Risks of doing busi-ness			

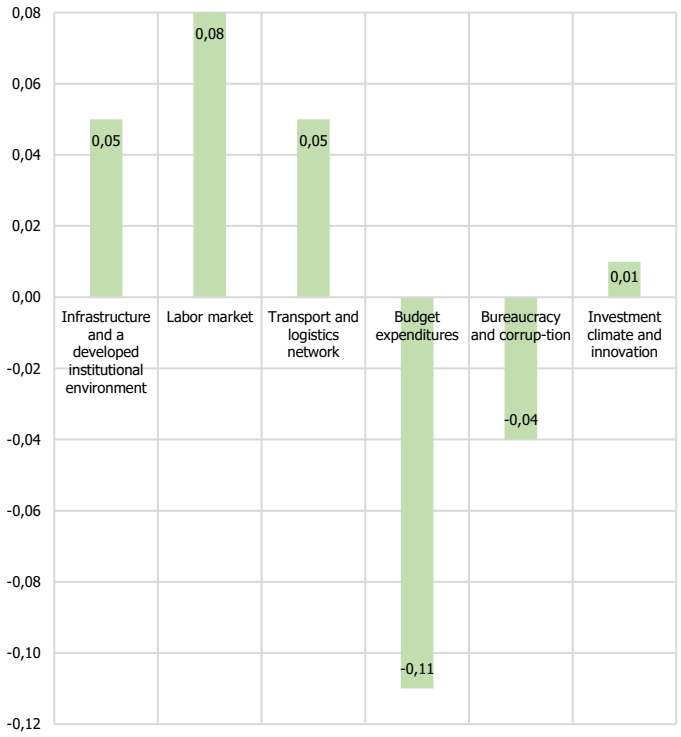

Figure 2. Study of the influence of the X1 component on the behavior of the model. *(Source: authors' development based on FCM software)*

To component X1, we add external component X2 – "the presence of infrastructure and a developed institutional environment" and the results of the impact on the target element "financial activity of the enterprises" are shown in Figure 3.

	Component	+/-	Pre-ferred State	Actual State
□	Brand and a positive image	1		
□	Infrastructure and a developed institu-tional environment	1		
■	Labor market			Increase
■	Transport and logis-tics network			Increase
■	Budget expenditures			Decrease
■	Bureaucracy and cor-ruption			Decrease
■	Investment climate and innovation			Increase
■	Diversified sources of financing			
■	The price of goods and the cost of ser-vices			
■	Competitiveness			
■	Sales channels			
■	Risks of doing busi-ness			

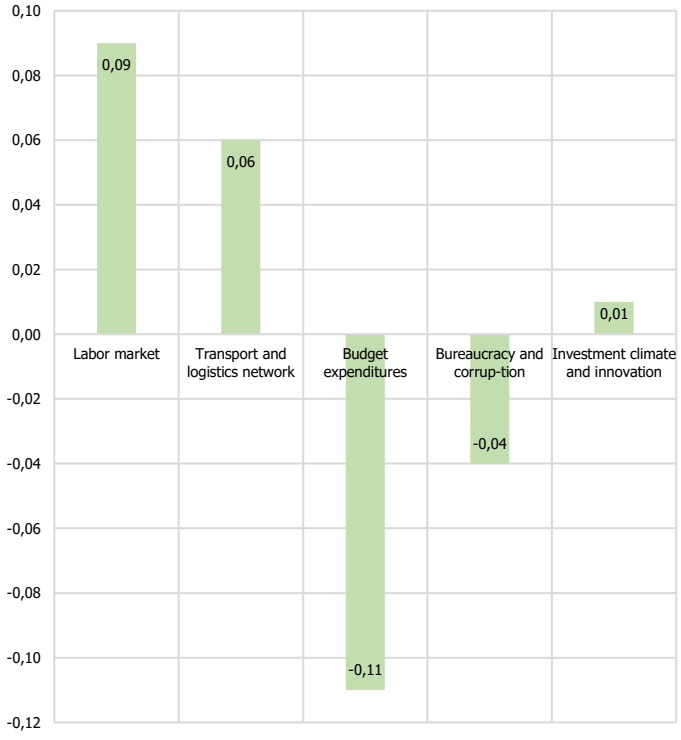

Figure 3. Study of the influence of components X1 and X2 on the behavior of the model. *(Source: authors' development based on FCM software)*

To the components X1 and X2, we add the external component X5 – "the percentage of budget costs for infrastructure development" and the results of the impact on the target element "financial activity of the enterprises" are shown in Figure 4.

	Component	+/-	Pre-ferred State	Actual State
□	Brand and a positive image	1		
□	Infrastructure and a developed institu-tional environment	1		
■	Labor market			Increase
■	Transport and logis-tics network			Increase
□	Budget expenditures	1		
■	Bureaucracy and cor-ruption			Decrease
■	Investment climate and innovation			Increase
■	Diversified sources of financing			
■	The price of goods and the cost of ser-vices			
■	Competitiveness			
■	Sales channels			
■	Risks of doing busi-ness			

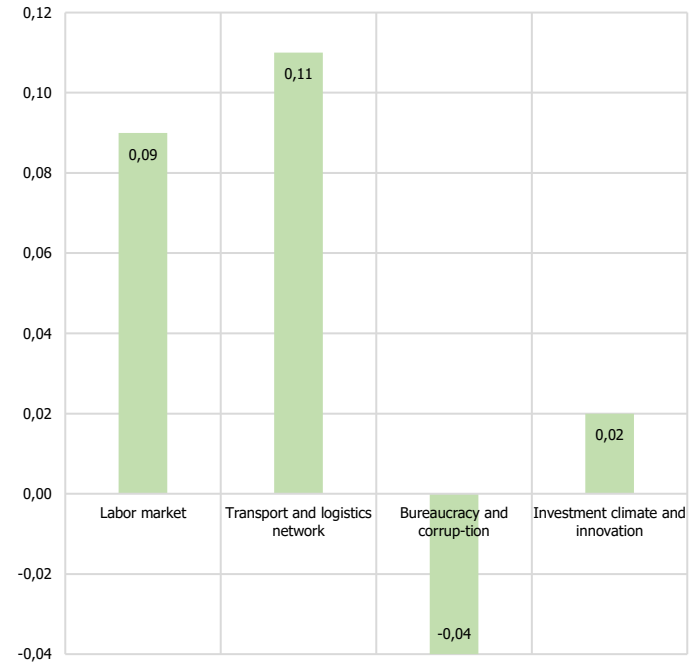

Figure 4. Study of the influence of components X1, X2, and X5 on the behavior of the model. *(Source: authors' development based on FCM software)*

To the external components X1, X2, and X5, we add the internal component X8 – "the presence of diversified sources of financing" and the results of the impact on the target element "financial activity of the enterprises" are shown in Figure 5.

	Component	+/-	Pre-ferred State	Actual State
□	Brand and a positive image	1		
□	Infrastructure and a developed institu-tional environment	1		
■	Labor market			Increase
■	Transport and logis-tics network			Increase
□	Budget expenditures	1		
■	Bureaucracy and cor-ruption			Decrease
■	Investment climate and innovation			Increase
□	Diversified sources of financing	1		
■	The price of goods and the cost of ser-vices			
■	Competitiveness			
■	Sales channels			
■	Risks of doing busi-ness			

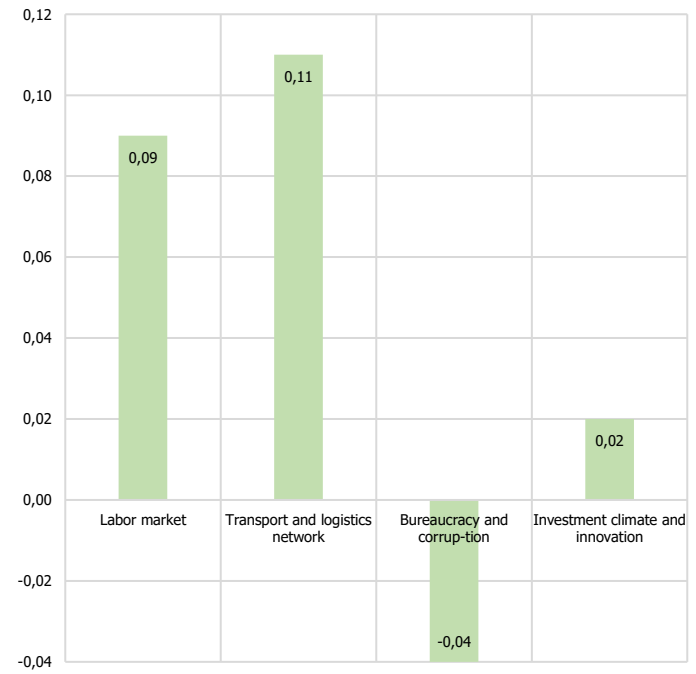

Figure 5. Study of the influence of external components X1, X2 and X5 and internal X8 on the behavior of the model. *(Source: authors' development based on FCM software)*

DOI: 10.55643/fcaptp.1.54.2024.4227

To the components X1, X2, X5, and X8, we add the internal component X10 – "competitiveness" and the results of the impact on the target element "financial activity of the enterprises" are shown in Figure 6.

	Component	+/-	Pre-ferred State	Actual State
□	Brand and a positive image	1		
□	Infrastructure and a developed institu-tional environment	1		
■	Labor market			Increase
■	Transport and logis-tics network			Increase
□	Budget expenditures	1		
■	Bureaucracy and cor-ruption			Decrease
■	Investment climate and innovation			Increase
□	Diversified sources of financing	1		
■	The price of goods and the cost of ser-vices			
□	Competitiveness	1		
■	Sales channels			
■	Risks of doing busi-ness			

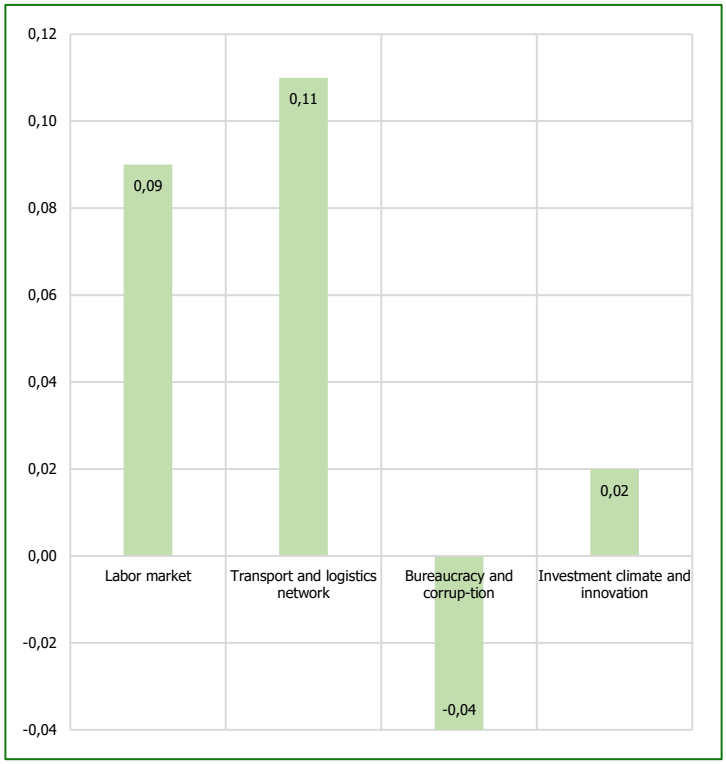

Figure 6. Study of the influence of external components X1, X2, and X5 and internal X8 and X10 on the behavior of the model. *(Source: authors' development based on FCM software)*

Graphs of the impulse processes of all five scenarios, which were generated using an incremental approach, revealed a tendency for the constant growth of the largest components X3 - "Development of the labor market"; X4 – "Development of the transport and logistics network"; X7 - "Favorable investment climate and innovation"; and the reduction of component X6 - "The level of bureaucracy and corruption".

Thus, even based on the results of the above scenarios, simulating possible processes in the system under study, a number of conclusions can be drawn at a qualitative level that does not contradict theoretical assumptions about the behavior of the complex "financial activity of enterprises" system.

Based on the analysis of the received scenarios, it is possible to adjust the strategy of the financial activity of agribusiness enterprises, which will help increase the activation of financial and economic processes and simplify the task of making management decisions.

Cognitive analysis of information and implementation of modeling of the development of agribusiness enterprises makes it possible to build scenarios of its development for the near future under the conditions of activation of the manifestation of certain concepts. At the same time, the scenario can be modeled in the following main directions:

1. The scenario of unmanaged development, i.e. decentralized self-development as such – activation of the development of the analyzed object without any influence of factors on the processes taking place.
2. The scenario of managed development based on the implementation of measures to improve the efficiency of the enterprise's financial activities and on the basis of setting goals for its development (desired level).

Construction of the enterprise development scenario is possible after carrying out all procedures related to the cognitive analysis of information and cognitive modeling. The enterprise development scenario is compiled according to the specified algorithm, starting with the introduction of positive impulses and ending with the analysis of the received data and the introduction of appropriate changes to the initially accumulated cognitive structured knowledge.

DISCUSSION

Interpretation of the essence and implementation algorithms of cognitive modeling in practice has quite different approaches. In Ukraine, software products for cognitive modeling are distributed free of charge mainly in demo versions, which have significant functional limitations. In addition, the interface of some programs is quite complex, which significantly narrows the circle of users. Problem areas of existing systems of cognitive modeling of situations are too painstaking process of developing models; opinions of experts may differ from data that could be obtained in more real conditions; created models within the framework of the industry, cannot be standardized. Quantitative evaluation of the mutual influence or influence of factors (detection of the weights of the arcs of the graph) is the most important and most difficult task because cognitive modeling is used in the study of a weakly structured environment with its variability, multifactoriality, weak formalization. The adequacy of the hypothetical model is determined by the completeness of the set of initial knowledge; the model can be clarified in the process of research and application, being in itself a source of structured knowledge. Cognitive (cognitive-target) structuring of knowledge about the object and the external environment depends significantly on experts and the arsenal of methods that will be used.

CONCLUSIONS

The application of the cognitive approach and the tools of simulation cognitive modeling of complex systems to the study and modeling of scenarios for the development of a system called in this study "financial activity of agribusiness enterprises", made it possible to foresee various processes of development of situations in this system that may arise in it under the expected influence of various economic factors, as well as the influence of regulatory and control systems. The influence of various external and internal factors on the financial activities of enterprises and the choice of modeling methods is widely discussed in the scientific literature. Many foreign and domestic scientists analyze various factors, choosing a different number of components. In any case, there are quite close relationships between endogenous and exogenous processes and their impact on the financial activity of the enterprise, which is confirmed by our research.

Using the FCM methodology, twelve components of the impact on the financial activity of agribusiness enterprises were selected and investigated. The constructed adjacency matrix made it possible to identify three external and two internal components that have the most significant impact on the target component. As a result of the conducted scenario analysis, the impact on the prognostic model was investigated, and it was found that the key concepts are the availability of infrastructure and a developed institutional environment and the percentage of budget expenditures for infrastructure development. We can come to the conclusion that in our case it is infrastructure factors that have the greatest impact on the financial activity of agribusiness enterprises. When adding other components to the predictive model, the system under study practically does not undergo changes.

Further research will be related to the analysis of the impact of various external and internal factors on the target component, including other factors that were not taken into account in cognitive modeling. We believe that this technique is a powerful tool for making effective management decisions regarding the financial activities of the enterprise.

ADDITIONAL INFORMATION

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DOI: 10.55643/fcaptp.1.54.2024.4227

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FUNDING

The Authors received no funding for this research.

CONFLICT OF INTEREST

The Authors declare that there is no conflict of interest.

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ФОРМАЛІЗАЦІЯ ВПЛИВУ ЕКЗОГЕННИХ ТА ЕНДОГЕННИХ ПРОЦЕСІВ НА ФІНАНСОВУ ДІЯЛЬНІСТЬ ПІДПРИЄМСТВ АГРОБІЗНЕСУ

Функціонування підприємницьких структур в аграрній сфері останнім часом суттєво ускладнилося. У сучасних умовах усе складніше стає розробляти безпекові стратегії для підприємств агробізнесу, адже значний негативний вплив на їхню фінансову діяльність мають чинники, які виникли порівняно недавно, особливо зовнішні. З метою ухвалення оптимальних фінансових рішень слід використовувати весь інструментарій, напрацьований і апробований багаторічним досвідом ведення підприємницької діяльності в аграрній сфері й за кордоном, і в нашій країні. Одним із таких методів є економічне описове когнітивне моделювання, яке дозволяє проаналізувати зовнішні та внутрішні фактори впливу на діяльність підприємств, оцінити силу їх взаємодії, графічно відобразити причиново-наслідкові зв'язки в динамічній слабкоструктурованій системі.

У роботі досліджено методику когнітивного моделювання з метою формалізації впливу екзогенних та ендогенних процесів на фінансову діяльність підприємств агробізнесу. У результаті проведеного дослідження проаналізовано компоненти розвитку підприємств в аграрній сфері з позиції забезпечення ефективності їхньої фінансової діяльності з використанням когнітивного моделювання. Побудовано матрицю причиновості та когнітивну карту впливу множини факторів на цільовий компонент «фінансова діяльність підприємств агробізнесу». Проведено імпульсне моделювання впливу заданих концептів і визначено рівень їхнього впливу на фінансову діяльність в інтегральній моделі їх функціонування. Результати проведеного когнітивного моделювання впливу факторів на фінансову діяльність підприємств агробізнесу можуть бути використані для розробки безпечної стратегії стійкого розвитку підприємств інших галузей в умовах динамічних економічних змін. Когнітивна методологія та програмна система Fuzzy-Logic Cognitive Mapping є потужним інструментом, який дає можливість системно та всебічно проводити якісний аналіз статичних моделей за допомогою «м'якого» системного підходу до програмування, верифікувати знання, виконувати сценарне імпульсне дослідження компонентів на фінансову діяльність підприємств, що дає можливість обирати оптимальний варіант розвитку подій та ухвалювати рішення з його практичної реалізації.

Ключові слова: фінансова діяльність, агробізнес, комплексна система, когнітивне моделювання, складові, верифікація даних, управлінське рішення

JEL Класифікація: G32, D81, C53

DOI: 10.55643/fcaptp.1.54.2024.4227