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# 9 MAKING OPTIMAL STRATEGIC DECISIONS IN CONDITIONS OF WEAKLY STRUCTURED SYSTEMS USING COGNITIVE MODELING TECHNIQUES

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**ABSTRACT**

The section studies the processes of making managerial decisions using the cognitive modeling methodology, which, given the prevalence of qualitative decision-making criteria, allows to ensure the achievement of strategic goals, taking into account the similarities and differences in the influence of factors on the strategic process. Based on the results of the study, the main stages of building a cognitive model were identified, key concepts were identified and a cognitive graph was built for the strategic behavior of enterprise, taking into account the current situation for the subject of the state and the market.

The aim of this research was to build a cognitive model of managerial decision-making in conditions of semi-structured systems, subdued by the polymorphic influence of the functioning environment.

To achieve this aim, the methods of theoretical analysis, generalization and systematization were used – to build an algorithm for the application of cognitive modeling of strategic management; graphic and tabular methods – for a visual presentation of statistical material, visualization of the obtained theoretical and practical provisions; cognitive modeling – to formalize decision-making processes in the field of strategic management by building a cognitive map.

In the course of the study, the relevance of the use of cognitive modeling to substantiate optimal strategic decisions in the conditions of management systems operating on the uncertainty and polymorphism of the environment and the factors that form it was determined. It is proved that the strategic management process meets the requirements for semi-structured systems, the advantages of the cognitive modeling methodology for the strategic process are determined on the example of the situation of production of strategic changes. The construction of a cognitive map (graph) of the process of making strategic decisions in the field of production of strategic changes at mining and processing enterprises, taking into account the following concepts: goals of strategic changes; the goals of the enterprise strategy implementation; the duration of the change lag; the level of encouragement of the team of changes; threshold opportunities for strategic change; unique opportunities for strategic change; average opportunities for strategic change; sufficiency of the potential for strategic changes; resistance to change; fiduciary corporate culture. The target concepts in the model define the goals of strategic changes and the goals of the enterprise strategy. All other concepts of the model are defined as unmanageable.

The applied nature of the proposed methodology is justified by its practical application based on the actual data of the implementation of the strategic process in the conditions of the mining and processing industry of Ukraine. Based on the results of modeling the influence of the indicators of the cognitive model on the factors of managing strategic changes, it is recommended to take priority into account in the course of the implementation of managerial impact: the duration of the

lag of strategic changes; threshold level of opportunities for strategic change; the laughter of the change team. The strengths of the application of the cognitive modeling methodology for making optimal managerial decisions are determined by its universality and the possibility of taking into account subjective models of managerial situations and managerial activity in general, built on the professional (cognitive) experience of the person making a managerial decision.

KEYWORDS

Strategic management, cognitive model, strategic process concept, strategic decision, strategic changes.

## 9.1 OBJECTIVE NECESSITY AND FEATURES OF THE USE OF COGNITIVE MODELING IN STRATEGIC MANAGEMENT

Crisis phenomena in economic systems are permanent processes, the accounting of which leaves an imprint on all elements of the management cycle – assessment of the decision-making environment, determination of factors influencing the process and procedures for making managerial decisions, the behavior of persons who are authorized to make and make economic decisions, etc. Such circumstances require the use, in addition to the standard, time-tested and management practice, methods of substantiating economic decisions, the use of non-standard, non-traditional methods for established economic systems, designed to take into account heuristic, non-standard approaches to assessing a managerial decision and its consequences. Such methods not only increase the reliability and efficiency of decision-making, but also reduce the time required to consider existing alternatives, which means they shorten the management cycle and ensure the timely response to the development of a crisis situation in its varied filling of components and consequences.

One of the most effective modern methods of substantiating economic decisions under the conditions of the above conditions and limitations is the use of cognitive modeling of problem situations based on the construction of cognitive maps (graphs), which are a powerful tool not only for disaggregating the most problematic management situation for the purpose of its detailed analysis, but and carrying out a targeted synthesis of the development of its components. It is cognitive modeling that makes it possible to maximize the scenario approach and identify key economic strategies for solving a problem situation in accordance with the goals, priorities and resources of all participants in the strategic process.

An analysis of recent studies and publications devoted to the use of cognitive modeling for the analysis and forecasting of phenomena and processes in semi-structured open systems, which include, among others, socio-economic systems, has shown that there is a significant number of scientists' developments in this direction. These include: research by Axelrod, R. (1976) [1]

(analysis of decision making in various fields using cognitive maps and models); Roberts, F. S. (1986) [2] (development of the theory of fuzzy cognitive maps); Avdeeva, Z. K., Kovriga, S. V., Makarenko, D. I. (2006) [3]; Verba, V. A. (2011) [4]; Savchuk, O. V., Ladaniuk, A. P., Hrytsenko, N. H. (2009) [5] (study of the foundations of the application of cognitive models in the management process); Kadiyevskiy, V. A., Perkhun, L. P., Izosimov, O. N. (2016) [6]; Maliarets, L. M., Lebediev, S. S. (2017) [7]; Rozenberg, I. N. (2015) [8] (studying the possibilities of using cognitive models to control systems of various levels and various spheres of production and economic activity), etc. Despite the rather deep research of the cognitive modeling methodology, various aspects of the use of cognitive models for making strategic decisions of development and activities semi-structured systems in market conditions require more in-depth research and refinement.

The aim of this research is to build a cognitive model of managerial decision-making in conditions of semi-structured systems, subdued by the polymorphic influence of the functioning environment.

The modern strategic management system is going through an era of restructuring, changes in approaches to understanding both the very essence of strategy (the main basic element of strategic management) and the tools for its development, implementation and justification. Organizational design, within which the processes of development, assessment and managerial decision-making take place, requires taking into account an increasing number of factors and situations in the external and internal environment of business entities. The factors themselves are multicomponent, unstable, dynamic and often do not provide opportunities for formalized assessment. All this prompts managers to make decisions based on a scenario approach, which is based on five basic components, which can be formulated as follows:

– the environment of activity is changing, but the problems of control systems conceptually remain constant;

– in modern society there is a tendency to overestimate technological changes and underestimate the technological capabilities of supporting management processes;

– simple decision-making tools are suitable for complex management tasks;

– the basis for an effective solution – the problem is correctly and timely identified and the person's habitual thinking is canceled, is engaged in making managerial decisions;

– strategic management is a transition from expectation to action by assigning (tools, methods, results) [9].

One of the functions of strategic management is to eliminate two mistakes, which can be called «hammer risk» and «nail dream». In other words, we forget what the function of the hammer is despite the nail (the dream of the nail), or we know how to use the hammer and imagine that each problem is like a nail (the risk of the hammer). In our case, the modern strategic management system seeks to develop simple tools that can be adequate to the conditions prevailing in the business environment. However, these simple tools require the development of a balanced management approach, which, first of all, allows to correctly set management tasks and is based on the intuition of the decision maker, her experience and completeness of information [10].

One of the modern methods for solving complex strategic tasks of business entities is the method of cognitive modeling, which allows, in conditions of weak structuring of the processes of making economic decisions and the absence of stable formalized procedures for their substantiation, to ensure the transfer of the control object to the desired state, taking into account the similarities and differences in the influence of factors on this an object of administrative influence (in our case, a strategic process). Cognitive modeling allows a management task to be considered as a set of variables (factors) having different sources of origin, but at the same time they are considered as interrelated – changes in one control variable (factor) are determined through a complex set of cause-and-effect changes in a set of other control variables (factors). When using the method, two types of causal relationships are considered: positive and negative. Positive relationships determine that with the growth of the factor-cause, the growth of the factor-effect occurs. Negative relationships lead to the opposite process – a decrease in the factor-effect [2, 6].

«The cognitive approach to supporting strategic decision-making is focused on activating the intellectual processes of the subject of management and helping him to fix its view of the problem situation in the form of a formal model. As such a model, the so-called cognitive map of the situation is usually used, which represents the basic laws and patterns of the studied situation known to the subject in the form of an oriented sign graph, in which the vertices of the graph are factors (signs, characteristics of the situation), and the arcs between factors are causal relationships between factors» [2].

There are five types of cognitive maps according to the type of relationships used in the process of developing and making strategic decisions [11, 12]:

1) those that evaluate the focus of attention, associations and the importance of factors (concepts);

2) those that demonstrate the sizes of categories and cognitive taxonomies;

3) those that demonstrate the level of influence, causality and system dynamics (causal cognitive maps);

4) those that reflect the structure of the arguments and conclusions;

5) those that illustrate frames and codes of perception.

The practice of using cognitive maps by leading companies shows that for the study of semi-structured open systems, it is advisable to use maps of the third type in the strategic process, that is, causal cognitive maps [11].

## 9.2 METHODS FOR CONSTRUCTING COGNITIVE MAPS IN SEMI-STRUCTURED SYSTEMS

Cognitive modeling is based on the method of constructing a cognitive map (graph) «which is a model of experts' ideas and knowledge about the laws of development and the properties of the situation under consideration in the form of elementary semantic categories linked by relationships» [13]. The cognitive map can be presented in the following form:

$$G = \langle V, E \rangle, \tag{10.1}$$

where:

1. $V$ – the vertices of the graph, or the so-called «concepts» $V_i \in V, i = 1,2,3.....k$, which in fact are elements (factors) of the studied situation or system. In the case of strategic decisions, the concepts may include «strategy», «strategic opportunities», «strategic potential of the enterprise», etc.

2. $E$ – connections between the vertices of the graph in the form of a set of arcs $e_{ij} \in E, i, j = 1,2,.....N$, which are mutual cause-and-effect connections between the concepts of the studied situation $V_i$ and $V_j$.

3. Influence of $V_i$ and $V_j$ on the cognitive map can be of three types: positive, negative or absent (determined by the method of linguistic heuristic modeling).

## 9.3 APPLICATION OF COGNITIVE MODELING TECHNIQUES FOR STRATEGIC DECISION-MAKING IN SEMI-STRUCTURED SYSTEMS

The implementation of the approach to substantiate strategic decisions using the cognitive modeling methodology in this study will be done for the problems of implementing strategic changes in the conditions of mining and processing enterprises in Ukraine. Strategic changes are inevitable with a situation that all subjects of strategic decision-making face without exception, since an effective strategy today is a dynamic, flexible and multicomponent structure that, as a result of a number of factors, moves from one state to another target state. It is these characteristics of the strategy that determine the existence of strategic changes and make it possible to use cognitive maps (graphs) to substantiate the directions for the implementation of strategic changes. Strategic changes should be understood as the processes of strategic management aimed at achieving goals for a business entity, due to the influence of the external and internal environment, which determine the content and tools for implementing the strategy, in the current or future state, as a means of achieving these goals [14]. The main parameters for the implementation of strategic changes in the conditions of mining and processing enterprises, as the basis for constructing a cognitive map (graph) are given in **Table 9.1**.

The situation of strategic changes takes into account as much as possible the requirements for the use of cognitive modeling, namely: there is a socio-humanitarian aspect of managerial decision-making associated with the competence of persons involved in the process of making decisions on strategic changes [15], their professional skills both in implementing the cycle of strategic changes and managing team of change and resistance; strategic changes fully correspond to the factor of uncertainty, including the stochasticity of the strategic environment, the riskiness of the situation of changes, the lack of complete information and the instability of the strategic situation [4]; focus on specific conditions for the development of enterprise strategy [5].

● **Table 9.1** Basic parameters for the implementation of changes in mining and processing enterprises for 2014–2018 [14]

| Enterprise | period | | | | |
|---|---|---|---|---|---|
| | 2014 | 2015 | 2016 | 2017 | 2018 |
| **Utilization rate of the potential for strategic change (kpsc )** | | | | | |
| CJSC «Northern GOK» | 0.75 | 0.87 | 0.83 | 0.69 | 0.57 |
| CJSC «Central GOK» | 0.75 | 0.53 | 0.31 | 0.38 | 0.87 |
| OJSC «South GOK» | 0.78 | 0.81 | 0.82 | 0.64 | 0.68 |
| CJSC «InGOK» | 0.82 | 0.76 | 0.99 | 0.70 | 0.61 |
| CJSC «PoltGJK» | 0.66 | 0.60 | 0.72 | 0.77 | 0.75 |
| **Utilization rate of the unique level of opportunities for strategic change (dusc)** | | | | | |
| CJSC «Northern GOK» | 0.95 | 0.66 | 0.63 | 0.57 | 0.96 |
| CJSC «Central GOK» | 0.40 | 0.54 | 0.83 | 0.49 | 0.29 |
| OJSC «South GOK» | 0.63 | 0.55 | 0.50 | 0.59 | 0.69 |
| CJSC «InGOK» | 0.67 | 0.68 | 0.38 | 0.12 | 0.60 |
| CJSC «PoltGJK» | 0.69 | 0.90 | 0.82 | 0.58 | 0.64 |
| **Utilization rate of the threshold level of strategic change opportunities (dtsc)** | | | | | |
| CJSC «Northern GOK» | 2.44 | 1.45 | 2.39 | 5.21 | 3.32 |
| CJSC «Central GOK» | 1.04 | 1.19 | 3.16 | 4.46 | 1.01 |
| OJSC «South GOK» | 1.61 | 1.92 | 1.92 | 5.40 | 2.38 |
| CJSC «InGOK» | 1.72 | 1.72 | 1.44 | 3.84 | 2.09 |
| CJSC «PoltGJK» | 1.75 | 1.98 | 3.13 | 5.27 | 2.22 |
| **Utilization rate of the average level of opportunities for strategic change (dusc)** | | | | | |
| CJSC «Northern GOK» | 1.42 | 0.99 | 0.99 | 1.08 | 1.51 |
| CJSC «Central GOK» | 0.61 | 0.81 | 1.31 | 0.92 | 0.46 |
| OJSC «South GOK» | 0.94 | 0.83 | 0.80 | 1.12 | 1.08 |
| CJSC «InGOK» | 1.00 | 1.03 | 0.60 | 0.79 | 0.60 |
| CJSC «PoltGJK» | 1.03 | 1.35 | 1.30 | 1.09 | 2.22 |
| **The level of lability to strategic changes (L)** | | | | | |
| CJSC «Northern GOK» | 0.96 | 1.00 | 0.98 | 0.99 | 0.96 |
| CJSC «Central GOK» | 0.98 | 1.05 | 0.96 | 1.00 | 0.96 |
| OJSC «South GOK» | 0.98 | 1.01 | 0.97 | 0.97 | 1.04 |
| CJSC «InGOK» | 0.99 | 1.07 | 0.95 | 0.96 | 1.00 |
| CJSC «PoltGJK» | 0.96 | 1.02 | 1.01 | 0.95 | 1.01 |

*Source: compiled on the basis of data [16–20]*

The purpose of using cognitive modeling during the implementation of strategic changes in the activities of an enterprise is to generate and test hypotheses regarding the combination of interaction of factors for the implementation of strategic changes that can explain the dynamic directions of development (a possible vector of development) of the situation of strategic changes and the achievement of their goals.

During the production of strategic changes at the enterprise, all the signs of semi-structured systems are observed:

1) the implementation of changes is influenced by a significant range of factors, which can be defined as a set of external and internal drivers of strategic changes. At the same time, the influence of factors on the processes of strategic changes is not entirely predictable, and the connections between them are complex and dynamic;

2) the influence of factors on the process of strategic changes and the goals of strategic changes (and hence the goals of the strategy) cannot be measured quantitatively, most of them relate to qualitative factors;

3) situations of strategic changes are uncertain, multivariate and have a complex structure;

4) to assess the components of the processes of strategic changes, experts are involved, whose assessments are mainly of a qualitative, linguistic nature (due to the specifics of the factors and situations under study), are subjective.

The use of cognitive modeling of enterprise behavior in the process of implementing strategic changes in activities has a number of advantages, the characteristics of which and the features of manifestation for the implementation of strategic changes are summarized in **Table 9.2**.

Are given in **Table 9.2** data allow to actualize the practical significance of the cognitive modeling methodology for the process of implementing strategic changes in the activities of the enterprise.

Generalization of the methodological apparatus of cognitive modeling of complex systems [2, 6, 7, 13] made it possible to structure the algorithm for constructing a cognitive model for the process of implementing strategic changes in the activities of an enterprise (**Fig. 9.1**).

Thus, the algorithm for creating a cognitive model is reduced to the sequential implementation of the following stages:

1. A qualitative description of the problem situation, the introduction of strategic changes containing the structuring of the views of the change team, the change leader and the head of the enterprise about the process and the constituent elements of strategic changes in the enterprise. A prerequisite for the implementation of this stage is the study and structuring of internal and external drivers of strategic changes. The result of this stage should be the definition of a list of factors (concepts) characterizing the situation of implementation of strategic changes.

For modeling purposes, the factors should be divided into: target concepts of strategic changes – the factors of change that characterize the processes, the results and/or goals of which need to be achieved; factors that influence the target concepts of strategic changes. They can be characterized as tools, levers of influence on target concepts with the help of which the team of strategic changes can achieve the goals of changes in the conditions of the current set of drivers;

factors-indicators of strategic changes are factors and processes that provide an explanation for the dynamics of the processes of implementation of strategic changes.

● **Table 9.2** Benefits of cognitive modeling for substantiating the behavior of business entities in the process of implementing strategic changes in activities

| Benefits | Characteristic | Features of the implementation of strategic changes |
|---|---|---|
| Effectiveness in the face of limited information | Set of factors influencing the studied situation is significant, and their influence in the current strategic management system is difficult to measure. This limitation is removed by limiting the number of factors studied | The method allows to assess the factors that form the most powerful drivers of strategic changes that are important for achieving goals, the formation of key competencies and the implementation of external opportunities for change |
| Structuring a problem-solving model | Ability to assess the entire set of situations of strategic changes and organize monitoring of the selected (desired) scenario of changes | Possibility of introducing any factor into the cognitive model makes it possible to assess the ways of achieving the goals of changes in various variations in the development of resource provision of changes and the level of resistance |
| Visibility of cognitive maps and models | Presentation of only the basic factors that are most significant for the strategic change management system and the links between them | Allows to additionally take into account the subjective opinions of the change team and the change leader without reducing the quality of the decisions made |
| Taking into account the multidimensionality and interconnectedness of phenomena and processes | The cognitive map allows to identify indirect links between factors and the reasons for their formation | Expansion of tools for assessing the impact of drivers of strategic changes, their combinations and the consequences of the impact on the enterprise as a platform for changes |
| Improving the quality of produced managerial decisions | Allows to develop various scenarios for the development of events | Combination of competence-based and scenario approaches allows to cover the entire range of possible strategic changes and ways to achieve their goals |
| The dynamic nature of the connections between the elements of the cognitive map | A cognitive map is a directed graph that allows to fix the spatio-temporal relationship between factors and situations | Allows to identify variations in the lag of changes and bifurcation points of strategic changes, to provide ways to optimize them |
| Taking into account the positive and negative relationships between factors | Modeling the positive and negative influence of factors and phenomena increases the potential number of consideration of possible scenarios for the development of the research object (management problem) | In the absence of a clear interpretation of positively and negatively-minded drivers of strategic changes, cognitive modeling allows to cover a wider area of situations of change and adequately take into account the drivers of changes in the course of implementing a certain strategy |

*Source: compiled from* [*2*]

To implement this stage, heuristic expert methods are used and, in addition to members of the change team, external analysts – change agents, stakeholders, etc., can be involved. This stage is one of the most important and at the same time one of the most difficult because it is weakly amenable to formalization.

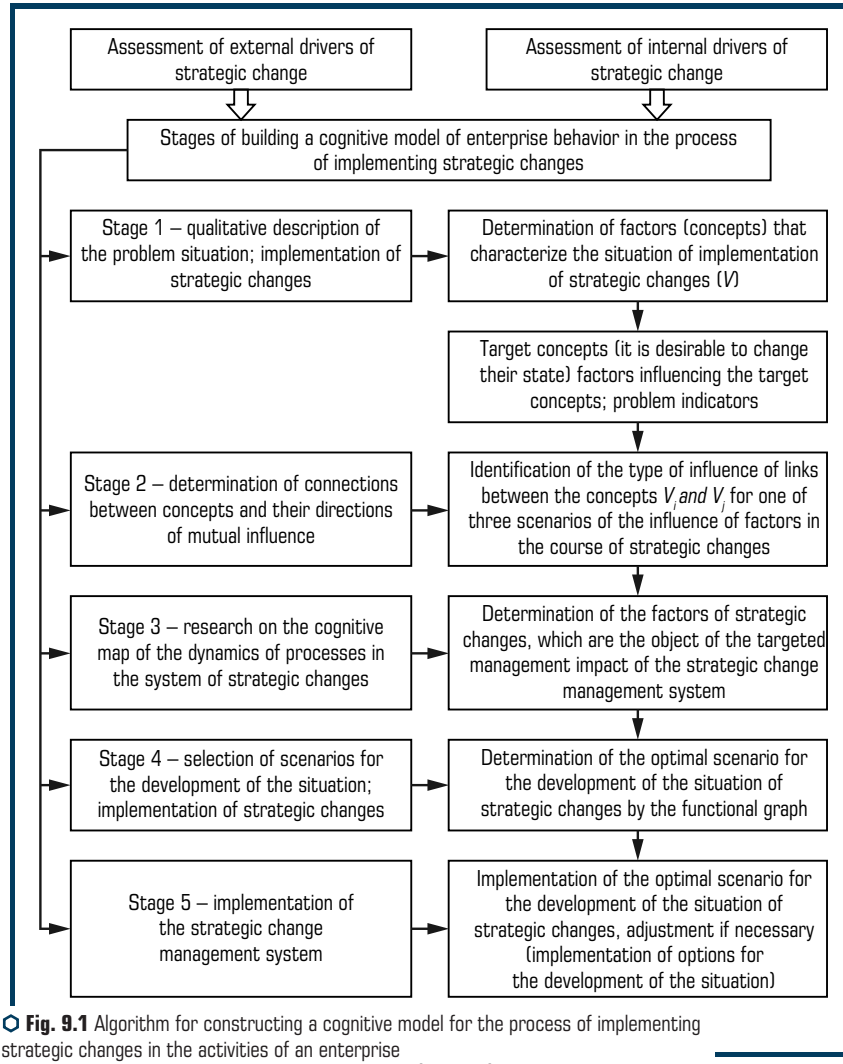


**Fig. 9.1** Algorithm for constructing a cognitive model for the process of implementing strategic changes in the activities of an enterprise
*Source: compiled by the author based on adaptation* [*6*, *7*, *13*]

2. Determination of connections between the concepts of strategic changes and the construction of cause-and-effect relationships (chains) with an indication of their polarity: positive, negative or absent. It is at this stage that a cognitive graph (cognitive map) is built that visually visualizes the connections of factors in the process of implementing strategic changes at the enterprise. At this stage, the head of the change team is able to identify pools of homogeneity of the influence of factors on each other, which increases the level of perception of strategic changes as a system of objects of management influence.

3. Research on the constructed cognitive map of the dynamics of processes (variations in the influence of factors and situations of changes) and determination of the range of factors of strategic changes, which are the object of the targeted management impact of the strategic change management system. The purpose of this stage is to determine the areas of influence of the strategic change management system on the change processes in order to optimize the change lag and achieve the set goals.

4. The choice of scenarios for the development of the situation, the introduction of strategic changes as a result of modeling the impulse process of the propagation of disturbances in the system of changes, that is, their transition from one state (scenario) to another either by evolutionary way, or as a result of a set of managerial influences from the management system and the team of strategic changes. The result of the stage is the determination of the optimal scenario for the development of the situation of strategic changes by the functional graph.

5. Implementation of the strategic change management system based on a set of managerial decisions on the implementation of the optimal scenario for the development of the situation of strategic changes.

The above stages are associated with the implementation of strategic change management at the enterprise on the basis of strategic management, but it must be borne in mind that since each situation of change is unique, the sequence of stages of cognitive modeling, their frequency and, in general, their presence, can change.

The set of factors of the cognitive model for the process of implementing strategic changes are shown in **Table 9.3**.

Among the above list of factors (concepts) for the implementation of strategic changes, two factors (concepts) were selected as target – the goals of strategic changes ($V_1$) and the goals of the implementation of the strategy ($V_2$), which should correlate with each other, but they cannot always be identified since the goals of strategic changes are in the majority cases provide for corrective actions in relation to the strategy, and therefore to its goals (in most cases – in functional components).

Among the list of factors ($V_i$), the following are recognized as manageable:

1) target factors ($V_1$, $V_2$) (concepts);

2) sufficiency of the potential for strategic changes ($V_8$). The potential for strategic changes is a set of strategic resources, competencies and internal capabilities that are accumulated and used (or can be used) in the process of implementing strategic changes by a business entity to achieve

strategic goals in a dynamic environment). The sufficiency of the potential for strategic changes is its ability to ensure the achievement of the goals of strategic changes in the specific conditions that have developed.

The controllability of these factors is related to the fact that a person makes a strategic decision, determines goals in accordance with the formed strategic potential (a set of strategic resources) of changes, which means that all three components of the strategic process are subject to its conscious impact (management).

● **Table 9.3** Factors of the cognitive model for the implementation of strategic changes in mining and processing enterprises

| Factor (concept) name | Designation ($V_i$) | Type of factor (concept) | Target |
|---|---|---|---|
| Objectives of strategic change | 1 | Guided | + |
| Objectives of the implementation of the enterprise strategy | 2 | Guided | + |
| Duration of change lag | 3 | Observable | |
| Level of encouragement of the team of changes | 4 | Observable | |
| Threshold opportunities for strategic change | 5 | Uncontrollable | |
| Unique opportunities for strategic change | 6 | Uncontrollable | |
| Medium potential for strategic change | 7 | Uncontrollable | |
| Adequacy of potential for strategic change | 8 | Guided | |
| Resistance to change | 9 | Uncontrollable | |
| Fiduciary corporate culture | 10 | Observable | |

*Source: compiled by the author*

Uncontrollable factors are defined:

1) possibility of strategic changes in their three manifestations – threshold ($V_5$) unique ($V_6$) and average ($V_7$), which generate, taking into account the capabilities of all participants in the target market (in our case, mining and processing enterprises), and therefore, a priori cannot be subject to any manager impact, since this may violate both the current antimonopoly legislation and the laws of the oligopoly market, which, in fact, is the investigated market for metal ruins of Ukraine;

2) resistance to change ($V_9$), which is carried by people involved in the strategic process, and which determines the distortions or adjustments of the goals of achieving strategic changes by the actions or inaction of the subjects of changes.

The factors that are observable in the cognitive model include:

1) duration of the change lag ($V_3$);

2) level of encouragement of the team of strategic changes ($V_4$);

3) fiduciary corporate culture ($V_{10}$), which is adopted in a business entity, which is a platform for changes or a basis for making strategic decisions.

To determine the relationship between factors (concepts) (**Table 9.4**), a dichotomous analysis was used, within which, according to a linguistic approach, the mutual influence of factors is quantitatively assessed using the values «1» for factors that have a positive, reinforcing influence on each other or «1». For factors that have a negative (inhibitory) effect on each other. It is possible to determine the value of influence «0» when there is no mutual influence of factors.

The resulting cognitive model for managing strategic changes at enterprises has the form of a cognitive graph, the vertices of which are the factors of the cognitive model, and the connections between them are defined by lines (**Fig. 9.2**).

**Table 9.4** Fuzzy cognitive matrix of adjacency of strategic change management factors in the enterprise

| Factor | $V_1$ | $V_2$ | $V_3$ | $V_4$ | $V_5$ | $V_6$ | $V_7$ | $V_8$ | $V_9$ | $V_{10}$ |
|---|---|---|---|---|---|---|---|---|---|---|
| $V_1$ | 0 | +1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| $V_2$ | 0 | 0 | 0 | 0 | +1 | 0 | 0 | 0 | 0 | 0 |
| $V_3$ | –1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| $V_4$ | +1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | –1 | +1 |
| $V_5$ | 0 | –1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| $V_6$ | 0 | +1 | 0 | 0 | +1 | 0 | +1 | 0 | 0 | 0 |
| $V_7$ | 0 | 0 | 0 | 0 | +1 | 0 | 0 | 0 | 0 | 0 |
| $V_8$ | 0 | +1 | 0 | 0 | +1 | +1 | +1 | 0 | 0 | 0 |
| $V_9$ | –1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| $V_{10}$ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | –1 | 0 |

*Source: [21]*

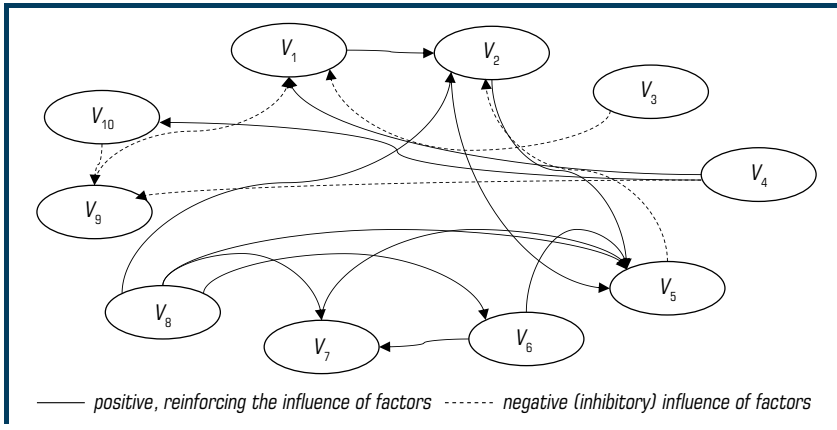


**Fig. 9.2** Cognitive map of strategic change management at mining and processing enterprises
*Source: compiled by the author*

The cognitive map for managing strategic changes in business entities shows that a positive influence in the management process can be traced between the factors: the goals of strategic changes and the goals of the strategy; goals of strategic change and support for a threshold level of opportunities for strategic change; to laugh the team of changes and the goals of strategic changes, as well as to laugh the team of changes and the fiduciary nature of corporate culture, proves the feasibility of introducing motivational measures for its formation; unique and threshold level of opportunities for strategic changes, as well as unique and average levels of opportunities for strategic changes, which is explained by their conditionality in the logical sequence of the implementation of the enterprise strategy; average and threshold opportunities for change; the sufficiency of the potential for strategic change and the goals of change, the sufficiency of the potential for strategic change and the threshold, average and unique opportunities for change.

At the same time, a negative (inhibitory) effect is observed between the factors: the duration of the lag of strategic changes and the goals of strategic changes, determines the expediency of an optimal reduction in the duration of the lag of changes in order to minimize the destabilizing effect of the drivers of changes on the process of achieving goals; encouraging the team to change and the level of resistance to change; threshold opportunities for strategic changes and the implementation of the goals of the enterprise strategy, which is associated with the need for additional search for strategic resources in the event of their change; resistance to change and goals of strategic change; fiduciary of corporate culture and level of resistance to change.

In order to move from a cognitive map to building a cognitive management model, each case of interconnections of factors (concepts) will be provided with a linguistic meaning corresponding to the type of connection between them («very high», «high», «above average», «average», «below average», «low» and «very low») and each variant of the linguistic meaning will be assigned a level of influence on the scale [0;1].

The analysis of the stability of the cognitive model of strategic change management at enterprises showed that its level corresponds to the value of 0.37 and characterizes it as medium stable. The assessment of the mutual influence on the factors (concepts) of the cognitive model of strategic change management, carried out using the capabilities of MS Excel, is shown in **Fig. 9.3**.

In the course of calculations, it was assumed that the target impact of the strategic change management system on the factors (concepts) of the model is 10 %. This made it possible to determine, taking into account the directions of the influence of factors on each other, taking into account the consonances of influence, the factors (concepts) of the model that require priority consideration during the implementation of managerial influence:

– duration of the lag of strategic changes (has a inhibitory effect on the achievement of the goals of strategic changes as a result of significant subordination (in the case of a long lag) to the destructive effects of the drivers of changes). Taking into account that the lag of strategic changes is the period of time from the detection by the strategic management system of the factor of occurrence of strategic changes until the end of the process of implementing the changes and receiving an innovation that is the result of strategic changes, then, in order to make an optimal

strategic decision, «dragging out» the processes of strategic transformations will lead to the malicious achievement of the goals of changes, and hence the goals of the strategy, which, corny, may become irrelevant in the external environment, which are stored at a certain point in time. Also, the lag of changes is determined by the research of scientists [22] as one of the options for the reaction to mines in the external and internal environment of a business entity;

| VARIABLE FACTOR | TARGET FACTOR | VALUE | CONSONANCE OF INFLUENCE |
|---|---|---|---|
| Targets of strategic change | Enterprise strategy targets | Δ ↑ 9 % | 0.5 |
| Enterprise strategy targets | Threshold opportunities for strategic change | Δ ↑ 5 % | 0.47 |
| Duration of the strategic change lag | Targets of strategic change | Δ ↓ 6 % | 1.0 |
| Change team commitment | Targets of strategic change | Δ ↑ 7.5 % | 1.0 |
| | Resistance to change | Δ ↓ 7 % | 1.0 |
| | Fiduciary corporate culture | Δ ↑ 7.5 % | 1.0 |
| Threshold opportunities for strategic change | Enterprise strategy targets | Δ ↓ 6.5 % | 0.5 |
| Unique opportunities for strategic change | Enterprise strategy targets | Δ ↓ 6 % | 0.35 |
| | Threshold opportunities for strategic change | Δ ↑ 4.5 % | 0.5 |
| | Medium opportunities for strategic change | Δ ↑ 5.5 % | 1.0 |
| Medium opportunities for strategic change | Threshold opportunities for strategic change | Δ ↑ 5 % | 0.55 |
| Adequacy of potential for strategic change | Enterprise strategy targets | Δ ↑ 8.5 % | 0.55 |
| | Threshold opportunities for strategic change | Δ ↑ 8 % | 0.5 |
| | Unique opportunities for strategic change | Δ ↑ 6 % | 1.0 |
| | Medium opportunities for strategic change | Δ ↑ 6 % | 1.0 |
| Resistance to change | Targets of strategic change | Δ ↓ 7 % | 0.65 |
| Fiduciary corporate culture | Resistance to change | Δ ↓ 7 % | 1.0 |

**Fig. 9.3** Evaluation of the results of modeling the impact of cognitive model indicators on the factors of strategic change management
*Source: compiled by the author*

– threshold level of opportunities for change (an increase leads to a distortion of the goals of change and requires a change in the focus of management towards supporting competitiveness). The threshold level of opportunities for strategic changes is the level of implementation of strategic resources, accumulated by the external environment, for the potential for strategic changes, which allows an enterprise to achieve the goals of strategic changes that can achieve (maintain) competitiveness in the market. The value and importance of control for the strategic management of this concept lies in its ability to form competitiveness and remain in an attractive strategic economic zone for the company;

– level of encouragement the team of changes (determines the course of the processes of changes and their implementation in conditions of dyspathy and fluctuation, the attitude to changes). This concept combines both resistance to change and the level of fiduciaries of corporate culture, forming an attitude towards the goals of strategic development and the goals of a specific program of strategic change.

## 9.4 INTERPRETATION OF THE RESULTS OF COGNITIVE MODELING BY THE STRATEGIC MANAGEMENT SYSTEM

Thus, the application of the cognitive modeling methodology for making strategic decisions on the example of the production of strategic changes made it possible to come to the following conclusions:

1. Making optimal managerial decisions in a crisis requires the construction of a structural description of the situation in the form of a frame or cognitive map (graph), which will ensure the quality of analysis of the problem situation and finding a strategy for its transfer from the current state to the target state.

2. The situation of the implementation of strategic changes at the mining and processing enterprises of Ukraine refers to the type of semi-structured areas and actualizes the use of cognitive modeling for the following reasons: there is a socio-humanitarian aspect of making managerial decisions; strategic changes are fully consistent with the uncertainty factor; orientation of changes in the specific conditions for the development of the enterprise's strategy and the specific conditions of activity.

3. The purpose of using cognitive modeling during the implementation of strategic changes in the activities of an enterprise is to generate and test hypotheses regarding the combination of interaction factors for the implementation of strategic changes that can explain the dynamic directions of development (a possible vector of development) of the situation of strategic changes and the achievement of their goals.

4. Based on the results of modeling the influence of the indicators of the cognitive model on the factors of strategic change management, it is recommended to take priority into account in the course of the implementation of the managerial impact of such factors: the duration of the lag of strategic changes; threshold level of opportunities for change; laugh the change teams.

5. The strengths of the cognitive modeling technique for making optimal managerial decisions are its versatility and the ability to take into account subjective models of managerial situations and managerial activity in general, based on the professional (cognitive) experience of the managerial decision maker.

The weak side of this technique is that it does not contain a universal algorithm (formula) for each specific strategic situation, it is a product of the dynamism of the modern environment of business entities and the uniqueness of each strategic decision-making situation.

An opportunity for further research is the application of the results obtained in the construction of neural development of strategic changes.

The threats to the application of the cognitive modeling methodology in making strategic decisions are the low competence of those who make strategic decisions and the uncertainty of the level of controllability of the factors involved in the process of making strategic decisions.

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