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CORPORATE STRATEGY FOR MANAGING EVOLUTIONARY PROCESSES OF THE ENTERPRISE DEVELOPMENT

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Abstract. *The method for analyzing phase portraits of bifurcation diagrams of enterprise life cycle scenario models using IT pattern recognition has been proposed, which allowed to numerically determine the geometric parameters of the spatial forms that form the surfaces of phase portraits, and their size, corresponding to the loci of stability and interaction of four populations in a network of trophic relations. To analyze the results of the recognition of phase portraits of ELC bifurcation diagrams, singular points of perturbation, attenuation, cycles, equilibrium, their stability, the input examples of the state of bifurcation have been classified into five separate clusters in accordance with the ELC development scenarios. An IT support algorithm for the corporate strategy for managing the evolutionary processes of enterprise development has been developed. It covers the following stages: analysis and evaluation of the internal and external environment of the enterprise population and trophic relations; identification of possible motives for changing trophic relations and causes of synergy; studies of the nonlinear dynamics of ELC model scenarios; analysis of many strategic alternatives; selection of a strategy and preparation of a strategic plan; monitoring the results of achieving a synergistic effect, which will allow choosing strategies depending on the ELC stages and ensuring the competitiveness of the enterprise.*

Keywords: *Mergers & Acquisitions, evolutionary model, enterprise life cycle, strategic management, bifurcation point.*

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Introduction

Today, evolutionary economic theory is actively developing in economic science. This is due to the fact that orthodox methodological approaches can no longer adequately and fully explain and predict the phenomena of social being. This process in time correlates with the intensification of research in the field of information technology (IT), and in the field of economic policy, these trends are associated with the need to modernize the socio-economic system in an unstable economic environment.

Evolutionary economic theory has made it possible to link processes in the economy with biophysics. This, in particular, is the classical model of mathematical biophysics, which describes the dynamics of the number of populations interacting on the basis of the "predator-prey" principle; the trophic chain of inter-population relations for obtaining resources (raw materials, energy, finances, labor, information, etc.), which is realized through M&A of some enterprises by others. Populations are sets of representatives of the same type of enterprises that belong to the same level of the trophic network and are characterized by limited available resources; producer population that provides raw materials; consumer population (potential competitor), which is a "predator" in relation to the "producer" and "victim" to the "predator"; "predator" population, which is an economic entity and is considered to be the top trophic level of the network.

Despite a significant contribution to the development of this problem, transformations in the economy necessitate an ongoing search for new IT approaches in research and modeling of economic processes, forecasting the synergetic effect of mergers and acquisitions (M&A), and the creation of new IT economical and mathematical modeling of the dynamics of evolutionary processes of trophic relations of enterprise populations. The outlined questions determine the relevance of the topic of the work, its theoretical and practical significance.

Literature Review

Evolutionary economics is a fairly new and promising area in economic science. In general, it is opposed to the main trends of economic theory, in particular neoclassical, that is, orthodox theory (Amankwah-Amoah, J., Boso, N., & Antwi-Agyei, I. (2018)). This confrontation is primarily in the fact that the evolutionary economy refuses an equilibrium approach, it is process-oriented.

The evolution of the economic system, is a dynamic process that occurs evolutionarily under the influence of innovations in science and technology, market needs, changes in organization and legal relations (Chen, S. H. (2017)).

Evolutionary economics, especially econophysics, is a relatively new and advanced area of economic science, capable of formalizing and predicting non-equilibrium non-linear economic processes, price dynamics, stochastic processes in financial markets, life cycles of economic structures (Feng, T., Tai, S., Sun, C., & Man, Q. (2017)). Evolutionary economics and econophysics exist and are developing in the space of economic knowledge, in which the concept of static rather than dynamic economic equilibrium still prevails. The part of the economic and mathematical models has become field-specific and isolated from other sciences, inevitably leads to a crisis of economic developments.

Evolutionary economic theory includes such economic studies where the system-wide principles of diversity, which is changing, agent heterogeneity, disequilibrium, development uncertainty, instability, and the like play a significant role; orthodoxy includes a study that focuses on opposite principles of solidified diversity, agent homogeneity, equilibrium, determinism, stability, etc. (Hamilton, D. (2017)).

Therefore, the result of the interaction of opposites should be their specific symbiosis. This is completely impossible since evolutionary theory and orthodox teaching are opposite in methodology. The first comes from the diversity, which all the time is in motion and develops, nonequilibrium, instability, and the second - from an unchanged, solidified diversity, equilibrium, stability and the like. It is impossible to mechanically combine such opposite principles and approaches because it contradicts the elementary laws of dialectics.

An even less convincing argument in favor of the parallel existence of these theories is that it seems that evolutionary principles are more clearly manifested in that part of the economy that produces material resources, and orthodox ones - in the economy that produces goods and services (Hodgson, G. M. (2018)). It is difficult to realize the "sector" division of the theory, and even more so the conclusion that the resource economy is better studied from the standpoint of dynamic and evolutionary theory, and the production of goods and services from the standpoint of statics and orthodoxy. It is easy to see that both sectors are developing and changing, therefore, these processes are most reflected in the dynamic, evolutionary economic theory.

And finally, the argument in favor of the various areas of competence of these two theories is that evolutionary theory is limited to the study of mesolevel and does not provide a complete analysis of evolutionary processes at the macrolevel. Indeed, starting with Keynesianism, macroeconomic issues have been intensively developed in economic theory (Huang, C., Cao, J., Xiao, M., Alsaedi, A., & Alsaadi, F. E. (2017)). Although there are actually problems here, it's quite clear that in the interests of the development of evolutionary economic theory that means a big step forward in understanding the laws of economics, it's not only possible but also necessary to use the achievements of neoclassics, adapting them to the system and principles of evolutionary theory.

Among the modern areas of research within the framework of the evolutionary economy, the authors single out studies of the enterprise population — an analysis of organizations as complex structures, which primarily include firms and markets, etc. (Lu, R., Wang, X., Yu, H., & Li, D. (2018)).

Like individuals, organizations have limited rationality and produce routines that enable them to operate successfully in changing environmental conditions (Metcalfe, S. (Ed.). (2018)).

Like standards, these routines have the function of saving knowledge and reducing transaction costs (Santangelo, G. D., & Meyer, K. E. (2017)). The latter is achieved due to the fact that the behavior of participants in the organization, adhering to certain rules, becomes more predictable. In other words, routines facilitate the interaction of individuals within organizations and embody accumulated knowledge.

The conducted analysis of theoretical studies of existing approaches to the formation of an evolutionary paradigm in the economy creates a significant basis for the development of evolutionary modeling, as well as the introduction of IT support for the management strategy of enterprise development processes.

The IT modeling of the dynamics of the evolutionary processes of trophic relations of enterprise populations includes:

genetic algorithm (GA) (Saviotti, P. P., & Metcalfe, J. S. (2018)), designed to optimize the functions of discrete variables, which focuses on genome recombination;

evolutionary programming (EP) (Smith, K. (2018)), focused on the optimization of continuous functions without the use of recombination; EP in the form of evolution of logical automata solves the problems of forecasting, diagnostics, recognition, and classification of images;

evolutionary strategy (ES) (Stefan, L., Thom, W., Dominik, L., Dieter, K., & Bernd, K. (2018)), focused on the optimization of continuous functions using recombinations;

genetic programming (GP) (Stenberg, J. A. (2017)), which uses the evolutionary method to optimize computer programs.

Evolutionary models (EMs) contain components that correspond to both ELC models and phase models and are intended to describe the sequences of development and interaction of model elements in the general evolutionary development model. EMs differ from each other but they are all based on the principles of evolution.

So, in the evolutionary model, in order to find general equilibrium in the group of markets under study (resources, labor, final product, capital markets, etc.), an equilibrium approach can be used: based on computational procedures, price and quantitative indicators are determined (i.e., the output of firms, populations, etc.) (Wallentin, G., & Neuwirth, C. (2017)).

The equilibrium parameters, the functions of individual and industry demand and supply in the markets are determined by the routines adopted by the firms (Wang, J., Cheng, H., Meng, X., &

Pradeep, B. S. A. (2017). However, in evolutionary models, due to the explicit introduction of blocks that reflect strategic dynamics at the mesolevel, it is taken into account that the formation of supply and demand in the markets, the real market structure in the long term is determined by the adopted strategies for functioning and development, as well as processes of changing the composition of existing objects and their strategies.

Evolutionary programming differs from genetic methods not only in the absence of crossbreeding but also in the representation of individuals in the population (Wu, B., Liu, P., & Xu, X. (2017)). Since there is no need to use chromosomes, an individual is often a real solution without additional coding.

In general, it should be noted that dynamic modeling prevails among the evolutionary economic theories: researchers single out some “features”, somehow substantiate their significance, build regressions, and get predictions. However, there is a lack of structural models with which one could study the evolution of the economy, the structure of routine, traditions, rules, and the like.

Methods

Theoretical general scientific methods (historical, analysis and synthesis, abstraction, hypothetical-deductive, system-structural, structural-functional analysis) are applied in the study of the development of the evolutionary theory of populations; empirical methods (comparison, observation, method of schematic diagrams and transfer functions) are used to determine the values of indicators of market evolutionary multipliers for various development scenarios; the methods of economic and mathematical modeling (object-oriented programming, dynamic optimization, evolutionary analysis and modeling, aggregation and decomposition of concepts, generalization and specialization of concepts) have been used for for modification and computer program implementation of the tools for economic and mathematical modeling of the dynamics of the evolutionary processes of trophic relations of enterprise populations.

Results and Discussion

In the process of changing the parameters of a dynamic system, the number of equilibrium points and their stability can change. Such changes in the nonlinear system associated with changes in the parameters of the system are the subject of bifurcation theory. Those parameter values at which the qualitative or topological properties of the motion of the points change are critical bifurcation values.

Today, the world economic system is at a bifurcation point, therefore, it is impossible to clearly determine the further paths of its development. However, it can be argued that the coming years will be characterized by increased uncertainty in the markets and new waves of crisis, and the current stage of development will be considered as a bifurcation one, during which a new global world order is formed (leader states are reorganized, the world institutional structure is accelerated, etc.).

The continuous development of economic, political, and technological processes determines the aggravation of contradictions in the system (both between elements and between different levels), which introduces it into the bifurcation stage of development.

The essentially nonlinear dynamics of interacting populations requires the combined use of both numerous and analytical methods. Analytical studies make it possible to use the results of the qualitative theory of differential equations and the bifurcation theory. They are used mainly for the analysis of bifurcations occurring in the population dynamics modeling. The main tool for proving the existence of solutions in bifurcation theory is the implicit function theorem for vector-valued functions of many variables.

During the deployment of the evolutionary process, there is a slow accumulation of quantitative and qualitative changes in the parameters of the system and its components, according to which at the bifurcation point the system will select one of the possible attractors of limit sets. As a result of this, a qualitative leap will occur, and the system will form a new dissipative structure corresponding to the selected attractor.

This happens in the process of adaptation to the changing environmental conditions. It is advisable to divide the motion of dissipative systems into two classes: the class of transitional unstable motions corresponding to the relaxation process from the initial to the limit set of states, and the class of stable stationary motions, the phase trajectories of which completely belong to the limit sets.

The presence of general patterns for the development of complex systems of any nature of origin led to the emergence of new science about the self-organization of complex systems - synergetics. The result of this interaction is synergy, and the quantified amount of synergy is a synergistic effect.

The basis of synergetics is the unity of phenomena and models that one encounters in the study of the processes of the emergence of order from chaos, that is, dissipative structures with new emergent properties.

If oscillations (fluctuations) take the system out of equilibrium, its development becomes unpredictable, qualitative changes occur in the system and new emergent properties appear. In this case, the nonequilibrium subsystem in the process of interaction with other subsystems begins to interact randomly with all elements of the system, leading to equilibrium with unpredictable results for the system as a whole.

Any of the described possibilities is realized when the system passes through a bifurcation point (zone) caused by fluctuations, in which the system acquires instability. The bifurcation point represents a critical turning moment in the development of the system (catastrophe) when it makes a choice of the further path. This is the point of branching of options for the further development of populations.

Such a process of chaotic interaction of system elements in a nonequilibrium state is a synergistic coherence. The whole system in a state of nonequilibrium, interacting with other systems, transfers disturbances to the latter, generating changes in them and determining the direction of their further development.

Self-organization as a process of coherence and orderliness of interconnections between elements of an economic system determines a change in its state. A change in the state of a system is regarded as orderliness to the result of the coherent interaction of its subsystems. It is under the influence of the synergetic coherent transfer of fluctuations in the system that it acquires new signs of its development. After self-organization, the system affects other systems interacting with it to a level adequate to itself, acting at the same time as a coincidence for such systems.

Depending on what determines the established order, the organization and self-organization of the system are distinguished. A common sign for them is an increase in order as a result of processes opposite to the establishment of thermodynamic equilibrium through independently interacting elements of the environment (also moving away from chaos by other criteria). In the course of self-organization, the system is associated with the action of forces, factors, and causes external to it. In turn, in the process of self-organization, ordered changes in the system are caused by internal factors and its inherent forces, therefore, their reason lies in the system itself.

Self-organization of populations is the ability of a system to independently maintain or improve the level of its organization with a change in the external or internal conditions of its existence, the activity taking into account past experience aimed at maintaining its integrity, increasing stability, and ensuring normal functioning and development.

The larger the number of enterprises in the population involved in restructuring changes, the more active will be the processes of self-organization. The activity of the self-organization of mesolevel systems determines the state of self-organization of the economy as a whole.

The result of self-organization is the emergence, interaction, M&A and, possibly, the regeneration of dynamic objects (subsystems), complex in the information sense than the elements (objects) of the environment from which they arise. The system and its components are essentially dynamic formations.

Depending on the influence factor, the processes of self-organization in populations can be classified as those resulting from purposeful human activity and those resulting from the chaotic interaction of subsystems of their functional units.

The reason for the disequilibrium in the development of the population and its further self-organization is, in particular, a coincidence. According to the synergistic approach to the study of economic systems, coincidence acts as a source of nonequilibrium, and depending on the nature of its origin, determines the direction of further development of the population. The most typical causes of coincidence are unaccounted patterns, the results of self-organization of other systems with which the population interacts in the course of its activities, the subjectivity of management, shareholders and heads of functional units, unidentified and unexplained phenomena, and lack of experience and staff skills.

According to the principles of self-organization, the structure of populations as the economic system will be the first to undergo a change at the bifurcation point, after it the connections of the elements of the system, their functioning, and behavior as a whole change. In the evolutionary period of development, the structure of populations provides stability, sustainability, and damping fluctuations that occur inside and come from the external environment.

Self-organization of the system is associated with the ability to self-reproduction and restoration of lost elements and subsystems, that is, to autopoiesis. Autopoiesis, inherent in natural and biological systems, is also manifested in socio-economic systems, as their core is a man.

Openness, activity, self-organization, and autopoiesis of socio-economic systems make them inert to managerial influences, that is, they respond to time-delayed management.

The main condition for adapting the production system to a dynamic external environment and an unstable spectrum of factors is its ability to adapt and create a mechanism for using favorable trends. This is ensured by the flexibility of the enterprise structure, which is understood as the ability of the system to purposefully adapt to a changing, complex environment, and with minimal cost.

The unstable state is characterized by violations in the production process, irregular production and unsatisfactory demand for it, inopportune material and technical supply, and an unsatisfactory psychological climate. This condition may be due to the influence of both external and internal factors.

If economically the system is not in equilibrium, then it moves under the influence of internal or external disturbances. In this case, different behavior of the dynamic system is realized. Depending on the structure and properties of the system, its behavior can vary significantly over time. There are two fundamentally different scenarios for the development of events after the system has undergone a certain perturbation from the outside: returning to the initial state or further distancing from it. These capabilities are described by the concept of stability.

System behavior may be subject to certain changes over time. Stationarity is a property of the processes that occur in the system and means that the nature and law of the functioning of the system do not change in time.

Any system at a certain point in time is characterized by its state and direction of movement. The population of enterprises, like any system, can be in two states: stable or unstable. These are two aspects of bifurcation theory: a stable (static) state and a dynamic one.

The static state is characterized by the rhythmic release of high-quality products and the existence of a stable demand for it, a uniform production process in all divisions, adequate logistical support and staffing, and a favorable psychological climate in the team.

As to the static approach, the researcher is only interested in the state of the (economic, social, etc.) system at a certain point in time. In the case of the dynamic approach, the subject of research is a set of system states over a certain period of time. The concept of equilibrium is associated with the state of the system.

The static bifurcation theory deals with the changes that occur in the structure of a set of functions with the change of parameters, these functions. In the case of differential equations, the equilibrium solutions are zeros of the vector field. Therefore, methods of the static bifurcation theory are directly applicable to them.

Integration or, on the contrary, a clash of these interests without the regulatory impact of a particular subsystem can be called the adaptation process. Adaptation can manifest itself as self-regulation, self-learning, self-organization, and self-improvement. In the case of self-regulation, the system responds to environmental changes by measures and actions that are rigidly established by a special program. The self-learning of the system means its ability to change response programs. As to the self-organization, the system changes not only the response program but also the internal structure. Self-completing systems can rebuild their structure not only within a given set of elements but also by expanding this set.

Thus, the study of the conceptual synergetics apparatus leads to the conclusion that in the process of its development the system goes through two stages: evolutionary (adaptive) and revolutionary (leap, catastrophe).

The evolutionary stage of development is characterized by the presence of mechanisms that suppress strong fluctuations of the system, its components, or the environment and return the system to a stable state, which is characteristic of it at this stage. Entropy is gradually increasing in the system because as a result of the changes that have accumulated in it, in its components and the external environment, the system's ability to adapt decreases and instability increases. There is a sharp contradiction between the old and the new in the system, and if the parameters of the system and the environment reach bifurcation values, the instability becomes maximum and even insignificant fluctuations lead the system to catastrophe – a leap.

At the leap phase, development becomes unpredictable since it is determined not only by internal fluctuations, the strength, and direction of which can be predicted by analyzing the history of development and the current state of the system, but also by external ones, which makes it extremely difficult, or even impossible, to perform a forecast. Sometimes a conclusion about the future state and behavior of the system can be made based on the "law of the pendulum": a leap can contribute to the choice of an attractor, "opposite" to the past. After the formation of a new dissipative structure, the system again enters the path of smooth changes, and the cycle repeats.

In recent years, the interest in a new qualitative structure, the so-called strange attractor, with which the chaos model is associated, has increased in the theory of qualitative solutions. So, while moving from one bifurcation point to another, the system develops. At each bifurcation point, the system chooses a development path, the trajectory of its further movement.

In nonlinear dynamics and synergetics, the state of any dynamic system is characterized by the location of the corresponding point in the phase space (PS), whose coordinates are the values of the meso and microparameters on the parametric diagram.

One of the significant capabilities of dynamic modeling is the visual representation of information, especially in the case of a small dimensionality of the system for a few parameters. For this, formal spaces are used: the space of states of the parametric diagram, the parameter space, and their various hybrid variants. The values of dynamic variables or parameter values are set on the coordinate axes of the formal space, or on some - parameters, on others – variables.

The state of the evolutionary forecasting system of the synergetic effect of mergers and acquisitions of enterprises at a certain point in time in phase space corresponds to a point with coordinates $xi_{i=1,3}(t)$, y(t), NPVS(t) is a figurative point that reflects the instantaneous state of the topological (qualitative) structure of systems.

These trajectories determine the qualitative characteristics of the system. These include, first of all, the points of the evolutionary stage of development that correspond to the modes of periodic oscillations of the system and closed trajectories (cycles) that correspond to the modes of the leap phase. Whether the mode is stable or not can be determined by the behavior of neighboring trajectories: stable equilibrium, or cycle, which draws closer trajectories, and if it does not, then this is an unstable equilibrium. Finally, in light of the questions raised, the forms of loci of attraction of the various stable modes and the boundaries of these loci are of interest.

The task of high-quality mathematical models is to describe the fundamental, qualitative characteristics of the processes under study, and not their detailed characteristics. Questions arising in the process of researching such models should be of a qualitative nature. A slow change in the parameter can lead to the fact that, with the crossing of a certain critical value, the existing system mode acquires qualitative changes. Quality questions are classified into two categories. The first type of question relates to predicting which modes can be set in a given system with fixed values of its behavior parameters. The most important in this case is a qualitative understanding of the nature of the modes established in the system after a long time (at the end of the transition process). In total, various modes can be set in the system, depending on the initial conditions. Answers to questions of the first type can be obtained from the parametric diagrams of the system — the totality of all its trajectories depicted in the space of phase variables (phase space).

The second type of question is a qualitative study regarding the events that occur in the system with a change in the parameter values $xi_{i=1,3}(t)$, y(t), NPVS(t). This means the definition of bifurcation (critical) parameter values and the description of the phenomena that occur when passing through the critical values of ELC scenarios. Thus, it is necessary to divide the space of system parameters into loci with qualitatively different types of dynamic behavior - to construct a parametric portrait of the system. Such a parametric portrait, together with the corresponding phase portraits in graphical form, contains information about the possible dynamic modes in the system and their qualitative changes.

Therefore, the task of a qualitative study of the system, which depends on the parameters, is to describe all the possible bifurcations in it, break down the set of bifurcation values of the parameters at the locus and recognize them with different types of rough phase portraits, construct a phase portrait for each locus, which corresponds to it, and determine the numerical values of the bifurcation states.

A parametric study of the state of the system of evolutionary forecasting of the synergetic effect of mergers and acquisitions of enterprises is possible only by fixing part of the phase coordinates and constructing a corresponding "slice" of the parametric diagram in individual cases for different stages (recession (lethal), explerent (birth), patient (development), violent (maturity), commutant (prosperity)) of the ELC development scenarios.

In the analysis of bifurcation diagrams, special attention was paid to the appearance and possibility of controlling the oscillations of phase variables.

A parametric study of the constructed system was carried out using two-dimensional slices of the parametric space obtained in the Matlab environment. To do this, the parametric plane of the selected pair of bifurcation parameters $xi_{i=1,3}(t)$, y(t), NPVS(t) was scanned provided that the others are fixed. At each point of this plane, the type of equilibrium state of each singular point of the system under study was determined, to which different loci correspond.

Figures 1 and 2 show the parametric diagrams of the model for the corresponding pairs of ELC scenarios: the ELC scenario - recession (lethal) and the ELC scenario - commutant (prosperity).

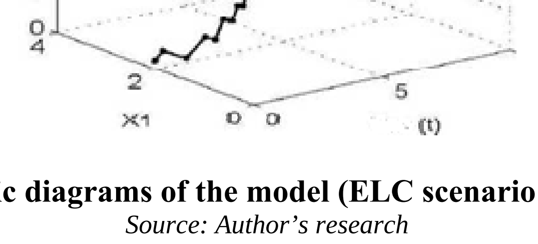

Figure 1. Parametric diagrams of the model (ELC scenario - recession (lethal))

Source: Author's research

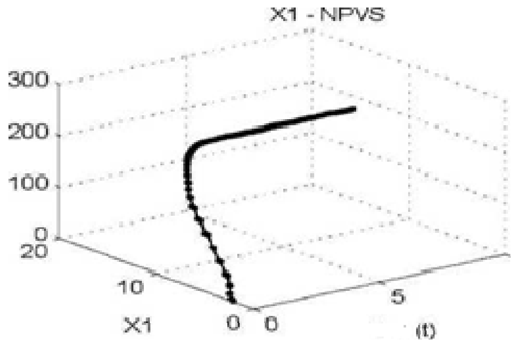

Figure 2. Parametric diagrams of the model (ELC scenario - recession (lethal))

Source: Author's research

The initial conditions determine the initial position of the point in space. The most meaningful information is the selection of only stable singular points at the studied loci of the parametric space of phase trajectory diagrams with one type of particular stability points.

The parametric study of the built system is combined with the reference point, that is, by opening blocks of integrators, the initial values are provided: x0i=1(t) = 2, x0i=2(t) = 0.01, x0i=3(t) = 0, y0(t) = 0.

The visual analysis of the obtained phase trajectories leads to the conclusion that the behavior of the information flows of different ELC scenarios is related.

In this case, a qualitative understanding of the nature of the modes established in the system after the completion of the transition process is essential. In total, depending on the initial conditions, various modes of population self-organization scenarios can be established in the system

Minor changes in the values of certain parameters of nonlinear systems cause the equilibrium to appear or disappear, change its type from unstable to stable, or, conversely, lead to global changes in the behavior of the system with the transition of the scenario from lethal to flourishing.

The convenience of displaying the process in the form of parametric diagrams of phase trajectories on the plane consists of the fact that the entire set of possible forms of transition processes under any initial conditions is presented in the form of a "phase portrait" of a single size. Thus, the phase plane, divided into trajectories, gives an easily accessible portrait of a dynamic evolutionary system that is readily accessible for inspection, makes it possible to capture and evaluate at a glance the whole set of processes that can occur under various initial conditions.

In the event of a change in parameters, the following types of system behavior can be observed:

after the loss of stable equilibrium, the new stable mode is oscillatory periodic (mild loss of stability, Fig. 1);

before the stationary mode loses stability, the locus of the extent of this mode narrows and any random disturbances eject the system from this locus before the length locus completely disappears;

the system exits steady state and jumps to the new mode of motion.

The influence on the system of both external and internal fluctuations of a different kind (including resonant ones with the system) is based on the action of two effects: a positive feedback loop and a cumulative effect. Fluctuations affecting the system, depending on their strength, will have completely different consequences for it. If the fluctuations of an open system are weak (especially the fluctuations of a critical parameter or subsystem), then the system will respond to them with the emergence of strong tendencies of a return to the previous state, structure, or behavior, and reveals the root cause of the failures of many economic reforms. If fluctuations are very strong, the system may collapse. And finally, the third possibility is to form a new dissipative structure and change the state, behavior, and/or composition of the system.

Any of the described ELC scenarios can be realized at the bifurcation point caused by fluctuations, at which the system is tested for stability. If the equilibrium is a node or focus, then the direction of motion of the phase trajectories is uniquely determined by its stability (before the reference point) or instability (from the reference point). A bifurcation point is a state of the system in which even a slight disturbance can lead to global changes in M&A.

So, while moving from one bifurcation point to another, the system develops. At each bifurcation point, the system chooses the path of further development, the trajectory of its movement.

If the system is attracted by the state of equilibrium, it becomes closed and, to the next bifurcation point, operates according to the laws inherent in closed systems. If the chaos generated by the bifurcation point is prolonged, then the destruction of the system is possible, as a result of which its components as constituents sooner or later enter another system and are attracted by its attractors. If the system is finally attracted by certain openness attractors, then a new dissipative structure, a new type of dynamic state of the system, is formed, with the help of which it adapts to the changing environmental conditions.

Systems and their components are subject to fluctuations (oscillations, changes, perturbations), which are quenched by themselves in equilibrium closed systems. In open systems, under the influence of the external environment, internal fluctuations can increase to such a limit when the system is not able to quench them. In fact, internal fluctuations are considered harmless in the concepts of self-organization, and only external influences cause a more or less significant effect. Recently, significant adjustments have been made to this situation, in particular regarding the "natural selection" of fluctuations: to realize self-organization processes, it is necessary that some fluctuations would be recharged from the outside and thus have an advantage over other fluctuations. However, in this case, the role in the development of the system of internal-origin fluctuations is underestimated. Only chaos theory indicates that the leap can be the result of internal fluctuations only.

Despite the complexity of the chaotic attractors, the knowledge of the phase space makes it possible to reflect the behavior of the system in a geometric form and, accordingly, to predict it in a certain way. Although it is practically impossible to predict the specific point of the phase space in which the system will be located at a particular time, the passage of the object of such a locus of space and its direction to the attractor are predictable.

The future of the object at the point of bifurcation is unpredictable. Their course is predictable only in the intervals between the nearest bifurcation points when events are determined by the necessary factors as random.

At the bifurcation point, there is a catastrophe - the transition of the system from the attraction locus of one attractor to another. The attractor can be the equilibrium state, the limit cycle, and the strange attractor (chaos). The system is attracted by one of the attractors and it can become chaotic and collapse at the point of bifurcation, go to equilibrium state or choose the path of a new order formation.

The fundamental point in the application and determination of the bifurcation state is the specific choice of the physical parameter that most fully characterizes it and is subject to fractal parameterization. Among the possible geometric parameters of the spatial shapes formed on the surface of the graphs, the area of the darkened surface of the bifurcation graph has been chosen since its shape, location, and size correspond to the stability loci (attractors) and the type of behavior of the $xi_{i=1,3}(t)$, y(t) parameters of the evolutionary process. To find out the bifurcation of ELC development, the image recognition systems (ImageMagick) have been used. The results of determining the bifurcation state and its size (the area of the darkened surface of the bifurcation graph in percent%) of the parameter diagrams for all ELC scenarios are shown in Table 1.

Strategic management can be considered a dynamic set of management processes that are consistently linked to each other, and there is stable feedback between them.

Table 1
Data on bifurcation state and size of the area of the darkened surface of the graph according to ELC development scenarios

$xi_{i=1,3}(t)$, $y(t)$	ELC development scenarios							
	Recession crisis (lethal)	Explerent (birth)	Patient (development)	Violent (maturity)		Commutant (prosperity)		
	1	2	3	4	5	6	7	8
$x1(t)$	3.59%	6.06%	4.82%	6.67%	4.41%	5.73%	6.03%	5.96%
$x2(t)$	25.62%	15.31%	8.18%	26.57%	19.53%	6.58%	8.38%	6.79%
$x3(t)$	7.77%	7.20%	4.10%	8.73%	6.49%	6.48%	6.35%	5.87%
$y(t)$	7.58%	11.58%	6.07%	7.32%	6.72%	4.99%	5.50%	4.98%
Dynamics of income (NPVS)	18	12	14	33	38	105	125	240

Source: Author's research

Therefore, the results of business management in the market depend on the level of IT support for analytical work, where evolutionary methods for the formation of alternative options of strategy, which allow choosing strategies depending on the ELC stages, ensuring the competitiveness of the enterprise, are of great importance.

Modern strategic enterprise management is based on IT support as the basis of analytical work. The enterprise is activity oriented on a production and requests of consumers, flexibly responds to changing conditions and in time makes changes in the organizational structure that meet the challenges of the external environment and make it possible to achieve specific benefits, which together will help the enterprise to realize its own goals.

IT support of corporate strategy for managing the evolutionary processes of enterprise development consists of several consecutive stages (Figure 3).

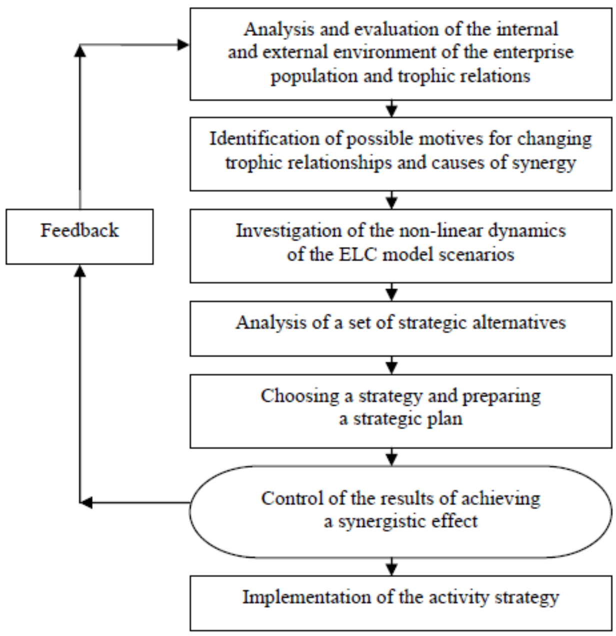

Figure 3. Diagram of IT support for a corporate management strategy of the evolutionary enterprise development processes
Source: Author's research

Stage 1. Analysis and assessment of the internal and external environment of the enterprise population and trophic relations are carried out according to the following scheme:

sets of enterprises and the interaction of trophic relations are determined, which include populations depending on the state of the enterprise life cycle (ELC);

on the basis of qualitative assessments of the external environment, the priority (most significant) indicators of the economic activity of the enterprise $\vec{X}_i = \{x_1, x_2, ..., x_n\}$ operating in the environment within the enterprise population are identified;

elucidates the values of the parameters of the ELC scenario model, the quantitative and qualitative characteristics of the influence of each factor on trophic relations in populations $xi_{i=1,3}(t), Ki_{i=1,4}(t)$ are identified.

Stage 2. Identification of possible motives for changing trophic relations and the causes of synergy.

Based on the variety of points of view on clarifying the causes of synergy, the authors determine the M&A motives, which are caused by trophic processes.

The mobilization of financial resources of the enterprise significantly affects the choice of corporate strategy: these are tax motives, diversification, reduction of financial costs, advantages in the capital market (fundraising), the difference between the liquidation and current market value of the company, the motives of shareholders, the separation of part of the business into an individual business unit, creation of the partnership.

The attraction of the strategic investors to your company. Investment motives are associated with the allocation of available funds, participation in a profitable business, the purchase of undervalued assets, the use of managerial skills, the separation of part of the business into an individual business unit, and the sale of part of the shares.

Changes in the behavior of the enterprise, requiring significant financial costs (for example, entering other markets, developing a new product, moving to a new industry).

Strategic motives include increasing business competitiveness, entering new sales markets, maintaining stability and market volumes, increasing the level of financial stability, ensuring the efficiency of managing business processes through highly qualified management, and changing the business model.

Specific functional-psychological motives include personal motives of management, attempts to increase the influence of the company administration. This group of M&A reasons and motives should include protection against hostile takeovers, that is, protection against raider attacks of enterprises, merger with a "friendly company". “Protective” motives are the possibility of growth by strengthening the market position, eliminating competitors. The interests and attitude of the owner and managers play a significant role in choosing a corporate strategy. At the same time, the attitude of company managers to risks is decisive. The personal likes or dislikes of managers can also significantly influence the choice of corporate strategy. Personnel qualifications are an important limiting factor in choosing a corporate strategy. Without qualified personnel, managers cannot choose corporate strategies, as this requires deep economic knowledge and high qualifications.

Operational motives include savings on the activity scale through the diversity of areas of this activity, the accumulation of resources and market share, the combination of complementary resources, and increased efficiency by eliminating duplicate functions in each of the merged companies.

Innovative motives include savings on the development and implementation of new IT, creation of a new type of production, goods, access to information (know-how), obtaining information about new technologies, consumers of products and services. Savings through the scale of reduction in the average cost per unit of production with a simultaneous increase in its output.

Stage 3. Investigation of the nonlinear dynamics of ELC model scenarios.

The procedure for constructing model scenarios of nonlinear dynamics of the life cycles of populations, used to develop an enterprise strategy, has the following phases:

setting model parameter values (averaged market evolutionary multipliers) for various stages of development of enterprise populations, under which phase variables will be analyzed;

determination of income dynamics in the system. Possible scenarios of population development are being investigated. Based on the information received, the strengths and weaknesses of the enterprise are comprehensively assessed, its potential capabilities, internal weaknesses, and external problems are identified.

Stage 4. Analysis of a set of strategic alternatives.

Based on the generalized results, a set of strategic alternatives for the development of the enterprise is determined. The effectiveness of an alternative strategy is assessed using the following criteria: the integrity of the strategy (under what conditions does each component affect the overall strategy); the compatibility of the strategy and the market (how much the strategy is consistent with the changing external environment), the balance of goals and available resources; consideration of possible risks; validity of timing of strategy implementation; consistency of activity of structural subdivisions of the enterprise; anticipation of possible economic risks; assessment of the impact of individual risks on the enterprise; development of measures to neutralize or mitigate the negative effects of risks, etc.

A methodological approach to the formation of a rational basis for determining strategic alternatives for enterprise development is based on the interpretation of the recognition results of ELC bifurcation state diagrams, quantitative characteristics of phase variables $xi_{i=1,3}(t)$, y(t) in space and time.

To determine the strategic choice of an enterprise, one should take into account the ELC, where at the stage of its implementation the main goal is to create a market for a new product, to provide conditions for increasing sales. At the stage of growth and maturity, the main goal is the rapid growth in various ways of sales over a long period, in particular, with the help of the modification of goods, cost reduction, and the like. At the saturation stage, when sales growth stops, the company's goal is to increase production profitability by reducing costs and other factors. At the recession stage, there is a steady decrease in demand, sales and profits. In these cases, the following strategies are possible: reduction of the price of goods, which gradually loses market demand; increase in sales promotion costs; slowing down business activity without harming one's own image and partners; removal of goods from production.

Stage 5. Choosing a strategy and preparing a strategic plan.

Implementation by the enterprise of previous corporate strategies provides certain inertia of its development. It is impossible to completely abandon all previous projects in connection with the selection of new corporate strategies. Therefore, choosing new corporate strategies, it should be borne in mind that for some time the obligations of previous years will still be in force, which will hamper the possibility of implementing new corporate strategies. The degree of dependence on the external environment significantly affects the choice of corporate strategy. The time factor should be taken into account when choosing a corporate strategy: growth; stabilization; reduction strategy. The growth strategy is implemented by:

merger is a combination of several enterprises by one owner; creation of joint ventures is the union of enterprises of different countries with the aim of implementing a joint project.

takeover of competing enterprises through the acquisition of a controlling interest;

reduction of transaction costs, increase of management efficiency, cost reduction due to vertical integration;

achieving a certain market share, oligopoly in the market, entering new markets, acquiring the status of a multinational corporation, obtaining the highest goodwill from the sale of business diversification, increasing the value of the company, strengthening market positions, entering into promising industries.

The stabilization strategy is implemented by:

optimization of the tax burden, elimination of inefficient management, diversification of production, access to innovations, application of modern production technologies and management optimization; redistribution and maneuvering of financial resources;

combining complementary resources, access to resources, consolidating the resource potential, selling as an alternative to bankruptcy, agreeing on competition conditions between the participants in the association and redistributing resources between them, eliminating debts, consolidating the resource potential and the possibility of using it as collateral in the financial market;

providing the buyer-enterprise with competitive advantages for business development by obtaining unique innovative technologies from the seller-company; competitive advantages are associated with the creation of barriers to eliminate the entry of potential competitors into the market;

increasing the efficiency of the corporation in the face of limited resources for development; fiscal minimization and optimization of taxation by paying a fixed tax; redistribution of property from inefficient management in favor of more efficient; classic performance criterion;

value-based management, the maximum increase in the well-being of shareholders; the use of transfer formation in order to minimize tax payments, in Western countries - the possibility of applying the principle of transferring losses of one company to future periods in order to reduce profits before taxing another (reducing future tax payments);

reducing costs by fulfilling obligations, increasing the level of management and coordination of the entire technological chain, improving the quality control and protecting their own IT;

"survival" in the face of fierce competition; companies are seeking growth opportunities through the acquisition of complementary assets, strengthening their market position, eliminating competitors (by purchasing them or increasing their own market share).

The reduction strategy is implemented through: reversal; separation; liquidation - if the enterprise reaches a critical point, a bankruptcy, it is liquidated, its assets are sold; choosing (changing) the location of the enterprise; reconstruction of production facilities; changes in the legal and organizational form of the enterprise, production structure, and management system; introduction of innovations; mergers, takeovers, acquisitions, and other forms of enterprise reorganization.

Stage 6. Monitoring the results of achieving a synergistic effect.

The model is based on a comparison of the state of the enterprise in the market and the ELC stage, that is, it is intended for multi-parameter strategic analysis. The basic prerequisite is that each type of business of the enterprise may be at one of the stages of ELC, so it must be analyzed based on the peculiarities of the particular stage and competitive state of the business in relation to others.

Conclusion

The synthesis procedures for the M&A synergetic effect evolutionary forecasting system have been improved using the method of structural schemes and transfer functions, which makes it possible to record the system of equations in the form of blocks with natural signs of connections and reflects the content of the process under study.

The study of the nonlinear dynamics of model scenarios of the enterprise population life cycle made it possible to identify the direction of the influence of environmental factors on self-organization processes. As a result of this influence, self-organization processes occur in the direction of a gradual improvement in the state of the industry and a decrease in the likelihood of bifurcation development in the absence of factors that neutralize such an effect.

Based on the analysis of the nonlinear dynamics of ELC model scenarios, characteristic evolutionary flow patterns of the studied populations have been found, the bifurcation analysis of possible scenarios of dynamic M&A system functioning modes using IT recognition systems has been carried out, mechanisms of the influence of the external environment and internal structure on the evolutionary model of enterprise populations have been identified.

Based on the analysis of the effectiveness of possible trajectories of the population evolution, the dynamics of the net reduced synergy effect in time of NPVS in the ELC scenario system, the parametric diagrams of the model and phase portraits of bifurcation scenarios have been constructed, the need to identify bifurcation points and influence parameters stability loci for the transition of the system from one attractor to another, from one ELC steady state to another has been proved.

The IT support algorithm has been developed for the corporate strategy for managing the evolutionary processes of enterprise development, which will allow choosing strategies depending on the ELC stages and ensuring competitiveness.

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