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# SYNERGETIC EFFECT - QUINTENCE OF INNOVATIVE DEVELOPMENT OF SOCIO-ECONOMIC SYSTEMS

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***Abstract:***. *The article presents the essence, content and conditions for the occurrence of synergistic effects in socio-economic systems. It is proved that the synergistic effect is the quintessence of the balanced innovative development of socio-economic systems. The most important forms of manifestation of synergetic effects are considered and analyzed: sustainable development, self-organization, phase transitions, system sensitivity, bifurcation, hysteresis, and emergence. Particular attention is paid to the process of self-organization in the context of spontaneous occurrence in the system of orderliness and new properties under the condition of insignificant control action. It is argued that the synergistic effect depends on the stage (stage of the cycle) of the development of the socio-economic system and the effectiveness of innovative management, and crises - a natural and regular stage of innovative development, where the platform of the next technological structure is laid. The question of society's desire for economic growth is touched on, which, on the one hand, does not solve the various social and economic difficulties of mankind, and even contributes to the emergence of new problems (environmental, structural, etc.), which is justified by the law of compensation of entropy, and on the other hand, it can act as a fluctuating force in the evolutionary period, pushing the business entity to bifurcation. It is followed by a revolutionary and qualitative transformation of its structure. It is proved that the balanced innovative development of socio-economic systems is determined by such basic parameters as "degree of internal ordering" and "strength of external control action". The essence and content of the synergetic potential of socio-economic systems are determined as their inherent property, formed through inter subject interactions and structural and institutional dynamics and providing sensitivity and an adequate response of the system to small exogenous and endogenous influences for its development according to a given vector of goals and indicators.*

***Key words****: synergistic effect, socio-economic system, innovative development, self-organization, synergetic*

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## I. Introduction

In the global dimension, the innovative development of mankind is constant and sustainable. It is carried out through various transformations in the socio-economic system (SES) due to scientific, technical and technological achievements implemented in programs and projects for the development of innovative potential of the management object. We consider the category of "innovation" as the final result of innovation, expressed in the introduction of innovation, entailing a qualitative transformation of the SES [1, 2, 3].

Socio-economic time and the evolutionary vector, piercing the axioms of conservative economic foundations, are the central leitmotif in the essential dialogue of the category "economic development". By "development", which is carried out evolutionarily or revolutionaryly, we mean a qualitative modification of the structure and composition of the system, elements and relationships, processes and forms of functioning. In systems theory, the concept of "revolution" is a sharp change in the trajectory of the system, a rapid and spasmodic phase transition, a crisis in development; and "evolution" implies a progressive qualitative-quantitative dynamics (growth and degradation, progress and regression).

The consequences of the emergent revolution, interpreted as the "time compression" effect, have not been sufficiently studied to date, which actualizes the solution of the economic problems of the transition from the measure "quantity" to "quality". Moreover, the results of phase-structural transformations in the SES call into question the traditional theoretical and methodological principles of economic science.

Orthodox economic theories study the ability of SES to adapt to the external environment in the context of globalization, fierce competition and the worldwide struggle for resources. The provisions of system theories, self-organization, and synergetics open up a new opportunity to study and use the mechanisms of SES coherence, which can lead to phase and structural transformations, unexpected synergies, and synergistic effects.

It is synergetics, which focuses on the processes of development and self-organization of complex systems of arbitrary nature, from the standpoint of V. G. Budanov, that takes on universal, interdisciplinary perspectives of serious research: A. I. Bogdanov's tectology, L. Von Bertalanffy's systems theory, N. Wiener's cybernetics . In the latter, general ideas about complex systems and their configuration, about mechanisms for maintaining integrity, ways of innovative management of systems with self-regulation, and more were formed.

## II. Theory and Methodology

An analysis of the scientific and theoretical framework, devoted to the issue of synergetic effects as the basis of the methodology of sustainable innovative development of SES, indicates a simplified view the majority of authors about its essence, without an explicit explanation of the process. In some cases, an incorrect interpretation of the synergistic effect occurs. Some researchers [4] see this as maximizing the utility functioning of the business entity as a result merging of individual parts into one structure through the system effect, the second [5, 6, 7] – the

transformational result of simple production systems in more complex, and the third [8] – the creation of integrated production structures, fourth [9] – the planned benefits from mergers and acquisitions.

The result of the merging of parts into a single system can be both an increase and a decrease in the efficiency of the process, and a synergistic effect also acts as a systemic result, creating a subset of the set of effects. Talking about increasing efficiency due to the combination of disparate components, it is more appropriate to apply the definition of "synergy effect" or "complementary effect". An economic entity minimizing costs maximizes the efficiency of the use of physical resources, thereby forming "complementary effects". The latter, according to opinion X. Itami, constitute the essence of the source of synergism [10]. For all their importance, they cannot provide sustainable competitive advantages SES due to easy repetition by rivals. We believe, partially sharing the positions of scientists [11, 12, 13], that the interpretation of the synergetic effect is limited from the standpoint of:

1) in the context of the phenomenon of the maximum use of latent abilities of structural elements in the production process;

2) in part of the mutually concurrent assets of certain structures, when the total result exceeds their sum individually;

3) as the true effect of the business, expressed in an increase in utility and lower costs for its formation with the most rational structuring of factors production at the corresponding levels.

In these situations, a synergy effect occurs. From our point of view, it is a mistake to use the concepts of "synergy" and "synergistic effect" as synonyms. First of all, the "synergistic effect" is a phenomenon of a qualitative rather than a quantitative nature. It cannot be measured, manifesting itself in a specific system. For innovative management today, to determine the essence of the "synergistic effect" in the SES, to reveal its nature, to identify the forms manifestations and the mechanism of achievement.

In A. N. Skiba, this phenomenon manifests itself in a nonlinear increase in the self-organization of SES due to an increase in the measure of the ordering of its internal connections [14]. A. A. Myasnikov compares it with the result of the cooperative action of the components of the SES, transforming the economic structure and development trend [15], G. A. Potasheva - with the property of the organizational system due to the consistency of the elements to obtain a high final result in relation to the sum of individual functioning [16].

Results research. Separating the designated interpretations, we consider that the synergetic effect in SES is "the result of the coherent action of the constituents, of which there is no significant endogenous transformations, fluctuations and resonant external influences "[17, 18]. There is no specific algorithm for achieving it. However, its significant, but insufficient conditions include: heterogeneity, coherence, components, developed positive feedback connection. We distinguish basic forms manifestations synergetic effects, some of which we will consider in more detail in this work, include: sustainable development, phase transitions, sensitivity SES, bifurcation, hysteresis, emergence and self-organization.

One of the most important for national economy synergetic effects - sustainable development, caused by attraction attractors. Empiricism indicates that the evolutionary trend any SES is represented by alternating stable

periods (for example, growth) and less than long transitional stages. Sustainable stages are characterized by positive dynamics key resulting indicators: growth rate growth GDP and productivity labor, index entrepreneurial confidence, number of employed and others. Despite the exogenous influence, SES retains the desire to cyclicality, automatically returning to the former position after each external exposure. Such a trend determines a attractor – a stable development vector, the presence of which in the economic system allows one to have behavioral patterns. In a series of scientific works [15, 19, 20, 21, 22] it is proved the presence of attractor in SES and, as a consequence, cyclicity in development. You cannot arbitrarily change indicators phase variables to save forced values in development SES, because she independently returns to the chosen path under the condition that exogenous influence did not bring her beyond the limits the region the attraction of the attractor. Therefore, it is difficult to manage innovation activities SES, related with the process withdrawal her beyond the limits attraction not the desired attractor.

Discreteness trajectories economic dynamics determines methodology innovation management taking into account specific properties specific subsystem and development stage SES. Based on this, for example, maintaining given rates growth and reducing technological lag some subsystems of the economy, may have negative (inverse) effect in others. Examples this is enough.

The expression of the synergetic effect, suggesting innovative development SES, is dependence performance innovation policy on stage development of the country. In such case strategic goal economic policies – providing conditions for transition SES to innovative trend (desired attractor) and subsequent maintaining her in necessary position. A similar effect is relevant for the economic system Russia and its subsystems in these conditions.

It is well known that the dynamics of properties SES is carried out in two ways:

1) evolutionary transformation – change paths development in region phase space (types possible movements);

2) revolutionary leap (phase region changes) – bifurcation occurs, a new phase space is formed and SES enters a new attractor. Economic development shows a lot of supporting examples: change economic regime and model market. Phase transition – process change SES attractor (without dependence on bifurcation). In this regard, “growth” and “development” are mutually conditioned, that is, economic growth under certain conditions can act as fluctuating force for an economic entity, bringing it to the point bifurcation, followed by revolutionary transformation of the structure, which qualitatively changes its properties (leap in development). The latter contributes to economic growth and STP leveling restrictions and и updating the structure of SES. Based on the law of entropy equilibrium, it follows that economic growth does not solve various social and economic difficulties of humanity. Moreover, even often contributes to the emergence of new problems: environmental, structural, social and others.

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Consider such a form manifestation of a synergetic effect as sensitivity SES to initial data, expressed in the fact that errors made at the stage of determining its initial state give rise to significant unforeseen effect producing big consequence in the end, leading to loss of information about her and to ineffective forecasting [21].

The non-linearity of economic processes gives rise to sensitivity SES to initial data that can be noted on examples of different levels of development countries that are growing inter-regional and sectoral imbalances in the economy of the Russian Federation. Empirical studies show that before 2008 ratings economic development subjects of the Russian Federation were stable. However, despite the favorable forecasts integration phenomena did not occur by any parameters. The reasons for this – the existing trajectory movement national SES and the following order parameters: budget and social policy, limited resources, deficit financial investments in welfare population regions.

The manifestation of such a type synergetic effect as bifurcation is expressed in high dynamics magnitudes of controlling parameters SES and reaching critical values. This follows loss state equilibrium and a little-predicted trend. Such moments are called points of bifurcation, when the SES is maximally unstable and insignificant the influence of on her leads to the explosive effect [24].

Preference SES one or another trend at point bifurcation with no verified exogenous influences depends, in most case, from actions random factors (maybe minimal fluctuations). Such behavior of a system subject to fluctuations and bifurcations does not lend itself to long-term forecasting [20]. High openness and heterogeneity, complexity of the structure and a large number of SES variables do not allow determining the trend after bifurcation. Examples – emergence of new industry markets; economic crisis, exacerbated by deep structural transformation; new areas of economic activity and directions development business and others.

Thus, economic ill-being in of the Russian Federation caused a wave of changes borders pension age, reduction of jobs in budget sphere, of a decrease in level remuneration labor workers in enterprises . The result is growth of social antagonism and the difference in welfare of poor and rich people is increasing. This, in turn, makes one think about the appropriateness of the capitalist system and, as a result, the concept of innovative development.

Sharing a point of view N. D. Kondratiev about the mechanisms development of the SES, we note that crises – a natural and natural stage evolution, usually accompanied by innovative transformations. At this moment, a platform of the next technological way is formed by natural selection from the set of capabilities of those innovations and of innovations on the basis of which will be built the next stage of the development of the SES. Indeed during the period of the crisis, acute problems are revealed, the outlines of the future appear and technologies are chosen that allow to translate it into reality.

Economic and political development of our country since 1990 is identified with cascade of bifurcations. Indeed, in that period before country successively there were problems choices scenarios development. In present time there are the following alternatives: breakthrough in future either degradation and possible decay [21].

The next interesting form synergetic effect – hysteresis, representing poorly studied phenomenon SES, which determines the dependence of the latter on previously applied forces, or on their history. C 1934 this phenomenon is objected by economists as a high inertness of a business, as resilience habits and system resistance to

transformation. Similar theses are widely used in identifying problems unemployment, inflation and social adaptation. For example, it was found that after eliminating incentives growth unemployment it does not decrease to the predicted level, and tends to an even greater value.

Hysteresis is provoked by spasmodic bifurcation in SES. When passing from one quality state to another, is inherently accompanied by a change of trajectory to directly opposite, not repeating its return path in an effort to return to its original position, as a result, returns to it step-wise. After this SES some time smoothly evolving, remaining in achieved state. And already in the former position SES passes spasmodically as a result of a new bifurcation.

Another one form synergetic effect is emergence. We believe that the last is some facet theories systems and synergetics. Firstly, it is a phenomenon irreducibility of common properties of a system to properties of its, elements, and secondly, the result of coherence of intra-system interactions. Therefore, in highly dynamic SES the synergetic effect has resonant origin. The influences of both exogenous factors and organizational and managerial efforts are transformed due to the presence and operation of inter-element and intersystem links that form and are distributed in the SES, providing coherence and its coordination subjects.

Emergence - dialectic principle transition quantitative characteristics in SES to qualitative, or effect organization, formed when occurrence intra system connections. Emergence is considered as a result of serious fluctuations, or unpredictable bifurcation of some subsystem, or as a result of restructuring of interconnects.

The most important place in the community of synergetic effects is given to self-organization, which G. Haken identified as spontaneous emergence of highly ordered structures from chaos, considering her most relevant from the existing spectrum of SES problems [21]. Today it is the most controversial aspect of management. The results of serious studies [15, 17–20] showed that self-organization is represented as:

– sequential reduction of parameters SES with target function to optimal;

– the formation of spatial, temporary, information and functional organization structure due to due to endogenous variables as a result of purposeful interactions with her environment This phenomenon is accompanied by the formation of heterogeneities in the economic space (territory economy, cluster structures, economic complexes, industry markets and etc.).

The process of self-organization in difference from organization, which occurs under exogenous control action, proceeds from both patterns of spontaneous interaction internal disturbances, so even with indirect exogenous influence. The driving force of the evolution of the system is its self-improvement, i.e. self-organization. At the end XX c. relying on tools synergetics, it was possible to identify the reasons for the instability of SES and structural dynamics, as well as the conditions its transition to a completely new state.

Engaged in modeling the process formation public opinions G. Haken (in work Synergetics, 1980) identified macroscopic constants of SES, using as parameters order number individuals with corresponding opinions: “for” and “against". Public consciousness was introduced through the transformation of the meanings of these numbers. With absence exogenous influences were possible two results. Due to frequent changes of existing

points of view there was a one-center distribution opinions in the team. Due to high stability bonds between subjects two opposite blocks were formed, corresponding to their polarization. Proposed G. Haken model provided an opportunity to understand the nature instabilities in SES, characterizing state society in dependence on the presence and / or strength of communication his individuals [21].

Cooperation and competition subjects SES equally degree are self-organizing processes. The difficulty of perceiving and accounting the connection between "order" and "chaos" in practice is that that the market, acts as an indicator, quickly exposes slow-moving products, unprofitable production of which leads to an increase in entropy values. With respect to SES, this looks as follows: relevant and in use high demand goods are produced in sufficient volume a (and this is the result of positive feedback feedback), on the contrary, increase negentropy in the SES, increase order, because accelerate processes production and exchange, multiply industry employment, satisfy the needs of society, and as a result, increase it quality of life. After some time, with expansion of output products, the market is saturated again with goods, market equilibrium is reached, but competing structures have already managed to master and bring new products with improved characteristics, activating thereby thereby commodity-money relations. If manufacturers many- new offers come continuously. So supported nonequilibrium SES and coherent functioning of its subsystems.

Self-organization in SES in the context of spontaneous occurrence in of it ordered structures and new properties: a different degree of coherence, stable relationships and corresponding restrictions, non-trivial organizational forms and driving evolutionary forces with slight governing impact. Self-organization is associated with a decrease in entropy and the emergence of new properties of SES. The origin of heterogeneities and subsequent their growth determine its properties.

It is noteworthy that that a favorable or critical location of SES accelerates spatial and economic processes, the presence of natural resources, which certainly accelerates or slows down the growth of the resulting indicators. For the same reason the socio-economic inequality of territories is emerging. This is due to the exogenous action of SES of a higher order and patterns of self-organization. Stimulate territorial development infrastructure and large business structures can.

A feature of the phenomenon under consideration is simultaneous action and alternating interconnected concepts self-organization and self-regulation. A good example is "invisible hand" of A. Smith's market, regulating prices and activating mechanism self-regulation – in - market equilibrium is established by anyone not created order. If self-organization is associated with restructuring the structure of the SES and a decrease in the level of p entropy in it, then the goal market self-regulation – alignment and the desire to equal values entropy). Therefore, self-organization with respect to the market system can be positioned as directly opposite self-regulation process [18, 24].

We are sure that the achievement of the synergetic effect of "self-organization" in terms of balanced innovative development SES contributes to providing the following main characteristics: development culture entrepreneurship, creative behavior and aspiration innovative solutions, formation creative class, sufficient degree freedom economic activity, cooperation and stable connections between subjects of SES, convergence institutional.

The study of the essence and nature synergetic effects in SES allowed to identify the necessary conditions their formation: consistency, non-linearity, κ openness, organization of electricity, freedom their economic activity a also coherence and effect positive feedback communication. Consider some of none [18].

Systematicity is a property of structured SES, which allows qualitatively new characteristics, different from manifest characteristics of its elements to be formed separately. An inherent feature SES is constant interaction its components and integrating processes, which can be innovative investment projects and environments of different formations. It is known that the functioning of economic entities is determined as state economic space with some measure distortion reality and duality perception what is happening in the conditions of collective activity. In view of this fact, limited rationality and distorted information generate biased knowledge. First of all, it entails management problems and objects ineffective result or lack of it at all.

The transition SES to new qualitative state with dynamics resulting parameters can be made due to endogenous spontaneous processes, as well as a result of point impact heterogeneous forces and mechanisms supersystems, capable under certain conditions to a coordinated action that causes resonance and fluctuation. In a like case, such an element of SES as "connection" only emphasizes dynamism, allowing to consider the latter as abstraction [17, 18, 19].

Transparency SES allows pulses from external environment (the main source of non-linear change its state) with their consistent behavior (as a set of interacting units) provoke significant dynamics that exceed the stability boundary, and as a result – systemic effect. The openness of SES explains the influence of the behavior of large economic entities on the evolutionary trend. Often they cause fluctuation processes and resonate as external pulses, introducing entropy into the SES and eventually lead to bifurcation.

Balanced innovative development SES is achieved due to: a) degree internal orderliness; b) the correct direction and force external control impact. On the one side, in the evolving SES synergetic effect arises provided that reverse connections with the sign "plus" dominate as inside, so and outside SES. The disequilibrium of the latter provokes an increasing resource flow, giving rise to integrative behavior of elements. This, in turn, destabilizes the old order and modifies the structure.

Inverse connections in SES, answering for the Roussour flows and mutual influences of subsystems cause resonant phenomena, and then quantitative and / or qualitative transformations of the initial signal into SES. The knowledge of such mechanisms, when resonant actions essentially exceed the "strength" of the control impact and entail the formation of innovative properties SES, reveals a new understanding and perspectives of management. We believe that state and its institutions are the most effective form of expressing feedback in the national SES. Considering her in the plane of the megasystem, the state is recognized as the decisive subsystem, responsible for its development.

With an increase in the level of SES none quilibrium, its susceptibility to dynamics non-linear feedback connections increases, which increases the degree of coherence of the system components. This constitutes a prerequisite for a synergistic effect – the possibility of unexpected and innovative characteristics (qualitative

changes in the structure, composition, business processes, mechanisms, etc.) of SES. Next, the mechanism resonance product reaction acts on the process according to the principle feedback and snow lump increases catalytic effect. Proven effectiveness mechanisms pricing, manifested by the ability of feedback relationships (synergistic effect) push the market to hyperinflation or commodity deficit.

Coherence in basis synergetic effect provides unity of the whole and parts of the SES, determines the occurrence of correlations between elements, is expressed in their coordinated behavior, with feeling increased awareness each about internal state of the system. Fully responding to the external managerial impact consistent with the content of the SES, it acquires innovative references. In such cases, coherence provokes a systematic order by building separate and / or weakly interacting elements into a more effective structure. The "order parameters" distinguished in this case expose the rest, and to SES appear internal mechanisms of coordinated interaction of elements.

For example, in Russia, coherence manifests itself in the form of the formation of informal institutions, creating prerequisites providing public benefits to economic agents. Institutions are presented in the form of special technologies or appropriate tools in production value chains with an imperative to ensure security and to make effective management decisions in business activities.

Oscillatory mode development SES or synergy is not necessarily provokes non-linearity. But only in a non-linear system are possible bifurcations and chaos, in some measure due to dynamics influence demand. In this case, the latter is interpreted as direct feedback the relationship between the industrial SES and the external environment, and management purposefully enhances communicativeness, to strengthen structural ties. With this approach, it is advisable to pay attention to the effect resonance, the determination of the driving forces and the conditions for its occurrence.

The ability of SES to self-organization and structural transformations determines its dynamic potential. Significant influence on it is exerted by the variables input and output SES (signals direct communication). In this case, the external environment supplies SES resources and means to maintain order and some degree of chaos for development. Internal environment perceives them perceives and converts into outgoing flows matter, information, energy, production and so on.

In the format state regulation innovation activities oriented on limitation negative system effects, appropriate efforts to reduce level consistency and ensure information clarity economic space. The she is higher, the more investment attractiveness areas activities, as well as business activity and efficiency decisions made management decisions. Minimum distortions information lead to increase their quality, and, therefore, to decrease amplitude possible fluctuations and stability SES.

"Organization" in the context prerequisite synergetic effect in SES is aimed, firstly, at its preservation and achievement of the goal, and secondly, at the new organizational level of development. In the evolutionary format "organization" appears as a result or a certain state SES, and in the functional plan - in a separate way, as an instrument for the implementation of the plan [18]. Actual studies of economic dynamics suggest that that in any

SES in sufficient degree there are selected premises formation synergetic effects. This gives reason to state - in large SES (national economy, industry, production complexes) there is the possibility of achieving a significant spectrum of synergetic effects. In simpler and smaller structures, synergies and complementary effects are most likely to occur.

## III. Conclusion

Strategic guidelines for the development of the Russian Federation require tactical measures mastery of the mechanism for achieving a positive synergistic effect of “self-organization” From the authors point of view, the management methodology today focuses on studying previously not known to economic science properties SES, its evolutionary patterns, mechanisms of cyclic development to implement “soft” resonant control effects on certain forecasting parameters. In this case, the state, in the context of the regulatory subsystem, should strive to ensure the integrity, stability and optimization of its structure.

Understanding the properties of and processes occurring in SES, will allow, firstly, to see imbalances in the structure of SES, and secondly, to identify trigger areas and governing parameters to maintain a balanced innovative the trend. The basis of the presented concept is the mechanism of coherent influences directing the system to the desired channel. In this state, SES is especially sensitive to influences, coordinated with its structural characteristics.

The authors are sure that it is possible to obtain a synergistic effect if there is a “synergetic potential” in the SES. It seems to be a systemic property that naturally arises as a result of certain intersubjective interactions and manifestations of the corresponding institutional environment, mainly due to intangible assets and synergy effects. Similar processes are accompanied by an increase in the level of entropy and activity of SES. This ensures the sensitivity of the latter and its necessary response to small external influences, consistent with the inherent properties to achieve strategic goals and the development of SES along a certain permissible trajectory [17, 18].

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