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Nature-Like Models as Contemporary Direction of Management

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Author's Photos



Author's short biographies

- Tetiana Yehorova-Hudkova, PhD of Economics/Candidate Degree, Associated Professor of Odesa I.I. Mechnikov National University, Odesa, Ukraine. Scientific contribution: more then 110 scientific papers, 7 collective monographs, 1 monograph.
- Traditional courses
- Anti - crisis Management
- Project Management
- Macroeconomics
- Management
- Original courses
- Econophysics
- Economic Security of State
- Mathematics of Harmony
- Synergetic Management
- Theory of Transdisciplinary

Introduction

- The purpose of the research is in the initiation of new methodologies, new worldview that minimizes the dissonance between the interests of Nature and the technosphere or the transition to Nature-like management.
- The evolution of technological and management systems, in search of ensuring sustainability, synergistic effect and efficiency, has changed the vector towards nature-likeness.
- However, the transdisciplinary approach and the invariant-variation composition of the economic system are used to a limited extent in modern research.
- In the conditions of the singularity - the constant presence of the economies of most countries of the world in a crisis or pre-crisis state, the shortage of many types of resources, the negative anthropogenic impact on the environment, the question of finding alternative management models, which should be correlated with the noosphere concept of life, remains unresolved.
- The basis for the development of the new methodology of Nature-like management are Universal principles and the transdisciplinary approach.

The Literature Review

- Nature-like management and its models based on the geometry of Natural objects can be used as one of the direction for solving problems of theoretical economics and designing self-organizing economic systems.
- Prof. E. Khitsenko defines self-organization as "Involuntary process of growth and maintenance of mutual coordination of system elements by increasing its complexity and imbalance".
- I. Prigozhin, one of the founders of the theory of self-organization, connected this phenomenon with the concept of dissipative structure - a structure that spontaneously arises in open unbalanced systems. "Coherent actions" or coherent behavior of elements of dissipative structures is the phenomenon that characterizes self-organization processes. I. Prigozhin defines self-organization as "choosing one of the solutions that arise at the bifurcation point, which is determined by probability laws" . Any system has its own metric characteristics. The most common mathematical constant found in Nature is the Phidias number or the Golden Ratio. The structural parameters of any living organism are characterized by the multiple presence of the Phidian number.
- Measure is the most important characteristic of the Universe, without taking Measure into account, any knowledge, description of processes and phenomena will be incorrect. The Law of the Golden Ratio is the Law of Measure established by the World and mathematically describes the metric characteristics of the Universe.
- P. Florensky notes: "The law of the golden section is really implemented in nature. But there are many spheres or plans for its implementation, and then the question arises about the general beginning of these proceedings. This beginning is being in its phenomenon. In other words, the golden ratio is an ontological law, and precisely, as explained earlier, it expresses the structure of the WHOLE as such. This establishes the meaning of the law that occupies us .

The Literature Review

- When designing economic and technical systems and aggregates of their components, we should be guided by the ratios of the Golden Section and its derivatives as components of the Law of Measure as mathematics base of Nature-like Management (Golden Section, recurrent series of golden sections, wurfa, "metallic" proportions).
- Non-observance of this fundamental rule leads to a violation of the principles of stability of artificial systems, the emergence of macroeconomic disparities, and the creation of conditions for the transfer of the crisis from economically more developed countries. According to the law of structural harmony of systems by E. Soroko, the structure of the system can be represented using invariants and variations. "Invariant is a structural element, a generalized quantitative or qualitative indicator that is preserved during some transformations, changes of the system it characterizes. Variations are elements of the system that change ".
- Experimental data show that if two parts of the whole (elements of the system) are in the ratio of the golden ratio, then they ensure the structural and functional integrity and stability of this whole (system) in interaction with the external environment. The "external harmony" of the modeled object "in statics" manifests itself in the form of m-numbers of Fibonacci and Luke, which appear in certain "static" parameters and characteristics of the object under study.
- The assessment of the state of a system with the properties of self-subordination according to K. Shannon can be determined by calculating the relative information entropy - an integral indicator, the values of which mathematically correspond to the generalized golden sections or fractions of a unit. Generalized golden intersections or special points of multiple relations of entropy and its antipode, redundancy, or measure of organization, measure of uniformity, when entropy is a measure of diversity, outside of equilibrium - diversity of the limited act as nodes of measure or invariants or attractors of the system.

The Literature Review

- The one consists of two opposites. "If one of the opposites is probability, then the other is improbability; one of them is a measure of chaos, the other is a measure of order; one is a measure of diversity, the other is a measure of uniformity, and so on. When the opposites are measurable, they have their quantitative measures, levels A and B, then they satisfy the law of conservation in the process of striving for a single measure: A + B = C, or in a relative, weighted form: A + B = 1 (the unit interval is an isomorphic image of a real numerical half-line) "[Thus, there are two measures in the dynamic space of the unit interval: and

- According to Lebesgue's theorem, if two measures are given in some domain, then they are multiples. In this case, this means that, depending on which of these measures to take as the standard (unit of measurement), one of two equations will be possible: or, where the multiplication factor, according to its definition, is a natural number: 1, 2, 3 , ...
- As a result, taking into account the previous relation (law) of co-conservation, we have one of the equations: or the roots of this equation, obtained at natural values of k, are called generalized Golden sections. They are the quantitatively expressed nodes of the nodal line of measure, designed for a unit interval: 0.5000 ...; 0.6180 ...; 0.6823 ...; 0.7245 ...
- The roots of the opposite content, that is, the most distant from them, are obtained at half-integer values of the parameter k = 3/2; 5/2; 7/2, ... can, by analogy with the same points, be called antinodes of measure: 0.5698 ...; 0.6540 ...; 0.7053

The Literature Review

- The first, measurement nodes, are attractors for integral indicators of systems, in particular - for relative information entropy as a measure of the state of any structurally complex system. These values are the basic characteristics of non-equilibrium stable, stationary states, self-organizing and evolving complex systems beyond the equilibrium of the latter, where this indicator, the relative entropy, is equal to 1.
- As R. Hartley showed, the logarithm of the probability of this event, taken with the opposite sign, serves as a measure of the amount of information contained in an event: - log p.
- But the logarithm of the improbability of this event can also be a measure: - log (1- p).
- From the multiplicity of these measures log (1- p) = k log p follows the equation: p k + p - 1 = 0. Its roots: 0.500; 0618 ...; 0.682 ... when k = 1, 2, 3, ... and there are nodes of measure p - generalized golden sections If the state of the system for which the values of the integral measure are equal to the numbers of the first row, i.e. coincide with the nodes, the growth of chaos is minimal and maximal an increase in organization, order, structural harmony and system quality, then the state of the system for which the integral measure takes values from the second series of numbers (and these are antinodes, which are indicators of such states, where the system properties of objects are manifested in the minimum possible forms), - there is a maximum increase in dissipation, dynamic chaos.
- Entropy becomes an expression of the amount of information related in the distribution of system components. Normalized to unity, that is, taken to its maximum value, it takes the form: ,
- (2) $\overline{H} = -\frac{1}{\log n} \sum_{i=1}^{n} p_i \log p_i$
- where n is the number of system components.

The Study

- According to the Models of Nature-like Management - attractors and distractors of non-equilibrium states of the system are nodes and anti-nodes - indicators of states that are inherent in any of the systems regardless of their scale and specific real specificity in the process of self-organization or evolution, and the transition between such states is quantized and fixed by nodes of measure.
- The ontological status of the measure and information entropy, the nodal value of which corresponds to the best options for solutions or optimization, ensuring the stability of the system based on the principle of diversity should be carefully studied on the example of different economic systems, Passing through a number of intermediate phase states in motion until the acquisition of the best possible harmonic stationary state, the system ultimately chooses an attractor structure from some class (countless) of such virtual structures with a fixed nodal value of the integral measure for each of them - that and entropy as measures of limited diversity. And thereby it finds its proper level of intensity of exchange processes, the tension of its characteristic functional mode, and therefore - the proper type of system quality.
- Speaking about the stability of complex systems designed on the principles of nature-like management, it should be noted that the meaning here is unbalanced stability.

Research Question(s)

- Nature-like management and corresponding simulation modeling based on the geometry of natural objects can be used as one of the methods for solving problems of theoretical economics and designing self-organizing economic systems/
- All objects of living nature have the properties of self-organization and self-harmonization. One of the first scientific works that laid the foundations of the theory of self-organization was A. Turing's work devoted to the study of the self-organization of phyllotaxis.
- The phenomenon of phyllotaxis, like everything in natural systems, is mathematically described by law of Measure or the law of the Golden ratio.
- The study of phyllotaxis by A. Turing established the transdisciplinary nature of the problem, modern research has deepened to the level of general laws of shape formation, which, in fact, is of interest to theoretical economics and the design of sustainable systems based on the principles of Nature-like management.
- Phyllotaxis is a unique lattice arrangement of leaves, seeds, petals and scales of many types of plants. Rows of nearest neighbors in such lattices, the so-called parastichy, which unfold in spirals on a flat, conical or dome-shaped surface or twist in helical lines around a cylinder.
- The Golden numbers Φ and ϕ correspond to the angles 222°29'32" and 137°30'28". At the angle ϕ, opposite arcs are formed in pairs with Fibonacci numbers — (34, 21), (55, 34), (89, 55).

Methodology



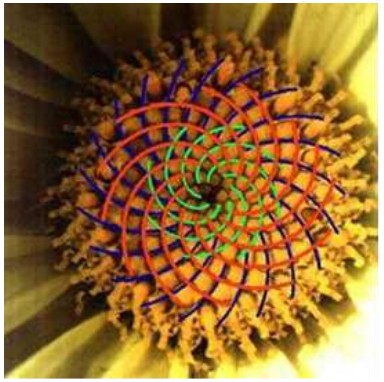


Fig. 1 Sunflower basket, number of seeds = 1000, ϕ = 137°30'28".

Fig. 1 shows the change in direction and number of arcs corresponding to adjacent Fibonacci numbers (34, 21), (55, 34), (89, 55). This is connected, obviously, with the fact that there is a recursion that determines the fractal structure of the sunflower basket. Fractal structures contain attractors or nodes in which the direction of the process changes. Numerical values (34, 21), (55, 34), (89, 55) exactly correspond to such attractors. There is a so-called "strange attractor" of Lorenz, sometimes the basket is formed in accordance with this attractor.

The main characteristics of phyllotaxis are: the number of genetic spirals (leaves in one node), the isomerism of the genetic spiral and the angle of divergence. The main characteristic is the divergence angle.

Methodology

- The limitation of phyllotaxis in nature to certain "ideal" angles is of great theoretical interest and requires detailed study. From a continuous series of possible divergence angles, nature chooses quite specific angles, turning the continuous into a discrete one. A discrete spectrum of natural types of phyllotaxis appears. How a discrete reality emerges from a continuous ocean of possibilities is an interesting methodological question“. In different sectors of the public economy or in the subsystems of the social supersystem, there is a constant need for changes, in the conditions of preservation of the chosen vector of the goal. This is an accepted practice in conditions of system redundancy.
- Nature-like management presupposes self-organization and self-harmonization of processes – implementation of changes without stopping, as it happens in nature. The phyllotaxis model provides us with the laws of dynamic shape formation.
- This approach is called system-dynamic. The main characteristic of the ego is such a manifestation of self-organization as self-reproduction of the cycle. As a mathematical support, it has generalized golden sections that systematically connect organization and disorganization, chaos and order in the structure and dynamic change of complex systems.

Methodology

- The phyllotaxis model presented to us by Nature is system-dynamic and provides continuous reproduction of the life cycle of the system. The model has the properties of integrity, self-organization and self-harmonization, it is structurally stable, since the golden section proportions are present in the structure. Possessing shape-forming properties, this model of natural origin can be used in a natural management system, for example, in the design of TNCs, clusters and vertically integrated companies.

Results

- An indicator confirming the ineffectiveness of the existing management system is the existence and growth of the shadow economy, as a complex of different types of economic activity carried out outside the framework of the legislative environment, which causes both asymmetry in economic development and deep violations in the economy from the point of view of ensuring integrity, operational closure and purposefulness of the economy as a system. According to various estimates, the share of the shadow economy in Ukraine ranges from 42.5 to 45.4% of the official GDP (2014).
- The basis of this phenomenon is the asymmetry of the price of legality and illegality of using the market mechanism, which is implemented through the mechanism of transaction costs. - the minimization of asymmetry is also due to the law of structural and functional harmony of systems with attractors of the recurrent series of golden sections and can be achieved when: - balancing and harmonization of the ratio of state and private capital in the economy; - harmonization of tax rates and the taxation system as a whole; - balanced income distribution between regions; - a harmonious ratio of external debt to GDP;
- - harmonious ratio of state and private property, expanded reproduction of state property and increase in state expenditures;
- - the proportional ratio of spheres and sectors of the economy based on the use of the principles of vertical integration and the design of creation of chains of added value, returning to the balance planning methods taking into account harmonic proportions;
- - ensuring the proportional ratio of export-import operations;
- - minimization of raw material exports and ensuring the priority of exports of goods with high added value.

Results

- To verify the hypothesis under consideration, a study of the activities of the world's largest TNCs, performed according to the methodology of its authors, was used. (***Stefania Vitali1, James B. Glattfelder1, and Stefano Battiston1y. The network of global corporate control. Chair of Systems Design, ETH Zurich, Kreuzplatz 5, 8032 Zurich, Switzerland. 42 p.)***
- The result of this study testified to the stability of the system of interacting TNCs, and according to the results of the graphical display of connections in the system of interaction of TNCs, a "strange Lorentz attractor" was shown. This fully confirms the hypothesis of stability and the emergence of additive properties in an artificially designed economic system based on the principles of nature-like management.
- 1.As a characteristic of the TNC network, as a complex open nonlinear system, a "strange Lorentz attractor" was obtained, which axiomatically confirms the presence of self-organization processes in this economic system.
- 2. Attractor - directing the system to a relatively stable state in the phase space.
- 3. "Strange attractor - the Lorentz attractor is most characteristic of self-organizing systems. Such attractors have a prognostic horizon or a corridor with a period of prediction of system behavior.
- 4. The space of the strange attractor has a fractal structure and this also extends the possibilities of prediction. Strange attractors are described by irrational numbers, or Fibonacci numbers, which is a manifestation of the Golden Ratio.
- 5. Strange attractors exist as a result of the existence of negative" and "positive feedback" in the system. When the system states are characterized by strange attractors, it becomes impossible to determine their position and behavior at each given moment, although one can be sure that the system is in the attractor zone.
- 6. With the help of calculation algorithms of the strange attractor, science begins to describe, for example, changes in the climate, forecasts of weather processes, the movement of some celestial bodies, the behavior of many elementary particles, thermal convection phenomena, etc.

Results

- The analysis of the activity of TNCs shows that they are less affected by the crisis than any other integrated hierarchical structures, they increase the pace of production the fastest even in crisis conditions, they increase the innovative level of production at the fastest pace and have a high level of financial stability. All signs of self-organization and self-harmonization are present *(Stefania Vitali1, James B. Glattfelder1, and Stefano Battiston1y. The network of global corporate control. Chair of Systems Design, ETH Zurich, Kreuzplatz 5, 8032 Zurich, Switzerland. 42 p.)*
- In 2011, researchers from the Department of System Design at the University of Zurich published a unique study of the structure of the TNC control network and its impact on the world market.
- The researchers found that MNCs form a giant "tie" structure (Lorenz attractor), and that much of the control is vested in a small, tightly knit core of financial institutions.
- The study was started with a list of 43,060 TNCs, the resulting TNC network includes 600,508 nodes and 1,006,987 ownership links. The network consists of many small connected components, but at most 3/4 of all nodes contain the leading TNCs with an economic value that accounts for 94.2% of the revenue from the total number of operating TNCs.
- The largest number of relationships contains only one dominant strongly connected component (1347 nodes).

Results

- Thus, the TNK network has a "bow tie“ or Lorenz attractor structure. Researchers found that only 737 top owners accumulate 80% control over the value of all MNCs.
- The study found that almost 4/10 of the control over the economic value of the world's TNCs is exercised through a complex web of ownership relationships by a group of 147 TNCs, which basically have almost total control over the network. Thus, the top owners of the core can be seen as an economic "super-entity" in the global network of corporations. An important additional fact at this point is that ¾ of the core are financial intermediaries.
- (Author - "unique" system of planning and marketing, network and other analytical studies).

Results

- The constituent methodologies of Nature-like management of the economic system can be presented in the form of the following algorithm:
- 1. Assessment of the status of the economic system.
- 2. Assessment of the structural and functional state of the system.
- 3. Analysis of the economic cenosis and assessment of the level of vertical integration of business in the context of industries and sectors of the economy;
- 4. Assessment of the share of added value in GDP;
- 5. Comparison of the evaluation results with attractors representing a recurrent series of golden sections: 0.500...; 0.618...; 0.682...; 0.725, as well as second derivatives of the law of proportional division, such as wurfs, Tn -coefficients, "metallic" proportions.
- 6. Control of reliability and viability of the system.
- 7. Study of the problem of system redundancy.
- 8. Entropy testing of the system (calculation of information entropy)
- 9. Formulation of the system restructuring (reengineering) project to bring it closer to natural attractors
- 10. Implementation of the project.
- 11. Evaluation of the compliance of the designed system with structural and functional compliance with attractors of the golden ratio and its derivatives

Discussion

- B. Popov notes that "modern official science, detached from nature, is not capable of conducting research aimed at creating something similar to nature - identical to the natural." Its results look very artificial, as if everything is composed of non-equivalent parts, which means that they cannot be used as a basis for the creation of successive transformational lines characteristic of natural processes. A science oriented to this has yet to be created as a matter of urgency. And humanity is not yet ready for the transition to nature-like technologies. The ego also needs to be intensified».
- "The results of numerous simulations lead us to the assumption that the Fibonacci phyllotaxis does not arise due to the absolutely accurate measurement of angles, which leads to the "preset harmony" of the optimal arrangement of grains, but as a result of the action of dynamic factors that impart structural stability to the system" (A. Schetnikov).

Discussion

- Methodologically, it should be taken into account that modern studies of phyllotaxis models, performed by V. Bryntsev testifies that "The maximum critical point can serve as a good geometric interpretation of the so-called regime with exacerbation, which is given a lot of attention in modern synergetics. When approaching the critical point, the number of elements in the parastitch cycle increases in an explosive manner. Of course, at the critical point, the number of elements is not infinite, it is limited by the length of the run, but it is not limited by the cycle. The behavior of points on a cylinder is a non-linear space, similar to the behavior of non-linear processes with positive feedback".

Discussion

- It is also expedient to use the cenological approach as a tool for Nature-like management.
- The method of regularity analysis for various business forms applied to economic cenoses was developed by .V. Fufaev. The essence of the technique can be presented as follows:
- 1. A list of all types of activity is compiled based on the selection of organizations of the selected economic cenosis.
- 2. Organizations with the same main type of activity are counted according to the list.
- 3. Types of activity represented in this sample by the same number of organizations are grouped into castes.
- 4. Castes are arranged in the order of decreasing number of types of activities in them, which results in the distribution of types of activities according to repetition.
- To diagnose the state of economic coenoses in the system of Nature-like management (as well as other types of formations) on the subject of "norma-pathology", it is necessary to use H-distribution of B.I Kudryn.
- The diagnosis of "norm - pathology" can also be carried out with the use of a recurrent series of golden sections - nodes of the measure characterize the norm and antinodes - characterize the pathology.

Discussion

- This approach is called system-dynamic. The main characteristic of the ego is such a manifestation of self-organization as self-reproduction of the cycle. As a mathematical support, it has generalized golden sections that systematically connect organization and disorganization, chaos and order in the structure and dynamic change of complex systems.
- It can be said that the problem of phyllotaxis is presented to modern researchers not as a specifically mathematical, biological, physical, chemical, crystallographic, etc., but primarily methodological one.
- Apparently, all or almost all possible elements of its solution have long been identified, — i the task of the researchers is, first of all, to coordinate them with each other, to indicate the limits of the reasonable applicability of each of the approaches . (V. Bryntcev).

Implications

- The absence of the theory and methodology of Nature-like management, the limited use of the cenological approach in management and in the design of economic systems as self-organizing integral distributed emergent systems with complex dynamics, ignoring the need to use the mathematical constants of the Universe and Nature in the management naturally determines the ineffectiveness of institutional intervention in management and the impossibility of providing a legislative environment harmonization of interests in society.
- Modern management science does not investigate stable systems existing in nature as possible models for the design of self-organizing and self-harmonizing micro and micro economic systems. In the conditions of the singular vertical of the forecast and its confirming reality of the emergence of crisis phenomena, such ignoring is unjustified and wasteful. The transition to the use of Nature-like technologies requires the development of a theory and methodology of nature-like management with the aim of achieving "pre-established harmony" according to G.V. Leibniz.
- Generalized Fibonacci numbers and generalized golden sections and their ratios are the basis of all structures of and the basis of the design of all artificial systems. This is one of the main directions of the formation of a new worldview and methodological structure.

Implications

- Developing the scientific conclusions of A. Stakhov to the topic of mathematical support of Nature-like control, namely: "the connection of a new class of hyperbolic functions with sequences of Fibonacci and Luke m-numbers is of a fundamental nature... Especially, "when modeling real physical, chemical, biological processes and structures using Fibonacci and Luke hyperbolic M-functions.
- At the same time, as a rule, the "external harmony" of the modeled object "in statics" manifests itself in the form of m-numbers of Fibonacci and Luke, which are in one or another "static" parameters and characteristics of the object under study. This is a signal that demonstrates that "the internal harmony of" this object" in dynamics" is based on one or another class of hyperbolic Fibonacci and Luke m-functions." systems and their components must be guided by the ratios of the golden section and its derivatives.

Suggestions for Further Research

- In continuation of the replenishment of the set of tools of the methodology of Nature-like management should be presented the research of V. Burdakov and V. Volov, according to it, in any complex-organized system as an organism, regardless of its subject specifics - technical-technological, biological or social - the internal load of resource life processes is self-similar, has a fractal nature, being based on the invariants of the Golden ratio.
- Using of the principles of Nature-like management for development of the methodological approach creates opportunities to design resistant to change and crisis disturbances of the economic security of the state and justify the correct choice of vector for evolutionary models of nature management in change.
- The Phyllotaxis model gives us the laws of dynamic formation. This approach is called system-dynamic. Its main characteristic is such a manifestation of self-organization as the self-reproduction of the cycle. It has as a mathematical software generalized golden sections, which systematically link the organization and disorganization, chaos and order in the structure and dynamic change of complex systems.
- We can say that the problem of phyllotaxis appears before modern researchers not as a specific mathematical, biological, physical, chemical, crystallographic, etc., but as predominantly – methodological.

Suggestions for Further Research

- The main methodology that provides managerial influence on any system is project management. Planning development programs and projects involves an assessment of its environment. In management theory, this is called environmental factor assessment. The success of the project is determined by the correctness of such an assessment. If the environmental factors are unfavorable, the project may be rejected or revised, because the achievement of the project goal becomes impossible or the project performance will differ significantly from the planned and tend to zero.
- For Future research - will try to investigate the possibility of introducing the principles of nature-like control of proportional distribution and fractal-cluster constants into the methodology of the logical-structural approach in project management.
- . A logical-structural approach is a synthesis of interrelated concepts that are used as part of an iterative process to facilitate a structured and systematic analysis of a project or program. It allows you to analyze and present information in a structured way, which in turn helps you formulate important questions and identify weak points.
- The logical-structural approach is a method of planning, implementation and evaluation of programs and projects, which includes the analysis of problems, tasks, strategies, the construction of a logical-structural matrix and the drawing up of a schedule of activities and a schedule for the use of resources

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