

## The Features of the Presentation of the Topic "Synergetics of the Economics" For Students of Information Technologies

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**Abstract:** The problems of teaching students the synergistic basis of economy is considered. The scheme of presenting the subject is provided, which is adapted to the aspects of modern students teaching.

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### 1. INTRODUCTION

Up to now, the valuable development of the theory of synergistic phenomena continues in economy. It is important to note that graduates of universities of economic and information specialties will inevitably encounter the need to complete the economic knowledge concept, which will be formed in the future. In connection with the above, there is a problem of students teaching in the main positions of economic synergetic. In the opinion of the authors, one of the most important problems arising in realization of the teaching process is insufficient basis knowledge of students. Synergy is based on regularities established for physical and physical-chemical phenomena. In the discussion of the economic phenomena such as the production of entropy, critical phenomena, irreversibility, parameter of the order, and others, the teacher encounters a non-understanding of students. Unfortunately, the natural science block of knowledge is currently withdrawn from the educational process of students of economic and information specialties.

In this connection, the following scheme of simplified ideas on synergetics, based on the use of only a general school course, is provided.

### 2. PROCEEDINGS OF THE SUBJECT "SYNERGETICS"

The presentation is assumed for four or five lectures. Four groups of questions should be highlighted: general concept of synergetics; examples of synergetic structures; mechanisms of self-organization, key synergistic processes; manifestations of synergetic phenomena in economy. Let us present below the theses of the discussion lectures.

#### 2.1 Synergistic and Non-Synergistic Processes

First of all, it is necessary to determine what synergistic processes differ from non-synergistic. At the present time, there is a vulgar identification of the phenomena of synergy and synergetics. Synergy means only the presence of a mutual influence of the components of the system on its general properties. That is, the synergy covers a much wider set of objects than synergetics. The Nobel Prize was awarded to I. Prigozhin for the discovery of a completely new class of phenomena. It is characterized by the presence of the following three unusual features:

- 1) spontaneous occurrence of structures "from nothing" (Haken 1978);
- 2) abrupt, catastrophic nature of process of changing properties of an objects and its structure;
- 3) the fundamental unpredictability of the occurrence and changing of the structures.

To clarify the meaning of the above classification, the poorly prepared students are expediently supported on either known or readily demonstrated phenomena. First of all, as examples of spontaneous structures it is possible to imagine a protuberance on the Sun and a tornado. They, obviously, arise "from nothing".

Next, let us offer students images of the pulsating Belousov-Zhabotinsky reaction and Benard cells, whose existence contradicts common sense. Then it is necessary to note the interdisciplinary character of synergetics, to perform an analogy of the physical processes discussed above with social processes. Typical examples of social disasters are the following events. The revolution of 2011 in Tunisia broke out after a minor event – the death of a vegetable trader. The

global First World War began after a banal contract killing. It should be reminded about the suddenness of economic crises. All these phenomena have an obvious feature of self-organization and catastrophism and can be attributed to synergistic.

Special attention should be paid to the limited predictability of synergistic processes. In particular, the interest of listeners is the phenomenon of the “Lorentz attractor” (that looks like a butterfly). It is that a butterfly somewhere in Brazil can swing its wings, and there will be a trickle of air that can intensify in a superheated and humid atmosphere, turn into an ascending stream that forms a rain cloud. Further, a cyclone can be formed, which will turn into a hurricane while moving over the Pacific Ocean and then will destroy half the state of Texas in North America. Thus, “the butterfly waving wings destroyed half of America’s state”.

Then there may be a question about the reasons of the “bad” work of meteorologists. It is shown that the weather is a synergistic and limitedly predictable process. Famous specialists in synergetics S.P. Kurdyumov and G.G. Malinetskii reported in their report for the RAS on the existence of “the horizon of predictability of weather equal to three weeks” in 2000 (Malinetskii, Kurdyumov 2001).

In the last twenty years, researchers came to the conclusion that there is a fundamental unpredictability of the development of a number of events. Since the time of Newton, the materialists argued that any phenomenon can be predicted. It is sufficient to take into account all the initial factors for this. However, the numerous phenomena discovered at the end of the 20th century have shown the unpredictability of the occurrence of many important things for people. In particular, these include the exact place, time and trajectory of the tornado movement, the occurrence of an earthquake, the beginning of historical and economic crises, the occurrence of dangerous comets from the outskirts of the solar system, etc.

The next one of the most important characteristic of the synergistic process is the “self-organizing structure”. Structures can be divided into two types – forced and synergistic. Laminar flow of water in a pipe is a forced process, and turbulence, suddenly occurring at sufficiently high velocities of water, is synergistic. The wind that carries air from the high-pressure region to the low-pressure region is a forced process. The tornado that appears suddenly and has abnormal characteristics of motion (high speed, rotation) is synergistic formation. Let us compare two visually distinguished structures: “house” and “mountain”.

The house is built according to a certain plan and this process is fairly predictable. It is a forced process. The growth of mountains is limited by a number of factors: the movement of continental plates, earthquakes, atmospheric and water erosion, the internal structure of geological rocks. The process of mountain growth leads to the fact that the pictures of mountain ranges and peaks are unique. This process has signs of unpredictability, self-organization and catastrophism, and therefore can be attributed to the synergistic type.

The increase in customs duties predictably will affect prices. At the same time there are chaotic, spontaneous price fluctuations. The price change is a synergistic process, etc. The similar division of structures into forced and synergistic ones can be found in a number of other situations.

Sufficiently clear transitions from forced structures to synergistic ones can be illustrated by the example of transformations of soldiers. The ranks built by the officer command represent a forced structure. Its scheme is shown in Fig. 1a.

After the command “at ease” the structure disintegrates, the random movement of privates takes place which leads to a chaotic system “b”. Then, at stage “c” it can be replaced synergistically by groups of people connected by common interests. Groups of two, three or more communicating people are appeared in Fig. 1c. The list of self-organizing systems can be expanded unlimitedly since the movement of the knowledge horizon opens up all new synergistic objects. Note here the structures discussed below in economics, politics, psychology, history, sociology, ecology.

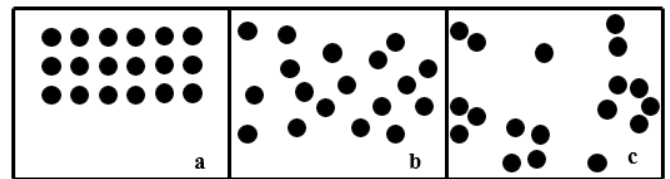


Fig. 1. Changing the structure of the soldiers (a – forced structure, b – chaotic, c – synergistic organization of short-range order) (Sachkov, Kormyshev, Naboychenko 2017).

The main features of the presentation technique are reflected in our textbook (Sachkov, Kormyshev, Naboychenko 2017). The main topics of lectures: the conditions of occurring of self-organization, key synergistic processes; manifestations of synergistic phenomena in economics.

## 2.2 The Basic Conditions of the Self-Organization

Why are there forces structures in one situations and synergistic self-organizing structures in others? It has been found that the occurrence of synergistic phenomena requires the simultaneous implementation of three general conditions:

- 1) sufficient value of the driving force of the process;
- 2) complexity of the system;
- 3) nonlinearity of the relationships between elements of the system.

The action of **sufficient strength of the process** is illustrated by a number of easily stated phenomena (Sachkov, Kormyshev, Naboychenko 2017). Classical synergistic objects are the following phenomena. The occurrence of Benard cells when the overheating exceeds the critical value, the turbulence of the fluid or gas flow as a result of exceeding the value of the Reynolds number, the laser flash when the

pump power above the critical. Critical phenomena are accompanied by kinetic transitions.

It is advisable to explain the condition of the **multi-component system** using the double pendulum model.

Fig. 2 shows the motion diagrams of two single pendulums (a, b) and the result of their connection. Single pendulums oscillate regularly, with certain frequencies. Their deviations are described by good sinusoids. However, when they join together, chaos arises and irregular rough movements occur (Fig. 2c).

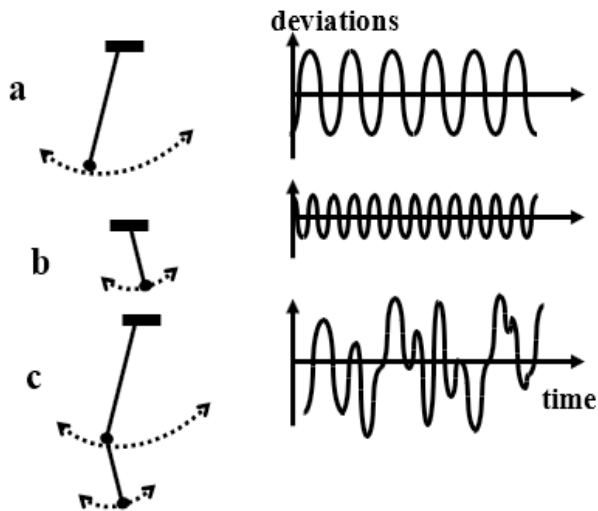


Fig. 2. Scheme of motion of two single pendulums and a double (a, b, c respectively) (Sachkov, Kormyshev, Naboychenko 2017).

The effect of multicomponent nature is manifested in the predator-prey system, chaotic motion of asteroids and comets, self-excitation of oscillations in systems with positive feedback. There is also the complexity of the system due to its fractality, i.e. the self-similarity of parts of the system at different scale levels. In particular, the turbulence is in fact the fractal structure of vortices with different sizes.

### 2.3 Synergistic Processes in the Economy

The most interesting manifestations of synergistic processes in the economy can be considered economic cycles, the phenomenon of “black swans” – comparison of market and administrative system of management.

When considering cycles, it is advisable to analyze the recent article (Gromkovsky 2017). The course of global cyclical business crises is phenomenologically analyzed there. It is shown that the characteristic “Use of production capacities” can be used as a parameter of the order characterizing the formation of the crisis. In particular, it was found that for the US economy in the period from 1945 to 2011 the average duration of the discussed cycle was 69.5-68.5 weeks.

The process, similar to the Lorenz attractor (or Lorenz butterfly), can be the phenomenon in the economy called

“Black swans”. The theory was proposed by N.N. Taleb. They are called hard-to-predict and rare events that have significant consequences (Taleb 2011).

“Black swans” are not so rare in financial markets”, – E. Nabiullina stated, the Chairman of the Bank of Russia, <<https://lenta.ru/articles/2016/07/01/storm/>>. There were three phenomena in recent years. First, the Federal Reserve System of USA announced the curtailment of the quantitative softening program and stopped injecting money into the American economy through the purchase of assets. Then the oil prices collapsed. Then it was necessary to take into account the risks manifested in the Chinese economy.

The methodology of comparison of market and administrative systems is presented in (Sachkov, Kormyshev, Naboychenko 2017).

The economy is characterized by a combination of synergistic and forced structures. The creation of large corporations and their interaction with each other occur “spontaneously” and form a system of self-organizing structures. At the same time, strict discipline prevails within corporations. The structure of the company and the management system is largely forced. Violations of discipline are severely suppressed. At the same time, elements of staff initiative are also needed. In particular, the success of the company is determined by the optimal ratio of self-organization and directivity.

The economy exists in interaction with other elements of society: technology and public consciousness as well as such structures as social, political, state, educational, etc. The interaction of all the discussed components forms a system of many bodies. The study of its behavior at the University requires an interdisciplinary approach. Graduates should understand that the economy is part of a synergistic system. Economic progress, decline, crises and “black swans” are often caused by processes in other areas mentioned above. High-level graduates of economic specialties should be multidisciplinary specialists.

The most well-known synergistic phenomenon in economy is Kondratiev waves. They reflect the interaction of two components: economics and technology. Fig. 3 shows the scheme of their realization.

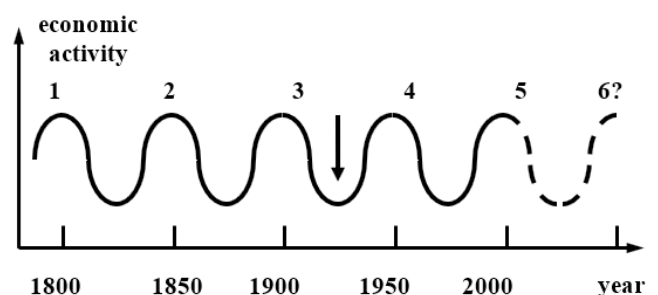


Fig. 3. Scheme of Kondratiev waves; the numbers near highs represent technological modes, the arrow indicates the crisis of 1929.

Fig. 4 shows the structure of the technological wave.

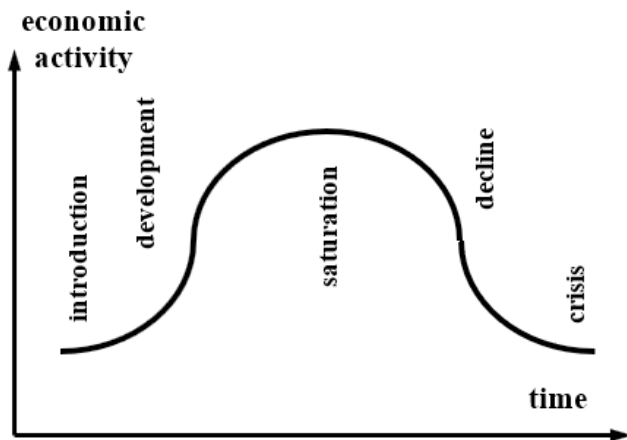


Fig. 4. Structure of the technological wave.

Consider, in particular, the effect of public consciousness on the economy. One of the most important but little-known synergistic processes in the economy is the formation of paradigms. The paradigm represents the mode of action adopted by this intellectual community at the level of psychological attitudes. Simplistically, in a narrower sense, the paradigm is a concept that has become axiomatic. The emergence of a new paradigm means a revolution (Sachkov 2015).

The most important feature of the paradigm is that it must master minds and become intuitively correct. This is a synergistic self-organizing structure of knowledge.

The influence of paradigms in society is well-known. The paradigm of racial exclusivity led to the catastrophe of 30s and 40s, the paradigm of class superiority – to the destruction of many elements of science in the USSR. The recent economic devastation in Northern Africa and the Middle East has been caused by the self-organized spread of the paradigm of radical Islam.

The need for an interdisciplinary approach in description of synergistic processes in the economy can be demonstrated on the other components of culture discussed above.

### 3. DISCUSSION

In the scheme presented above, there are no number of important characteristics and processes of synergetics. It is connected with the low level of students learning. It is necessary to look for a way out of the “information pit” caused by refusal of the teaching of science block of subjects to students of economic and information specialties. Possible solution – reading of interdisciplinary courses.

The content of the proposed direction is supported, in particular, by our textbooks (Sachkov, Kormyshev, Naboychenko 2017; Sachkov 2015) and others. They contain lectures of interdisciplinary topics. The book (Sachkov 2015) considers the relationship of economics, social synergetics and the development of physical knowledge. All discussed

materials are characterized by the most accessible presentation of lectures. It is important to note that depriving students of economic and information specialties of the opportunity to gain knowledge of the natural science unit deprives them of the possibility of further interdisciplinary activities. Meanwhile, it is expected that a significant part of the scientific developments of the 21st century will be interdisciplinary.

### 4. CONCLUSIONS

The educational materials are presented for the development of students’ knowledge are presented in the field of economic synergetics. It is suggested to use interdisciplinary courses designed to reduce the gaps in natural science education of students of economic and information specialties.

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