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**BUSINESS ECOSYSTEM AND ITS FEATURES IN THE REAL
SECTOR OF THE ECONOMY**

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Abstract

The business ecosystem is the result of the evolution of ecosystems from biology to economics. The concept formulated at the end of the last century today is transformed into the strategic priority of large business in various industrial markets, including in the real sector of the economy. The purpose of this study is to investigate the evolution of the term “ecosystem” in the economy and assess the empirical features of ecosystems in the real sector. The study is based on general and special methods of scientific knowledge: empirical research (data collection and study), comparative analysis (comparativistics), synthesis of theoretical and practical material, event analysis (event window method). A systematic approach and grouping methods, classifications were used for systematizing information. In the process of research, scientific literature, existing industrial ecosystems, and statistical data were analyzed. The evolution of existing business models in the direction of the business ecosystem is a fundamental trend observed in various segments of the economy. The modern business ecosystem is a large-scale, diversified, platform-oriented, most often multi-core preferential business model. In different segments of the economy, the specificity of the ecosystem as a business model is inevitable. The ecosystem in the real sector of the economy, along with the characteristics described above, focuses on environmental pollution and the need to maintain environmental standards in the location.

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1. Introduction

Ecosystem, or ecological system (from ancient Greek οἶκος - house, location and σύστημα - system) - the term from the biology, coined by the English ecologist Tansley in 1935. Ecosystem is a complex self-organizing, self-regulating and self-developing system, the main characteristic of which is the presence of relatively closed, space and time stable input and output flows of matter and energy (Tansley, 1935). Sukachev (1945) introduced the concept of biogeocenosis as a Russian-language synonym for the ecosystem in 1944.

The term “ecosystem” is used in biology and ecology; its analogues exist in geology (geosystem, Holocene) and geography (geocobiota). Business strategist James Moore transferred the idea of an ecosystem from biology to business, formulating the concept of a business ecosystem in 1993 (Moore, 1993) (business ecosystem, entrepreneurial ecosystem).

2. Problem Statement

Most publications about ecosystems in the real sector of the economy (industrial ecosystems) focus on environmental pollution in industrial zones. In the simplest interpretation, an industrial system is an ecosystem that forms on the territory of an industrial enterprise. Although industrial enterprises for centuries have worked closely in the primary supply system, that is, in the development and production of products for the market, secondary supply systems in them (for example, the exchange of by-products of production and the sharing of utilities) are becoming increasingly important with environmental, economic and social point of view.

3. Research Questions

To follow the evolution of the concept of “ecosystem”, summarize the views of theoreticians and practitioners on the business ecosystem, formulate an author’s vision of the business ecosystem in the context of the digitalization of the economy, and identify its characteristic features. To structure and systematize empirical experience in the field of industrial ecosystems, to generalize foreign experience in the formation of self-organizing industrial ecosystems (SOIE), to describe their features.

To formulate the author’s position, which interprets the business, including industrial, ecosystem as a global and, therefore, a promising trend that is being formed at the junction of such systemic transformations as informatization, digitalization, servicization and virtualization of society / economy.

4. Purpose of the Study

The essence of James Moore's concept is as follows:

- any business is an open economic system that operates in a business environment, which represents interacting organizations and individuals (organisms of the world of entrepreneurship);
- the ecosystem of any business includes consumers, suppliers, market intermediaries (including channels for the movement of goods), sellers of related products and services partly ecosystem’s participants are direct and potential competitors;

- participants in the business ecosystem are owners and other stakeholders, as well as institutions to be reckoned with - government and regulatory agencies, associations and organizations that ensure compliance with standards and represent consumers and suppliers;

- in a saturated and competitive market, working alone is futile - it is necessary to develop “environmental awareness” and collaborations with all (as many as possible) participants of the business ecosystem;

- in order to survive and continued growth, an understanding of the laws of development of the business ecosystem is necessary and the co-evolution (joint evolution) of its participants is important;

- for the development and growth of the ecosystem, four stages of co-evolution are obvious and inevitable (1 - the foundation of the ecosystem; 2 - expansion of the ecosystem; 3 - establishment of dominance in the created ecosystem; 4 - renewal or death); the latter is explained by environmental variability - in these conditions those who are capable of rapid adaptation and innovation survive.

The concept of a business ecosystem is a synthesis of several scientific areas (systems theory, synergetics, tectology - organizational science and scientific discipline, developed by the scientist-economist A.A. Bogdanov in the 20s of the XX century) and is at the junction of several areas of economic knowledge (strategic management, business modeling, logistics and many others). Thus, the ecosystem is considered by theorists and practitioners from different angles:

- a set of players directly or indirectly interacting in the “value chain” (suppliers, sellers, customers, universities, communities, etc.);

- a marketplace, which offers a variety of products and services covering the widest possible range of client needs of one profile;

- self-developing organization - “living organism” (concept of “quasi-living system”, concept of “turquoise organization”).

If we follow the idea of James Moore, the business ecosystem is a combination of participants (players, actors), their environment (incl. marketplace), and developing, adaptable corporate management.

Regardless of the angle in the study of the business ecosystem, there are following characteristics:

- a wide line of various products (complex products) in a single digital window (the idea of a “supermarket”) and their addition with numerous related offers and services (Product as a Service), including information - a consequence of the objective trend of recent decades - the informatization of society / economy;

- collection and analysis of the client base (including BigData) for psychographic profiling of clients and targeted personalized offers (positioning on the principles of Life-style partner for the client);

- digital platform, allowing integration with partners (flexible and scalable IT architecture for using a single protocol by all players) and flexible adaptation to changes in the external environment.

Ecosystems in the real sector of the economy are systems in which companies of different types of activity, usually located close to each other, exchange various resources / materials / “waste”. The exchange of “waste” in some activities has been going on for more than a century because it makes sense for business. However, the creation of “industrial ecosystems” is a relatively new phenomenon, the most famous example of which is located in Kalundborg, Denmark. An ecosystem was created there, which

includes, inter alia, an oil refinery, a gypsum plant, a pharmaceutical company, a fish farm, a power plant and the municipality of Kalundborg.

Kalundborg is a complex and constantly developing network of companies of various types of activities, whose cooperation in the field of energy, water, material resources and waste management has led to economic, environmental and social benefits for individual businesses and the city as a whole (Jacobsen & Anderberg, 2004).

Self-organizing industrial ecosystems (SOIE) are another type of ecosystem in the real economy. A typical pattern for the development of SOIEs is as follows: several firms produce by-products for individual benefits and deliver to each other, while they do not realize that they are part of a wider synergetic system.

In their study, Walls, and Paquin (2015) separate the following factors that contribute to and impede the growth of self-organizing industrial ecosystems:

1. suppositions:

- the presence of industries that act as anchors (providing materials to various entities, for example, a power plant that provides steam or waste heat);
- support from the government side;
- abundance or scarcity of natural resources;
- favorable economic conditions at the firm level (for example, cost reduction, efficiency, revenue streams);
- social, cultural and / or institutional pressure on firms (collaboration, conservation of resources, etc.).

2. emollients:

- trust, openness and cooperation among company employees;
- strong social ties;
- knowledge creation and exchange;
- embeddedness (cognitive, social).

3. environmental restrictions:

- loss of key players;
- too weak or too strong diversification of the environment;
- restrictive environmental standards;
- asymmetry of power (i.e. who wants to cooperate with whom);
- risk problems;
- high dependence.

4. effects:

- environmental benefits (e.g. environmental performance in material and energy flows);
- economic benefits (e.g., lower costs, increased sales);
- innovation (for example, developing a new product or business model);
- network resilience (i.e. fault tolerance).

All ecosystems of the real sector of the economy go through development stages characteristic of one company: creation, growth, maturity and decline. Table 01 presents the existing ecosystems and their main characteristics.

Table 01. Characteristics of industrial ecosystems at different stages of development

Industrial ecosystem	Phase	Number of firms (nodes)	Number of firms involved in symbiosis (nodes)	Number of materials / resources in interaction	Number of industries (diversification)	Network structure
Kalundborg	Creature (till 1980)	8	7	5	8	Preferential Attachment, Single Core
	Development (1980-2000)	12	12	19	11	Preferential Attachment, Single Core
	Maturity (from 2000)	23	22	27	11	Preferential Attachment, Multi-Core
Kwinana	Maturity (from 2008)	52	37	47	11	Random, many unnecessary interactions
Styria	Maturity (from 1997)	39	39	44	14	Random, many unnecessary interactions
Barceloneta	Creature (till 1990)	10	10	9	3	Preferential Attachment, Single Core
	Maturity (till 2005)	20	14	20	7	Preferential Attachment, Single Core
	Decline (from 2005)	8	9	0	3	No current network

Source: authors.

At the initial stage, ecosystems are characterized by a small number of firms participating in several joint activities. As it develops, one (single-core system) or several main groups (multi-core system) can form - this is often determined by the presence of anchor firms. A large number of firms participate in numerous joint operations at a mature stage. Preferential attachment seems to be a way of growing in networks with a large anchor firm that either supplies or receives materials from many other businesses such as Kalundborg. Ecosystems that lack an anchor grow at random, while new businesses join many other firms with which they have common interests.. For example, processing companies in the Styria ecosystem. It is noteworthy that systems such as Kwinana and Styria at the maturity stages are larger than Kalundborg and Barceloneta, in terms of the number of firms and the synergy of materials. This suggests that multi-core ecosystems (without anchors) have the potential for more dynamic growth than anchor networks. In successful SOIEs, the number of firms grows and persists over time. It should be noted that the collapse of the ecosystem might not necessarily occur at the initial stage, but also at more mature stages of development.

One example of the decline of a well-functioning industrial ecosystem is pharmaceutical companies (Barceloneta, Puerto Rico). The companies collaborated for decades with each other in the field of water and material resources. However, in the mid-2000s, most firms in this sector ceased operations on the island.

The decline of the network occurred due to global changes in the global pharmaceutical market, as well as due to regional economic policies that eliminate tax breaks that were claimed by manufacturers on the island. The scale of foreign economic unrest affected the economy of the island and destroyed the relevance of symbiosis for most firms that began to go out of business (Ashton, 2009).

Analogues of business ecosystems related to the real sector of the economy in Russia are called industrial parks (IP). The Association of Industrial Parks of Russia was created in 2010 - an all-Russian industrial non-profit organization uniting most of the industrial parks and special economic zones of the country, as well as service providers in the field of industrial construction in order to promote common interests and attract investors. According to the Ministry of Industry and Trade of Russia, in 2019 there are 196 industrial parks in the country, which are structured into two types: greenfield, i.e. prepared land, and brownfield - an industrial zone where production was previously located and from them remained buildings and structures suitable for further operation. Greenfield with prepared infrastructure is more attractive for organizing large and medium-sized enterprises. Brownfield is often an industrial area around an existing enterprise, and it can supply neighboring small businesses with orders or raw materials. Currently, about 50% of IP in Russia are state-owned, half are privately owned. Analysis of existing IPs showed that the key to them is the convenience of placement, and not additional financial incentives. Competition forces parks to position themselves Altinvest (2019). Often, IPs are formed within the boundaries of established specialization or in related activities. Cooperation between participants in the industrial park can be based on the creation of production chains, or on the joint consumption of resources: warehouses, laboratories, workshops, automation systems, etc.

5. Research Methods

The study is based on general and special methods of scientific knowledge: empirical research (data collection and study), comparative analysis (comparativistics), synthesis of theoretical and practical material, event analysis (event window method). A systematic approach and grouping methods, classifications were used for systematizing information. In the process of research, scientific literature, existing industrial ecosystems, and statistical data were analyzed.

6. Findings

The concept of a business ecosystem is not considered in modern management a panacea for all ills. However, it is at the junction of objective trends in society (informatization, digitalization, service, virtualization of society / economy) and therefore is unlikely to be among the passing theories. If initially the term was addressed to companies from the field of information technology, today the concept is implemented in many segments of the economy - in e-commerce, industry, agriculture, the media, and financial markets. The popular examples of the business ecosystem have already become: in IT - Microsoft, Apple, Google, Tencent, in Media - Facebook, in e-commerce - Amazon, Wal-Mart, Alibaba, EBay, in agriculture - John Deere etc. The formation and development of ecosystems in the real economy is one of the radical approaches to achieving higher levels of efficiency of using the resource potential of locations.

7. Conclusion

The evolution of existing business models in the direction of the business ecosystem is a fundamental trend observed in various segments of the economy. The modern business ecosystem is a large-scale, diversified, platform-oriented, most often multi-core preferential business model. In different segments of the economy, the specificity of the ecosystem as a business model is inevitable. The ecosystem in the real sector of the economy, along with the characteristics described above, focuses on environmental pollution and the need to maintain environmental standards in the location.

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