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Telecommunication ecosystems: Special features of management and interaction

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Abstract. The article explores the current situation in the telecommunications industry. The current analysis is based on the dual nature of the telecom operator, which can be regarded as an independent ecosystem company and as an infrastructure basis for implementing the model by companies engaged in other areas of the economy. Diversification of services leads to the formation of ecosystems of high-tech companies. The methodological framework of the study includes theoretical principles of the ecosystem approach and the theory of management of complex systems. The research methods are deduction, comparison and classification. In the course of the analysis of the telecommunications market, we find that an ecosystem is a complex socio-economic whole consisting of sets of harmoniously functioning blocks. Each ecosystem forms its own industry distinguished from every other. The ecosystem emerges on the basis of the technological platform created by the company. The ecosystem is not built around the company as a legal entity, but precisely around its brand. In order to win the telecom operator's communication channels, ecosystems interact and unify through partnership or parasitic integration. These integration processes may indirectly indicate that a non-telecommunication company applies the ecosystem concept. The interpenetration of two or more ecosystems can lead to their merger in the future. These particularities show that it is impossible to categorize ecosystem as an unambiguously micro- or mesoeconomic component. Ecosystem management should be based not on the traditional principles of company management, but on a combination of management projects, which are unique, rather than routine, solutions in the form of regulation and assistance in attaining the set goals. The obtained results are of theoretical importance for performing further studies on ecosystem formations in today's economy. In practical terms, the research results can be useful for the management of companies belonging to various ecosystems to justify the formats of effective business models and development strategies.

Keywords: ecosystem; ecosystem theory; telecommunication; communication economics; information and communication technologies (ICT); industry.

JEL Classification: L1

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INTRODUCTION

Ecosystem as a complex system of well-orchestrated building blocks can be interpreted as a set of interrelated components that embraces four subsystems: object-related, environmental, process- and project-based [Kleiner, 2010]. The four elements combined into a single system are a manifestation of circular economy [Kleiner, 2019]. Telecommunications operators are among the most active proponents of the ecosystem approach to business organization.

Information and communication technology (ICT) as an economic field is not only innovative in itself, but also provides a technological basis and infrastructure for innovations in other areas [Makarov, Blatova, 2013, p. 68; 2014, p. 279]. The current research examines the ecosystems of modern telecom operators as the infrastructure basis for the implementation of the ecosystem concept by enterprises operating in other economic sectors. Currently, this business area is one of the prominent examples of a standard company turning into a complex polysystemic structure.

For many years, the telecommunications market has been one of the drivers of Russia's economic development and served as the infrastructure basis for the creation of the country's digital economy. The industry's leading companies are among the largest businesses of Russia. The national telecommunications market is an integral part of the country's micro-economic interests and digital policy. According to TMT Consulting, market revenue in 2018 amounted to about 1.7 trillion rubles. Infocommunications change the business models of companies, as well as the approaches to their functioning in the markets [Trachuk, Linder, Antonov, 2014]. Back in 2012, a survey conducted by Booz & Company revealed that the management of information and communication flows was the critical factor in increasing a company's performance. For the overwhelming majority of large and successful companies, the development of communications in the internal and external environment becomes part of their economic policy and development strategy. However, an ecosystem as a new approach to providing a multi-purpose product needs to be comprehended and analyzed.

In this regard, the research aims to develop an approach to managing the socio-economic ecosystem. Using the case study of the telecommunications market as one of the typical examples of the ecosystem approach to the implementation of business processes, we seek to accomplish the following

objectives: to establish the boundaries of an ecosystem company and formulate the key principles of the management of this complex intersectoral structure using system-based economic theory.

TELECOMMUNICATIONS MARKET: FROM OPERATOR TO ECOSYSTEM

Since the 1980th, the telecommunications services market of developed countries has been forming based on the so-called "critical mass". The number of subscribers should exceed a certain numerical threshold so that each of them could feel all the advantages of using these services [Laffont, Tirole, 1994; Laffont, Rey, Tirole, 1998]. Thus, the utility of communications services is directly dependent on the number of the operator's subscribers [Ponomarev, 2009], i.e. the value of the service will exceed or equal the costs paid. Once the numerical threshold is reached, it becomes much easier for the operator to attract new clients, since they turn into some sort of "conductors" by encouraging their family members and friends to subscribe to the operator's services.

Attracting new subscribers was the key objective for the telecommunications operators at the extensive stage of the telecommunications market development. With the transition to the intensive development stage, this objective still appears relevant, especially when providing a new service.

In the context of telecommunications tariffs going down and price wars, there emerges another fundamental principle of the development of the telecommunications market, namely the continuous offer of new services by the telecommunications operator. This leads to the fact that technological innovations are imposed on subscribers. This, in turn, results in the technological development of the operator's infrastructure, cost optimization and eventually increased revenue. At the same time, traditional services, such as various types of communications services, have been stagnating for several years. As forecasted by TMT Consulting, since 2020, the growth rate of the telecommunications market in Russia is expected to slow down sharply to 2 %, and this trend is going to persist in the future. Subscribers are increasingly less likely to use traditional communications services and give precedence to new ways of communication.

The special features of the telecommunications market indicated above, as well as some other characteristics (see, for example, [Makarov, 2007; Kobylko, 2011]), form its landscape. The emergence of new niches for business diversification, mergers and acquisitions gives rise to new, non-standard forms of transformation of telecommunications companies' business models. In the past, the telecommunications market followed a common development path, i.e. every operator provided mainly those services that were typical of its technological niche. However, at the beginning of the 21st century, there developed a new trend towards expanding the functionality of telecommunications operators through entering the sector of information technologies [Reyman, 2002; 2003]. Today, under conditions of diversification, every operator combines functions from different niches, such as mobile telephony, Internet access, digital television, etc., and offers the necessary equipment and customer service. Such a polysystemic approach adopted by telecommunications operators is comprehensively analyzed in [Cowhey, Aronson, 2012; Warf, 2013]. Such transformations imply a radical rethinking of the approach to positioning companies in the market. The leading companies of the Russian telecommunications sector – Rostelecom, MTS, MegaFon and VimpelCom – do not specify in their advertising campaigns what types of services they provide. The array of their products and services is so vast that this is inexpedient. They have transformed themselves from operators to suppliers of a full range of information and communication services [Rozanova, Yushin, 2015].

The development of partnering relationships between competitors made it possible to achieve the remarkable diversity of products and services provided by the operators and enhance the multifunctionality of the infrastructure. In the work by Academician Viktor Polterovich [2015], this behaviour is referred to as "a philosophy of cooperation". Excessive costs incurred in the individual technical and technological development of each of the operators encouraged them to work together: their cooperation took the form of partnering construction and the use of infrastructure facilities in the fields, where duplication of each other's networks was impractical. Currently, the competitors share the costs associated with building new antenna mast structures and trunk channels using them in combination or granting access to them on the rental basis. This facilitated the development during the post-extensive period and, on the basis of the key actors, led to the formation of initially sectoral ecosystems and industrial ecosystems using the principles of the so-called "system-based modernization" (for more details, see [Kleiner, 2015]).

The concept of the ecosystem was first introduced in botany by Arthur Tansley, who interpreted an ecosystem as the integration of a biotic community and its physical environment [Tansley, 1935]. In a general sense, this is a set of relationships between the community members. In the late 20th century, the issues of such interaction were assimilated in the economic field. The term "ecosystem" is applied by Moore [1999] in the context that considers consumers and producers as interrelated and complementary entities. Today, in management, ecosystem is interpreted as a combination of companies united by a common business line and the external environment. The outcome of such collaborations is a transformation and development of companies due to close inter-organizational ties. Such transformations occur through general business processes. These primarily include associations, mergers and acquisitions, etc. While developing jointly, an ecosystem is strengthened through the emerging opportunity to manage complex interactions based on a worldview shared by all the participants [Ugnich, 2016, p. 93]. The companies grow within the ecosystem, complement and enhance it. This collaboration results in an increase in the competitiveness of each company.

BOUNDARIES OF THE TELECOMMUNICATIONS MARKET ECOSYSTEM

It is worth noting that it is quite problematic to delimit an ecosystem company's market because of the massive coverage of economic sectors and difficulties with statistical recording of such activities [Simonova, Mamiy, 2019, p. 94].

According to the strategies employed by Russia's largest telecommunications operators, forming an ecosystem within an umbrella brand is one of the strategic decisions. Three out of four companies – Rostelecom, MegaFon and VimpelCom – openly indicated that in their development strategies in 2019. At the same time, MTS has repeatedly claimed that it also implemented the ecosystem concept, but this development aspect was not specified directly in their strategy "3D: Data. Digital. Dividends".

Socio-economic ecosystems have four distinguishing features [Kleiner, 2018]. Further, we consider whether the telecommunications ecosystem complies with these peculiarities.

Spatial geolocation – the functioning of the ecosystem's participants occurs within relatively limited territorial boundaries. In terms of the telecommunications market, such "limitedness" is rather relative, since the very essence of this industry comes down to connecting scattered subscribers. The phenomenon of "geographical proximity" within the telecommunications ecosystem is perceived through its own tools.

Production and reproduction circuit – the ecosystem's products are consumed mainly by its participants. This peculiarity is clearly manifested in the activities of today's telecommunications market, where communication service is not the only one to be provided. The polysystemic approach of telecom operators has enhanced the companies' diversification which neared the scope of industries [Kobylko, 2016].

Diversity. This special feature derives from the polysystemic specificity of the telecommunications market, where large companies demonstrate all the four subtypes of the socio-economic systems. This maintains communication between the system and the external environment and ensures the processes of internal functioning.

Adaptability as an intention to preserve the ecosystem as a whole is typical of the telecommunications sphere. At that, a particular ecosystem is formed as a result of synergy and differentiation of sectors precisely for its conservation and development.

Belousov and Penukhina [2018] formulate the distinguishing features of an ecosystem.

The sustainable integrated structure. As indicated below, the telecommunications system is a comprehensive set of businesses operating in different economic sectors, the main of which are information technology, finance, entertainment, etc.

The sustainable interaction system. The nomenclature of goods and services within the ecosystem should be complementary, but not contradictory. This helps establish the communication links in the process of functioning that not only allow the transfer of information, but also redirect the client from one ecosystem component to another.

Transformation of system resources. Due to the fact that the ecosystem's production cycle is partially closed, the resources are partly transformed within the system. The telecom operator's ecosystem is formed, inter alia, to reduce costs incurred in operating its own network through collaborations, including partnerships with competitors.

An ecosystem is a relatively closed structured "organism" with a set of internal connections that ensure self-reproduction and meet the requirements of the external environment. The ecosystems of a telecom operator can be identified through a set of services, related products and works. The operator, as a polysystemic company, provides different services that can be categorized into the following groups: basic services, i.e. direct communication services; complimentary services; and non-core services.

Basic services are:

- telecom services: mobile and landline;
- long distance communication;
- internet access: mobile, wired and wireless;
- pay TV: mobile, cable, IP-TV, satellite;
- delivery and traffic exchange services;
- trunk services.

Complimentary services based on the operator's own infrastructure:

- call centers;
- communications outsourcing;
- retail and installation of telecom equipment;
- infrastructure sharing;
- systemic integration;
- big data;
- data center;
- cloud services;
- CCTV;
- computer security;
- media services (incl. over-the-top – OTT);
- artificial intelligence (AI);
- Internet of things (IoT);
- telematic services.

Non-core services based on the operator's infrastructure:

- financial services: e-commerce, banking, etc.;
- entertainment and gaming services;
- e-learning;
- research and development (R&D);
- corporate university;
- telemedicine;
- e-government infrastructure services;
- design and construction of telecom infrastructure;
- adjustment and maintenance of equipment.

Some of these services are provided by not the telecom operator, but by other legal entities as part of its umbrella brand. From the standpoint of the consumer, however, this is the operator that offers services. Thus, an ecosystem is being formed within the umbrella brand. It largely meets the operator's needs in providing the necessary infrastructure

and a set of additional services aimed at generating new offers for subscribers. This statement is confirmed by Iansiti and Levien [2004], who claim that the effectiveness of the functioning of the whole ecosystem is directly dependent on the effectiveness of its individual elements: poor-quality services provided by one of the ecosystem's actors may jeopardize the existence of the entire umbrella brand and the ecosystem per se.

Non-core services exert a marked effect on the formation of a modern operator's ecosystem component. They help enhance the assortment and nomenclature of products, services and works in those business areas that are non-traditional for the telecom operator. For example, nearly 10 % of Rostelecom's revenue is derived from non-telecommunication services; for MTS, this share is even bigger – 20 %. Thus, at the present stage of development, telecom operators have turned into diversified companies offering a wide range of products. This fact implies the emergence of new forms of business, a wave of mergers and acquisitions, the formation of partnerships, etc.

INTERSECTION AND NESTING OF ECOSYSTEMS

Ecosystem covering large market players has been a key aspect of long-term development in recent years. This is openly stated by not only telecom operators, which pay special attention to the ecosystem component in their development strategies, but also by representatives of other business areas, such as Yandex and Sberbank as the largest organizers of ecosystems within their business area. In general, the financial sector is among the pioneers in the development of digital products, which inevitably leads to the formation of an ecosystem around financial institutions [Akatkin et al., 2017, p. 19].

The ecosystem's components should be seamlessly interconnected and complement each other, as well as deal with a wide range of various life domains. Part of its resources is consumed by the ecosystem itself to satisfy its own needs. The relationships of the ecosystem's building blocks with each other and the external environment are ensured through information and communication technologies. These interconnections stimulate customers to consume other services provided by the ecosystem.

It is reasonable to address the services of Yandex LLC to illustrate these aspects in practice. The components of the company's ecosystem embrace a rather broad array of needs, fulfill them in a consistent manner and create new ones. Yandex.Maps serves as the basis for a number of other geolocation services. It liaises with related services and, in addition to its primary address function, suggests mapping out a route from Point A to Point B using Yandex.Transport, Yandex.Metro, the carsharing service Yandex.Drive, etc. or using its own taxi aggregator. While you are on the way, Yandex.Taxi will offer you to order food from the nearest restaurant via Yandex.Eats. While driving a car rented from Yandex.Drive, the car stereo will be playing the music from the driver's playlists in Yandex.Music, etc.

Within the framework of the given paper, an ecosystem refers to a set of companies (legal entities), products, services, works, etc. designed to meet customers' needs in various life domains within the single umbrella brand. Satisfying the needs implies not only handling the requests by customers, but also those by the ecosystem organizer itself, which results in the formation of a conditionally closed system. A company's activities within the ecosystem are so much diversified that go far beyond its original business, spreading to not only neighboring industries, but also to completely different sectors of economy.

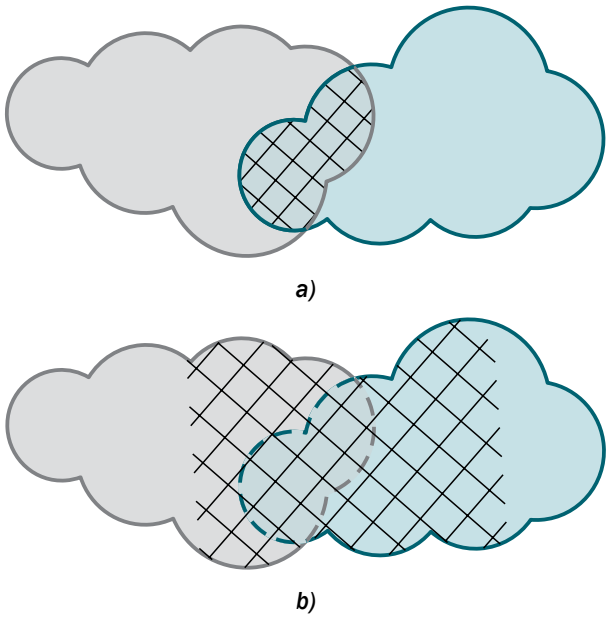
Ecosystems of telecommunications companies have a considerable advantage over ecosystems of companies operating in other industries: they have their own communication infrastructure. This peculiarity can be regarded as a key one, since the implementation of the ecosystem concept for the most part implies the application of information and communication technology. In particular, one of the signs that there is an ecosystem being formed within a non-telecommunications company is the creation of MVNO, i.e. the provision of communication services under its own brand in the absence of its own network infrastructure and sometimes of appropriate licenses for carrying out such activities.

These initiatives by such companies are obvious due to the fact that any person is a user of communication services. The number of consumers of mobile communication in Russia in recent years has remained at around 250 million subscribers, i.e. more than one and a half times the country's population. According to TMT Consulting, 33.2 million households in Russia had internet access at the end of 2018. The Russian Association for Electronic Communications (RAEC) forecasts that by 2020, 75 % of the Russian population will be internet users, and 65 % of the population will be mobile internet users. Without such services, it is impossible to implement the concept of ecosystem viewed as a maximum satisfaction of requests in various life domains.

Different ecosystems contact and interact with each other through the ICT component (Fig. 1a). Such a system is impossible to build if communication channels are not formed; hence, it is necessary to engage the owners of the infrastructure. In case of such a merger, the special role of telecommunications within the new, integrated ecosystem will be maintained.

In the process of interaction of the two ecosystems, their partnership relations may go beyond the initial ones aimed at ensuring communication channels (Fig. 1b). The interaction boundaries can be expanded or even vanish, which will lead to interpenetration and rooting. This, in turn, can be an intermediate step towards unification and merger of ecosystems in the future. In the current study, interaction refers to not so much the provision of services (in this case, telecommunications services) by one ecosystem to another, as the processes of interaction resulting in integration, interpenetration, collaboration, and unification [Kobylko, 2019].

Even today, there are examples of such interactions, including those occurring beyond the sphere of communica-



a)

b)

Fig. 1. Interaction and unification of ecosystems
Рис. 1. Взаимодействие и объединение экосистем

tion services provided by one ecosystem to another. The creation of the marketplace Beru is a telling example of an alliance between the two large ecosystems – Yandex and Sberbank. In this joint venture, the e-commerce platform Yandex.Market serves as the basis for delivering Sberbank's financial products. The commodity and financial relationships within the case under review can underlie the formation of new forms of interaction between the two ecosystems, which in the future can result in the emergence of some kind of a hyper-ecosystem.

Interaction between ecosystems may have a significant influence on their evolutionary development. Building a complex system evincing interests in various fields requires a novel approach to business processes organization allowing for the specificity and difficulties with interaction mechanisms. Therefore, one expects the emergence of ecosystem operators endowed with competencies in management of such complex objects and their development.

The ecosystem of products and services is formed and evolves on the basis of a particular technological platform [Ceccagnoli et al., 2012; Gawer, 2014]. For the bank's ecosystem, such platform is a combination of financial services application technologies; for the ecosystem of the search engine, this is a set of online services; and for the ecosystem of telecommunications operators, this is a number of communication services technologies implemented on the basis of communication infrastructure. In this vein, the format of the ecosystem management can duplicate the "the service operator + the infrastructure operator" format in the telecommunications sphere. It implies that the existing telecom operators are able to transform themselves into companies that only provide communication services based on the alienated infrastructure, whereas the infrastructure itself, its functioning, maintenance, development, etc. are the responsibilities of another company. This delimits different communication services, while allowing each counterparty to concentrate on their key areas, i.e. providing services according to the MVNO model as an operator of communication services and telecommunications infrastructure network (for more details, see [Kobylko, 2016]).

The functioning of the ecosystem can be organized according to the same principle: a special body responsible exclusively for its harmonious functioning is established within the ecosystem. Obviously, this will raise questions about the organization of the ecosystem components' coordination. If the ecosystem is regarded as a tetrad of subsystems, in terms of product, it can be represented as a set of four types of "products":

- *goods* manufactured by the ecosystem as an object subsystem;
- *services* provided by the ecosystem as an environmental subsystem;
- *works* implemented within the ecosystem as a process subsystem;
- *management* of the ecosystem as a project-based subsystem.

The interaction within the tetrad can be seen as communication processes between its subsystems. The project-based subsystem will perform the management functions. At that, the interpretation of management should be broader than that of the traditional concept, i.e. as a product that ensures the functioning of the ecosystem. This "product" is directed towards the inside of the ecosystem and exists to transform it, which corresponds to the functions of the project-based subsystem.

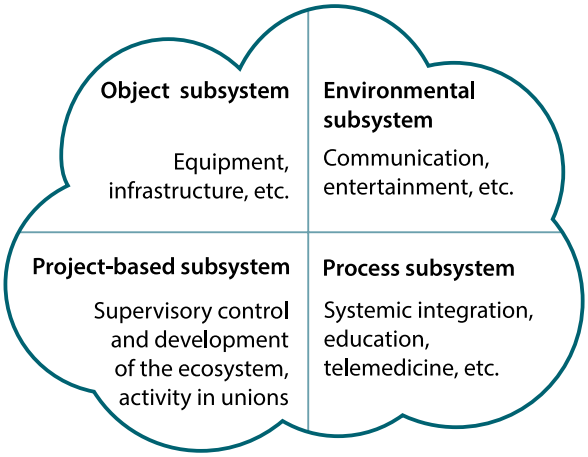


Fig. 2. Ecosystem of telecommunications from the product-based perspective
Рис. 2. Экосистема телекоммуникаций в продуктовом разрезе

Considering the characteristic features of the project subsystem – its limited space- and time-related reach – we identify its primary functions. With ecosystems, management should not be regarded as a process (a set of cyclical operations), but as a project. It involves dealing with challenges using a creative approach, but not routine guideline-based operations. It is worth specifying that, in a classical sense, management is a sort of a process-related and cyclical activity, but in terms of ecosystems, this is one of the "prod-

ucts" focused on transformation and regulation, but not on administration. Such an activity is similar to the functions of sectoral associations and unions that are entrusted with the task of resolving non-standard issues affecting all participants in the industry.

CONCLUSION

A company-based ecosystem is formed due to the technological platform, which is clearly illustrated using the case of the telecommunications ecosystems, where the platform is the infrastructure and the data transfer technologies implemented on its basis. Such technologies and equipment underlie the formation of their own ecosystems within telecom operators, and serve as the infrastructural communication basis for the functioning of ecosystems of companies operating in other industries.

The ecosystem within a telecom operator spreads far beyond the traditional scope of its activity. Ecosystem companies operating in any industry diversify their own products and services in such a way that blurs the classical vision of economic industries. Large-scale horizontal, vertical and diagonal integration processes have led to the situation, where the leading companies in the communications industry are present to a greater or lesser extent in all its sectors. That is, telecom operators can be identified with the telecom industry itself. Hence, all ecosystem companies actually form a new industry of ecosystems by themselves, which covers various economic sectors. That is, telecom operators can be identified with the telecom industry itself. Hence, all ecosystem companies actually form a new industry of ecosystems by themselves, which covers various economic sectors. At that, every ecosystem is capable of transforming its "industry" to a unique one, which underlies the specificity of researching this phenomenon.

When analyzing the industry in the product-related context and from the standpoint of the systemic economic theory, we can assert that an ecosystem is not formed around the company as a legal entity, but precisely around its brand. This peculiarity is due to a large number of subsidiaries that in fact ensure the ecosystem's functioning in various industries. This is the brand that serves the connecting link from the viewpoint of both the consumer of its goods and services and the totality of the companies forming it.

In order to win the telecom operator's communication channels, ecosystems interact and unify through partnership or parasitic integration. The formation of a set of telecom services is a desired function of virtually any ecosystem. Entering into partnerships with a telecom operator and creating MVNO can be considered an indirect sign of a non-telecommunication company implementing the ecosystem concept. The interpenetration of two or more ecosystems can result in their merger in the future.

These peculiarities demonstrate the necessity to develop special methodological tools for stimulating the ecosystem economy as an individual sphere, as it is impossible to categorize it as an unambiguously micro- or mesoeconomic component. This substance forms new, i.e. industrial level that go beyond the traditional reading of the industry.

Obviously, interaction and possible unification of ecosystems will require not only a special management apparatus to be developed in the future, but also gaining the comprehension of these processes from the perspective of economic theory, as well as the development of special regulations for such interaction due to the ambiguity and complexity of the mechanisms and structures.

When dealing with this fact from the systemic viewpoint (management of an ecosystem as a project), we can observe the emergence of a set of management effects on the functioning and development of the ecosystem. Its organization should be premised not on the classical principles of company management, but on a combination of management projects, i.e. unique, not routine, solutions in the form of regulation and assistance in achieving the stated goals, rather than targeted management impacts. ■

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Телекоммуникационные экосистемы: особенности управления и взаимодействия

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Аннотация. В статье исследуется современная индустрия телекоммуникаций. Анализ строится на дуальной сущности оператора связи: как самостоятельной экосистемной компании и как инфраструктурного базиса для реализации подобной модели компаниями из других областей экономики. Развитие в направлении диверсификации услуг приводит к формированию экосистем высокотехнологичных компаний. Методологической базой исследования является совокупность теоретических положений экосистемного подхода и теории управления сложными системами. В качестве методов исследования применяются общенаучные методы дедукции, сравнения и классификации. В результате анализа телекоммуникационных рынков были сделаны следующие выводы. Экосистема определяется как сложная социально-экономическая совокупность, состоящая из гармонично функционирующих блоков. Каждая экосистема фактически образует вокруг себя индустрию, не похожую на другую. Формирование экосистемы происходит вокруг технологической платформы, созданной компанией. Экосистема образуется не вокруг компании как юридического лица, а вокруг ее бренда. Процессы взаимодействия и объединения экосистем с целью получения коммуникационных каналов оператора связи могут происходить за счет различных видов интеграции. Подобные интеграционные процессы могут косвенно указывать на реализацию экосистемной концепции нетелекоммуникационной компанией. Взаимопроникновение двух и более экосистем приведет в будущем к процессам их поглощения. Эти особенности говорят о невозможности однозначного отнесения экосистемы к микро- или мезоэкономической составляющей. Подход к ее управлению стоит осуществлять не с классических позиций менеджмента предприятия, а с позиций набора управленческих проектов. Это должны быть уникальные, а не рутинные решения в формате регулирования заданных целей и помощи в их достижении. Полученные в работе результаты имеют теоретическую ценность для дальнейших исследований экосистемных образований в современной экономике. В практическом плане результаты исследования могут быть полезны для менеджмента компаний, входящих в различные экосистемы, а также для обоснования форматов эффективных бизнес-моделей и стратегий развития.

Ключевые слова: экосистема; экосистемная теория; телекоммуникации; экономика связи; ИКТ; индустрия.

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