



## Patterns and principles of the development of digital ecosystems

## Patrones y principios del desarrollo de los ecosistemas digitales

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### ABSTRACT

In the era of digitalization of the global economy, companies are beginning to create their digital platforms and digital ecosystems, transferring the main activities of the company to the digital environment to maintain global competitiveness. The study of the patterns and principles of the development of digital ecosystems is relevant for business from the point of view of creating its peculiar sustainable competitive advantage. The object of the study is digital ecosystems. The subject of the study is the features and trends of the development of digital ecosystems in the modern economy. The purpose of this work is to identify patterns of development of digital ecosystems and make recommendations for companies that want to create their digital ecosystems. The study of annual reports, conducting in-depth interviews and statistical analysis of the stock price allowed us to achieve the set purpose. The results of the study will be useful for representatives of traditional companies to implement projects to create their digital ecosystems, representatives of government agencies to regulate the activities of digital ecosystems, and for startups that are building new business models in the digital economy.

**Keywords:** innovative business models, digital environment, global competitiveness, statistical analysis.

### RESUMEN

En la era de la digitalización de la economía global, las empresas están comenzando a crear sus plataformas digitales y ecosistemas digitales, trasladando las principales actividades de la empresa al entorno digital para mantener la competitividad global. El estudio de los patrones y principios del desarrollo de los ecosistemas digitales es relevante para las empresas desde el punto de vista de la creación de su peculiar ventaja competitiva sostenible. El objeto de estudio son los ecosistemas digitales. El tema del estudio son las características y tendencias del desarrollo de los ecosistemas digitales en la economía moderna. El propósito de este trabajo es identificar patrones de desarrollo de ecosistemas digitales y hacer recomendaciones para empresas que quieran crear sus ecosistemas digitales. El estudio de los informes anuales, la realización de entrevistas en profundidad y el análisis estadístico de la cotización de las

acciones nos permitió alcanzar el propósito planteado. Los resultados del estudio serán útiles para representantes de empresas tradicionales para implementar proyectos para crear sus ecosistemas digitales, representantes de agencias gubernamentales para regular las actividades de los ecosistemas digitales y para nuevas empresas que están construyendo nuevos modelos de negocios en la economía digital.

**Palabras claves:** modelos de negocio innovadores, entorno digital, competitividad global, análisis estadístico.

## 1. INTRODUCTION

Digitalization has made significant changes in the life of society and one of these "innovations" is the digital ecosystem which at the same time acts as a competitive advantage of a modern innovative enterprise. Communication technologies have made fundamental changes in the life of society and predetermined the emergence of a post-industrial or digital economy in the future (Rigkin, 2014). The World Bank defines the digital economy as "A new way of the economy based on knowledge and digital technologies, within which new digital skills and opportunities are formed for society, business and the state" (World Bank, 2020).

First of all, let us pay attention to the origin of this term. The "ecosystem" concept, taken from the natural sciences, implies a biological system that is formed as a result of the interaction between living organisms and the natural environment in which they live" (Stolyarova, 2020). In the economic context, this concept implies a certain environment where various businesses and services that previously existed separately from each other interact with each other.

Considering the "digital ecosystem" concept, it is first of all important to mention that this is a set of digital services of the company, united by a technological platform and interconnected with each other.

The concept of a digital business ecosystem was created in 2002 by a group of scholars, including Francesco Nachira, Paolo Dini, and Andrea Nicolai (2007).

The digital ecosystem is "an adaptive, open socio-technical system with the properties of self-organization, scalability, and sustainability, inspired by natural ecosystems" (Briscoe; De Wilde, 2006). Digital ecosystem models are based on knowledge about natural ecosystems, especially concerning aspects related to competition and cooperation between various subjects (Dini, 2005) This term is used in the computer industry, the entertainment industry, and the World Economic Forum.

Therewith, these services together have additional value for the client. An example of a digital ecosystem can be a mobile operator or a bank, which, with the help of a created technological platform, can provide various services to its customers.

However, this concept has several features that have been highlighted by several entrepreneurs and researchers. For example, the chairman of the board of "Sber" Herman Gref, talks about the features of the "digital ecosystem" on the example of his bank. He believes that the bank is an ecosystem (Tadviser, 2021).

Also, a striking example of an entrepreneur's point of view on the interpretation of the "digital ecosystem" concept is the position of the director of the strategic planning department of MTS, A. Demyanov, who believes that an ecosystem is a collection of products from different industries that support business development (Posypkina, 2019).

In addition, in this context, we can cite the position of researchers S. Warner and P. Vail, who believe that the ecosystem is a network of device companies and customers that allows creating value for all participants.

According to A.A. Abrosimova, there are three main approaches to understand the "digital ecosystem" concept: as a set of participants, as a platform for the sale of goods and services, as an evolving organization (Abrosimova, 2020).

After considering several positions on this issue, it can be revealed that the digital ecosystem is a set of interrelated business elements: products, servers, companies, and so on.

Now that several approaches to the definition of the "digital ecosystem" concept have been considered, it is necessary to consider the main factors that have influenced the development of "digital ecosystems" in addition to digitalization. These factors include:

1. Saturation of companies' markets;
2. High competition in the market;
3. Changing the nature of competition;
4. Big Data Development;
5. Development of open Data API technology (Krivorotova, Litova, Bozhko, 2017).

Based on these factors, it can be understood that the business is reaching a new level, namely, it is becoming part of the digital economy. In this space, each enterprise should have several competitive advantages for successful business promotion.

However, it is important to note that the digital ecosystem allows not only increasing the competitiveness of the enterprise but also doing the following:

1. Increasing the value of the company;
2. Reducing the cost of attracting customers;
3. Increasing customer loyalty.

It follows that the "digital ecosystem" contributes to accelerating the innovative development of the company, as well as increasing profits by reducing restrictions on marketing activities and increasing the number of potential customers.

Concerning the structure of the digital ecosystem, there are three main components:

1. Integration services;
2. Common coordination center;
3. Single technological platform.

These three components are complementary, which implies ensuring the stable operation of the system, only if all three components work properly.

Also, the conceptual structure of the digital environment ecosystem can be reflected in the form of a certain set of levels (Fig. 1) (Akarkin, 2017).

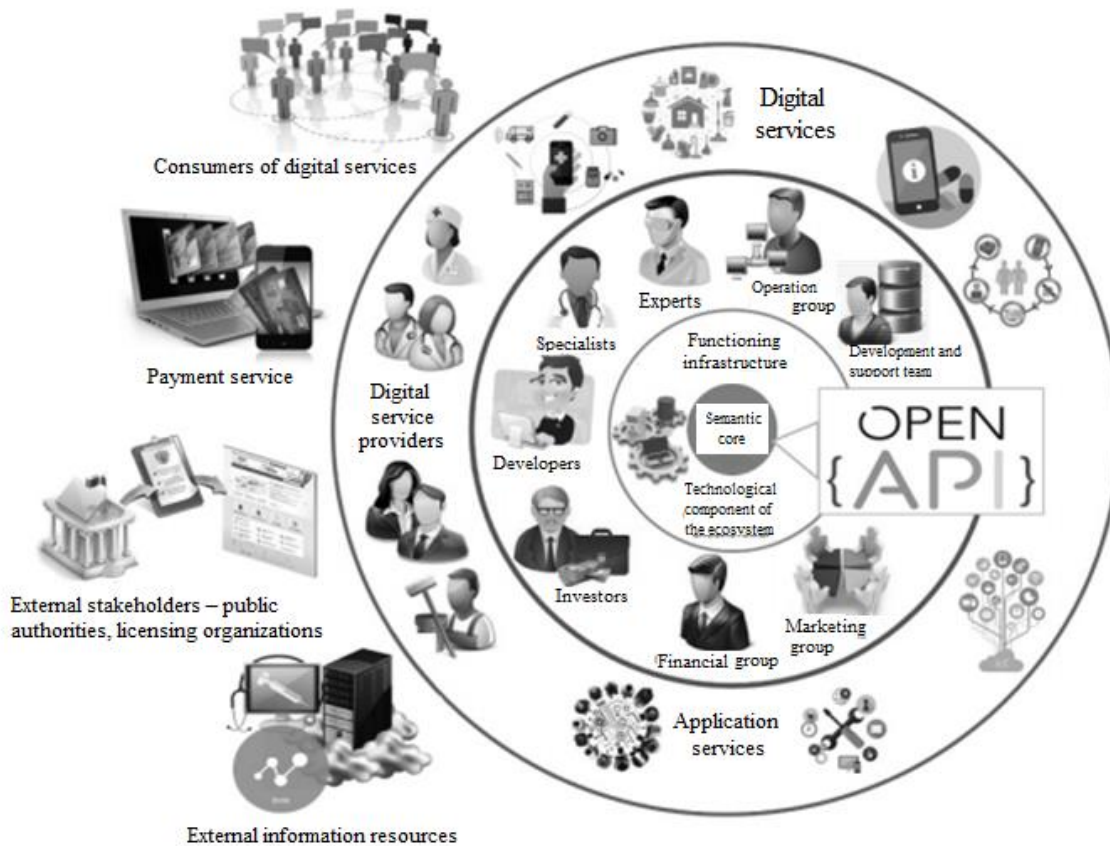


Figure 1. The conceptual structure of the digital environment ecosystem

Based on the presented scheme, it can be noted that the authors distinguish 4 levels in the structure of the ecosystem:

1. Semantic core;
2. The infrastructure of digital services functioning is a technological component of the ecosystem;
3. User and application digital services, including visual interfaces and an application store (marketplace), open tools for developers;
4. Personalized devices and devices of the Internet of Things.

In this context, we also note that there are several ways to form digital ecosystems. These include:

1. Creation of digital ecosystems with investments (development of own projects, creation of joint ventures).
2. Implementation of partnerships with existing businesses;

It is important to note that a specific set of services and partners plays a significant role in the development of "digital ecosystems", therefore, the development of proprietary megaprojects in this situation is a rather complex course of action, leading to uncertain results. Therewith, the protection of personal data of citizens becomes particularly valuable in these conditions, since due to the transition of a large number of services to a remote format, data leaks become a special danger for the security of personal data of citizens (Keshelava, 2017).

Digital ecosystems are a consequence of the process of digitalization, namely the formation of the digital economy. That is, digital ecosystems exist in the digital economy and, depending on the pace of development of the digital economy, the pace of the emergence of digital ecosystems is determined. In addition, an important feature of this technology is that in the process of its implementation, the advantages of the conducted research correspond to the needs of the business, which allows responding to emerging market trends correctly and most optimally (European Commission, 2014).

The hypothesis of this study is the existence of development patterns for digital ecosystems. **The object of the study** is digital ecosystems. **The subject of the study** is the features and trends of the development of digital ecosystems in the modern economy. **The purpose of this work** is to identify patterns of development of digital ecosystems and make recommendations for companies that want to create their digital ecosystems.

The following tasks was solved to achieve this goal:

- to determine the impact of the digitalization process on the modern economy;
- to consider the structure and features of the digital ecosystem;
- to determine the patterns of development of digital ecosystems in 2015-2020 based on 5 companies: Google, Alibaba Group, Amazon, Sber, Yandex;
- to make recommendations for the formation of digital ecosystems.

**The novelty of the research** consists in studying the patterns of global digital ecosystems and forming several recommendations for companies that want to develop as ecosystems. The results of the study will be useful for representatives of traditional companies to implement projects to create their digital ecosystems, representatives of government agencies to regulate the activities of digital ecosystems, and for startups that are building new business models in the digital economy.

## 2. MATERIALS AND METHODS

General scientific and special research methods were used: analysis, synthesis, comparison, induction and deduction, abstraction, the method of comparative analysis, and the system-structural method. Special research methods were used in the course of the work, such as the collection of scientific sources and information, the analysis of statistical data and official documents.

The annual reports of five companies were studied to identify patterns in the development of digital ecosystems: Google, Alibaba Group, Amazon, Sber, Yandex, a correlation and statistical analysis of the dynamics of the price of their shares was carried out (based on the data of the financial exchange Investing.com, data on the share prices of 5 companies in the period from 2015 to 2020 were taken), as well as in-depth interviews with their representatives were conducted.

## 3. RESULTS

Several trends were identified based on the correlation study, as well as statistical analysis, interviews, and the use of several other methods of analysis.

Before proceeding to the consideration of the trends identified based on the data analysis, let us turn to the results of an interview with one of the Google employees (Alphabet Inc.).

The following was revealed from an in-depth interview with a representative of Alphabet (Google):

Buying new services and companies is always interesting for ecosystems such as Alphabet. At some point, new services may not bring profit and even be unprofitable, despite this, companies do not seek to get rid of them for several reasons:

Firstly, in the aggregate, this service/company can complement the others well, so in general, the entire ecosystem benefits.

Secondly, ecosystems have a long-term position, they work for the future. The acquisition and creation of new services are carried out both because of the economies of scale and to attract customers. The ecosystem is not about the profitability of individual services, but rather about the growth of the number of customers, their commitment, and loyalty (NPS), so these parameters often play a crucial role.

Fig. 2 shows examples of the growth of the share price of Alphabet Inc. against the background of the addition of new services.

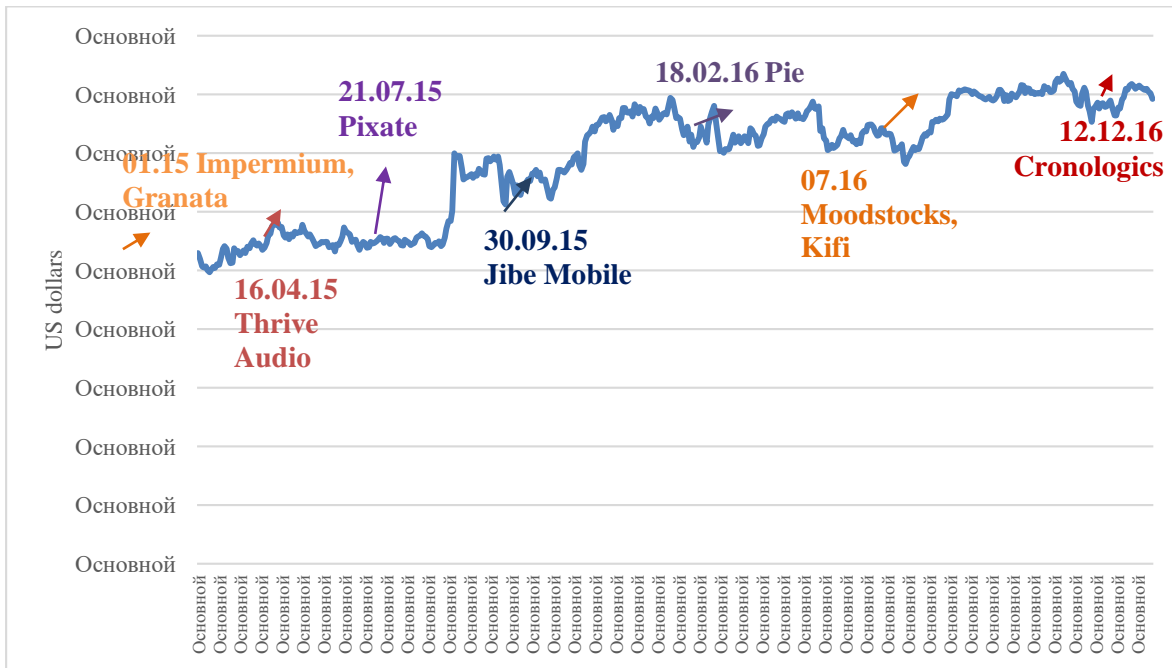


Figure 2. Alphabet Inc. share price in 2015-2016 Compiled by the authors according to <https://www.finanz.ru/>

Using the example of this company, it can be noted that, in general, the strategy aimed at acquiring new startups (acquisitions) is quite justified and productive, since the company can extract certain benefits, such as by improving certain characteristics of an existing product and forming an information resonance, which this may lead to a change in the value of the shares.

Now let us turn to the trends identified during the study of the annual reports of the 5 companies considered: Alibaba Group, Alphabet Inc., Yandex, Sber, Amazon. During this analysis, it was possible to visually analyze the industry structure of the startups being absorbed, the development of new services, taking into account the principle of historicism and the main activity of the company. In general, it can be noted that most of the startups being acquired are somehow interconnected with the main activity of the company. Meanwhile, companies are trying to expand their areas of activity by investing in completely different sectors. As an example, Google has acquired several startups related to medicine, education, electronics, and other areas. Due to a competent strategy for acquiring startups and their further development in line with the company's activities, they have an impact not only on revenue and other key economic indicators but also on increasing the company's scale and suppressing competitors in general. This may be evidenced by the tactics of Amazon, which during the so-called "dot-com" crisis actively bought up companies that went bankrupt or were on the verge of bankruptcy.

Special attention should be paid to the trends identified based on the historical analysis of the formation and success of the studied companies.

Firstly, the success of the companies under consideration was strongly influenced by the cost-sharing mechanism. The companies spent a large amount of money on the innovative development of the organization, hired highly professional employees, due to their competent administrative policy, the companies managed to build an effective management system, as well as to form the corporate culture of the organization.

A separate feature of almost all the studied companies is their main goal, which in itself is innovative, in demand in society, which makes significant changes in the life of society. For example, the Yandex and Google developers have identified the problems of search algorithms, thus making a significant contribution to the development of search engines. The founders of the Alibaba Group and Amazon companies identified the need to optimize the shopping process, the consumer's need to reduce the time for purchasing a particular product or service.

Comparing the company's data, it can also be noted that the development of one of them was largely influenced by public administration. This company is Sber, which is controlled by the state. Therewith, we note an important feature in the development of the Alibaba Group company. Taking into account the existing mixed economy in China, where elements of socialism still have influence, the company still managed to enter the category of innovative private companies, while experiencing the serious influence of state policy. In addition to the previously highlighted trends, the competent tactics of entering financial exchanges brought special success to companies.

Completing the definition of historical trends in the development of companies, we should pay attention to the peculiarity of their corporate culture. The importance of corporate culture is such that, due to a clear alignment of the system of values of employees to the common cause, to each other, and the goals of the organization, it is more likely to achieve the intended goals. Companies contribute to the development and realization of the human potential of employees, consider it not as an object, but as a subject of management, giving it certain authority. Employees take part in the discussion of important issues of the organization, where their opinion will be unambiguously taken into account, which is a symbol of an innovative company, which are only 5 percent at present in Russia according to researcher V.I. Maslov. By creating a comfortable environment for employees, companies simultaneously create conditions for comfortable and productive work, since an employee should experience emotional satisfaction from it, which is what these companies focus on.

Also, ecosystems are growing in the number of participants. In the modern world, people are very valuable, so companies are not ready to give up qualified personnel. More and more new employees are coming to the company, but the old ones are not being cut. Due to the support of trade unions and the interest of the company itself, employees are constantly undergoing training and retraining. Re-training programs, when an employee can change his/her field of activity with the help of training and the formation of new skills. A striking example is an educational project from Sberbank called "School 21", which trains IT specialists, on the principle of collective learning. It is worth noting that this initiative is completely free.

Let us proceed directly to the consideration of the trends obtained in the process of applying various methods of data analysis.

First of all, several trends were identified in the process of studying the dynamics of stock prices of the studied companies, building the necessary charts. Based on the data of the financial exchange Investing.com, data on the prices of shares of 5 companies in the period from 2015 to 2020 were taken. Then, using the timelines built earlier based on studying the annual reports of companies, the ratio of prices for the company's shares and the acquisition of a particular startup was carried out, and then the dependence of the growth rate of share prices for 1 month was calculated (Table 1). The dependence of the growth rate of stock prices for 2 months (Table 2).

Table 1. Dependence of the growth rate of stock prices for 1 month

Companies	From the fact of the project implementation		From the number of projects	
		standard error		standard error
Alibaba Group	2.403	7.733	2.143	7.728
Amazon	3.367**	6.736	2.496***	6.713
Alphabet Inc.	2.693**	5.993	0.919*	6.064
Sber	2.460	6.931	0.449	6.995
Yandex	2.443	8.335	1.257	8.367

Compiled by the authors, source: <https://www.finanz.ru/>

Table 2. Dependence of the growth rate of stock prices for 2 months

Companies	From the fact of the project implementation		From the number of projects	
		standard error		standard error
Alibaba Group	3.464	12.385	2.748	12.390
Amazon	3.961	10.375	3.170*	10.223
Alphabet Inc.	2.624*	7.242	0.734	7.319
Sber	3.766*	10.372	1.413**	10.402
Yandex	2.180	12.775	2.362	12.704

\*\*\*significance at the 1% level

\*\*significance at the 5% level

\*significance at the 10% level

Compiled by the authors, source: <https://www.finanz.ru/>

From the tables, it is possible to see the presence of positive correlation coefficients between the introduction of new projects and the growth of stock prices for the companies under consideration. Based on Table 1, we can assume that there is a positive correlation between the fact of the project implementation and the increase in the share prices of Amazon and Alphabet companies in the next month, compared with the previous one, in which the project was implemented. In addition, there is also a



positive dependence on the number of projects for these companies. Based on Table 2, Amazon and Alphabet maintain a positive dependence on the growth of shares two months after the implementation of the project (Alphabet has a dependence on the fact of acceptance of the project, and Amazon has a dependence on the number of projects). In addition, there is a positive correlation between the fact of the project implementation and the increase in the share prices of the Sber company two months after the newly purchased service. Sber also has a positive relationship with the number of projects.

With a high probability, it can be argued that paired regressions do not take into account many possible factors that affect the change in stock prices, so we can only assume based on the constructed paired regressions that there is a positive relationship between the fact of the introduction of new projects by the company, their number and the quotes of company shares.

Thus, it was revealed that the acquisition of the largest startups contributes to the growth of stock prices. For example, the dynamics of the share prices of the Alibaba Group demonstrates a sharp rise in share prices when acquiring companies such as Yueke, Youku, Daraz.pk. Or, for example, a similar trend is observed when Alphabet Inc. acquired such startups as Pixate, Moodstocks, and others. This once again proves that the company's expansion strategy is associated with the absorption of new services and companies in general. Based on the general analysis, we can conclude that there is a connection between joining, creating new services, and increasing the share prices of companies.

#### 4. DISCUSSION

The creation and development of a digital ecosystem require not only a large number of financial injections but also competent planning of the company's development strategy since the creation of a digital ecosystem is an element of the innovative development of companies.

It is important to note that first of all, companies care about the key business areas that bring the greatest profit. Even though the company generally adheres to the main type of activity, while investing in a large number of different areas, companies, being commercial institutions, strive to maximize profits. In the first period of the company's existence, it should first of all focus on the type of activity that brings the greatest profit. This has a significant impact on the chance of not only further innovative development but also the development of the organization as a whole.

Any business platform has several main products that are based directly on it. When producing these products directly, at least at the first stage of the organization's development, the company will be able to ensure stable development and growth of financial indicators. Sometimes this is not always appropriate, for example, Yandex.Music and Kinopoisk HD are unlikely to be able to become multilateral platforms, but they serve as a means of building consumer loyalty.

After the main product brings the company a stable income, it can enter related industries. For example, the PIK company, which is engaged in housing construction, switched to a rental housing service, thereby expanding the range of services provided and gaining the loyalty of a larger number of potential buyers. The most important recommendation for any company is to follow the takeover tactics of other startups in certain industries of interest. The advantage of this tactic has been proven more than once in the course of work on the example of several companies. The acquisition of other services or startups allows the company to quickly acquire a market share, thereby taking its place in it or even entering a new market. It is also important to note here that the company should purchase prospectuses only if there are available funds. In another case, the company shall make a large number of investments in the development of the digital ecosystem, hiring highly qualified personnel, and so on.

After the company's digital ecosystem has started to develop rapidly, the company needs to take care of its continuous development. Depending on whether the company has funds that are not used in production, as well as the fact that there is a development strategy, the following ways can be chosen, highlighted by the researcher Sukhanov:

1. "To switch to new markets, creating a platform on them and build services around it that create a mini-ecosystem.
2. To monitor the market, finding new growth points, and absorbing promising startups that will already have established business processes and already have their audience.
3. To combine the previous two approaches. For example, it is possible to create a platform in a new market, and then increase its value by absorbing startups in related markets".

Often, companies are faced at this stage with a certain choice related to investing finance in a particular area. The company should not be "dispersed into several directions", since this can threaten a sharp drop in profits due to the bankruptcy of acquired startups.

The strategy and recommendations discussed above are often a special case of the development of certain companies and these rules cannot be applied to all companies in all cases and all areas, so it is necessary to focus on the features of digital transformation as a whole, touching on its main steps.

Without touching on the issues related to the prerequisites of digital transformation and its theoretical justification directly, we draw attention to the fact that the transformational logic existing within the framework of this theory requires rethinking not only existing approaches to business but also the competent performance by all authorities of their functions, namely the provision of public services, the implementation of control and necessary supervisory activities. That is, the digital transformation of society covers not only the sphere of business but also all other spheres of human activity.

Thus, the development of a digital ecosystem, in addition to serious technical potential, involves the construction of a stable corporate governance system, since employees shall be aware of the constantly changing mission of the company and have time to monitor the changes taking place in the world.

## 5. CONCLUSION

The digital ecosystem is a consequence of digitalization, which contributes to significant changes in the flow of business processes, transferring them to the Internet space. The digital ecosystem has a complex structure, where each element plays an essential role.

The largest companies, representing a digital ecosystem, such as Google, Alibaba Group, Amazon, Sber, Yandex possess several features and have general patterns of development, such as a strategy for the absorption or creation of new services and startups; the focus on a single activity of the company, combined with the spread of influence in other areas; preference is given to the development of IT: cloud computing, education, artificial intelligence. Also, the development of digital ecosystems allows companies themselves to keep the employment of employees at the same level, through retraining and staff training, as well as to increase it by hiring highly qualified specialists. Digital ecosystems are developing dynamically, which has a positive impact on the activities of companies. Earlier empirical and theoretical analysis showed that the acquisition or development of large and technological startups contributes to the growth of the share prices of the company itself, introducing new projects, thereby increasing its scope of activity and influence.

The creation of digital ecosystems allows companies to significantly increase the efficiency of economic activity. For example, in 2020, the volume of assets of Sber increased by 25% compared to 2015 taken as a base period. Also, for example, Amazon's net profit in 2020 was 35.79 times higher than in 2015. Similar trends have been observed in such indicators as revenue, net cash flow, number of services, revenue per employee, return on assets, and other indicators.

In addition, during the correlation analysis, based on data on stock prices of various companies, as well as the number of services developed or purchased in the period from 2015 to 2020, it was found that there is a positive correlation between the fact of the project implementation and the increase in the share prices of Amazon and Alphabet companies in the next month, compared to the previous one, in which the project was implemented. Similar trends were revealed when analyzing the median values of stock returns. This repeatedly proves the effectiveness of the introduction of digital ecosystems, which directly affects the economic performance of the company.

Due to the formation of an innovative corporate culture, the system of effective administrative management, personal qualities of management, companies such as Alibaba Group, Alphabet Inc., and other companies, the activities of which were studied in the course of the study, managed to become innovative international companies that, along with the production of effective and high-quality goods and services, are sources of innovation, the development of scientific and technological progress.

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