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Determinants of Financial Performance of Business Ecosystems in Russia

Ivan Lukin
Investment Analyst LLC «PSB II», Moscow, Russia,
lukin.ivan.57@gmail.com, ORCID

Abstract

The scientific literature provides a comprehensive description of business ecosystems and their key advantages. However, there is a lack of thorough exploration into the practicality and efficacy of implementing business ecosystems, as well as strategies to enhance their economic impact. This study examines the impact of three key factors on the effectiveness of business ecosystems: ecosystem self-sufficiency, service integration, and customer satisfaction. A sensitivity analysis of the Net Present Value (NPV) of ecosystems was conducted using discounted cash flow models for two leading Russian technology companies, IC PJSC Yandex and IC PJSC VK. The analysis focused on key drivers such as the number of active clients, average customer churn rate, digital sales funnel, and average transaction value. Ecosystem self-sufficiency significantly and variably affects NPV, with the removal of even a single business line leading to a negative impact on ecosystem value (ranging from –5 to –167%). The level of service integration has a minor influence on ecosystem NPV, with a 50% variance in subscription users leading to an NPV deviation of no more than 16%. Customer satisfaction, however, can have a substantial positive effect on ecosystem NPV, with a 1% improvement in satisfaction leading to a potential 3.7% increase in NPV. From the point of view of scientific novelty, this study allows to conclude that each factor of the effectiveness of ecosystem implementation is associated with the ability to collect and use information. For the Russian technology sector, a significant impact was identified in two of the three key factors: ecosystem self-sufficiency and customer satisfaction. The practical significance of the results of this study lies in determining the general factors that show under what conditions the introduction of an ecosystem is economically justified for the technology sector.

Keywords: digital business ecosystems, business ecosystems, valuation of business ecosystems, business development, business strategy

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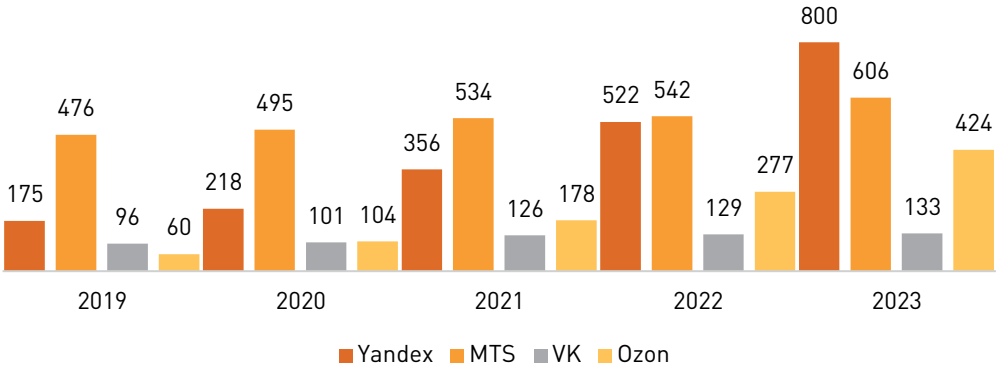
Figure 1. Revenue of the largest Russian non-financial ecosystems, bln. rub.



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Introduction

Over the last 10 years the majority of large Russian companies have announced the development of their own business ecosystems. In banking, telecommunications and, first and foremost, technology some of them have used the lead building business models based on the ecosystem principle [1].

For example, Yandex and Ozon are large Russian technology companies, which managed to increase their revenue more than four-fold between 2019 and 2023 (Figure 1). Using an extensive technological base combined with an aggressive investing policy the companies built a stable business model capable of expanding to numerous segments of the Russian technology market. However, some ecosystems, for instance MTS and VK, have not harnessed the growth potential of this business model to the full extent: in 5 years their revenue growth did not exceed 50%. In this respect the problem of searching for factors that explain such a substantial difference in the effect from ecosystem implementation is significant from the practical point of view because it will allow Russian companies to use the existing resources in a more efficient manner when building their business models.

The majority of prosperous Russian business ecosystems were based on existing companies in a certain industry. According to the currently relevant definition [2], a business ecosystem is a company development strategy that entails offering a range of complementary products and/or services which create additional value for the customer.

The coronavirus pandemic was the first significant trigger for business integration into a combined business environment. It forced companies to develop digital sales channels in order to survive a slump in consumer demand.

Sanctions produced a mixed influence on the development of Russian ecosystems [3]. On the one hand, a lack of access to advanced developments of mature economies significantly limits the development of digital business ecosystems. Entry into foreign markets, even friendly ones, is also restricted due to the secondary sanctions risk. Media services have been denied access to foreign information content, which results in significant limitations of sustainable development of digital ecosystem businesses. On the other hand, Russian digital ecosystems continue to develop driven by restrictions on foreign technology, among other things: in order to survive under the pressure of new realities companies have to create cooperation channels in the research and development sphere. Withdrawal of foreign companies from Russia offers prospects for the development of domestic technological solutions. Companies are capable of creating such solutions as a part of building closer relationships and establishing business ecosystems.

The most important and rapidly developing ecosystems operate in the following five industry sectors: banking, IT, telecommunications, retail and classifieds [4]. As the ecosystem develops, the boundaries between industries are erased: banks establish non-banking services, non-financial sector creates its own fintech services.

The key unique characteristics of Russian business ecosystems are as follows [5]:

- the majority of ecosystems are at the stage of emerging and development, which manifests itself as untapped potential and probable development of this cooperation form in the future;
- combines the features of transactional and solution ecosystems; classified as a hybrid business ecosystem;
- predominance of earnings from the core business in the revenue structure, which provides an opportunity to develop new business lines using the generated cash flows.

Apart from the above-listed unique characteristics, we should emphasize the prime advantages for Russian companies provided by the business strategy based upon the ecosystem approach:

1) Maintaining and enhancing loyalty of active clients.
2) Expanding the client base by entering "neighboring" and "distant" markets.
3) Generating more revenue from the core business by creating an inflow of users from related business lines.
4) Business diversification.
5) Enhancing business resilience by increasing flexibility of the investment strategy.

6) Search for new potential lines of business development based on customer information.

Enhancing business resilience by increasing flexibility of the investment strategy means that the company is able in a timely manner to get rid of "unnecessary" services that have a detrimental effect on financial performance and are incapable of providing economic benefits in the future due to changes in the external environment or integrating new, most promising projects rapidly. Based on the analysis of the information about a customer, the company can build a more flexible investment strategy, adapting to the newest trends, thus enhancing the investment attractiveness of the business ecosystem. For example, in 2022–2023 Russian business ecosystems closed down 37 loss-making projects and launched 67 new ones [6]. Due to a rapid response to sudden changes in the external environment, business ecosystems are able to enhance business resilience and make more efficient use of their resources based on data analytics.

A turbulent Russian macroeconomic environment makes large companies diversify their project portfolio, but in order to build a flexible investment strategy integration of interrelations between business lines should be enhanced, thus ensuring the efficient use of customer information.

However, apart from distinct advantages, there are also disadvantages. Thus, the creation of a business ecosystem may affect the company in a negative way. For example, if a business ecosystem offers a range of goods and services intended for antagonistic user target groups, offering one product and/or service which comes with another product may cause loyal customer churn because the consumer is unwilling to pay for something he does not need. Some scientific ecosystem studies show that just 15% of them attain the "leadership" stage [7].

Companies that are most effective at collecting and using customer information gain the biggest advantage from the implementation of an ecosystem. The more a company knows about the customer, the more suitable is the set of goods and services that the ecosystem can offer him.

Development of digital technology and its growing availability allows ecosystems to make more efficient use of information about the customer. However, far from all companies are able to implement and use effectively this technology. Technological business ecosystems have to spend rather serious resources on marketing, development of applications and web sites, as well as data storage. Few companies can do it without external assistance. The problem of relevance and efficiency of building a proprietary ecosystem is of practical importance a Russian company because Russian large and medium businesses exhibit investment activity in this area.

The purpose of this paper is to study the key factors that define the efficiency of implementing the ecosystem approach for Russian business using Russian public technology companies as an example.

The main research problem raised in this study is the search, detection and analysis of the key factors that allow ecosystems to gain a competitive advantage over other business models using Russian technology companies as an example.

This research considers the influence of three different factors on the financial performance of certain business lines within the same business ecosystem and on determining the value of the ecosystem itself by applying the DCF method and using two Russian technology companies – IC PJSC Yandex and IC PJSC VK – as an example. This is the first paper to conduct and present a qualitative analysis of influence of the key factors of a business ecosystem's development efficiency and quantitative evaluation of the impact of these factors on the business ecosystem value. This research focuses on assessing the value of a business as a business ecosystem using the drivers that describe the interrelation between the elements of this ecosystem, rather than a holding with several business lines, whose value is equivalent to the sum of individual unrelated values of these business lines.

The paper consists of three parts. The first part presents a review and analysis of the academic literature, which demonstrates the existing results of research papers and reveal the relevant understudied research issues on our topic. The results of qualitative analysis presented in the existing academic papers allow us to make an assumption about the potential key factors of efficiency of the ecosystem approach implementation in the classic business model. The second part determines the factors that influence the efficiency of business ecosystem implementation on the basis of analyzed sources and statistical data, and also presents the research methodology. The third part lays down the research results and their scientific and practical importance.

Theoretical Foundations of a Business Ecosystem

In academic literature there are several avenues for examining a business ecosystem. The studies of the first type focus on defining the business ecosystem phenomenon and its unique characteristics as compared to other forms of market participants' interaction. The second research line addresses the objective of revealing various types of ecosystems, their classification depending on legal relationships between participants, ways of interaction, etc. The third line of research is based on comparison of business ecosystems at the country, industry and individual company level. In order to perform a critical analysis, we should consider the definition of a business ecosystem.

Definition of a Business Ecosystem

The term "business ecosystem" was introduced and studied in detail by the scientists J.F. Moore and M. Rothschild [8–11]. In their papers the term "business ecosystem" is defined as a community of interacting organizations and individuals involved – the organisms of the business world. The authors point out the main difference in the principle of company operations in a business ecosystem. A company is considered as a part of the shared business ecosystem involving a lot of industries, rather than a participant

of certain markets. Interindustry relations form the main trigger for the emergence of a business ecosystem, similarly to an ecosystem in biology [12].

The most important research issue in defining an ecosystem is related to its ability to create greater value for the customer than an individual firm. R. Adner writes the following in his research paper: "When they work, ecosystems allow firms to create value that no single firm could create alone" [13]. Study of the game console market development shows that a winning position in the complementary goods markets is not guaranteed by creation of the best product. It is the creation of matching products and offering them as a package that allows technology companies to get loyal customers and obtain a long-term competitive advantage. Investment of resources by different companies and organizations within an ecosystem results in the creation of common value for the consumer, thus leading to a higher customer satisfaction [14].

The most up-to-date sources define a business ecosystem as a purposeful business arrangement between two or more market players to create and share collective value for a common set of customers [15]. The brands of all members of a business ecosystem are presented in the value propositions. Every ecosystem has several participants and at least one orchestrator. The concept of a modern business ecosystem implies joint coordination of all participants' actions by orchestrators related to business agreements, market positioning strategies, value creation and sharing mechanisms as well as ecosystem risk management.

The life cycle of a modern digital business ecosystem is divided into 4 stages: foundation, expansion, leadership and self-renewal (otherwise it is death) [16]. For a company, implementation of an ecosystem is accompanied by challenges. Some of them are relevant not only for ecosystem businesses: demand generation in the absence of supply or the reverse situation, uncontrolled cost growth at the scaling stage when network effects emerge, control of product quality in the period of explosive growth as well as competition with copies of the platform when the barrier for market entry is low. The authors emphasize that the management methods used for conventional businesses are not suitable for business ecosystems. It is impossible to preplan or pre-engineer an ecosystem. It develops and evolves as a living organism, adapting to users' rapidly changing preferences and needs.

Four parameters form the basis of an ecosystem: modularity, customization, multilateralism, and coordination [17].

Modularity means the possibility of independent development of a product by each ecosystem model member. Then it is integrated into the common network of ecosystem products that complement each other.

Customization implies the integration of each product into the common value proposition. In other words, each new product complements the product already presented to the user.

Multilateralism of ecosystem members means that their relations cannot be reduced to bilateral interactions because each member interacts with several other ecosystem members simultaneously. A member breaking off relations with one ecosystem participant loses their relations with others.

Coordination indicates that interaction between ecosystem participants is regulated by generally accepted standards and processes, but is not strictly regimented as in a hierarchical structure.

A business ecosystem combines the features of an open market and a vertically-integrated organization where all processes depend on a certain system participant. A business ecosystem is on the one hand a decentralized segmented system, but at the same time interactions between its participants are highly coordinated.

Any ecosystem is based on a compelling value proposition. In order to assess the prospects for ecosystem implementation, first of all, it is necessary to evaluate the opportunities offered by the market situation, rather than company characteristics because the ecosystem approach may also comprise the integration of various market participants. In such a case a company does not need to raise large amounts of funding: each participant makes its contribution.

Based on our literature analysis, we may conclude that the problem of defining a business ecosystem as an individual type of a business model has been raised in science rather recently and is still relevant. The reason is the explosive development of digital technology and the accompanying development of inter-industry relations.

The diversity of inter-industry relations caused by rapid digitalization has opened up an opportunity to create different forms of business ecosystems. The scientific problem of classification of these cooperation forms within the ecosystem approach is also of relevance.

Types of Business Ecosystems

Apart from the importance of providing a definition of a business ecosystem and comparison of this business model type with other possible forms of inter-company cooperation, academic literature classifies business ecosystems on the basis of various features.

Interaction of market participants within the same ecosystem may be attributed to one of 5 types based on their relationships and legal dependence on each other [18].

The authors observe that this classification of business ecosystems is established with consideration of the level of closeness of ecosystem participants' interaction. Commodity supply chains imply the minimum interaction level, while newly integrated companies imply the maximum level of closeness and involvement of participants within the ecosystem in order to create a shared value for the customer.

There is an ecosystem classification based on the mode of participants' interaction [19]. BCG experts distinguish two types of business ecosystems: the transactional ecosystem and solution ecosystem.

The authors also point out that it is possible to create a hybrid ecosystem. For example, Apple built a solution ecosystem from the very start. However, after it founded its own

app store, the ecosystem was able to operate as a transactional one. This implies that the company's business model may be classified as a hybrid ecosystem.

Experts of the McKinsey & Company consulting firm defined 6 different models of business ecosystems depending on the strategy of interaction with the customer and/or asset allocation: the acquisition engine model, platform business model, multibusiness ownership model, data monetization model, asset and resource synergy model and infrastructure and capability enabler model [20]. The acquisition engine model, platform business model, multibusiness ownership model and data monetization model allow to increase the revenue by achieving a synergy of various business lines. The asset and resource synergy model and the infrastructure and capability enabler model imply a synergetic effect of spending optimization and, consequently, business performance enhancement.

Table 1. Classification of Ecosystems

Classification author	Cambridge	BCG	McKinsey & Company
Classification criterion	Legal dependence	Economic relationship	Customer interaction and/or asset allocation
Parameter of the relation between the elements	Level of closeness of participants' interaction	Direct and indirect network effects/quality control or technology	System of coordination and control of assets/product quality/customer interaction
Type according to the classification	Commodity supply chains	Transactional ecosystem	Acquisition engine model
	Bilateral relationships		Platform business model
	Multilateral relationships	Solution ecosystem	Multibusiness ownership model
	New company		Data monetization model
	New integrated company	Hybrid model	Asset and resource synergy model
			Infrastructure and capability enabler model

Thus, as a part of this scientific problem we may distinguish three different types of ecosystem classification based on various modes of element interrelations: Cambridge – legal dependence, BCG – economic relations, McKinsey & Company – customer interaction and/or asset allocation (Table 1).

The fundamental scientific problem of ecosystem classification arises out of scientific studies of business ecosystem development at the regional, national and industrial level, as well as the study of the individual business ecosystem experience .

Review and Comparison of an Ecosystem Business Model at Different Levels

The research papers dedicated to the comparison of business ecosystems may be divided into three main subcategories: analysis of business ecosystem development at the country level, relevance of business ecosystem implementation at the industry level and comparison of the effectiveness of business ecosystem implementation on the basis of analysis of individual companies' experience.

The first subcategory of academic literature comprises the papers dedicated to a greater extent to experience of companies in ecosystem implementation and the prospects for development of this business model with regard to regulatory and market-specific features of certain countries.

The most relevant foreign papers on business ecosystem development in certain regions mainly describe the experience of emerging countries. For example, the paper by L. He, Y. Cheng, X. Su covers the problem of business ecosystem development in China [21]. Based on Chinese companies' experience the authors revealed that defining the "boundary barriers", construction of a dynamic business model and unlocking a company's potential are the key factors of sustainable ecosystem development.

Defining "boundary barriers" implies identification of negative factors which impact the independent functioning of an individual company. For example, in the energy sector the authors revealed three factors: technological, product and productive. To develop technology, improve product quality and raise productivity companies have to create relationships similar to the ones formed by biological organisms within an ecosystem: aggregation and integration of company resources as a part of ecosystem cooperation allows to diminish the negative effect of "boundary barriers".

In the authors' opinion, exchange and use of information related to customer needs (external communications) in addition to just technology makes cooperation more effective.

Analyzing the prospects of ecosystem development, the author indicates significant limitations of business ecosystem development in India due to the gap between sociocultural and government institutions, placing special emphasis on the specific features of the created business environment [22].

The problem and prospects of business ecosystem development in Russia have been raised repeatedly in scientific research literature [23–28]. The authors of academic papers have considered ecosystems from the viewpoint of different levels and approaches: regulation, management and general principles of participants' interaction. Scientific papers also point out the importance of development of regional business ecosystems against the background of development of a country's individual regions.

The most relevant study of Russian ecosystems offers an insight into the trends and prospects for business ecosystem development with regard to Russian business environment specifics, especially when the Russian economy faced partial isolation related to trading with a range of countries that are advanced from the point of view of technological development [29].

The authors define three strategies of ecosystem implementation on the basis of Russian companies' experience: development of their own services (Yandex, Sber and MTS) using the existing corporate resources, entering into partnerships with other services (Tinkoff Bank) and the hybrid strategy (VK).

The authors of the abovementioned paper place the greatest emphasis on distinctive features of ecosystem regulation. Instead of antitrust regulation, the regulator focuses mostly on protection of personal data and consumer rights as well as service providers' non-discrimination.

The most common strategy for linking users within the same ecosystem that allows to offer supplementary services and products is a general subscription option. This offer enjoys the greatest popularity with Yandex and MTS users. However, the potential of this strategy has not been fully realized in the Sber and VK ecosystems.

The authors concluded that existing Russian business ecosystems are at the foundation stage and have not fulfilled their potential. The main positive effect of ecosystem implementation is the distribution of technologies and solutions among services that allow to develop them faster by means of creating better innovative products and enhancing customer satisfaction.

The satisfaction of each customer depends on ecosystem capability to determine customer preferences. Thus, the key driver of ecosystem development is the ability to collect, store and use information about the customer [30].

The second subcategory of academic literature is dedicated to relevance of business ecosystem implementation in certain industries.

Implementation of a digital business ecosystem may exert a positive impact in healthcare [31]. In spite of the obvious benefits arising out of ecosystem implementation, the authors revealed the main obstacles to development of this form of companies' cooperation. The major challenge of ecosystem implementation consists in the ability to coordinate and control the participants. The key factors that determine the ecosystem resilience include diversity, efficiency, adaptability and management cohesion.

Implementation of digital technologies and organizing interaction among market participants according to the business ecosystem principle may also be effective in the agroindustrial complex [32–33]. The key driver of this cooperation form is the technological solution exchange between the ecosystem participants because a significant technological gap between participants has a detrimental effect on productivity parameters and the industry in general. Construction of an ecosystem on the basis of an agricultural bank allows to solve the complex strategic task of developing Russia's agroindustrial complex. Development of complementary banking products based on the experience of customer interaction enhances the resilience of the core business and opens up new opportunities for further growth,

The business ecosystem concept may be applied to consider the interaction of certain regional economic zones [34]. The authors of this research set the goal to define the key characteristics of the companies that pertain to regional business ecosystems using the Italian machine building industry as an example in order to calculate the extent of influence of local conditions on the management, competitiveness and nature of interrelations. The research results show that company affiliation with a regional ecosystem allows to gain an advantage related to access to innovation and to ensure high product quality through close cooperation and exchange of information with each ecosystem participant about the characteristics of a certain type of components.

The third subcategory of academic research literature comprises the papers on comparison of effectiveness of various business ecosystem forms using certain companies as an example.

One of relevant studies of the business ecosystem concept using certain technology companies as an example is dedicated to the experience of Amazon [35]. The key characteristic feature of Amazon's business strategy is a combination of different approaches and practices. On the one hand, this technological giant combines the single company concept, controlling all main business processes. On the other hand, the company enters into a range of partnerships which allow it to integrate products and services of unrelated parties into its services. By combining these strategies, the company becomes a conductor of infrastructure for its partners and a forming unit for the comprehensive value proposition to the customer. Expanding its own range of products by means of engaging partners and its own products, the company expands the set of prospective customers, gaining a competitive advantage in the electronic commerce market.

One of the most relevant modern studies of business ecosystems compares two different technological digital platform concepts: Huawei HarmonyOS and Xiaomi Smart Home [36]. The main difference between these digital business ecosystems is defined by technology. Huawei HarmonyOS was created as an open business ecosystem concept, while Xiaomi Smart Home is a closed system focused on development of its own branded technological solutions. In the authors' opinion, the first concept may be more effective in the long term, while in the short term heightened control over participants' interaction is necessary. The second strategy may be effective in the short term due to the rigid coordination of interaction between participants. However, in the long term this strategy may lose its competitive advantage.

1) Comparison and detection of distinctive features of business ecosystems at the regional (country) level.
2) Comparison and relevance of business ecosystem implementation at the level of individual industries.
3) Comparison and detection of distinctive features of business ecosystems using individual companies as an example.

A fairly large number of relevant research papers have tackled the topic of business ecosystems. Qualitative methods of factor evaluation are mainly applied to assess the relevance of ecosystem implementation. The key factor that influences the efficiency of ecosystem implementation is the ability to collect, process and use customer information provided by each participant in order to improve the product at each link of the value chain or to develop a complementary product or service that enhances customer satisfaction.

However, the problem of efficiency of business ecosystem implementation and the factors determining it, as well as quantitative evaluation of these factors have been understudied.

Scientific novelty of the present research consists in a more detailed study of the insufficiently explored problem, namely the definition and quantitative evaluation of the impact made by the key factors – the effectiveness of creation and integration of the ecosystem approach into an existing business.

Most business ecosystem studies have limitations related to the applied qualitative analysis methodology. The quantitative analysis elements used in some papers do not completely reveal or validate the results of qualitative analysis. In the present paper quantitative analysis is used in conformity with qualitative analysis.

Research Methodology

Defining the Factors which Impact Efficiency of Business Ecosystem Implementation

On the basis of analysis of academic literature and other sources one may make the conclusion that company ability to collect, process and use information on customer preferences is the key factor which determines development of a business ecosystem.

The present research considers three parameters that influence the effectiveness of collecting, processing or use of customer information (Table 2).

Table 2. Factors of Effective Ecosystem Development

Factor	Influence on efficiency of data collection and processing	Influence on efficiency of data use	Quantitative evaluation
Ecosystem self-sufficiency	More sources for information collection	More products and services may be offered to the customer – expanded target group	Number of business lines in the ecosystem
Ecosystem products integration	Relevance of the information obtained from one service for another service	A higher probability to sell to the customer a complementary product or service	Number of active users making use of more than one service/number of general subscription users (loyalty programs)
Ecosystem customers' satisfaction	Obtaining more detailed customer information	The higher the customer loyalty, the more services may be offered	Evaluation of the application by users

Each factor may have a mixed impact on corporate cash flows. The present research considers the direct influence of various factors on revenue or other proceeds (commission income) as well as the impact on business expenses based on corresponding drivers. The effect from these factors' impact on other general and administrative costs and capital expenditures requires access to more detailed information than that available through regular disclosure by companies.

The key driver of revenue is the number of active users defined on the basis of customer inflow and outflow. Each factor has a positive impact on the driver because it contributes either to an increase in user inflow or decrease in outflow:

1) An increased number of business lines entails an enlarged user inflow as the number of user attraction channels grows for each individual service of the digital business ecosystem.
2) Growing integration of ecosystem products represented by the number of the general subscription users allows to increase the inflow of active users to each individual service of the ecosystem through the existing channels of attracting new users.
3) Customer satisfaction contributes to reducing user churn because the more convenient the service for the customer, the lower the probability of customer churn. High service quality allows to retain active users even when the market offers analog products.

The key driver for business expenses is the need to attract third-party users. The smaller the number of the ecosystem active users or the larger the churn, the more the company has to spend on attracting third-party users: customer inflow from the services integrated in the ecosystem is insufficient to compensate for the churn, so the company has to incur more business expenses in order to maintain the ecosystem's digital products or to develop the application to reduce the churn.

Also, the company has to maintain integration of digital services offering other ecosystem products to active users of a certain business line. However, intersegment revenue/expenses on advertising of various ecosystem business lines within the ecosystem itself may produce a significant effect if it has a higher conversion rate among loyal users. This may be achieved by means of enhancing the efficiency of customer data processing or reducing the cost of attracting one new active customer.

In this paper we consider the impact of certain factors on cash flows, first of all, from the viewpoint of influence of such factors on the inflow and outflow of active users (Table 3).

Table 3. Relationship between Efficiency Factors and Cash Flows

		Ecosystem self-sufficiency	Ecosystem product integration	Customer satisfaction
Income	Revenue growth rate	Positive dependence	Positive dependence	Positive dependence
Expenses	Net cost growth rate	No evident impact	No evident impact	No evident impact
	Business expenses growth rate	Positive dependence	Negative dependence	Negative dependence
	General and administrative cost growth rate	Positive dependence	No evident impact	No evident impact
	Capital expenses / development costs growth rate	Positive dependence	No evident impact	Positive dependence
Impact on cash flows		Mixed impact	Positive impact	Positive impact

On the basis of studied literature as well as qualitative analysis of the influence of the three factors (business ecosystem self-sufficiency, ecosystem product integration and customer satisfaction) expressed in quantitative indicators (number of business lines, number of general subscription users and evaluation of applications by users) on cash flows, we generate the following hypotheses of the present research:

1) Reduction in the number of business lines produces positive impact on ecosystem NPV.
2) Growth in the number of general subscription users exerts a significant positive impact on ecosystem NPV.
3) Increase in ecosystem user satisfaction makes a significant positive impact on ecosystem NPV.

Thus, the hypotheses put forward are as follows.

Hypothesis 1: Reduction in the number of business lines produces a positive impact on ecosystem NPV

It is rather difficult to determine the effect from the increase of the number of business lines in the present research since it requires a higher level of information disclosure by the studied companies or a large number of assumptions. However, it is possible to define the potential effect of a reduction in the number of existing business lines within the financial model by means of judgements and assumptions based on publicly available data disclosed regularly by companies.

Confirmation of the first hypothesis indicates that the ecosystem is completely inefficient. By increasing the number of business lines, the corporate management brings down the value of the business. Such a situation may occur when there are numerous lossmaking services with a negative value and/or a strong negative synergistic effect from im-

plementation and integration of these services. In the first case, the ecosystem has to get rid of unnecessary lossmaking and unpromising projects or give up completely on the ecosystem approach. In the second case, a holding company development strategy is involved: the business comprises completely unrelated business lines. Combination of these strategies will entail an increase in ecosystem value and general business asset value.

Disproval of this hypothesis points to a non-negative effect when implementing the ecosystem approach and confirms a possible positive effect when implementing new services. The non-negative impact of the ecosystem self-sufficiency factor described above is confirmed. If an increase in business value exceeds the value of individual unrelated business lines, we may assert that the ecosystem is efficient and that there exists a positive synergistic effect from implementation of this development strategy.

Hypothesis 2: Growth in the number of general subscription users exerts a significant positive impact on ecosystem NPV

The second hypothesis verifies the degree of the impact of the second factor – ecosystem product integration. The most important factor of ecosystem development is the existence and closeness of the links established between services which allow, within separate segments of the technology industry and interconnection between various industry niches occupied by a certain business ecosystem, to raise the level of service penetration for each individual customer. The greater the number of services used by each particular customer, the higher the loyalty of each particular customer and, consequently, the higher corporate revenue. The element of customer inflow from other business lines into a certain ecosystem unit has a beneficial effect on the growth rate of corporate revenue and cash flow in the future. This raises the ecosystem value.

Hypothesis 3: Increase in satisfaction of the ecosystem users makes a significant positive impact on ecosystem NPV

The third hypothesis verifies the degree of influence of the third factor: ecosystem customer satisfaction. It is assumed that the extent of customer satisfaction shows an inverse dependence on customer churn. The more customers are content with a digital product, the longer they are ready to use it. In order to simplify calculations, the research proposes a linear dependence.

A significant impact in the second and third hypotheses means that when the quantitative parameter (evaluation by users) grows by 1%, the increase in the key performance indicator (ecosystem NPV) is raised by over 1%.

Description of the Research Object: IC PJSC Yandex Ecosystem

The Yandex ecosystem comprises several multidirectional business lines. Each of them comprises a range of different digital services intended to satisfy customer needs in a certain area. For example, a search service, a browser, direct and navigation services are useful to the customer as they provide access to information. Targeted advertising is the main monetization source. It provides the opportunity to advertise services of a specific business line, as well as services representing other business lines.

In the most recent annual statements this business ecosystem disclosed a total of six key business lines: Search & Advertising, RideTech, a combined business line of three different digital e-commerce services, FoodTech and Delivery, Ads Services, Yandex Plus and entertainment services, a combined business line of other technology solutions within the ecosystem.

Similar to most Russian digital business ecosystems, the Yandex ecosystem has the features of a transactional ecosystem (business line services of e-commerce, FoodTech and Delivery, as well as the Ads Services business line) and a solution ecosystem (RideTech and SDG services, Navigation Services and RideTech, the Search Service as well as Devices and Alice etc.).

Over the last year, the share and amount of intersegment revenue have increased significantly. This is indicative of a potentially high integration of services (Figure 2). The intersegment revenue indicator against the background of a digital business ecosystem shows the extent of attention paid in the corporate strategy to the synergy of the services. The more use each business line makes of the user attraction channels or innovative products offered by other business lines, the closer the interrelation between the ecosystem participants and, consequently, the more efficient the information exchange concerning customer needs.

The parameter evaluated in the present research – the number of general subscription users – has also showed a growth tendency over the last year. The ecosystem uses the Yandex Plus subscription to monetize the Yandex Music and Kinopoisk content services. This subscription is also a component of the loyalty program [37] which customers may use to get discounts in other services. This helps to get an additional inflow of active users to these services (Figure 2).

Description of the Research Object: Ecosystem of IC PJSC VK

The IC PJSC VK and IC PJSC Yandex ecosystem comprise several multivarious business lines: social networks and content services, educational technology, business technology and new business lines. When building the business ecosystem, VK management, instead of concentrating on maintaining the operational efficiency of business or growth of service integration, focuses on maximizing revenue by increasing the number of services in each of the four business lines. This is done in an effort to maximize the share in a certain market segment as similar foreign technology solutions withdraw from the country. The company's aggressive investment policy entails not just a significant rise in capital expenses, but also a subsequent increase in operational expenses in order to maintain non-core business lines. Company management spends ecosystem resources unevenly. It does not control or use its main

cash cow – the VK social network – both in terms of the user attraction source and Revenue growth potential.

From the viewpoint of ecosystem classification, applying the abovementioned BCG method, IC PJSC VK combines the features of transactional and solution ecosystems.

If we consider service integration indicators that we used for IC PJSC Yandex, the most apparent difference is the combination with the user satisfaction indicator: the minimum amount of intersegment revenue (Figure 3) combined with a low rating of the main application in app stores (3.8 out of 5 as of 01.05.2024 [38]). On the one hand, the company does not use its key service as a promotion channel for its own products. On the other hand, poor effectiveness of customer information processing may be the reason for the company's insufficiency of investment in development of the core product. A significant factor of the disincentive to develop the core product is the company's almost monopolistic position in the social network market [39].

The indicator of the number of general subscription users is not disclosed in the last annual statements. For this reason, in case of VK one cannot consider the hypothesis of a significant positive impact of this parameter on ecosystem NPV.

Methodology of Building DCF-Models of Business Ecosystems of IC PJSC Yandex and IC PJSC VK

Financial models of both companies have significant limitations related to undisclosed information concerning some segments or entire business lines. For this reason, we have to introduce a range of judgements and assumptions.

The overall scheme of constructing a financial model for business ecosystems is based on the calculation of financial indicators using the main drivers that comprise the average transaction value together with the number of active users of the service. The revenue and business expenses indicator expressed in terms of the cost of attracting one customer and the number of attracted users is calculated separately for each service.

Since there is no data concerning the number of active users of Other Services, it is assumed that the revenue dynamics of general subscription is repeated, out-of-segment expenses duplicate the inflation dynamics, segment expenses are calculated based on the ratio to revenue. Working capital and CAPEX are also calculated on the basis of the historical ratio to Revenue.

In case of VK, the general methodology for calculating financial indicators that comprise the cash flow does not differ significantly from the methodology used for the calculation of Yandex's financial performance. Based on the data regularly disclosed by the company, one may make a forecast using the main drivers for 3 out of 4 business lines: Social Networks and Content Services, Educational Technology and New Business Lines. For the Business Technology business line, the financial performance is calculated proceeding from the premise that the company share in this market segment will grow uniformly up to 5% by the end of the forecast period, with the target market forecast based on data from Statista [40].

The methodology for forecasting the number of active users of each service differs in the two considered financial models. The inflow of users in the Yandex financial model is predicted based on the premises of the active users' inflow via the existing user attraction channels and of the absence of the third-party customers' inflow. In case of VK, apart from the user inflow via the existing channels, third-party users are attracted. They sufficiently compensate for the outflow of current users to keep the total number of active users unchanged. The inflow of "internal" ecosystem users is defined by a determinate sales funnel. It is presumed that each active user of at least one ecosystem service sees contextual advertising of other internal services, 4% of users follow the link, 33.33% complete the registration process, and 80% use at least 1 service. This qualifies as the category of an active user within one forecast period. User churn is predicted for both models identically. The total amount of "leaving" users is calculated on the basis of a determinate indicator of the ratio of the total number of departed users to the total number of users. The latter, in its turn, is defined based on the linear inverse dependence of the rating of this service's application to the highest and lowest value of this indicator (churn rate): 24% and 4% respectively [41]. It is presumed that the cost of attracting a third-party customer is higher for the ecosystem than attracting an internal customer via its own channels.

Research Results

Verification of Hypothesis 1: Reduction in the number of business lines produces a positive impact on ecosystem NPV

Verification of the first hypothesis on the positive impact of a reduction in the number of business lines on ecosystem NPV. It is verified by means of consistent elimination of each business line except for the core one from the ecosystem. After calculating the ratio of an "incomplete" ecosystem consisting of several business lines to the "complete" one, we may calculate the effect of reducing the number of business lines on ecosystem NPV.

As a result of elimination of RideTech and e-commerce business lines, a significant negative impact is revealed. Thus, the NPV indicator takes on negative values – a drop by over 100% – which is explained by the largest share in revenue and the largest number of active users among the complementary business lines (Figure 2). The loss of one of complementary business lines means the loss of one of user attraction channels. This has a negative effect on the rest of business lines and the ecosystem in general. Elimination of the Other Business Initiatives business line produces the least negative effect. The reason is that there is no direct influence of this business line on the active customer flows because it is predicted based on a methodology different from the forecast of other business lines.

Figure 2. The effect of consistently removing each business line from the complete Yandex ecosystem, % of the complete ecosystem

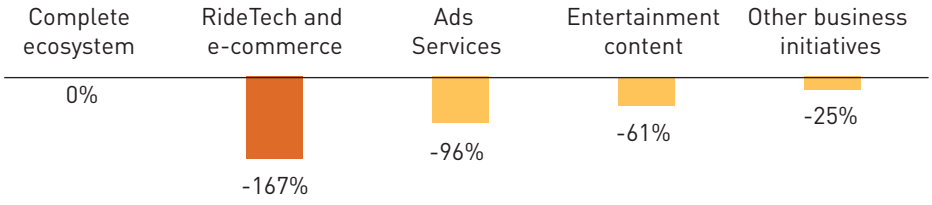


Figure 3. The effect of adding to the main business line in the Yandex ecosystem, in % of the main BL

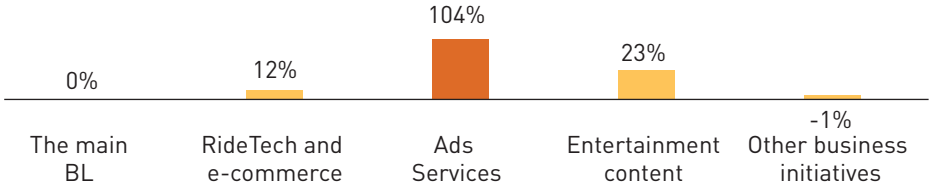


Figure 4. The effect of removing one of the business lines in the VK ecosystem, in % of the NPV of the complete ecosystem

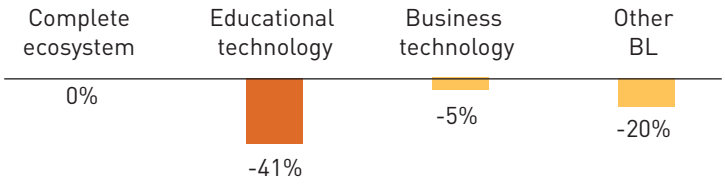
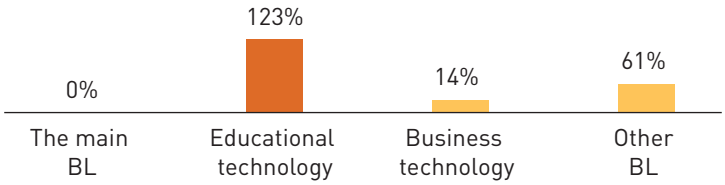


Figure 5. The effect of adding to the main business line in the VK ecosystem, in % of the main BL



Adding one complementary business line to the core business line may have a negative effect due to the growth of working capital in the first forecast period and no compensation of this effect from this business line because at the end of the forecast period positive flows are significantly decreased as a result of the discount factor (Figure 3). Unlike RideTech, the customer base of ads services is not large. Therefore, customer flow from the main business line (Search and Portal) is significantly larger than the outflow in this business line. This exerts a significant positive effect on NPV of the "incomplete" ecosystem.

In case of the VK ecosystem the results of verifying the first hypothesis are similar to the ones obtained after testing this hypothesis for the Yandex ecosystem (Figure 4). Elimination of any complementary business line produces only a negative effect on the ecosystem value. However, the inflow of third-party users mitigates this negative effect.

Similar to the Yandex ecosystem, elimination of a business line calculated on the basis of other suppositions (Business Technology) due to the lack of data on the number of active users has the least negative effect. Consequently, within the financial model such business lines are poorly integrated into the general ecosystem, and their elimination has no impact on the key revenue driver of other business lines – the number of active users (Figure 5).

Unlike in the Yandex ecosystem, the addition any complimentary business line to the core business line has only a positive effect on the incomplete ecosystem indicator. At the same time, the addition of a business line calculated without the key driver also produces the least effect.

Based on the above analysis, we may conclude that the hypothesis regarding the positive impact of a reduction in the number of business lines in the ecosystem is not confirmed. However, when building an incomplete ecosystem that comprises the main business line and one complementary business line, it is possible to obtain a negative effect on ecosystem NPV.

Verification of Hypothesis 2: Growth in the number of the general subscription users exerts a significant positive impact on ecosystem NPV

According to the second hypothesis, the change in the number of the general subscription users (business lines integration parameter) produces a significant positive influence on the ecosystem value.

Due to abovementioned limitation related to available information, the second hypothesis is verified using only the IC PJSC Yandex ecosystem as an example.

Table 4. Calculation of the impact of a change in the number of the general subscription users on the NPV indicator in an "incomplete" IC PJSC Yandex ecosystem, excluding the Other Business Initiatives category (%)

Change in the number of Plus subscribers	-50	-25	-10	0	10	25	50
Change in the ecosystem value	-6.4	-5.8	-2.6	0.0	2.9	7.5	15.6

Table 5. Calculation of the effect of a change in the number of the general subscription users on the NPV indicator of the "complete" IC PJSC Yandex ecosystem (%)

Change in the number of Plus subscribers	-50	-25	-10	0	10	25	50
Change in the ecosystem value	-4.4	-4.4	-2.0	0.0	2.3	5.9	12.3

Table 6. Analysis of Sensitivity to User Satisfaction of the Yandex Ecosystem (%)

Change in the score of the application, % of max.	-3.0	-2.0	-1.0	0.0	1.0	2.0	3.0	5.0
Search and Portal	-7.1	-3.6	-3.6	0.0	0.7	4.3	5.6	4.5
Yandex GO	-10.0	-6.4	-3.7	0.0	3.7	7.4	11.1	4.9
Yandex Market	-6.4	-3.8	-2.0	0.0	2.7	4.9	7.2	4.7
Yandex Lavka	-5.2	-3.7	-1.6	0.0	2.2	4.5	6.7	4.8
Yandex Nedvizhimost	-2.1	-1.3	-0.8	0.0	0.7	1.4	2.1	4.6
Auto.ru	-1.0	-0.6	-0.4	0.0	0.2	0.5	0.8	4.6
Yandex Puteshestviya (travel)	-2.0	-1.3	-0.7	0.0%	0.7	1.3	2.0	4.8
Kinopoisk and Yandex Music	-3.7	-2.7	-1.5	0.0	1.1	2.7	4.2	4.8

If we consider the impact of change in the number of subscribers in an incomplete ecosystem without the Other Business Initiatives business line, we may detect a disproportionate effect when the number of subscribers decreases or increases. In case of an increase, the effect is 2.5 times greater. At the same time, the effect on the NPV indicator is significantly lower than the changed parameter. This contradicts the main hypothesis of a significant impact of this parameter on the key performance indicator (Table 4).

In case of a complete ecosystem, the effect is smaller. However, a disproportionate effect remains when the number of subscribers increases or decreases (Table 5).

Based on the above analysis we may conclude that the hypothesis of a significant impact of the number of the general subscription customers on an ecosystem's NPV is not confirmed. We should also specially mention a disproportionate effect of an increase or decrease of the number of subscribers: the effect of an increase of the number of subscribers is significantly more serious than that of a decrease.

Verification of Hypothesis 3: Increase in satisfaction of ecosystem users has significant positive impact on ecosystem NPV

The third hypothesis of this study suggests a significant impact of customer satisfaction expressed in user evaluation of the company services on ecosystem NPV.

Each of the ecosystem's services belongs to a specific business line. In case of the Yandex ecosystem, satisfaction of the users of Search and Portal services is determined by one score. Each of the other business lines comprises several applications and the effect of a change in satisfaction with each service is calculated separately. To verify this hypothesis, we considered a deviation of users' score by 0.05 points on a scale of 1 to 5 points. Also, this deviation is divided by the users' score and is expressed as a percentage of the customer satisfaction score. For reference, the table on the right shows the users' valuation of the service application.

If we consider the Yandex ecosystem from the point of view of hypotheses, it is important to point out the mixed

impact of satisfaction of a particular service's users on ecosystem NPV. The larger the share of service revenue within the business line and the greater the business line's share in the revenue structure, the more serious the effect of change in user satisfaction (Table 6).

Satisfaction of users of the majority of Yandex ecosystem services exerts a significant impact on ecosystem NPV. This confirms the hypothesis of a significant impact of the user satisfaction factor on the efficiency of ecosystem functioning using the example of the Yandex ecosystem.

In case of the VK ecosystem there is no significant impact of user satisfaction (when the quantitative indicator of the factor changes by 1%, the key performance indicator changes by more than 1%). This may be due to the premise that a loss of users is compensated by an inflow of third-party "non-ecosystem" users. We should also note that a change in the score by the same value will be higher in percentage terms with a lower service score (Table 7).

Table 7. Sensitivity Analysis to User Satisfaction of the VK Ecosystem (%)

Change in the score of the application, % of max.	-3.0	-2.0	-1.0	0.0	1.0	2.0	3.0	5.0
VK social network	-3.3	-2.2	-1.1	0.0	1.0	2.0	2.9	3.8
Odnoklassniki social network	-2.5	-1.5	-0.7	0.0	0.7	1.5	2.3	4.2
Mail service	-0.7	-0.5	-0.3	0.0	0.3	0.7	1.1	4.8
Dzen	-1.8	-1.2	-0.6	0.0	0.6	1.1	1.7	3.9
Skillbox Holding Limited	-1.6	-1.1	-0.5	0.0	0.5	1.1	1.7	3.8
Uchi.ru	-2.6	-1.7	-0.9	0.0	0.9	1.8	2.8	4.4
Mail.ru cloud	-1.3	-0.8	-0.4	0.0	0.4	0.9	1.3	4.6
VK Play	-1.6	-1.1	-0.5	0.0	0.6	1.1	1.7	4.7
RuStore	-1.4	-0.9	-0.5	0.0	0.4	0.9	1.3	3.8

Based on the above analysis we cannot conclude that changes in service user satisfaction produce a definitively significant impact on ecosystem evaluation. In case of the Yandex ecosystem, this hypothesis is confirmed for the majority of services, but this hypothesis is not confirmed for VK. This may be due to an additional inflow of "non-ecosystem" users, which mitigates the negative effect of an increased user churn. In case of the VK ecosystem, the previously mentioned absence of compensation of user churn with the inflow of "ecosystem" users is also relevant. Consequently, the effect of a decrease or increase in customer churn is compensated by increased business expenses.

Conclusion

Based on the research results we may make a conclusion concerning the research hypotheses in relation to the considered Russian ecosystems, namely Yandex and VK:

1) Reduction in the number of business lines produces a positive impact on ecosystem NPV. – Not confirmed for both ecosystems (Yandex and VK).
2) Growth in the number of the general subscription users exerts a significant positive impact on ecosystem NPV. – Not confirmed for the Yandex ecosystem, has not been considered for the VK ecosystem in the present research.
3) Increase in ecosystem user satisfaction makes a significant positive impact on ecosystem NPV. – Confirmed only for the Yandex ecosystem, the impact for the VK ecosystem is insignificant.

On the basis of the verified hypotheses, we may conclude that there is a significant positive impact of such factors as ecosystem self-sufficiency and user satisfaction, and there is an insignificant positive impact of the factor of ecosystem products integration on the key indicator of ecosystem efficiency (NPV).

As a result of comparison of the two companies (IC PJSC Yandex and IC PJSC VK), we may also make the conclusion regarding the key unique characteristics of these ecosystems and their efficiency. Both ecosystems combine the features of solution and transactional ecosystems. By the intersegment revenue indicator, the service integration of Yandex exceeds that of VK. A high satisfaction indicator for the Yandex ecosystem users provides an opportunity to increase the number of active customers without attracting third-party users. Using only the existing channels of active user attraction, the ecosystem acquires more customers than it loses. This is expressed in a more sustainable revenue growth and, consequently, larger cash flows.

Maintaining the customer base by attracting "non-ecosystem" active users from other channels in case of the VK ecosystem allows the company to stabilize revenue. However, in order to increase revenue growth rates ,the company has to improve customer satisfaction which, in its turn, is related to the efficiency of customer data use. VK's weak customer focus is the key factor that influences the increased churn of active users. As a result, the company is deprived of opportunities to obtain more customers within each individual service, business line and the ecosystem as a whole. Low integration of business lines indirectly con-

firms the inefficiency of customer data exchange between business lines. This manifests itself in a low efficiency of investment, which is large with respect to revenue.

Loss of users of the core business line may be compensated by a simultaneous growth in the number of users in other "complementary" services, where an increment of users from the existing channels is significantly higher than the churn. This is observed in the Yandex ecosystem (Figure A1–A5).

In case of the VK ecosystem, the loss of the core line users may not be compensated by the inflow of users to the ecosystem's other business lines from the existing channels . Stabilization of the number of users manifests the ecosystem's inability to grow on the basis of the existing customer attraction channels. This requires compensation from other (third-party) channels of user attraction (Figure A2).

The practical importance of the results of the present research is related to the construction of the most efficient strategy of creation and development of a business ecosystem. The ecosystem approach may be effective if corporate management is capable of building a model of flexible user "flow" from one service to the other. Constructing an ecosystem based on an existing business with a large number of active customers may be more effective than building a range of complementary services from scratch because in this case the company does not need third-party channels to attract users. It is possible to provide user "flow" without losing the total number of "non-unique" users in case of high user satisfaction with the ecosystem services and a high degree of integration of these services. By dvertising an ecosystem service by means of its own sales channels (this function is performed by other ecosystem services), the company may obtain more customer information and, thus, improve user satisfaction. This reduces the churn in the future.

The scientific contribution of our results consists in finding a new line of scientific thought aimed to foster the search for the key factors and evaluation of the degree of their impact on the effectiveness of implementation of the ecosystem approach in business in the context of various industries, regions and countries.

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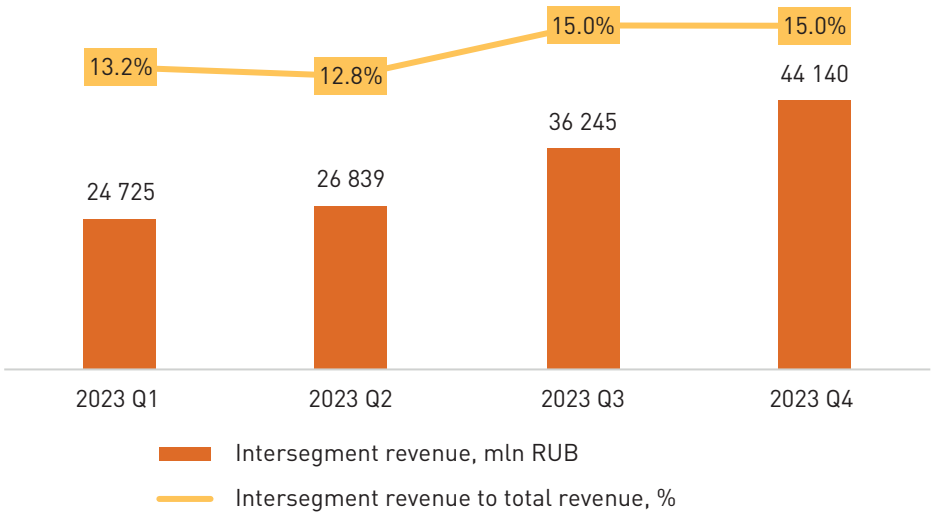
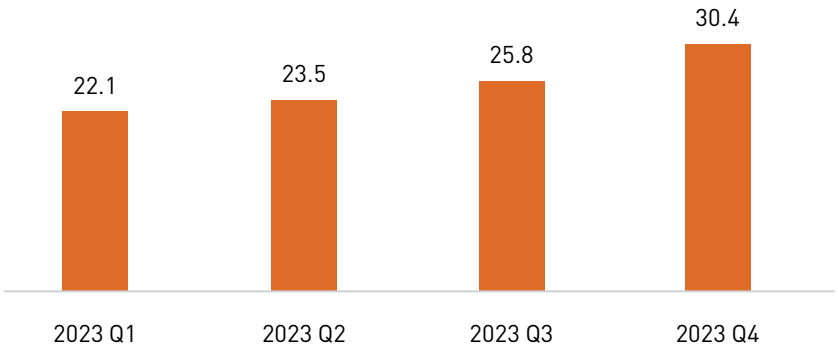
Appendices

Figure A1. Intersegment revenue of the Yandex business ecosystem



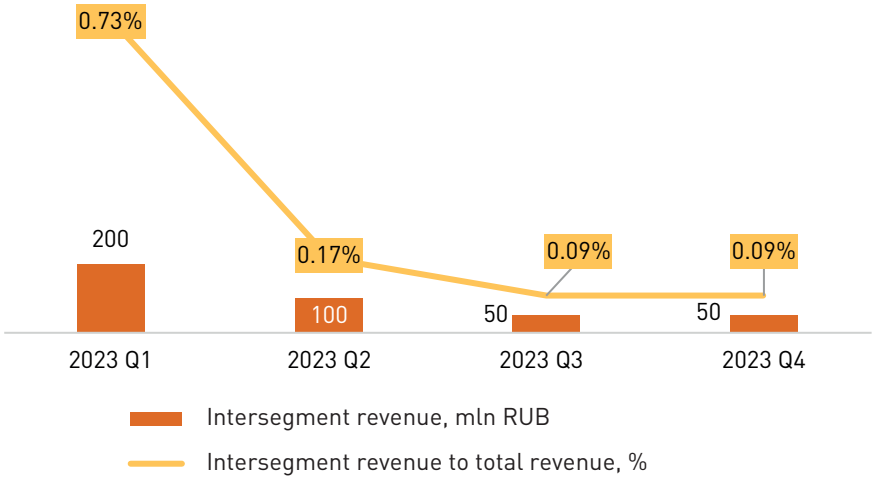
Source: IC PJSC Yandex.

Figure A2. The number of active users of the Yandex Plus service in 2023, mln MAU



Source: IC PJSC Yandex.

Figure A3. Intersegment revenue of the VK business ecosystem



Source: IC PJSC VK.

Figure A4. Total number of users in the business lines of the Yandex ecosystem, mln (non-unique) users

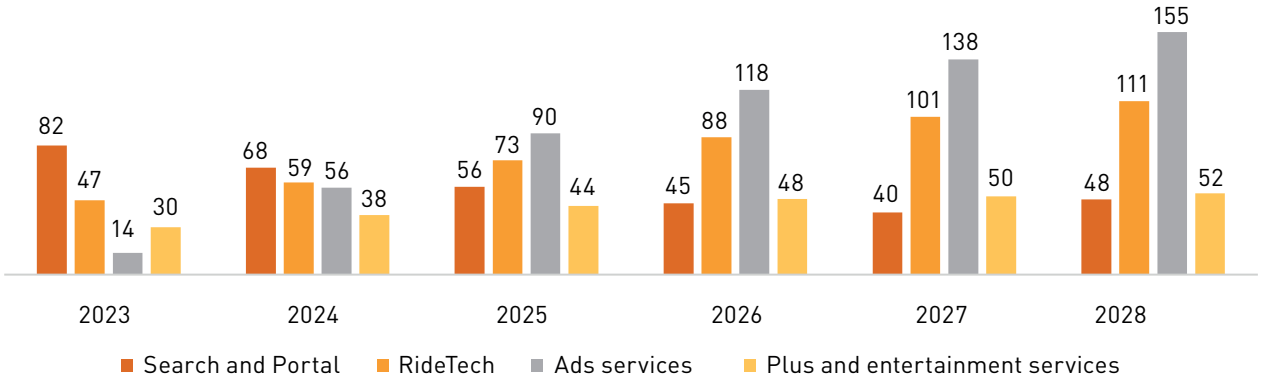
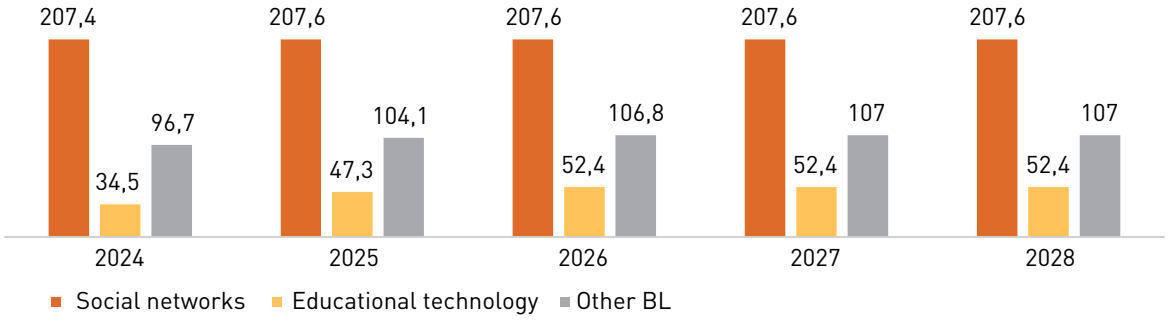


Figure A5. Total number of users in the business lines of the Yandex ecosystem, mln (non-unique) users



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