ORIGINAL PAPER

DOI: 10.26794/2304-022X-2022-12-3-6-23
UDC 334.021.1(045)
JEL L51

Ecosystem Approach to the Management of Economic Agents' Interaction in the Industry

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ABSTRACT

The article is devoted to the theoretical and methodological substantiation of the ecosystem theory application to manage the interaction of digital economy actors in the context of industry's development, including its high-tech sector. **The subject** of the study was the assessment of objective and subjective components of the process of forming a united digital space necessary to ensure interaction in the enterprise management in the new digital economy, and **the goal** was to solve the question of choosing a theoretical basis in favor of ecosystem theory. **The results** of the article carried out using the methods of description, scientific analysis and synthesis consist in identifying the completion of digital transformation when the ecosystem level is reached, substantiating the necessary conditions for this; systematizing the objective need to update classical approaches, proving the need to adapt life cycle models for ecosystems taking into account the uncertainty of technological development and proposing an original cyclic model that takes into account transformation of enterprises and the formats of their interactions in the digital economy. As **conclusions**, the basic provisions on the elements of a united digital space (platform, network effects and market expectations) and a dynamic model of its formation based on an ecosystem approach are presented. The authors have formed **recommendations** for the creation of a management system for the interaction of economic agents, taking into account the rules of communication of ecosystem partners, competition between them and the possibilities of coordination. **The relevance** of the work done is determined by the proposal of a unified interpretation of the process of forming a united digital space as one of the most important consequences of the digital breakthrough of the economy.

Keywords: digital economy; ecosystem; business model; management; interaction; unified digital space; digital solution; industry; industrial production; life cycle

For citation: **Kovalchuk J.A., Stepnov I.M., Bikalenko M.S. Ecosystem approach to the management of economic agents' interaction in the industry. *Management sciences*. 2022;12(3):6-23. DOI: 10.26794/2304-022X-2022-12-3-6-23**

INTRODUCTION

The emergence of the digital world has led to a number of irreversible changes in the economy and society. The new technological cycle, with a significantly higher propagation rate than previous ones, continues to widen the gap between countries, which change existing economic, technological and social models of decision-making and behavior. The technology update caused by these factors is transforming relationships, according to researchers, both economic and social, and political [1, 2]. Digital economy in many ways became the integrator of changes. Russia, according to estimates[1] [3], despite a significant lag from the leaders, was in promising segment of the digital economy (*Fig. 1*), (*Table 1*).

Identified trends need to be more thoroughly developed and studied at all levels, ensuring balance in national development strategies and the organization of business–government interaction.

At present, two major megatrends have been established that reflect most of the digital changes in the modern economy [4]:

- shift from trade in goods to trade in activities arising in value chains, resulting in intermediate products rather than complete goods or services);
- growth of high–tech intangible assets and the transfer of values therein (from patents to service models), which significantly increases the importance of innovation, and to reduce the life cycle of technologies; provide the growth of emerging markets to realize both megatrends more efficiently than old industrial areas.

[1] Digital Intelligence Index. The Fletcher School. Tufts University. URL: https://digitalintelligence.fletcher.tufts.edu/trajectory (accessed on 01.05.2022).

The prospect of digital growth for Russia is also confirmed by the increasing costs of its implementation, which contributes to the accumulation of the potential for a new breakthrough (*Fig. 2*).

In many cases, digitalization is defined as a social process [5] reflecting the rate of change by new technologies. At the same time, market power in the digital environment shifts from manufacturers to end users, who are forced to expect increasingly complex digital services [6]. Relations (as a common generic concept of current processes) are realized in two processes: digitization (i.e. presentation of pre-existing and new data in digital format) and digital transformation, while the second, based on the first, forms new organizational and technical cooperation. It should be noted that the digitization itself is considered by individual researchers, for example [7], as "creative destruction" (by J. Schumpeter), justifying the processes of creation more accessible to consumers while reducing transaction costs.

The concept of a unified digital space (further — UnDS) gives the most real opportunity for Russia's economic growth, due to the digital breakthrough that has become a promising segment of digitalization (with these mega–trends and increasing the communication potential) [8–11], increasingly popular in both scientific research and practical solutions.

But the category, as were the related theoretical and methodological approaches, was not given a unified interpretation, which leads to the need for its substantiation within the framework of the macroeconomic understanding of new economic relations and the organization of industry markets.

It should be noted that the processes of digitization and digital transformation

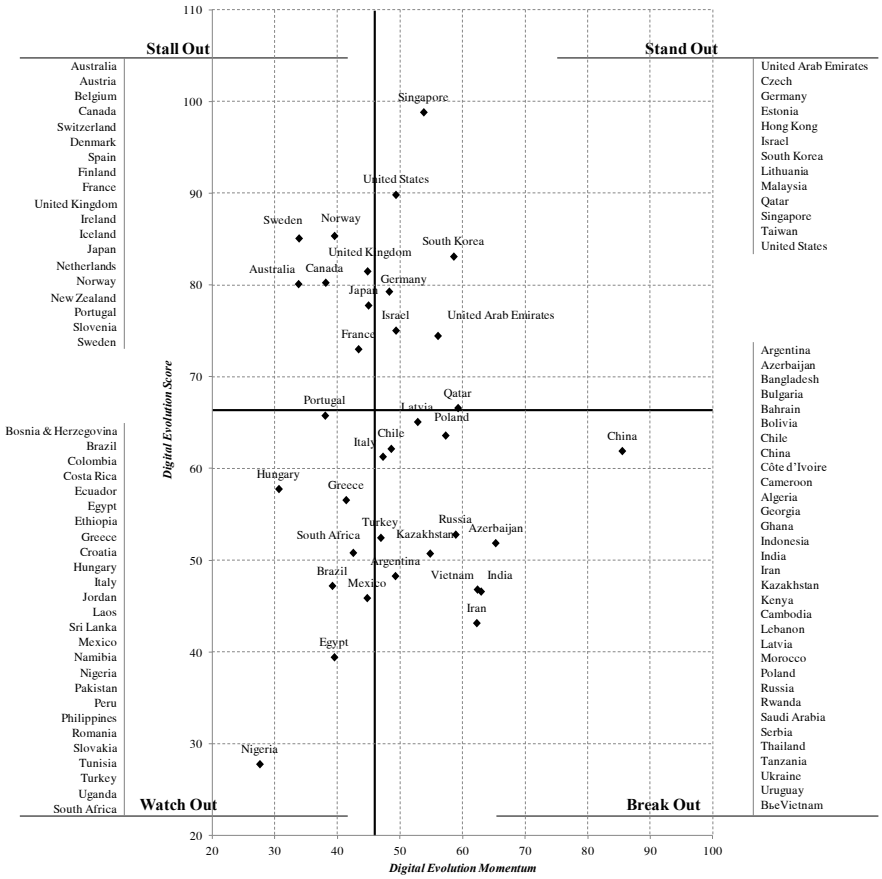

Fig. 1. **Positioning countries by speed and level of digital development, 2020**

Source: compiled by the authors based on Digital Intelligence Index. The Fletcher School. Tufts University. URL: https://digitalintelligence.fletcher.tufts.edu/trajectory (accessed on 01.05.2022), [3].

Table 1

Comparative characteristics of high-tech sectors of the economy of various countries, 2019

Country	Russia	Germany	Norway	US
The country's position on the digital development rating (according to Fig. 1)	Break Out	Stand Out	Stall Out	Stand Out
The share of value added of the medium and high–tech, % of GDP	30	62	43	47
Number of medium– and high-tech, units	40 274	39 437	2097	171 147
Employment in high–tech, million people	24.3	41.7	2.6	59.6
Value added per employee per year, dollars	20 456.8	58 743.9	71 776.9	162 291.9

Source: compiled by the authors on the basis: Problems of regulation and law enforcement practice hindering the development of high-tech companies in the Russian Federation. The Expert Center under the Commissioner and the office of the Public Ombudsman in the field of protection of the rights of high-tech leading companies Special Report, 2020. URL: http://doklad.ombudsmanbiz.ru/2020/6.pdf (accessed on 01.05.2022).

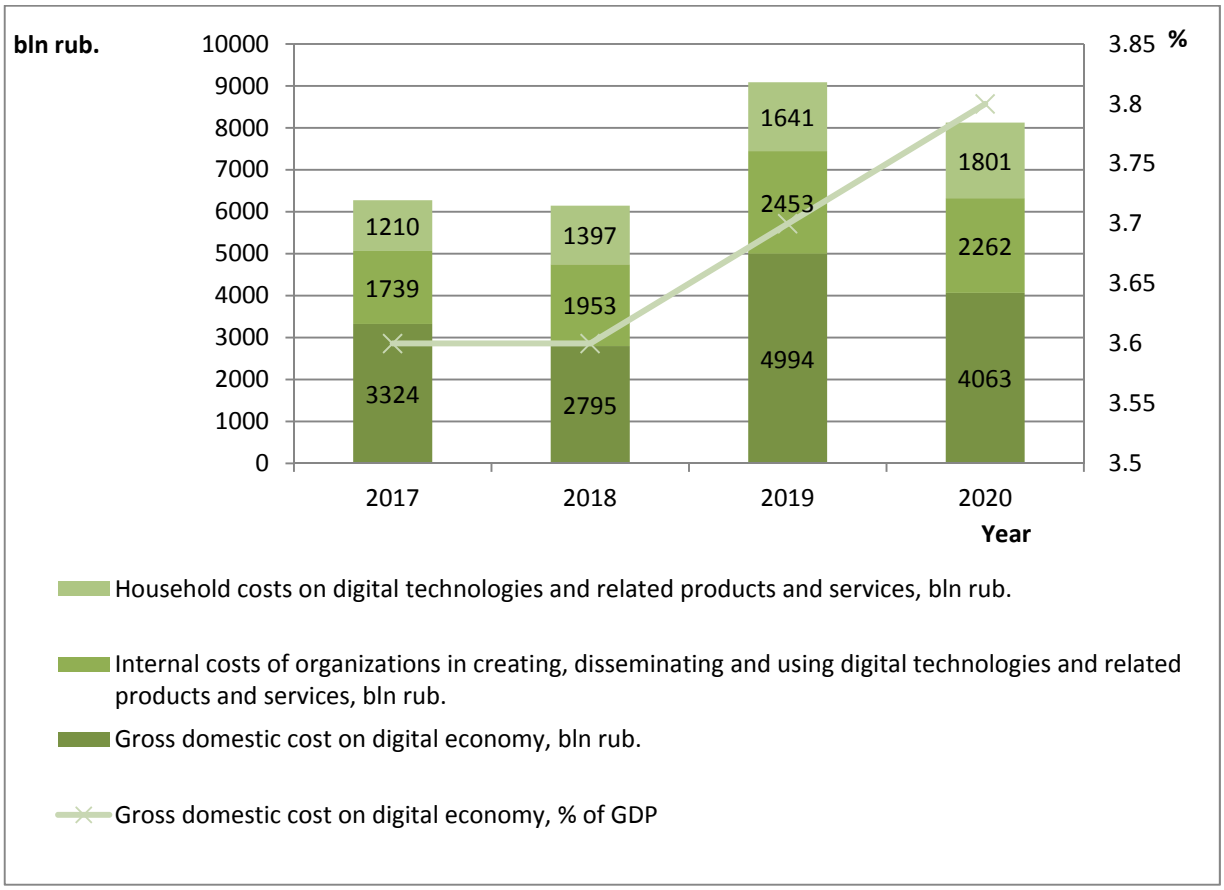

Fig. 2. **Increasing costs of digitalization in Russia**

Source: compiled by the authors on the basis: 2022. Digital Economy. A brief statistical collection. Gokhberg L.M., Kuzminov Ya.I., Parshin M.V. and others., eds. Moscow; HSE; 2022:12–13.

are instruments of transformation of the economy, and not system factors, and therefore it is impossible to form the theoretical basis of the UnDS concept. The research question is whether to consider it as: 1) new theory of ecosystems or 2) as the development theoretical views on the formation of value chains in the digital environment regardless of the level of subjectivity of such a space.

The first direction is now becoming the most accepted and developed: It is based on the organization of production, industry market theory, conformity market design, firm theory and strategic management theory, whose scientific experience has required revision based on digital relationships and the predominance of digital solutions. Such updates are usually systematized by researchers precisely within the framework of the emerging theory of ecosystems.

The author of the concept of ecosystems in business, J. Moore, published his first work in 1996, and since then the topic has been continuously explored to identify trends and provide practical recommendations [12]. Several researchers are connect the dominance of large companies (for example, *Walmart* and *Microsoft*), hat form a unified digital environment as a business ecosystem to the success of their new architectures, defining the latter as "free networks

of suppliers, distributors, outsourcing companies, manufacturers of related goods and services, technology suppliers and many other organizations that influence the creation and provision of own company offers" [13]. Other researchers define digital ecosystems as "interacting organizations that are related to digital connectivity and support modularity and are not controlled by hierarchical authority" [14]. In addition, the ecosystem means, "a set of interdependent subjects and factors coordinated in such a way that they ensure productive entrepreneurship in a particular territory" [15].

The following three — platform, network effects and market expectations — are the main elements for building a successful ecosystem [16]. In the formation of UnDS, we proceed from the need to provide parameters such as interdependence, consideration of factors, coordination, productive entrepreneurship and limited territory (national or subnational level) and compare its framework with the above-mentioned elements of ecosystem architecture strengthened by government regulation and support. All this in the framework of creating a theoretical landscape for managing the interaction of economic agents in industry in the modern digital economy.

METHODOLOGY OF RESEARCH

The author's idea of the composition of the concept of "unified digital space" is based on the clear identification of four major approaches to its definition:

1) limited notion "Internet" to a specialized digital environment, within which both interaction and its management is carried out, that only by technical parameters, without establishing rules for the formation and implementation of managerial and economic relations in such an environment; such an approach is inherent in understanding the "common" space rather than the "unified"; it is thus obvious that there may be several segments of such a space, both connected and independent, but this connectivity (independence) is determined not by organizational and managerial relations, but by the rules (and procedures) of access to such environment;

2) narrowing the digital space to an industry digital environment that ensures the unity of data within the framework of implemented relationships (unity of information base). This understanding allows for more trusting relationships within the new space, avoiding duplication of data and ensuring its validity; but in such an environment no interaction or control algorithms are yet to be implemented except for regulated procedures, competitions or procedures that require standardization;

3) use of the concept of "ecosystem" in the notations of J. Moore and his followers, including both universal ecosystems and more specialized, for example, entrepreneurship, knowledge, human capital, open innovation, etc.

4) value chain approaches for specific projects at different levels and scales.

It is important to note that from the first approach to the fourth there is a *reduction* in the level of complexity in terms of the scale and technical design of the system itself, and the degree of algorithmization of managerial decisions, on the contrary, is *increasing*.

Certainly, the broadest definition of UnDS is contained in the first vision, which implies two options for accessing such an environment: either fully open or limited to registration (openly

conditional). Subsequent options, however, are characterized by the introduction of additional restrictions, both functional and managerial, which also allow the concepts of protectionism and economic sovereignty to be realized (including at the national level), ensuring the competitiveness of countries in the world space with selected domestic economic policies (while more open spaces are characterized by global trends).

The basic premise for this research is the initial focus of digital transformation on three objectives: cost reduction, networking and cost targeting [17], and, therefore, its completion at the ecosystem level is fair (i.e. after digitally transform operations and organizational processes, as noted in a research by specialists from the International Business School at Massachusetts Institute of Technology [USA]) [18]. This, in turn, suggests that for the industry, the digital transformation will be considered complete after the creation of a unified digital space. This conclusion correlates with the logic of the four levels of ecosystem definition we have identified above.

The authors take the following position regarding the identification of an objective need to update the classical approaches (including characteristics of digital relations, within UnDS):

- change of the classical concept of "external environment", which under conditions of digital economy undergoes significant transformations;
- rejection of resource approaches to the formation of strategies, including the replacement of the basic postulate that "strategy is the result of assessing the compliance of the external environment and the ability of the company", statement that "strategy in the digital environment as a business model is a reflection of the potential of customer-centric cooperation";
- transformation of the content of the concept of "technology", which becomes double in content, i.e. includes transforming and controlling parts, in doing so, the latter part becomes exclusively digital, including access to such technology.

In addition, the transition to the concept of "everything as a service"[2] also has its imprint on the mentioned problems, which defines many new properties of digital economic relations, but does not create fundamentally different solutions (in terms of final consumption), only greatly reducing transaction costs.

The initial selection of the ecosystem theory as the theoretical basis for UnDS requires the identification and assessment of the main problems faced by the new concept.

Justifying its potential, we note that the first and main problem and the related discussion are based on the fact that the ecosystem (as the business model considered the main strategic decision in ecosystems) is not a mainstream as such, but a set of contradictions (of opposites) — "fragile balance" [19] between integration and disintegration. This allows speaking about the possibility of dialectical vision of digital space: two key vectors — "centripetal forces and centrifugal forces" [19] are diametrically opposed, and their compromise largely determines the forms of the existence of digital solutions.

The second problem, which is reflected in the work of many researchers, is a passion for the functional approach (which is particularly relevant in the context of the

[2] Tech Trends 2017: The kinetic enterprise. Deloitte University Press. URL: https://www.deloittedigital.com/us/en/blog-list/2017/the-kinetic-enterprise-announcing-deloittes-2017-tech-trends-report.html (accessed on 01.05.2022).

prevalence concepts of sharing economy, the economy of services, etc.), which objectively describes various processes and in the digital economy has an advantage over the product and process. Too much protrusion of certain functions leads to negative outcomes rather than an informed understanding of many digital solutions.

The third problem — is the constant dynamics of the external environment, in which the idea of including resources in the business model begins to prevail, i.e. there is a radical need to move away from resource strategies: effective use of resources becomes a pressing issue instead of attracting resources.

The authors also identify the issue of the preferential choice of the management system as discussion — for many researchers the ecosystem (and potentially UnDS) turns out to be independent of the dichotomy "market — plan" quite unexpectedly and can be realized in the framework of both platform capitalism, and regulation of the economy with significant state participation. At the same time, it is obvious that it is impossible to theoretical justification the effectiveness (advantage) of ecosystems in various management systems — it will be proved in a practical way.

RESULTS OF THE STUDY

Ecosystems in the cyclical development model

By now, there are quite a number of ecosystem types and the typology itself is not sufficiently developed. Most commonly identified: business ecosystem, entrepreneurial ecosystem, innovative ecosystem, knowledge ecosystem [20]. It is also important for researchers to divide them into levels — global, national and subnational [21]; it does not consider the production and creative ecosystems but global and regional also. At the same time, the attention remains and network potential with a qualitative highlighting of such properties as "good" or "bad" functioning network [22]. Most scientists consider quality assessments of ecosystems development to be dominant, so attempts to conceptualize their types more specifically are only just beginning [23]. Obviously, for the purposes of UnDS design, the classification associated with the level (national or subnational) or with the sectoral division (e.g., industrial, creative or scientific) is most applicable.

However, it should be concluded that ecosystem typologies will be difficult to understand without understanding their life cycle, so one model of cyclicality should consider, inter alia, the life cycle itself [24] or the survival indicator (with funding and influence of the time factor) [25].

In many ways, the need to define a life cycle is linked to some of the technological uncertainties inherent in modern digital solutions; of course, in order to reduce it in decision-making it is not necessary to evaluate the development of technology itself (which is essential and important for R&D). Their implementation in society and economy (which is of great importance for UnDS as an ecosystem), which is most fully expressed by such categories as "strategies" and "business — models". Therefore, these are the concepts used further as the basic.

Cyclical models that take into account the feasibility of technologies (in terms of consumer value) and the diffusion of innovations (i.e. their development and commercialization potential for the producer) are preferable to assess the life cycle. The practical value of diffusion and competition models is not high enough given the insufficiently of experience with digital technologies and the lack of a direct

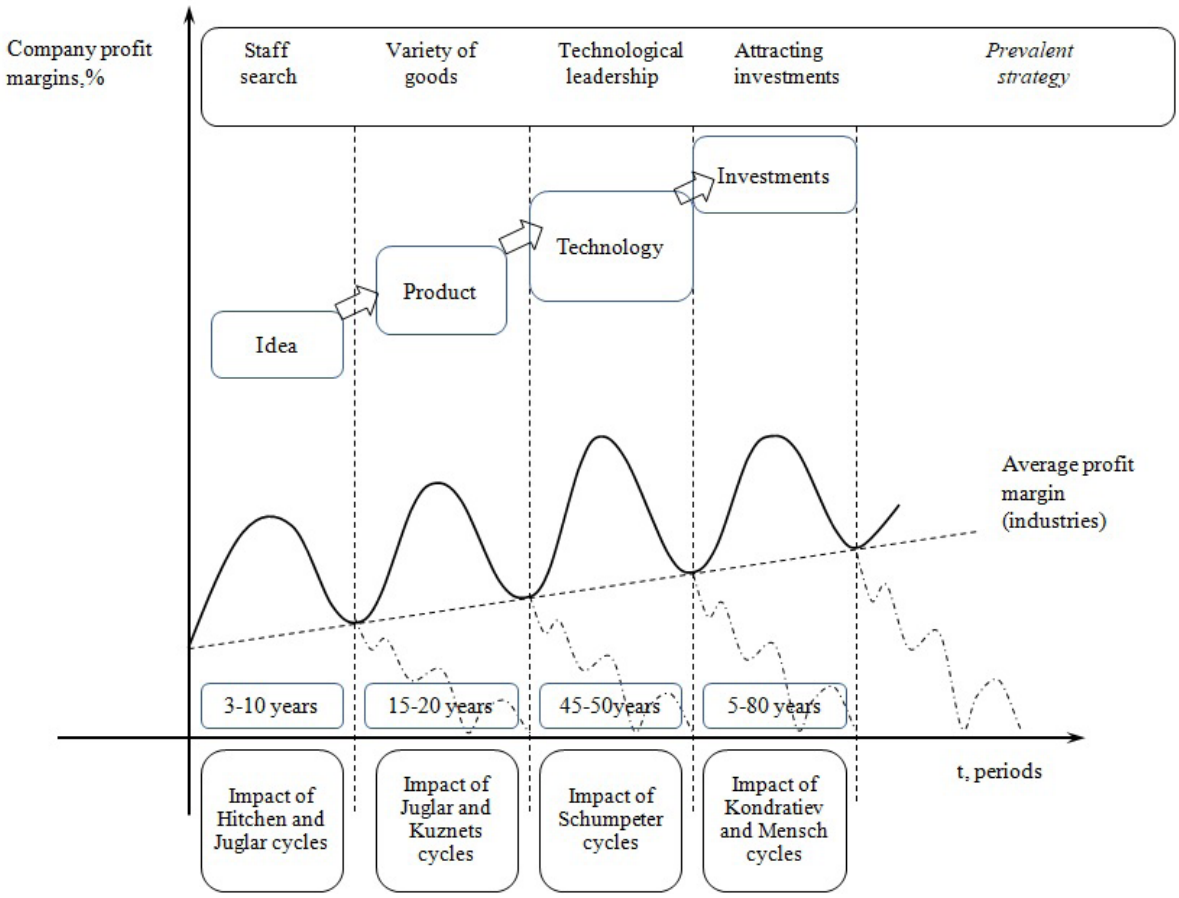

Fig. 3. **The basic model of the company's cyclical development**

Source: [29].

link to the business model; it is important to note that at the same time as developing the most promising business concepts, the right combination of technological priorities cannot be determined for sure [26].

The potential of technologies should be the basis of the proposed model — it can be estimated with the following 8 metrics [27]: technical system objectives and business objectives; product life cycle phases; its preferred behavior in these phases; product life cycle; technological properties; links between product properties and desired consumption choices; potential effects of investments and assessment of financial performance. This list shows that, for example, for a service whose market exit is long, a limited number of metrics can be used, with the popular cost measurement completely dependent on expert assumptions, when evaluating technical parameters [28]. However, the increasing complexity of the cyclical model should be selected as the vector to demonstrate the change in business — decisions in the medium and long term. Such periodization can be derived from the previously developed original author's base model presented on *Fig. 3*.

In order to justify the use of a particular version, it is necessary to clarify the constants that ensure continuity of industrial and digital periods, and for

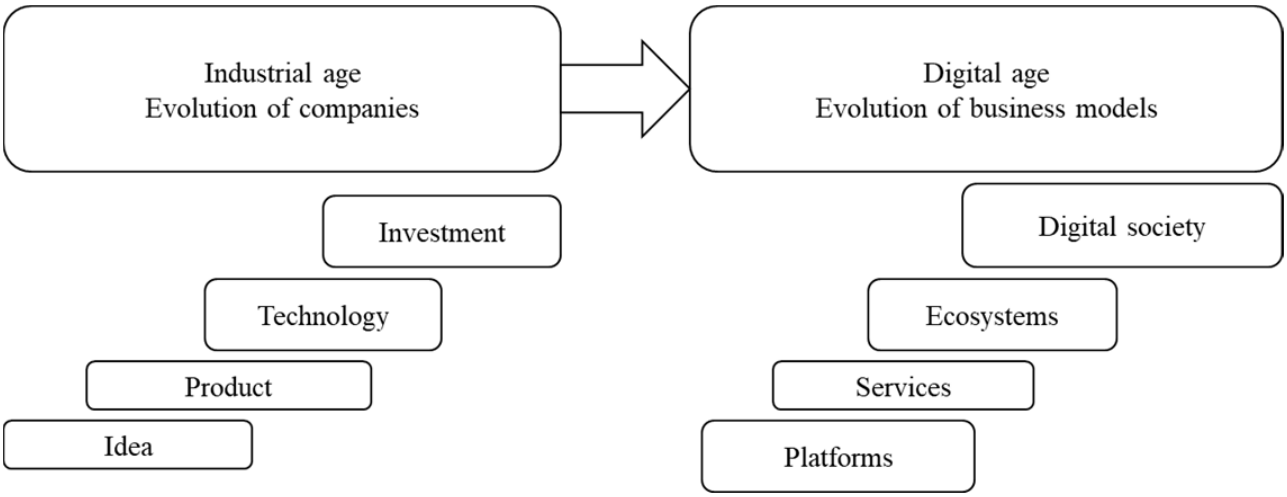

Fig. 4. **Transformation of the prevailing strategy**

Source: [31].

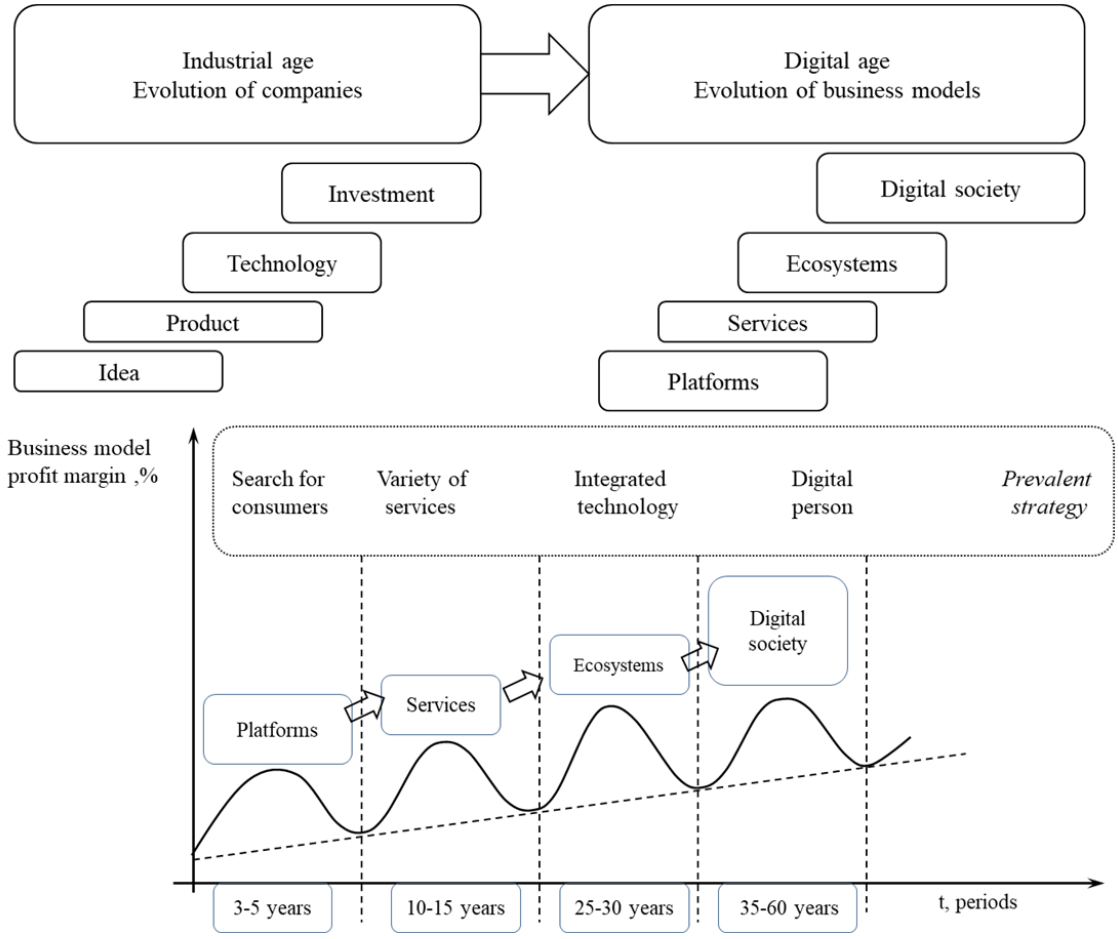

Fig. 5. **Cyclical model of the "digital economy" stage**

Source: [31].

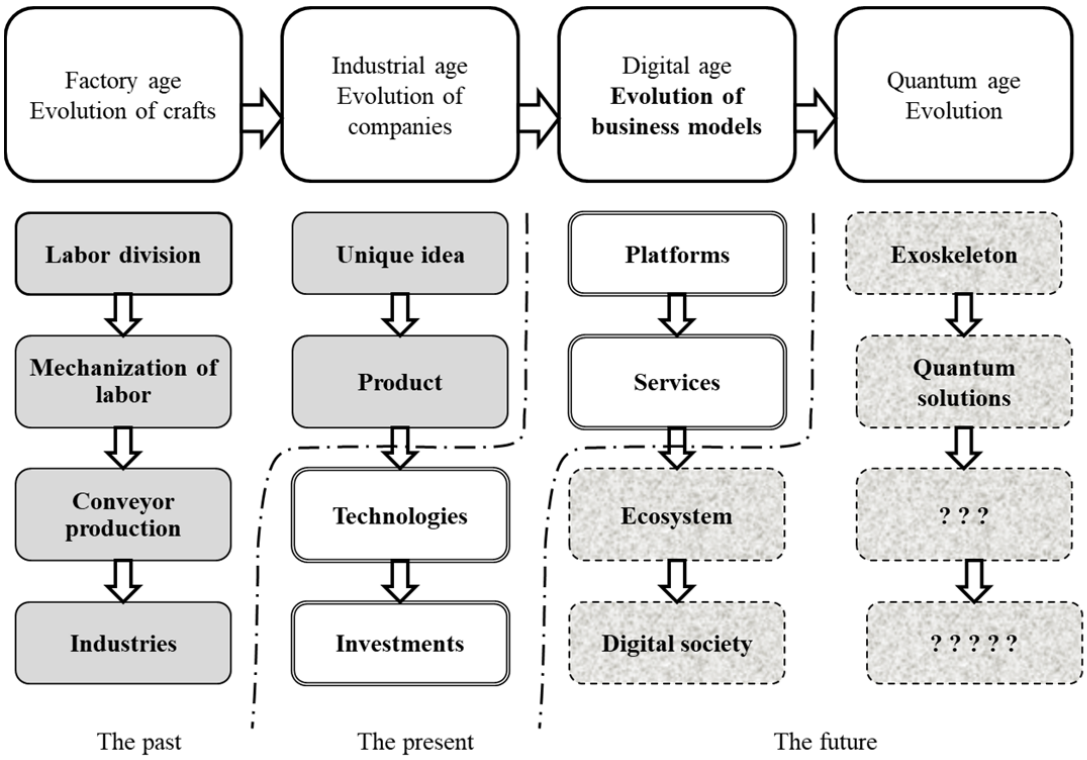

Fig. 6. **Matrix representation of the cyclicity model**

Source: supplemented by the authors based on [31].

adaptation — the differences between industrialization and digitalization:

• technologies have the property of growing in complexity in a number of stages of their development, before completely changing the solutions used;

• development of economic relations is cyclical, characterized not by one but by several manifestations of different periodicity.

The unity of understanding and presentation of modern technology is ensured by the single separation of two components. The first is material (instrumental or transformative) and the second — consists of management decisions, i.e. the flow of technology data transferred to management [30]. The delivery process (logistics) in this case should become open and external — then there will be a unity of presentation of both the technology and the business models generated by it, which will reduce the uncertainty in the future.

As a result, models were obtained: transformations of the predominant strategy (*Fig. 4*), cyclical, adapted to the digital economy (*Fig. 5*) and their totality, taking into account historical data (*Fig. 6*).

First, note that on *Fig. 5* it is not a company but a business model that is being considered, as different organizational forms begin to lose their purpose in the digital economy: many of their internal costs are becoming comparable to those of others, and the role of formal integration is therefore somewhat reduced. In other words, the new stage of business development, namely — digital, is not connected with organizational forms of entrepreneurship and their strategies (including efforts to reduce the cost of support), and it's business models that, with their physical

structure, are getting closer and closer to the digital reality of the future; replacement of their generalized type has and will continue to do so in a sequential (cyclical) manner, supported by various technologies (as has already happened in the industrial economy).

Accordingly, the "platform" (*Fig. 3*) reflects the stage of a huge number of different startups, the so-called "idea", which was realized, practically without affecting the production, leaving it with the prospect of digitization. During this period, it was the technologies–integrators, implemented primarily through communications. Such platforms, while rarely producing goods, had a significant impact on income distribution in the value chain.

It is important to note that it is within the framework of value creation that common application technologies have achieved "easy" digital victories, reducing transaction costs for a number of companies, thanks to which they have gained leadership. However, should be considered, such results will become less frequent and less profitable in the development and dissemination of a holistic digital environment. Estimate of the duration of the second stage of the evolution of the digital economy — 10–15 years, and therefore it will be estimated to end in 2025–2030. Note that the features of this period should be the active replacement of the product by the service and the development of the sharing economy. Accordingly, the key technologies will be those that can provide.

The third stage will be entirely devoted to the creation of digital ecosystems — it is there that our idea of technology as a multi–component model will be demanded. Today's leaders are undoubtedly already forming the first ecosystem approaches, which will receive full development only after the implementation of the stage "service". It should also be noted that the maximum possible digitalization by this time will be completed, the digital advantages will be converted into a digital necessity. The fourth stage can be considered only in terms of its duration and the new society now, based on digital relations, whose contours can only be traced in philosophical notions. Taking into account the presented cyclical model (*Fig. 5*), note that the creation of value chains remains the content of the first stage ("Platforms"), which does not mean the rejection of such decisions. However, taking the established trends as a basis, it is necessary to focus the business on the formation of the transition to services in the maximum number of segments.

This model, applied to UnDS, allows you to draw the following conclusions:

- the final structure of UnDS is not defined, as the main period of creation of such solutions is expected in the range 2025–2040;
- in connection with the beginning of the creation of similar UnDS, it is important to explore the role of leaders, adjust their future image;
- the development of UnDS as an ecosystem does not mean the abandonment of platform solutions and networks (including value chains), but rather the transfer of UnDS from targets to mandatory tools;
- the formation of UnDS it is required to focus on its main elements within a unified structure to ensure sustainability in future periods: otherwise, the lack of solutions will not allow in the future to form an independent UnDS and will have to turn to import institutions again (as it did in the 1990s).

Table 2

Changing the paradigm of society (2010s vs. 2020s)

The paradigm of the 2010s.	The paradigm of the 2020s.
Globalization	Protectionism
Monetarism	Keynesianism
Financial losses	Threat to life
People	Robots
Deflation	Inflation
Reduction of borrowed funds in banks	Reduction of borrowed funds of companies
Low taxes	High taxes
Minerals	Clean energy
Economic recovery after the crisis	Anti-crisis support programs
Shareholders	Stakeholders
Profit Maximization	Moral Capitalism
Growth	Value

Source: adapted and supplemented by the authors based on: Bank of America Merrill Lynch 2020 Market Outlook: Profits Rise, Economy Slows, Globalization Peaks, and Business-as-Usual Investing Comes to an End. 2019, 03 Desember. URL: https://newsroom.bankofamerica.com/press-releases/global-markets/bank-america-merrill-lynch-2020-market-outlook-profits-rise-economy (accessed on 01.05.2022).

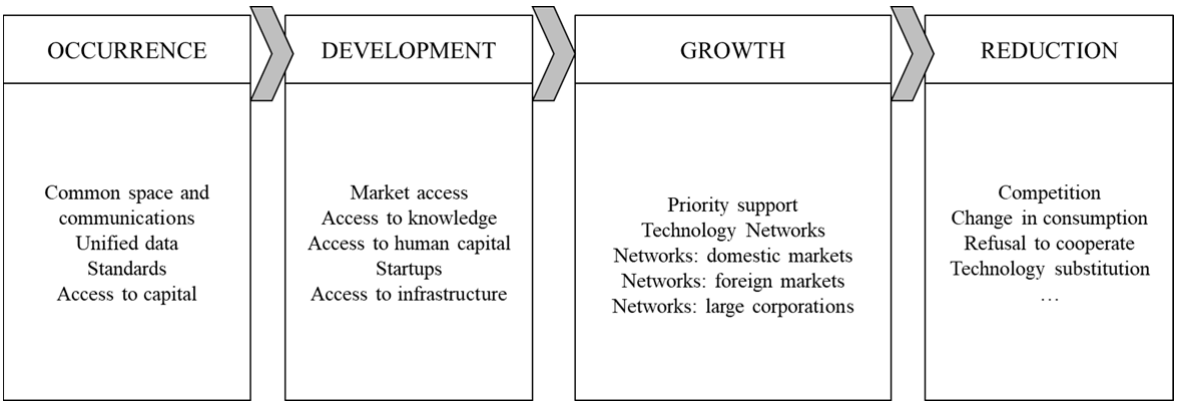

Fig. 7. **Stages of formation of a single digital space**

Source: developed by the authors.

Ecosystem structure and the new digital environment

The structure of the ecosystem is understood by some authors as a set of presented elements (supporting entrepreneurial culture, access to finance, access to human capital, innovative capacity, and formal business support organizations [32]), a set of which is considered by many researchers to be an essential and determining factor for its effectiveness [22].

However, the list above does not include the important component of institutional infrastructure which is understood as the combination of "cognitive, normative and regulatory elements and activities that provide stability and meaning to social behavior" [33].

In our opinion, in general, the components of the UnDS ecosystem base can be divided into several groups: state economic policy; leadership; financing; human capital; research (in some cases — research results defined as knowledge); physical infrastructure (most logistics and rental); markets; entrepreneurial culture; communications.

Each of them, when implemented, can be expanded in more detail depending on the purpose of the created spaces, but is required to have ecosystem element properties: avoid duality and duplication, be scalable, interact with digital solutions, and operate in a digital environment.

In this regard, it is also important to approach the formation of this new environment as the basis of "activity" UnDS. The external environment, whose importance dates back to the 1950s, remained the basis for the development of strategies and a key part in most of the related processes prior to digitalization (and in a number of sectoral segments still remains). The most important logical design for more than half a century is the prerequisite to assess the relevance of available resources to the potential of the external environment by considering the organization as a system. Various aspects, including institutional, have since supplemented this theory. As a result, the concept of the target environment was proposed, including suppliers, customers and competitors, which can be defined as "adaptive" [34]. However, a paradigm shift is taking place even from the 2010s (*Table 2*).

The transformation of the external environment (when designing industrial interactions under digital transformation) should be understood as the integration into UnDS and itself, and the resources available, which will facilitate their use for participants; therefore, when establishing UnDS, it is necessary to consider the possibilities of conformity market design. The choice of such an approach as the base instead of the "adaptable" is the main principle difference of ecosystems, for ensuring the requirements of the correspondence between the internal and the external environment [35, 36]. It is important to note, however, that the creation of conformity markets does not mean a market economy retreat — on the contrary, it increases its efficiency.

In addition, it is possible to distinguish a few less radical but essential in the design of interactions within ecosystems and UnDS changes, namely:

- preconditions for designing — business model performance analysis instead of environmental compliance analysis;
- accounting and assess the availability of new types of reality — augmented, virtual and hybrid — to different processes instead of resource availability;
- analysis of ecosystem borders (beyond traditional industries) instead of the previously key sector analysis;

• analysis of value chain participants as basic elements instead of analysis of micro– and macro–level and dynamics of indicators of industrial development;

• using decentralized financial services for calculate instead classic bank transactions;

• attracting finance through digital approaches instead of classical debt financing;

• using internal ecosystem performance criteria rather than traditional environmental utility assessments.

CONCLUSION

There is a definite dynamic model of UnDS formation based on the ecosystem approach, which is consistent with the previous cyclical model of the last, 4th stage of development (*Fig. 7*). Each one on *Fig. 7* is presents a generalized, because in the design of UnDS, the choice of initiative advantages that develop and ensure the growth of factors, should be carried out individually with reference to a specific task.

Given the sustainability of the largely equitable argument that technology transforms economic linkages, coordination and competition play an equally important role in industrial transformation. In this case, the main vector should be directed towards their synthesis, or, in other words, cooperation. There is no doubt that the classic model whereby a company with access to scarce resources gains a competitive advantage remains fair; however, another thesis is also logical: if opposing parties agree to cooperate, the economic result becomes more significant. As a result, while other processes remain competitive, increased competition leads to increased cooperation rather than the reverse, which is what high– and medium–tech industries linked to the same suppliers are seeking [37, 38].

Therefore, as recommendations for creating a structure of industrial interactions under UnDS within the framework of the ecosystem approach is necessary:

establish clear rules for communication between ecosystem partners, setting them at the level of model development;

Justify the use of other control techniques in ecosystems, and thus compromise decentralization and centralization through the necessary variety of platforms, taking into account that traditionally value chains have been created as linear, final consumption chains and that vertically integrated organizations have been created to address emerging issues (which, in turn, require typology and appropriate measurement);

• to decide on vertical or horizontal integration, based on the conditions of control of profit in the value chain created;

• to develop a system of criteria for choosing between coordination and cooperation in terms of technological independence from competitors, which is generally provided by the alternative of not engaging with competitors. With public participation, such an alternative should be controlled at the highest level, allowing only value chains with technological sovereignty;

• the choice of cooperation should be evidenced by the specific market situation and therefore be short– and medium–term rather than long–term obligations;

• to assess the functioning of ecosystems to manage them. Since there is no consensus on the methods to be used, different approaches [39] may be used to group the way ecosystems are measured on the basis of multiple elements: worldwide

governance indicators (formal institutions); entrepreneurship index (entrepreneurship culture); networks; physical infrastructure; finance; leadership; human capital quality; market demand; services; exit opportunities provide the basis for the formation of basic parameters of ecosystem design to ensure modern digital interactions in industry for the benefit of economic and social development.

ACKNOWLEDGMENTS

The article was prepared based on the results of research carried out at the expense of budgetary funds under the state task of the Financial University.

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Conflicts of Interest Statement: The authors have no conflicts of interest to declare.

The article was submitted on 23.05.2022; revised on 25.05.2022 and accepted for publication on 05.06.2022.
The authors read and approved the final version of the manuscript.