

УДК 334.75

DOI: 10.18524/2413-9998.2022.1(50).286036

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DESIGN AND DYNAMICS OF BUSINESS ECOSYSTEMS IN THE CONTEXT OF «INDUSTRY 4.0» CONCEPT

The development of technological cooperation alongside with customer value-creation value chain led to development of a business ecosystem concept. Originally developed for innovation industries this concept spread around many industries but has been keeping its focus on the innovation. The design of a business ecosystem is mostly defined by the structure of the technological cooperation and technological solutions which are core for customer value. Information and Communication Technologies served as a model for developing different designs of a business ecosystem, as high-tech industries pioneered the business ecosystem approach to build competitive advantages. But within other industries along with technological factors economic, financial, strategic factors also contribute to the shaping of the business ecosystem structure. The design of business ecosystems is crucial for their developments. As the concept “Industry 4.0” marks the fifth industrial revolution, many industries adopted strategies and approaches from innovative industries. Five distinctive designs of business ecosystems were distinguished, which differ on the core platform types, levels of cooperation, paths of development and distribution of competences.

Keywords: business ecosystem, innovation strategy, technological platforms, Industry 4.0.

Problem statement. The growth of business ecosystems not only affects the structure of industrial and commercial relations, but also fundamentally changes the content of organizational strategies, development goals and performance criteria. Business models are undergoing fundamental changes. key success factors, key competencies, consumer value creation chains [1]. Today, the dynamics of the development of business ecosystems continues to accelerate under the influence of both global factors, such as the economic consequences of the COVID 19 pandemic, local factors of the transformation of industrial and consumer markets, and technological factors such as the technological concept «Industry 4.0». The sectoral structure of the modern economy, which took shape at the end of the 1930s, constantly evolved, forming the standards of industrial policy and business

strategy. However, the increasingly widespread use of information technologies and a deep rethinking of the concept of efficiency, replacing cost and cost indicators with consumer value indicators, are blurring traditional industry boundaries. The concept of business ecosystems serves as a theoretical and methodological basis for the study of those dynamic processes that occur in the field of inter-organizational relations and industry development strategies.

Literature review. From the first mention of the business ecosystem in the Moore's May/June 1993 Harvard Business Review article, titled «Predators and Prey: A New Ecology of Competition» the topic gained its popularity as the research area. Many researches were devoted to technological issues, but some addressed strategic issues, authors like S. J. Makinen and O. Dedehayir closely examined the strategic considerations for business ecosystem developments. Other researchers, like G. Benitez, N. Ayala, A. Frank analyzed the value creation issues, which represented more customer oriented compared to technology-based approach for studying business ecosystems. As the concept of «Industry 4.0» was widely adopted by industry strategists researchers reveal its influence of the whole framework of industry relations. Particularly, M. Brettel, N. Friederichsen, M. Keller and M. Rosenberg studied how different technologies affected the process of industry ecosystem development. Some very specific structures of business ecosystem were presented in numerous papers, like by G. Vlăduț, who adopted business ecosystem approach for commercialization of research results, Jon Nordmark, who defined the business ecosystem within Amazon. The recent trends of business ecosystem research and applications about design-led approach to its development were consolidated by McKinsey authors – N. H. Joshi, H. Khan, and I. Rab.

Results and discussions. The ecosystem is seen as a multi-stakeholder community but also as an analytical framework or a field from which emerge opportunities but also constraints (rules of the game). On the first point, the definition does not provide elements of additional understanding. Indeed, the interest of the business ecosystem as an analytical framework lies in a better consideration of the logic of cooperation, thus allowing to better understand the dynamics of collective innovation in an environment overall. The notion of dynamic capacities illustrates on the one hand, the need for companies to quickly renew their skills to cope with changes in

their environment and other hand, the ability of management to integrate, build and reconfigure internal and external skills to respond to these same developments. The business ecosystem makes it possible to better explain this process of integration-construction-reconfiguration of internal and external skills, process that Moore had described by mobilizing the notion of skills ecosystems i.e. the co-evolution of the capacities of business ecosystem members with those of the leader. In this approach, the business ecosystem becomes the framework that underpins two key processes associated with dynamic capacities: the reconfiguration of resources and learning, processes partly supported by the platforms.

These same processes are at work in open innovation and platforms also occupy an important place. The ecosystem as an infrastructure that supports collective innovation and which sets the rules of the game. The control of the technological architecture conditions the performance to term of the pivot firm and therefore of the business ecosystem. In other words, the “rules of the game” are susceptible to manipulation by the keystone and therefore result in less than one process of co-evolution (or the interplay of actors) than the will of the keystone to set its own rules (on which will depend the contributions of other actors). The architectural choices are therefore particularly important and condition the degree of openness of the innovation process.

Ultimately, the business ecosystem approach provides a better understanding of the dynamics of collective innovation, cooperation strategies, the architectural choices of the leader - which condition the degree of openness of the innovation process - and the development of dynamic capacities.

The strategy of a keystone is above all a platform strategy. Thus, while Moore analyzes the life cycle of the ecosystem through the ability of leaders to manage at each stage of its developing the collaboration-competition tension it is possible to see the development of the ecosystem through the platform strategy adopted by the keystone. The ability to manage the collaboration-competition tension is therefore apprehended through the uses the pivot firm makes ICT and in particular the platform strategy implemented and the choices of underlying architecture.

Business ecosystems are networks characterized by a loose coupling between different partners and in which ICTs are not only a support for the organization of exchanges (collaboration) but also the «currency» and the

very object of innovation. Different inputs or technological bricks can thus be integrated into an original offer, thus making it possible to explore several technological trajectories and to extend the business ecosystems. These inputs can also concern intangible assets i.e. ideas, patents, trademarks or expertise. In a business ecosystem, companies should strive to take advantage of all available skills and resources; which supposes to have access to it. The terms of access to these resources are therefore particularly important. In fact, the nature of the platforms (open vs. closed) partly condition the value likely to be created in the business ecosystem. Companies that own such platforms (platform owners) therefore play a fundamental role, ensuring the coordination of actors and promoting the creation of collective value by pooling and sharing of resources. These platforms make it possible to standardize access to certain resources and thus contribute to increasing the capillarity of the network of partners. These latter – niche players – can then connect to these platforms to use these resources or develop new products and services based on them. These actors generally register in a logic of specialization which pushes them to innovate in order to maintain a sufficient level of differentiation and ensure their survival. However, if for these partners the platforms represent opportunities for the creation of value, they are also a threat to their own survival. In effect, if the services in question pose a threat to the keystone i.e. if they are likely to call into question its status, the keystone can decide to develop them itself and then integrate into its platform to maintain its leadership. The behaviors of “predation” are therefore not totally absent from business ecosystems. The keystone will however have to ensure that the defense of its interests does not turn into a heist, making it a dominator. This aspect also highlights the importance for the keystone to have certain integration skills or capacities to absorb the potential threats.

Ultimately, while Moore sees business ecosystems as a collaborative space dedicated to innovation, thus the platform represents the collaborative space dedicated to innovation and embodies (literally) the business ecosystem. It constitutes a set of resources availability of partners to innovate or a system that makes it possible to collect ideas to innovate. The greater the number of partners using these resources will be important and the more the value of the platform will be important (externalities network). In return, the contributions of the members of the ecosystem are likely to develop the platform, which opens up a number of strategic options for the

platform holder, particularly in terms of improvement of the breadth and/or depth of the platform.

From this point of view, ICTs and in particular platforms constitute a vector of development of the business ecosystem and make it possible to maintain the dynamic of innovation by opening up the innovation process to a larger number of contributors. ICTs and in particular platforms therefore make it possible to build collaborative processes that underpin collective innovation.

In many ecosystems, platforms are means that allow access resources and facilitate interactions between partners engaged in a collective innovation process that can be more or less open. These platforms are devices that are intended to facilitate interactions between two or more groups of interdependent actors, which constitute the sides of the same market.

There are a wide variety of platforms. We can distinguish between market leaders who allow members of distinct groups to exchange (Amazon, eBay), audience-builders who put in relation to an audience (traffic) with groups of actors likely to value this audience or this traffic (Google or Netflix), finally, the demand-coordinators who develop products or services intended to generate indirect network externalities (video game consoles by example). In the latter case, we are generally in the presence of shared input platforms i.e. hardware or software platforms, where at least one group of actors needs to obtain access to the platform to deliver value to members of another group.

This is the case in many business ecosystems: the pivot firm provides its partners with resources intended to develop a product or service that will be valued by another group. Demand-coordinators can also similar to cost-minimizers therefore – in more to facilitate access to the platform - which they make available to a group of actors with tools allowing them to increase their productivity. Thus, the software libraries are resources made available to developers to facilitate their work and encourage them to invest in the development of the platform. The more they will be to join the platform and the more the potential value is likely to be delivered for customers will be important, and with it that of a business ecosystem. There are proprietary platforms (proprietary platforms) where a single player controls the technology developed (Apple) and shared platforms where several companies collaborate and develop the technology while competing

to offer consumers different versions but compatible with the platform (for example Google Android).

Platforms therefore play a central role in the development of many business ecosystems. Beyond the functions of resource sharing and coordination of actors involved in the collective innovation process, the platforms have another effect on the development of business ecosystems: they contribute to increasing the scope of the business ecosystems i.e the market areas covered by them. For better to understand this phenomenon, we must return to platform strategies. The firms owning platforms have two main strategic levers development: this is the case with depth and breadth. Improving the depth of a platform means creating new features i.e. services or products for market faces or already conquered communities. This movement is similar to a strategy quite classic saturation of the needs of existing customers. By intensifying and by capturing all the existing direct externalities, the platform succeeds to guard against intrusion from another platform and therefore from an ecosystem competitor. Increasing the scope of a platform means looking for new sources of values and create new indirect externalities by adding new faces or the recruitment of new communities of economic agents on the platform.

The formation of multi-layered inter-organizational pattern of information and production connections at the level of an industry, as well as at the level of national and world economies, which combine competitive relations with various forms of cooperation and go beyond traditional industrial cooperation, and most importantly are aimed not at reducing costs but at creating a consumer cost, led to the reformatting of industry structures and the emergence of not only new forms of production, but also new challenges for management. The best concept that describes such a structure is an industry or business ecosystem. This concept is based on the works of Moore, including an article in Harvard Business Review in 1993 [4]. In it, Moore emphasized that successful businesses are those that develop quickly and efficiently, but such developments require the involvement of all resources, both the business itself and stakeholders. Such engagement requires cooperation that crosses industry boundaries and focuses on creating competitive advantage through innovation. Inter-organizational network structures connections, which are built around joint investment in innovations that turn into the main factor of consumer value, were initially formed around the high-tech sector, primarily in the USA. Silicon Valley

can be considered the first ecosystem that was formed around enterprises that formed new innovative industries. The first smartphone from Apple Inc. is a prime example of a product that is really just a platform for a consumer to access numerous services from many businesses that build an ecosystem around such a platform.

However, the formation of the concept of «Industry 4.0» first expanded the technological possibilities for business development, and then required structural changes in the system of industrial and economic relations. Innovations required a management system, both for the enterprise and the industry [2]. Establishing multi-layered communications requires a significant revision of management practices, and often business models.

At the current stage of the development of inter-organizational structures, it can be noted that an ecosystem is a dynamic and extensive community of independent organizations that cooperate in their efforts to create consumer value, pursuing their own commercial goals and sometimes remaining competitors at the level of products and profits. Ecosystems allow combining the efforts of large and small enterprises, which thus get the opportunity to expand their opportunities to access various resources and markets. The lack of vertical coordination significantly accelerates the speed of cooperation, but requires a new level of mutual trust and willingness to take joint risks. An ecosystem develops through mutual adaptation rather than through directed coordination. A mature ecosystem is a source of competitive advantage, but it does not belong to any of its participants, which usually complicates the application of traditional business performance measurement tools.

With the development of information and telecommunication technologies, the concept of a business ecosystem has spread to other industries, which were traditionally dominated by vertically integrated corporations [3]. New means of creating consumer value are used by both industry leaders and emerging businesses. Even such conservative industries as banking are witnessing the development and implementation of strategies that involve building ecosystems. It doesn't matter how perfect the product is, what matters is whether it is part of an ecosystem that is a source of sustainable competitive advantage.

Among the main trends in the development of business ecosystems, which will affect the principles and tools of both strategic and operational management of modern enterprises, it is possible to note:

- further blurring of the traditional industry structure, gradual transformation of industry skills, penetration of consumer value as a criterion of efficiency to all deeper levels of operational activity;
- formation of internal and inter-industry alliances, which will look for new technological and management solutions that should provide answers to social challenges while maintaining prospects for increased profitability;
- resolution of contradictions between the regulatory policies of the state, which are designed to maintain the balance of public and business interests, and the needs of rapid development of the newest industries that are formed within the business ecosystems;
- the gradual transformation of supply chains, which are built on the principles of commercial obligations, into consumer value chains that require much closer cooperation, including in the field of research and innovation, a greater level of autonomy and trust in mutual efforts, an effective mechanism for sharing profits in the short term and long-term prospects;
- a change in the corporate structure of the business, which is caused by the growing importance of the network of cooperation and interaction relations in relation to the relations of control and ownership, revaluation of assets, their structure and content, as well as the role in the strategy of business development, and, as a result, the revision of merger and acquisition strategies;
- the formation of organizational platforms based on the principles of entrepreneurship, which encourage innovation at all stages of the production process, rapid organizational changes without disrupting the production structure, with an orientation towards the maximum transformation of consumer value into business profit;
- the emergence of new key competencies that underlie a competitive business strategy, which are more oriented not on the process, but on skills, not on established practices, but on innovative approaches, not on perfect solutions, but on adaptability and speed.

The business ecosystem development reveals the new forms of arrangements on a larger, macroeconomic scene. The concept of network economy emerges as the fast-growing phenomena, which integrated products with digital solutions. McKinsey estimates that the revenue of the network economy will reach 70 bn USD in 2030.

As the ecosystems becomes more and more complex, the issue about their design become more relevant. Functioning mostly as a self-regulated system a business ecosystem evolve into a complex multilayer pattern of economic, manufacturing, financial, informational networks. By targeting the consumer value an ecosystem shall adopt a strategic approach, thus some organizational design is needed. The main factors, which define the design of a business ecosystem are:

- Flow of capital, knowledge, ideas and talents
- Co-creation of customer value
- Exploiting economies of scale and scope
- Cooperation via coordination, adaption and participation
- Orchestrating strategies and business models
- Gain sharing and profit distribution schemes

The interaction among this factors forms the intensity, scope and tools of the cooperation among the actors of the certain ecosystem. The observance of the business practice allows to distinguish five major design modes of a business ecosystem. These are:

- solar system – an ecosystem built around product/service provider, technological platform or brand identity;
- coral reef – an ecosystem built upon supportive environment has been created for certain types of business activities;
- football team – an ecosystem built upon an agreement of distribution of customer service responsibilities or of operational processes;
- puzzle box – an ecosystem built upon a bilateral relations interconnected into a network of value creation or cost-saving;
- mycelium (colony) – an ecosystem built on spreading competitive advantages on different (related or unrelated) markets.

Solar system is a design mode, there a technological, manufacturing, financial or commercial leader expands its activity through collateral services of smaller companies. So marketing and sales, customer communication and service, as well as product itself may be tailored to the specific marketing segment, creating a variety of choices for a customer within a single provider. This type of an ecosystem is forming around a technological platform of tech giants, like Google or Apple, but also around marketplace platforms like Amazon, or unique brand positioning, like Disneyland.

Coral reef business ecosystem forms under some preferential conditions,

most often provided by a state or region to boost some type of activities. But in some cases these conditions are due the specific resource allocation, market segmenting or other factors. Most of business and technology parks, tourist areas, transport hubs are functioning under this scheme. So someone or something creates some favorable conditions, which make business flourish just like corals on artificial reefs. Many innovative industries adopt that type of ecosystem, especially in a form of business split-up of University research activities.

A football team is a mode of ecosystem there a role distribution is well presented. Companies interact to create a single product, which has much higher customer value than their separate products. The aviation trip as an example that a customer gets services in one ticket. Many innovative industries adopt that type of ecosystem, especially in a form of business split-up of University research activities. Some innovative projects within large companies also follow this type of the design. For example, in the automotive industries, research activity on self-driving car, alternative fuel or car-sharing sales model are run as a team of interconnected specialized ventures.

Then companies engage in bilateral relations, which spread along technological cooperation, distributional channels, financial flows to adapt to market or cost-cutting possibilities, an ecosystem of puzzle box type is gradually forming. The most common case is development of more close relations on the basis of out-sourcing. Regional proximity also plays a role as companies develop links to exploit regional resources, economic and technological interconnections, supply chains or customer behavior intersections.

And finally the mycelium or colony type of ecosystem brings companies together around more general project than just a product. It combines efforts of many companies to develop a new business model, a new technology to share, a new market to exploit. As the start-up industry flourish, this type of business ecosystem become more common. Even large companies level up to small ventures in common projects as peer partners. As the project develops it asserts multiple roots in different markets and different industries. The other case for such a mycelium type ecosystem is social entrepreneurship. The good practice developed in one place quickly seeds out in other places.

Conclusion. Industry 4.0 concept makes its contribution to the

efficiency of a business ecosystem whatever design it takes. In Solar systems the core techniques of Industry 4.0 recreates production, supply and value chains with relevant informational flow. Coral Reef ecosystems may use this concept as one of the core infrastructural factor to attract and grow new businesses. In case of football team Industry 4.0 platforms serve as integration tool for different players. The puzzle box ecosystem due to Industry 4.0 may transformed into more organized forms and catch most of the market or cost-cutting possibilities. A mycelium type ecosystem perfectly fits the main idea of Industry 4.0 as integrating resources, capabilities, technologies, knowledge to create a value of totally new dimension.

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Стаття надійшла 9.01.2022 року

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СТРУКТУРА ТА ДИНАМІКА БІЗНЕСОВИХ ЕКОСИСТЕМ В КОНТЕКСТІ КОНЦЕПЦІЇ «ІНДУСТРІЯ 4.0».

Розвиток технологічного співробітництва разом із ланцюгом створення цінності для споживачів призвів до розробки концепції бізнесових екосистеми. Спочатку розроблена для інноваційних галузей, ця концепція поширилася в багатьох галузях, але зберігає свою увагу на інноваціях. Структура бізнесових екосистеми здебільшого визначається структурою технологічної співпраці та технологічними рішеннями, які є основою цінності для споживача. Інформаційно-комунікаційні технології слугували моделлю для розробки різних варіантів структури бізнес-екосистеми, оскільки високотехнологічні індустрії започаткували підхід бізнесових екосистеми для створення конкурентних переваг. Але в інших галузях, поряд з технологічними факторами, економічні, фінансові та стратегічні фактори також сприяють формуванню структури бізнес-екосистеми. Дизайн бізнес-екосистем має вирішальне значення для їх розвитку. Оскільки концепція «Індустрія 4.0» знаменує собою п'яту промислову революцію, багато галузей взяли на озброєння стратегії та підходи з інноваційних галузей. Було виділено п'ять характерних структур бізнес-екосистем, які відрізняються типами основних платформ, рівнями співпраці, шляхами розвитку та розподілом компетенцій.

Розвиток бізнес-екосистеми відкриває нові форми домовленостей на більшій макроекономічній сцені. Концепція мережевої економіки виникає як швидкозростаюче явище, яке об'єднує продукти з цифровими рішеннями. За оцінками McKinsey, у 2030 році дохід мережевої економіки досягне 70 млрд дол. США.

Оскільки екосистеми стають все більш і більш складними, питання про їх структуру стає все більш актуальним. Функціонуючи здебільшого як саморегульована система, бізнес-екосистема перетворилася на складну багатопарову модель економічних, виробничих, фінансових та інформаційних мереж. Орієнтуючись на споживчу цінність, екосистема повинна прийняти стратегічний підхід, тому потрібен певний організаційний дизайн. Основними факторами, які визначають структуру бізнес-екосистеми, є: потік капіталу, знань, ідей і талантів; спільне створення цінності для споживача; використання ефекту масштабу та обсягу; співпраця через координацію, адаптацію та участь; організація стратегій і бізнес-моделей; схеми розподілу прибутку та прибутку.

Взаємодія між цими факторами формує інтенсивність, масштаби та інструменти співпраці між акторами певної екосистеми. Дотримання бізнес-практики дозволяє виділити п'ять основних режимів проектування бізнес-екосистеми. Це сонячна система, кораловий риф, футбольна команда, коробка з пазлом, міцелій – екосистема, побудована на поширенні конкурентних переваг на різних (споріднених чи неспоріднених)

ринках.

Концепція «Індустрія 4.0» робить свій внесок в ефективність бізнес-екосистеми, незалежно від її дизайну. У сонячних системах основні методи «Індустрії 4.0» відтворюють виробництво, постачання та ланцюги створення вартості з відповідним інформаційним потоком. Екосистеми коралових рифів можуть використовувати цю концепцію як один із основних інфраструктурних факторів для залучення та розвитку нових підприємств. У випадку футбольної команди «Індустрія 4.0» платформи служать інструментом інтеграції для різних «гравців». Екосистема скриньок-головоломок завдяки «Індустрії 4.0» може трансформуватися в більш організовані форми та захопити більшість можливостей ринку або скорочення витрат. Екосистема типу міцелію ідеально відповідає основній ідеї «Індустрії 4.0» як об'єднання ресурсів, можливостей, технологій, знань для створення цінності абсолютно нового виміру.

Ключові слова: бізнесова екосистема, інноваційна стратегія, технологічні платформи, Індустрія 4.0.

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