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The ecosystem approach as the basis for the formation and development of ecosystems in ecosystem economy

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Abstract: The article substantiates the prerequisites, prospects and advantages of applying the ecosystem approach in the economy. The landscape of ecosystems is analyzed, and the possibilities of their classification by type are established.

Similarities and differences in the formation and development of economic and socio-economic ecosystems, as elements of the ecosystem economy, are created for the joint development of new system solutions and services for integration into the single market and the achievement of the goals of sustainable socio-economic and ecological development.

Keywords: ecosystem approach, ecosystems, economics of ecosystems.

1. Introduction

The ecosystem approach is the conceptual basis for solving ecosystem problems of the economy, society, and the environment with the help of scientific research [1]. In ecology, the ecosystem approach is a strategy of integrated management of land, water and living resources, which promotes conservation and sustainable use on a fair basis [2]. The ecosystem approach became the central principle of the implementation of the Convention on Biological Diversity [3]. The ecosystem approach does not exclude other approaches, but can integrate all other approaches and methods of working with complex situations [4]. An ecosystem in nature consists of a community of interacting organisms in a physical place. Similarly, an economic development ecosystem consists of a well-designed network of interconnected organizations and institutions within a given area that work together to improve the economic well-being of the community. An economic ecosystem thrives when participants develop patterns of behavior that regulate the flow of ideas, talent, and capital in the system [5]. In the economy, the ecosystem approach helps to create the economy of the future, in society it helps to create the society of the future [6], and in education it helps to create the competencies of the future [7,8]. The ecosystem approach sets the ecological, economic and social goals of blue growth, based on the premise that the ecosystem forms the basis of economic activity and that there is no economic growth without a strong natural base [9]. The ecosystem approach as an analytical tool takes into account the risks, sustainability, dynamics, complexity and interrelationships of all relevant ecosystem participants. All ecosystems develop against the same background: integration into a single market with research, engineering, manufacturing, assembly and service activities that can shared between different member states. The ecosystem approach in economics promotes the interaction of ecosystem participants and helps politicians and investors identify the most relevant players in each ecosystem during the preparation of national and regional

plans and investment projects for socio-economic development [10]. The ecosystem approach becomes the basis of the theoretical and methodological substantiation of the theory of the economy of ecosystems and economic management [11]. Economic growth through the application of the ecosystem approach at the global, national, and regional levels can lead to sustainable development by incorporating the ecosystem approach into economic development planning and decision-making. It is expected that the total income of existing ecosystems will quickly reach 70-100 trillion US dollars and will account for approximately 30 percent of the global economy [12].

2. Research of existing solutions of the problem

Modern global challenges are trends of a systemic nature in the economy and their solution requires systemic solutions that go beyond the resources of companies, industries, communities and even countries and a certain transformation of all sectors of the economy and spheres of society. Systemic changes tend to cross the boundaries of industry sectors and require effective collaboration between the public and private sectors. At the threshold of these enormous global challenges, companies and society need new models, approaches and practices to find a better way to be more competitive and develop sustainably [6]. The unstable and dynamic environmental situation, the aggravation of global economic, environmental and social problems and the growing degree of interdependence of business entities significantly complicate the solution of scientific problems. Many traditional scientific approaches to the study of economic systems and socio-economic systems were applied in isolation from each other, not allowing to fully take into account the complexity of the conditions of existence, functioning of economic entities and their interrelationships.

This necessitates the creation of new theoretical and methodological approaches based on the ecosystem approach. The advantages of the ecosystem approach to the study of complex economic and socio-economic systems is that it allows the use of the tools of evolutionary and institutional economic theory in a single complex, as well as the use of network, cluster and other approaches [13]. Ecosystem economics is a new economic paradigm that focuses on co-creation, cooperation and interdependence. Unlike traditional business, which focuses on individual organizations, the ecosystem economy emphasizes the power of collaboration and collective intelligence to create new value [14]. Ecosystem economics, which consists of the transition from industrial sectors to customer-oriented ecosystems, is becoming the largest economic reorganization in history. Ecosystem economy is a new era of borderless economic sectors and organizations/companies need to ensure their place in the evolution of ecosystems. In the last decade, the ecosystem revolution shaping value creation has created companies with the largest market capitalization focused on the ecosystem. Ecosystems in the economy are communities of interconnected organizations, companies that come together across traditional sectors of the economy to provide customers with what they want and how they want to consume it. Ecosystem-focused businesses are customer-first and create more value for customers. Second, focus on the platform and develop relationships with other companies around that platform. Third, they seek to expand activities with their ecosystem partners. Ecosystem-oriented businesses are more profitable, capturing more of the value creation [12]. Ecosystemicity, as a feature of the economy, is at the basis of the formation of the basic concept of the organization of the functioning of economic activity. The ecosystem, as an institutional and organizational form of effective cross-sectorial economic convergence, allows to improve certain aspects of the activity of both the entire ecosystem and its various participants. Within the framework of the ecosystem approach, it is possible to explain why the approach of closed production, which exists within the framework of a rigid vertical of power, is historically doomed. The emergence of new ways of development became possible due to effective cooperation and distribution of resources in the ecosystem. Within the framework of ecosystems, coordination of multi-level interaction of business entities is ensured, which turns the way from general competition to total cooperation [15]. Ecosystem economics offers a compelling new perspective on

how the global economy is being fundamentally transformed by the acceleration of new technologies, the evolution of consumer preferences with business models and organizational and performance management structures [16]. The ecosystem approach has become the conceptual basis of ecosystem economics and the emergence of a significant number of different ecosystems that require analysis and systematization.

3. Research results

The application of the ecosystem approach in the economy stimulated the emergence of various communities and networks of organizations/companies that interact and seek balance in open public-private economic and socio-economic ecosystems, creating an effective tool for the joint development of new systemic solutions to achieve the goals of sustainable development with positive impact to ecological ecosystems. As a result of the development of the ecosystem approach in the economy and society, a number of diverse ecosystems appeared, the definitions of which are given in table 1.

Table 1. Definition of different ecosystems

№	Ecosystem type	Definition	Source
1	Ecological ecosystems	It is the study of the living and non-living components of the environment that interact with each other and how natural and human-induced changes affect their functioning. Ecological ecosystems: water ecosystems (sea or ocean, freshwater); terrestrial ecosystems (soil and plants above the soil surface); global ecosystem contains millions of species of organisms and plants arranged in a complex pattern governed by interacting physical environmental factors.	[17-20]
2	Ecosystem of knowledge	A community that takes the form of vertical and horizontal networks of autonomous actors bound together by the desire to seek, generate new knowledge and focused on the creation and exchange of knowledge within a certain area or between of group of participants. The knowledge ecosystem usually includes local universities, public research organizations as central actors responsible for generating knowledge at the pre-commercialization stage. The research process had achieved only through joint research activities, which had considered as a central part of the knowledge ecosystem.	[21]
3	Research ecosystem	It is a complex and interconnected network of actors, organizations and resources involved in the research process. This ecosystem encompasses various elements that contribute to the creation, dissemination and application of knowledge. Key components: research institutions and universities; researchers; financial organizations; magazines, publications; libraries, archives; technological infrastructure; government policy and regulation; collaboration and networking; ethics committees; commercialization and industry partnerships; public involvement; non-commercial organizations.	[22]
4	Technology transfer ecosystem	An organizational set of universities, technology transfer offices, science parks, incubators, university venture funds, connected by the process of transferring science results to the markets.	[23]

Continuation of Table 1

5	Ecosystem of startups	It is a network of resources: people, investors, institutions and companies that together create an environment for startups to thrive. Formed by people and different types of organizations at different stages in places (physical/virtual) interacting as a system to create and scale new startup companies.	[24,25]
6	European startup ecosystem	It is a dynamic space, with a variety of hubs, support networks, investment opportunities where creative minds come together to collaborate on business creation. It is an ever-evolving landscape of ideas and solutions.	[26]
10	Global ecosystem of startups	The cluster of startups and related organizations focuses on innovative or technological companies that have been within the last 10 years and/or have a scalable business model.	[27]
11	Ecosystem of deep technologies	Covers many stakeholders to create deep technology startups based on long-term research and is a well-balanced part of the relationship between startups and large companies, corporations, universities.	[28]
12	Entrepreneurial ecosystem	It is a system of interdependent actors and relationships that directly or indirectly support the creation and growth of new enterprises. It is a set of different elements, such as culture, politics and networks which the influence the local or regional creation of new enterprises.	[29,30]
13	Industrial ecosystems	Covers all participants in the value chain: from the smallest startups to the largest companies, from academia to suppliers. Covers a complex set of interrelationships and interdependencies between sectors and firms that extend across single market countries.	[31]
15	Business ecosystem	Gradually moves from a random set of elements to a more structured community, customer interests and talent generated by innovation. It is a network of organizations that includes suppliers, distributors, customers, competitors, government agencies and other that participate in the supply of a particular product or service through competition and cooperation. It is a network of different entities that come together to achieve something that is beyond the effective capacity of any single independent organization. Are dynamic and interact with each other to create and share sustainable value, use common standards and jointly deliver goods and services to their customers.	[32-35]
16	Technological ecosystem	It is a network of interconnected and interdependent various business objects. They come together to support each other and drive innovation.	[36]
17	Transit ecosystem	It consists of several modes of transport, covering different services, infrastructure, ownership and delivery models that differ from city to city.	[37]
18	Transport ecosystem	The vehicles that consumers want to use and the transportation infrastructure that can support it. It is a complex integrated set of sensors, nodes, a community of partner organizations from government, industry and academia working in the transportation and mobility ecosystem.	[38]

Continuation of Table 1

19	Marine transport ecosystem	The interconnected network of activities and processes involved in the transportation of cargo and passengers by sea. Covers various components such as shipping, freight, ports and information systems.	[39,40]
20	The logistics ecosystem	Brings together potential partners in a way that creates the greatest value to maximize valuable relationships (land carriers, ocean carriers, air carriers, freight forwarders, agents, customers, distributors, retailers, financiers, suppliers).	[41]
21	Digital ecosystem	Group of interconnected information technology resources that can function as a single entity. Digital ecosystems consist of suppliers, customers, trading partners, applications, third-party data service providers and all related technologies.	[42]
22	Digital entrepreneurial ecosystem	The concept includes digital entrepreneurship and the entrepreneurial ecosystem, which had considered the foundation.	[43]
23	Information ecosystem	A system with the ability to manage information and create connections between ecosystem participants.	[44]
24	The Information technology ecosystem	An IT ecosystem is a network of services, suppliers, and other organizations related to an organization that create and provide information technology products and services.	[45]
25	Platform ecosystem	System with an underlying structure that influences its behaviour, functioning, and evolution over time. The system consists of interacting subsystems, such as the platform itself and a portfolio of application services.	[46]
26	Educational ecosystem	It is a concept that emphasizes connections and cooperation between stakeholders to ensure quality education: heads of educational organizations, teachers, pupils, students.	[47]
27	Urban ecosystem	System solutions to the dynamic interaction between socio-economic and biophysical forces affecting the interaction between people and socio-economic and ecological processes.	[48]
28	Recycling ecosystem	Recycling pathways in an ecosystem play a critical role in maintaining an ecosystem's nutrient and energy balance. These pathways involve the movement of essential elements such as carbon, nitrogen and phosphorus through the various biotic and abiotic components of an ecosystem.	[49]
29	Ecosystem green	Characterized by a high level of environmental sustainability and minimal negative impact on the natural world, it provides solutions for the preservation and protection of biodiversity, habitats and ecological processes.	[50]
30	Cross-industry ecosystems	Cross-industry interaction within a common platform will expand external communications and promotion channels, enabling the introduction of digital business models and diversifying production, but also requiring interoperability between industrial enterprise systems and a functioning digital platform and cloud environment.	[51]

Continuation of Table 1

31	Ecosystem of materials	Network of interconnected technologies, processes and people that transform used plastics and renewable energy sources into useful materials Includes: everyday consumers, stakeholders in waste management, recycling, design, manufacturing, retail, brand owners and public policy.	[52]
32	Healthcare Ecosystem	It is a community consisting of the patient and the doctor, as well as all the accompanying entities that participate in the process of providing medical care services or staying in the hospital.	[53]
33	The connected aviation ecosystem	This concept visualizes an aviation industry where all participants – airlines, airports, air traffic control, support services and even passengers – are seamlessly connected, optimizing airport operations and improving the air travel experience.	[54]
34	Aviation ecosystem	Refers to processes in which all participants from airport operators, airlines, government agencies and other stakeholders are involved in the operations, conduct and functioning of aviation-related activities.	[55]
35	Innovative ecosystem	Diverse range of actors and resources to facilitate ongoing innovation to the markets. These are organizational enabling environments (spaces) designed for joint decision-making and collective actions to create innovations through the cooperation of a set of actors, assets and interactions or means of communication created by the joint activity of networks of various shapes and sizes.	[56, 57]
36	Socio-economic ecosystem	This is a set of objects and subjects grouped by certain interests, including professional interests, related to the determination of priorities, directions and systemic solutions for the adaptation of society and the state to the existing environment, which includes rules, laws, moral and ethical norms	[58]
37	Global economic ecosystem	It breaks down the barriers of isolated traditional industries and provides systemic solutions for organizing the economy around key needs and challenges.	[12]

The analysis of table № 1 shows that presented 40 ecosystems, it is possible to classify them according to the following types: economic, socio-economic, social and ecological (natural).

Ecosystems can take many forms. Some communities had based on network, experience, research, value chain, while other ecosystems had related to geographic, water and terrestrial location. Economic and socio-economic ecosystems share conceptual similarities, namely ecosystem participants form a community or network in a physical or online environment and focus on collaboration, partnership to co-create value for all community stakeholders, strive for social responsibility, and provide systemic solutions and services in specific areas sustainable socio-economic and ecological development.

Therefore, the knowledge ecosystem and the research ecosystem generate new knowledge and provide joint research solutions [21, 22]. The technology transfer ecosystem provides the results of the process of transferring science results to the market [23]. The startup ecosystem creates and scales new startup companies [24-27]. The deep technology ecosystem creates deep technology startups based on long-term research [28]. The entrepreneurial ecosystem supports the creation and growth of new enterprises [29, 30]. The industrial ecosystem encompasses a complex set of relationships of all participants in the value chain [31]. The business - the ecosystem provides system solutions for a

network of interdependent companies and organizations [32-35]. The technological ecosystem provides system solutions for a network of interconnected and interdependent various business objects that support each other and stimulate innovation [36]. The transit ecosystem provides system services delivery of multiple modes of transport [37]. The transport ecosystem provides the vehicles that consumers want to use and the transport infrastructure that can support it [38]. The maritime transport ecosystem provides services for transporting goods and passengers by sea [39, 40]. The logistics ecosystem provides services bringing together partners to create value and maximize relationships [41]. The digital ecosystem provides information technology resources to various participants [42]. The digital entrepreneurial ecosystem provides system solutions for digital entrepreneurship [43]. The information ecosystem and IT ecosystem create connections between ecosystem participants and provides information technology services [44, 45]. The platform ecosystem consists of interacting subsystems that provide application portfolio services [46]. The educational ecosystem provides quality training [47]. The urban ecosystem forms systemic solutions of the dynamic interaction between socio-economic and biophysical forces on a local scale [48]. The recycling ecosystem forms ways of processing the balance of nutrients and energy [49]. The green ecosystem provides solutions for the preservation and protection of biodiversity, habitats and ecological processes [50]. The cross-industry ecosystem provides digital cross-industry interaction within of a common platform [51]. The ecosystem of materials transforms used plastic and renewable energy sources into useful materials [52]. The health care ecosystem provides a medical care service or a hospital stay [53]. The connected aviation ecosystem visualizes the activities of the aviation industry by optimizing airport operations [54]. The aviation ecosystem refers to the processes, operations, conduct and functioning of activities related to aviation [55]. The innovation ecosystem provides systemic solutions for the creation and implementation of innovations to the markets [56, 57]. The socio-economic ecosystem determines priorities, directions and systemic solutions for the adaptation of society and the state to the existing environment [58]. The global economic ecosystem provides systemic solutions for organizing the economy around key needs and challenges [12].

The diversity of ecosystem participants is the main common feature of economic and socio-economic ecosystems. The same participant can be in communities of different types of ecosystems, but the goals and logic of their actions in each ecosystem may differ and be different. Thus, universities and research institutes play a central role in the knowledge ecosystem and the research ecosystem. People, various organizations and investors play a central role in the startup and entrepreneurial ecosystem. Research institutes, deep tech startups, large companies, and corporations play a central role in the deep tech startup ecosystem. Networks of interconnected and interdependent companies play a central role in the business ecosystem and technology ecosystem. The interconnected information technology resources of suppliers, customers, trading partners play a central role in the digital ecosystem, the information ecosystem and the platform ecosystem. Heads of educational organizations, teachers, pupils, students play a central role in the educational ecosystem. Dynamic interactions between socio-economic and biophysical forces play a central role in the urban ecosystem. The set of objects and subjects of society and the state, as well as laws and norms, play a central role in the socio-economic ecosystem.

Certain relationships can be established for some ecosystems. Thus, the knowledge ecosystem can be linked to the research ecosystem. In turn, the research ecosystem can be closely related to the technology transfer ecosystem, the deep technology ecosystem, and the technology ecosystem. A startup ecosystem can be closely related to an entrepreneurial ecosystem, a digital entrepreneurial ecosystem, an industrial ecosystem, and an urban ecosystem. A business ecosystem can be closely related to an industrial ecosystem and a technology ecosystem. The logistics ecosystem can be closely related to the transit ecosystem, the transportation ecosystem, and the maritime transport ecosystem. The recycling ecosystem and the green ecosystem are closely related to ecological ecosystems. The global ecosystem, the socio-economic ecosystem, the environmental ecosystem, as well as the digital ecosystem, the information ecosystem, the platform ecosystem can all be related to the aforementioned ecosystems in one way or another. Interrelationships and dynamics between different

types of ecosystems impose features of interaction on each other and are an important topic of separate research, regarding the creation of tools that will allow crossing boundaries between ecosystems and exerting influence, especially on socio-economic and ecological development.

4. Conclusions

Based on the analysis of the landscape of 40 ecosystems, it is possible to classify them according to the following types: economic, socio-economic, social and ecological (natural). Despite the fact that a number of definitions are still in the framework of scientific discussions among scientists it had established that different types of ecosystems have conceptual similarities regarding the formation of a community or network of companies/organizations that provide system solutions and services in certain areas of sustainable socio-economic and ecological development.

The diversity of economic and socio-economic ecosystems participants is also a common feature of different types of ecosystems. The same participant can be in communities of different types of ecosystems, but the goals and logic of their actions in each ecosystem may differ and be different. The presence of a significant number of different ecosystems in the modern landscape of the economy of ecosystems shows that the application of the ecosystem approach to the economy creates more sustainable communities and networks of organizations/companies. Each ecosystem is to some extent unique and has different goals, approaches, and practices to make a focused, fragmented socio-economic impact. It had established that certain connections between some ecosystems allow strengthening the positive influence on the joint development of new system solutions for integration into the single market, solving socio-economic and environmental challenges and achieving the goals of sustainable development.

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