Section 1.2. Institutional and Digital Infrastructure for Entrepreneurship Development in the Digital Economy

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Abstract. *The development of entrepreneurship in the digital economy increasingly depends on the quality of institutional and digital infrastructure that enables coordination, innovation, and resilience under uncertainty. In countries undergoing structural transformation, infrastructure becomes not only a technical basis for business activity, but also an ecosystem mechanism that reduces transaction costs, expands access to resources, and supports sustainable entrepreneurial dynamics. This study aims to conceptualize entrepreneurship infrastructure through an ecosystem lens and to justify a model of "dual multilevelness" that integrates the internal functional architecture of infrastructure with the external ecosystem environment in which it operates. The research applies theoretical generalization, structural and functional analysis, and conceptual modeling to synthesize existing approaches to entrepreneurship support and to systematize infrastructure components across multiple levels. The findings position entrepreneurship infrastructure as an open, dynamic system in which institutional, financial, innovation and technological, informational and consulting, and logistics and production components interact. The proposed dual multilevel model links these internal functional subsystems to external natural, technogenic, socio-economic, and institutional value layers, making it possible to identify synergies, dependencies, and systemic risks. This framework strengthens the analytical basis for strategic planning of entrepreneurship development and for designing balanced policy instruments in the digital economy. The ecosystem interpretation and the dual multilevel model provide a coherent basis for diagnosing infrastructure gaps and improving coordination among actors and resources. Future studies should operationalize the model through measurable indicators, test it empirically across regions, and evaluate its usefulness for policy design and digital maturity assessments.*

Keywords: *entrepreneurship infrastructure; digital economy; institutional infrastructure; digital infrastructure; entrepreneurial ecosystem; sustainable development.*

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1. Theoretical foundations of infrastructure support for entrepreneurship: essence, structure, functions. One of the key factors of sustainable economic development of Ukraine is the formation of a competitive business sector integrated into the European and global economic space. This requires a deep understanding of the economic essence of entrepreneurship, its structural characteristics and the system for ensuring effective functioning. Despite the significant development of the theoretical and methodological foundations of entrepreneurial activity, a number of issues related to the institutional, organizational and infrastructural basis of entrepreneurship development remain open.

The study of the evolution of scientific approaches to understanding the essence of entrepreneurship indicates a gradual shift in emphasis from rationalistic and utilitarian interpretations to the dominance of psychological, creative and behavioral aspects in modeling the image of an entrepreneur. In modern economic theories, the category of "entrepreneurship" is increasingly associated with such characteristics as initiative, risk, innovation, creativity, intuition, the desire for development and the ability to act in conditions of uncertainty. The realization that such features are not universal, and the level of economic progress is largely determined by the scale and intensity of entrepreneurial activity, necessitates the creation of effective mechanisms for its support, primarily through the development of market, institutional and physical infrastructure.

The issues of the formation and development of entrepreneurship in Ukraine have been widely covered in the works of domestic scientists, including Yu. Bazhal, O. Belyaev, V. Bobrov, Z. Varnalii, V. Vasylenko, T. Vasyltsiv, S. Dzyubyk, P. Yeshchenko, S. Zinko, A. Krutyk, I. Lukinov, V. Medinsky, V. Melnychuk, S. Mocherny, Yu. Pakhomov, A. Pimenova, V. Podsolonko, A. Protsay, S. Reverchuk, O. Ryvak, V. Syzonenko, O. Ustenko, D. Chervanov, A. Chukhno, L. Sharshukova, I. Yastremsky, etc. Despite the commonality of research approaches, the authors offer different interpretations of the essence of entrepreneurship. Thus, V. Bobrov, A. Krutyk and A. Pimenova consider entrepreneurship mainly through the prism of its main goal - making a profit (Bobrov, 1995). According to S. Dzyubyk, O. Ryvak, V. Medynskyi and L. Sharshukova, the key function of entrepreneurial activity is innovation and the ability to solve economic problems non-standardly (Dzyubyk, 1994).

The most comprehensive definition of this category, in our opinion, is given by Varnalii (2015), who considers entrepreneurship as “initiative, independent, innovative, systematic activity in the production of products, performance of work, provision of services, carried out at one’s own risk and

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under personal property responsibility in order to obtain entrepreneurial income". The scientist emphasizes that entrepreneurship encompasses three interrelated components – personal, economic and organizational and managerial, which form a single process of reproducing the entrepreneurial type of management.

The advantage of this approach is the emphasis on innovation, systematicity and recognition of entrepreneurship as a special type of economic activity that combines the creative potential of the individual with rational management mechanisms. At the same time, it remains insufficiently reflected in aspects related to the uncertainty of the external environment, the institutional conditions of entrepreneurship and the infrastructural mechanisms of its support, which determines further directions of theoretical research.

An important contribution to the development of theoretical and methodological foundations of institutional support for entrepreneurship was made by Antonyuk (2016). In his works he reveals the essence of institutional infrastructure as a system of institutions, norms and mechanisms that create an environment for business development at the regional level. The scientist defines the structural elements of institutional infrastructure, conducts typology according to functional characteristics, and also carries out an econometric assessment of the impact of institutional factors on the entrepreneurial activity of regions. Particular attention is paid to the issues of modernization of institutional infrastructure in the context of European integration processes, emphasizing the importance of synergy between state institutions, business and regional systems of entrepreneurship support. Thus, these studies complement classical approaches to understanding the essence of entrepreneurship, focusing on the institutional dimension - that is, on those structural and regulatory conditions that determine the boundaries, incentives and opportunities for the development of entrepreneurial initiative.

In the current conditions of digital transformation, global competition and structural restructuring of the economy, it is the infrastructural support of entrepreneurship that becomes crucial. It determines the ability of economic entities to effectively interact in the market environment, realize their innovative potential and ensure sustainable development at the macro, meso and micro levels. In this context, the clarification of the theoretical foundations of the formation of entrepreneurial infrastructure, the definition of its essence, structure, functions and role in ensuring sustainable economic growth becomes particularly relevant.

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Infrastructural support for entrepreneurship is a key element in creating a favorable environment for business development and ensuring its competitiveness. In a broad sense, the infrastructure of entrepreneurship is understood as a set of institutions, organizational structures, material, technical and financial resources, as well as information and communication systems that contribute to the effective activities of business entities. The essence of infrastructural support is to create a business support system by reducing transaction costs, providing access to finance, knowledge and technology, as well as creating conditions for the integration of enterprises into domestic and foreign markets.

The essence and composition of infrastructure can fundamentally change within a certain analytical section of the economic system. In particular, the Economic Encyclopedia (2000) defines infrastructure as "a complex of branches of the national economy that are related to servicing industry and agriculture, as well as market infrastructure, which should be understood as a set of enterprises, institutions, organizations that ensure the stability of the development and functioning of the market mechanism of economic regulation, the continuous movement of goods and services in various spheres of social production". Hrytsenko & Sobolev (1998) define market infrastructure as "a system that is a set of elements that ensure the uninterrupted multi-level functioning of economic relationships, the interaction of market economy entities and regulate the movement of commodity and money flows. Likholat (2001) distinguishes the main infrastructure, to which he includes a number of infrastructure components of the wholesale market: commodity exchanges, fairs, wholesale markets, auctions, warehouses, and the general infrastructure, to which he includes banking and credit institutions, financial organizations, communication institutions, various consulting, holding, leasing, advertising, auditing, information and other companies, law firms, marketing research centers, business centers.

Accordingly, the internal structure of the entrepreneurship infrastructure is multi-level (Table 1.13) and includes: institutional component (state bodies, local governments, business associations), financial infrastructure (banks, venture funds, credit unions, insurance companies), innovation and technological infrastructure (technology parks, business incubators, technology transfer centers), information and consulting infrastructure (marketing and consulting companies, information platforms), as well as logistics and production infrastructure (transport, communications, energy, warehouse complexes). The interaction of these components forms a single ecosystem of entrepreneurship support, which

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combines material and intangible resources. This describes the internal multi-level structure of the entrepreneurship infrastructure.

Table 1.13. Functional levels of entrepreneurship infrastructure within the economic system

Level	Ingredients	Main function
Institutional	government agencies, local governments, business associations	formation of rules of the game, coordination, legal field
Financial	banks, venture capital funds, insurance companies	mobilization and distribution of financial resources
Innovative and technological	technology parks, incubators, R&D centers	support for innovation, technology transfer
Information and consulting	consulting companies, marketing agencies, IT platforms	knowledge exchange, information support for business
Logistics and production	transport, communications, energy, warehouses	ensuring physical flows and material base

Source: developed by the author

Thus, in its internal structure, the infrastructure of entrepreneurship consists of separate subsystems or levels of business support that perform different functions. Accordingly, the essence of infrastructure provision is to form an environment that contributes to reducing transaction costs, provides access to resources and knowledge, and supports entrepreneurial initiative and innovation.

In the context of global instability, climate challenges and digital transformation of economic systems, traditional ideas about the infrastructure of entrepreneurship are undergoing a significant rethinking. In modern research, there is a tendency to expand the meaning of the concept of "infrastructure" - from a technical base to a system of interaction of natural, social and economic processes. Infrastructural support for business development is increasingly viewed not only as a set of technical, financial or organizational tools, but as a holistic socio-economic ecosystem within which natural resources, technological solutions, institutional mechanisms and value orientations of society interact.

Also important in the context of entrepreneurial activity is the principle of balance between economic interests, environmental sustainability, and social value.

The ecosystem approach, formed at the intersection of economic ecology, systems analysis and institutional theory, allows us to interpret the infrastructure of entrepreneurship as an open dynamic system capable of self-organization, adaptation and evolution. It functions in continuous exchange with the natural, technological and social environment, ensuring

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the ability of business not only to respond to external changes, but also to create new value in the process of these changes.

At the heart of the ecosystem approach is the idea that sustainable development of entrepreneurship is impossible without harmonizing the links between economic activity and natural processes. In this context, the authors of the concept of "Rethinking Sustainable Infrastructure" (Adhitya et. al., 2016) propose to consider infrastructure as a system of three interconnected levels:

1. Natural processes that form the basic conditions for life and economic activity - water, air, energy, soils, climate;
2. Man-made infrastructure, which includes technical, energy, transport, information and financial networks;
3. Socio-economic services implemented through the interaction of the first two levels - education, healthcare, business services, entrepreneurial ecosystems.

In such a model, the balance between natural processes and anthropogenic influences plays a key role, which is a prerequisite for the long-term sustainability of the economic system. As noted by (Adhitya et. al., 2016), sustainable infrastructure should be considered as a "living system" that maintains a balance between resource use and the restoration of ecosystem functions. This approach involves not only technical modernization of infrastructure, but also a value reorientation - from maximizing economic growth to achieving complex socio-ecological value.

Modern infrastructure, as the authors note, often ignores the interdependence of these levels, which causes imbalances - from the degradation of the natural environment to the social vulnerability of business structures. Therefore, sustainable infrastructure provision should be based on maintaining a balance between natural cycles and economic interests, between man-made changes and ecological stability (Adhitya et. al., 2016).

The ecosystem model of infrastructure support for entrepreneurship (Table 1.14) reflects the relationship between natural, man-made, socio-economic and institutional subsystems that form a single space of sustainable development.

From the standpoint of ecosystem thinking, the infrastructure provision of entrepreneurship performs not only a service, but also a regulatory and coordination function, contributing to the harmonization of interaction between market agents, the state and the natural environment.

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Table 1.14. Components of an ecosystem model of infrastructure support for entrepreneurship

Level	Key elements	Functions	Streams	Interaction
Natural subsystem (basis of the ecosystem)	land, water, energy, climate, biodiversity	providing material and energy resources, restoring the environment, supporting life processes	natural cycles (water, carbon, energy)	forms the boundaries and conditions for man-made infrastructure
Technogenic infrastructure subsystem	transport, energy, manufacturing, digital, financial and utility infrastructure	providing entrepreneurial activities with resources, logistics, finances, communications	financial, informational, technological	transforms natural resources into production factors, creates a basis for socio-economic activity
Socio-economic subsystem	enterprises, markets, business associations, labor resources, consumers.	formation of demand, innovation, employment, income, social effects	economic activity, investments, business ties	creates new value, determines the directions of development of man-made infrastructure
Institutional and value subsystem (management environment)	state and local institutions, legal field, sustainable development policy, educational and scientific organizations	regulation, stimulation, balancing interests between the natural, economic and social environment	regulatory, managerial, educational, cultural	coordinates other subsystems through mechanisms of policy, innovation, and values

Source: summarized by the author

This means that the efficiency of infrastructure is determined not so much by the volume of investments or the number of objects, but by the quality of interaction between subsystems, their adaptability to external changes and the ability to maintain social well-being without depletion of natural resources. The model is built as a multi-level system with vertical integration of resource flows, information and value, which ensures the sustainability of entrepreneurial activity (Figure 1.1).

Figure 1.1 shows that the infrastructure support of entrepreneurship is an ecosystem in which natural resources are transformed into socio-economic value through technogenic networks, and the institutional system ensures the management of the balance of these flows. The implementation of such an approach contributes to the formation of adaptive, innovative and environmentally responsible infrastructure capable of supporting sustainable business development at various levels - from local to national.

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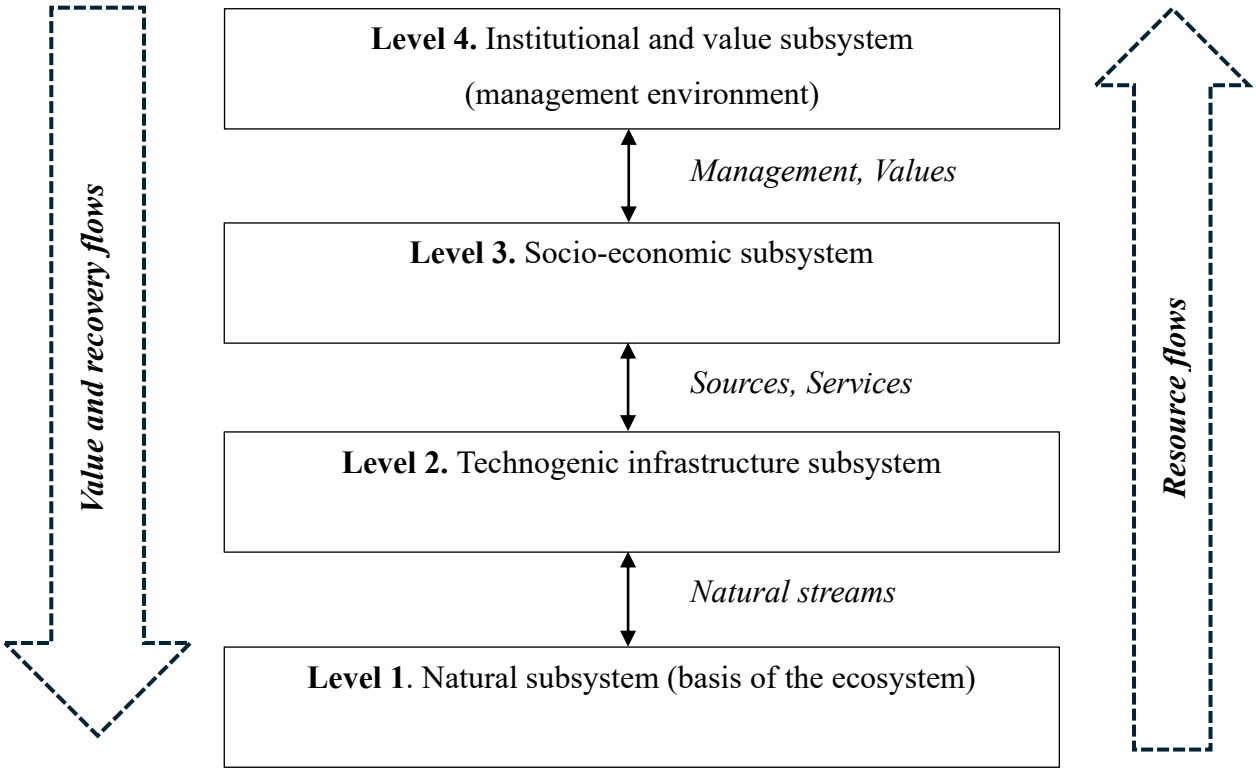


Figure 1.1. Ecosystem model of infrastructure support for entrepreneurship

Source: developed by the author based on (Adhitya et. al., 2016)

The infrastructure of entrepreneurship in such a system plays a dual role: on the one hand, it acts as a tool for economic development, and on the other, it is an environment that shapes constraints and opportunities for entrepreneurial activity. Its effectiveness is determined not only by the volume of resources or services provided, but primarily by the quality of interaction between subsystems, their adaptability to external changes and the ability to ensure well-being without depleting natural capital.

The ecosystem model of infrastructure support for entrepreneurship operates according to the principles:

- system interdependence - all subsystems function in a mutual exchange mode;
- balance and recovery - economic activity should not exceed natural reproduction capacity;
- value orientation - priority of socio-ecological value over quantitative growth;

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- contextual adaptability - the model takes into account the specifics of the territory, resource base, and cultural factors;

- inclusive governance – participation of the state, business, science, and community in joint decision-making.

Thus, the ecosystem approach allows us to consider the infrastructure of entrepreneurship as an integral space of sustainable development, which combines economic efficiency, innovation dynamics and ecological balance. Its implementation creates methodological foundations for the development of a policy of "balanced entrepreneurship", focused on long-term socio-economic effects, institutional sustainability and the preservation of natural capital.

Modern processes of digital transformation, globalization shifts and the growing role of sustainable development necessitate a rethinking of the architectonics of infrastructure support for entrepreneurship. The study showed that existing theoretical approaches mostly reflect only the internal structural hierarchy of infrastructure - that is, the set of its functional subsystems (institutional, financial, innovation and technological, information and consulting, logistics and production). However, the modern business environment does not function in isolation, but within a broader ecosystem, which includes natural, social, technological and institutional-value levels, which is revealed in the concept of the ecosystem model of infrastructure support for entrepreneurship.

In this regard, it is advisable to propose an integrated concept of “double multilevelness”, which combines the internal functional structure of the infrastructure of entrepreneurship and the external ecosystem stratification of the environment of its functioning, described above.

Internal (functional) multilevelness reflects the internal logic of the formation of infrastructure elements that provide support for entrepreneurial activity. Such components include:

- institutional infrastructure - a system of state bodies, local governments, and business associations that form rules, norms, and the regulatory field;
- financial infrastructure - banks, credit unions, venture funds, insurance companies that provide access to financial resources;
- innovation and technological infrastructure - technology parks, business incubators, R&D centers, technology transfer centers that stimulate innovation processes;
- information and consulting infrastructure - marketing, consulting companies, IT platforms that provide knowledge dissemination and decision support;

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- logistics and production infrastructure - transport, energy, communications, warehouse complexes that create the material base for business.

These components form a horizontal cross-section of the system, which reflects the specialization and functional areas of infrastructure activity.

The external structure shows the environment in which the business infrastructure operates and what levels affect its sustainability. It includes:

- natural level - energy, climate, land, and water resources that create an ecological base for economic activity;
- technogenic level – man-made material and technical systems (production, transport, energy, digital infrastructure);
- socio-economic level - entrepreneurial communities, markets, labor resources, institutions of consumption and innovation;
- institutional and value level - legal, political, cultural and educational mechanisms that set value guidelines for development.

This vertical slice demonstrates the systemic interdependence of entrepreneurial infrastructure with its natural, technical, and socio-cultural context.

The combination of internal and external multilevel allows us to create a matrix model of interaction (Figure 1.2), in which: rows (horizontally) represent types of infrastructure by functional characteristic; columns (vertically) represent levels of the ecosystem environment in which they operate. The intersections between elements reflect specific forms of interaction - for example, how financial infrastructure depends on the institutional-value level or how innovation-technological infrastructure interacts with natural resources through eco-innovation mechanisms.

Thus, the model allows for a systematic description of the relationships between types of infrastructure and environmental factors; to identify nodes of synergy or imbalance in the functioning of business ecosystems; to determine the priorities of public policy - at what levels and in which subsystems it is worth concentrating investment, institutional and regulatory resources.

The model presented in Figure 1.2 illustrates an integrated system of internal functional and external ecosystem multilevelness of the business infrastructure. It reflects the logic of interaction of different types of infrastructures (horizontally) with the levels of the ecosystem environment (vertically) in which they function. This approach allows for a systematic description of the structure, connections and points of interdependence between the subsystems of the business environment and factors of the external context.

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	Natural level	Technogenic level	Socioeconomic level	Institutional and value level
Institutional infrastructure	Regulatory framework for sustainable use of natural resources; environmental legislation; ecosystem management mechanisms	Energy standards, requirements for environmental certification of technologies	Public administration, cultural norms, public participation in decision-making	Strategic planning system, legal framework, sustainable development policy
Financial infrastructure	Nature-based investing; environmental insurance	"Green" financial instruments (eco-bonds, ESG funds)	Financial inclusion, microcredit for small businesses	Public-private partnerships, tax incentives, financial policy
Innovative and technological infrastructure	Development of eco-innovations; renewable energy technologies	Energy-efficient systems, "smart" production clusters	Startups, business clusters, technology transfer centers	Innovation policy, research programs, state support for R&D
Information and consulting infrastructure	Natural resource monitoring systems; digital environmental platforms	Energy consumption data management, business process automation	Communication networks, open access to information, consulting services	Education, training, communication policy, digital literacy
Logistics and production infrastructure	Rational use of energy, renewable resources, ecological logistics	Industrial parks, transport and energy systems, communication networks	Development of labor mobility, human capital, consumer logistics	Regional infrastructure development strategies, spatial planning

Figure 1.2. Author's model of double multi-level entrepreneurship infrastructure

Source: developed by the author

The vertical axis of the model is represented by five key functional components of the entrepreneurship infrastructure - institutional, financial, innovation and technology, information and consulting, and logistics and production. They form *the internal structure of business support* , providing the regulatory, resource, intellectual, informational, and material and technical basis for business activity.

The horizontal axis of the model reflects the ecosystem stratification of the environment in which entrepreneurship develops. It includes four interconnected levels:

- the natural level, which sets the basic conditions for the viability of the economy through resources, energy, climatic and environmental factors;
- the man-made level, which encompasses man-made infrastructure – production, transport, energy, and digital base;
- socio-economic level, which reflects the interaction of economic entities, markets, labor resources, and consumer relations;

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- institutional and value level, which determines the regulatory, managerial, cultural and educational foundations of entrepreneurship development.

The intersections between horizontal and vertical components indicate specific areas of interaction and interdependence. In particular, the institutional infrastructure correlates with the natural level through regulatory mechanisms for sustainable resource use and environmental legislation; the financial subsystem interacts with the man-made environment through eco-investments and "green" bonds; the innovation and technological component is closely linked to the socio-economic level through the formation of clusters, startups and technology transfer; the information and consulting infrastructure is integrated with the institutional and value level through the development of educational platforms, communication policy and digital literacy; the logistics and production infrastructure reflects the connection between the natural and social environment through the principles of rational resource use and increased mobility of labor resources.

Overall, the model demonstrates that the effectiveness of infrastructure support for entrepreneurship is determined not only by the quality of individual elements, but primarily by the balance of interaction between them at different levels of the ecosystem. It allows identifying “bottlenecks” in infrastructure development – for example, a lack of connections between the innovation and financial subsystems or insufficient integration of institutional and natural levels in regulatory processes.

Thus, the dual multilevel model provides a methodological basis for a systematic analysis of the business environment. It can be used to construct analytical indicators of the interaction of infrastructure elements, develop comprehensive strategies for entrepreneurship development based on an ecosystem approach, and determine priorities for state business support policies taking into account natural and social constraints.

Therefore, the matrix model reflects the relationships between the five main functional components of the entrepreneurship infrastructure (institutional, financial, innovation-technological, information-consulting, logistics-production) and the four levels of the ecosystem environment in which they function (natural, man-made, socio-economic, institutional-value).

The model reflects the logic of double multilevelness, where each type of infrastructure interacts with all levels of the environment. Such a matrix structure allows to identify systemic interdependencies, in particular:

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- natural interaction - forms the basic ecological conditions for the functioning of entrepreneurship;
- technogenic - provides the material and technological basis of activity;
- socio-economic - determines the dynamics of market processes and social integration;
- institutional and value-based – sets norms, values, and directions of state policy.

The integration of these components forms a single ecosystem architecture of infrastructure support for entrepreneurship, ensuring its adaptability, innovation, and sustainability in a changing environment.

The developed model reflects the author's approach to interpreting the infrastructure support of entrepreneurship as a dynamic, open and self-organized system, which combines material, financial, institutional and environmental factors. Its practical application allows assessing the effectiveness of sustainable development policies, identifying synergistic relationships between subsystems and increasing the resilience of the national business environment in the face of external challenges.

Thus, based on the results of studying the theoretical foundations of infrastructure support for entrepreneurship, the theoretical foundations of infrastructure support for entrepreneurship have been improved by developing a matrix model of “double multilevelness”, which combines the internal functional structure of infrastructure (institutional, financial, innovative, informational, logistical) with the external ecosystem environment (natural, technogenic, socio-economic, institutional and value). The model allows you to reflect the relationships between different types of infrastructure and levels of the environment, identify sources of synergy or systemic risks, and also provide a theoretical basis for strategic planning for the development of entrepreneurial ecosystems.

2. Methodological approaches to researching the infrastructure environment of entrepreneurship. The infrastructural environment of entrepreneurship encompasses a broad set of institutional, financial, organizational, technological, informational, and spatial elements that enable the creation, support, and scaling of entrepreneurial activity. Its study requires the use of a multi-component methodological toolkit that can combine structural analysis, institutional characteristics, spatial-network relationships, and digital aspects of development.

Modern research on the digital economy and infrastructure (in particular, the works of T. Shtets, O. Ovsienko, K. and N. Kraus, D. Antonyuk, O. Ukrainy and I. Shifrina , as well as the works of other scientists) demonstrate that the analysis of the infrastructure environment of

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entrepreneurship is carried out through a combination of systemic, institutional, structural-functional, spatial-network, ecosystem and cognitive-analytical approaches.

The system approach involves considering the infrastructure of entrepreneurship as a holistic complex of interconnected elements, the activities of which are aimed at creating favorable conditions for business development. The concepts of "system" and "systematicity", which gained high authority in German classical philosophy, were often criticized in the irrationalist movements of the 19th century, since systematicity was often identified with a formal and pedantic procedure for ordering meanings (Kagan, 1996).

From the perspective of a systems approach, the infrastructure environment is considered as an open dynamic system capable of adapting to changes in the external environment.

Methodologically, the systemic approach is implemented through structural-functional analysis, decomposition methods (separation of subsystems), modeling of resource flows, and identification of relationships between infrastructure entities.

It is especially clearly manifested in works devoted to the digital economy: the digital economy sector is described as a system that has certain subjects (business, state, private users), objects (concepts, technologies, infrastructure networks), products (digital services, e-platforms, software) and consumers, between which stable relationships are formed.

T. Shtets justifies the systemic nature of the digital economy sector by identifying structural and functional components, where the structure is represented by subjects, objects, products and infrastructure, and the functions are represented by their impact on innovation, communication, productivity and competitiveness of the economy. The research used methods of theoretical generalization, analysis and synthesis, as well as graphical modeling, which allowed the author to visualize the structure and functions of the digital sector (Shtets, 2023).

This approach scales well to the business infrastructure in general: institutional, financial, logistical, informational, and digital subsystems can be interpreted as structural blocks that perform certain functions – reducing transaction costs, providing access to finance, innovation, markets, knowledge, etc. In this sense, the structural and functional analysis of the digital economy becomes a methodological basis for the decomposition of the business infrastructure into subsystems with clearly defined functional roles.

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The institutional approach focuses on the mechanisms of formation of rules, norms and institutions that determine the behavior of participants in the entrepreneurial environment. It reveals how formal (legislative, regulatory) and informal (traditions, business ethics) institutions influence entrepreneurial activity.

The institutional approach focuses on the rules, norms, organizational structures, and mechanisms of power and regulatory influence that determine the framework conditions for the functioning of entrepreneurship. In Antonyuk's research (2016), the institutional infrastructure of entrepreneurship is viewed as a set of formal and informal institutions that provide business support at the regional level and influence entrepreneurial activity by changing the configuration of transaction costs, access to resources, and organizational capabilities.

Antonyuk (2016) offers scientific and methodological approaches to modeling institutional infrastructure, including assessing the efficiency of infrastructure through transaction costs, constructing integral development indicators, differentiating regions by the level of development of infrastructure components, and using system-network analysis to reflect the interaction of institutions. This makes the digital infrastructure of entrepreneurship a critical factor in the competitiveness of regional economies, and its modernization determines the efficiency of entrepreneurial reproduction processes.

At the level of digital infrastructure, the institutional approach is implemented through the analysis of state concepts, strategies and programs. The Concept of the Development of the Digital Economy and Society of Ukraine defines digital infrastructure as a set of technologies, products and processes that provide computing, telecommunications and network capabilities on a digital basis, while emphasizing that its development should ensure the possibility of using digital technologies by businesses regardless of their territorial location.

Studies dedicated to the digital infrastructure of small business support emphasize that the formation of such infrastructure in Ukraine takes place with the participation of the state, non-governmental, commercial and international organizations, and the set of digital services includes both free (business registration, consultations, online training) and paid services (consulting, auditing, etc.).

Methodologically, this approach is implemented through institutional analysis, content analysis of the regulatory framework, assessment of transaction costs, expert survey, and comparative analysis of institutional models.

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Thus, the institutional approach to studying the infrastructure environment of entrepreneurship involves not only an analysis of the regulatory framework, but also an assessment of institutional configurations (a combination of public, private, international institutions and platforms) that provide entrepreneurs with access to infrastructure resources.

The evolutionary approach (J. Schumpeter, B. Lundvall) treats infrastructure as a dynamic system that evolves in response to technological and institutional changes. The main emphasis is on innovative waves of development, adaptation processes, and mechanisms of knowledge diffusion.

The synergetic approach, in turn, studies the processes of self-organization in the infrastructure environment. It explains how minor changes in one element can cause systemic transformations (the effect of "sensitivity to initial conditions"). The methodological tools include scenario modeling, system dynamics, simulation models, and cognitive mapping.

An important component of the methodological understanding of the infrastructure environment is the distinction between material (hard) and intangible (soft) components. The article devoted to the digital infrastructure of SMEs states that digital infrastructures are the basis of the digital economy, and their creation is shared between the state and non-state structures. Legislation and scientific literature distinguish elements of hard infrastructure (broadband access to the Internet based on fixed and mobile technologies, radio infrastructure for the Internet of Things, public Wi-Fi networks, cloud computing resources, cybersecurity infrastructure) and soft infrastructure (identification and trust services, open data infrastructure, e-governance, interoperability infrastructure, e-commerce, payment and transaction, geoinformation and blockchain services).

This approach allows us to methodically structure the digital infrastructure of entrepreneurship as a combination of a technical foundation (networks, data centers, equipment) and a service superstructure layer (digital services, platforms, regulatory and trust tools), which is related to the division of infrastructure into material and institutional-organizational in studies of the institutional infrastructure of entrepreneurship.

A valuable methodological contribution to the understanding of digital infrastructure as an object of research is contained in the works of O. Ukrainy and I. Shifrin, which consider different research approaches to the interpretation of this category. The authors show that:

- the technological/artifact approach focuses on digital infrastructure as a set of technical solutions and IT resources;

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- relational models propose to evaluate digital infrastructure through the perceptions and practices of its users and stakeholders: digital infrastructure is viewed as a relative property that acquires significance in the context of organized activities and socio-technical relations;
- the strategic asset approach, based on the traditions of positivism and strategic choice theory, analyzes digital infrastructure as the result of management decisions regarding the formation of a portfolio of IT resources aligned with the strategic goals of the organization.

Within the framework of the methodology for studying the infrastructure environment of entrepreneurship, these approaches create the basis for:

- analysis of digital platforms and services as elements of a networked business organization;
- studying socio-technical integration – how business, state, and user practices transform technical solutions into infrastructure standards;
- assessment of digital infrastructure as a strategic resource of enterprises, which determines their competitiveness, adaptability and ability to innovate.

This complements classical system-structural approaches, allowing us to shift the emphasis from the "list of elements" to the processes of interaction, perception, and strategic management of infrastructure.

D. Antonyuk shows that it is advisable to consider the infrastructure environment as a network of organizations (state institutions, business associations, financial structures, innovation centers), the interaction between which is formed not only by vertical (hierarchical), but also by horizontal connections.

This approach is logically combined with the spatial dimension, where the infrastructure of entrepreneurship is analyzed by regions, agglomerations, territorial communities. In modern international studies of the digital transformation of small and medium-sized businesses, in particular in analytical materials of the OECD, the digital infrastructure and digital maturity of enterprises are assessed using indices and maturity models (Digital Economy and Society Index, models for assessing the digital readiness of SMEs, indices of digital development of territories).

This opens up the opportunity to combine regional analysis of entrepreneurship infrastructure (data aggregation at the oblast/community level) with network methods (analysis of connections between digital service centers, business incubators, DIH hubs, business support platforms).

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D. Antonyuk's works consider a number of methodological approaches to assessing the effectiveness of business infrastructure. In particular, the following are analyzed:

- transactional approach, where infrastructure efficiency is determined by the level of business transaction costs;
- indicator approaches based on the formation of a system of indicators for the development of individual infrastructure components and the construction of integral indices;
- benchmarking of infrastructure institutions (using the example of business incubators), which uses a system of indicators of efficiency, effectiveness, impact on regional development, sustainability and viability.

The advantage of these approaches is the ability to quantify the results of infrastructure operation; the disadvantage is the need for a large amount of reliable data and the risk of reducing complex qualitative characteristics to a limited number of indicators.

In the field of digital infrastructure, similar ideas are implemented through:

- methods for assessing the digital maturity of enterprises (digital maturity assessment), which are widely used in international practice to measure business readiness for digital transformation;
- indicator systems for assessing access to digital infrastructure, e-commerce, remote work and the use of digital services in SMEs, offered in analytical materials from the OECD and other international organizations.

Such tools can be integrated into research on the infrastructure environment of entrepreneurship as a basis for constructing composite indices of regional infrastructure capacity.

The spatial approach allows assessing infrastructure as an element of the territorial organization of the economy. The main methods are regional analysis, clustering, geographic information modeling (GIS), and spatial accessibility indices.

The network aspect (Castells, 2010]) emphasizes the interdependence of subjects, the formation of partnerships, horizontal connections between business, state and science. Social network analysis (SNA) methods are used, as well as indicators of centrality, density and structural holes, which allow us to quantitatively assess the interaction in the infrastructure field.

The ecosystem approach views infrastructure as an interconnected set of economic, natural, and social processes. Adhitya, Dolan, and Tyler (2016) in their concept of “Rethinking Sustainable Infrastructure” propose three

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levels: natural, man-made, and socio-economic, the interaction of which ensures a balance between growth and sustainability.

Methodologically, the approach is based on multi-criteria analysis, sustainability indices, LCA life cycle assessment, and analysis of actor interaction within business ecosystems.

The cognitive-analytical approach reflects the current stage of digitalization of the economy. It combines econometric, information and cognitive methods for analysing the relationships between infrastructure elements. Neural network forecasting, machine learning, cluster analysis, PCA-component analysis, dynamic modelling of data panels are used.

Its advantage is high analytical flexibility and the ability to process large data sets; limitations are dependence on digital sources and the complexity of interpreting the results.

Table 1.15. Comparative analysis of methodological approaches

Approach	Essence	Methodological tools	Advantages	Limitation	Scope of application
Systemic	Infrastructure as a holistic system of interacting elements	Structural-functional analysis, system decomposition	Integrity, universality	Insufficient dynamism	General characteristics of the infrastructure structure
Institutional	Research on norms, rules, institutions	Content analysis, expert assessments, institutional mapping	Taking into account regulatory aspects	The difficulty of quantification	Assessment of the regulatory environment
Evolutionary	Analysis of historical phases of infrastructure development	Historical and comparative analysis, typology	Identifying the dynamics of change	Does not take into account spatial context	Studying the stages of development
Synergistic	Self-organization of the system, nonlinearity of processes	Scenario modeling, system dynamics	Explains complex relationships	High modeling complexity	Analysis of crisis and transition states
Spatial-network	Spatial distribution and interaction of actors	GIS, clustering, SNA analysis	Visualization of connections, spatial maps	Requires big data	Regional infrastructure analysis
Ecosystem	Balance between natural, man-made and social environments	Multi-criteria analysis, LCA, stakeholder analysis	Takes into account sustainability and interdependence	The difficulty of measuring intangible factors	Sustainable development modeling
Cognitive-analytical	Data analysis using AI and ML	Neural networks, regression modeling, PCA	High accuracy of predictions	Difficulties with interpretation	Infrastructure performance forecasting

Source: developed by the author

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A comprehensive study of the infrastructure environment of entrepreneurship requires the synthesis of several methodological approaches. The most effective is an integrated methodological model that combines system-institutional analysis (to determine the structure and regulatory mechanisms), spatial-network methods (to assess regional specificity) and cognitive-analytical tools (for forecasting). Such integration ensures the complexity and scientific verifiability of the results and also creates the basis for the formation of adaptive mechanisms for the development of entrepreneurial infrastructure in the digital economy.

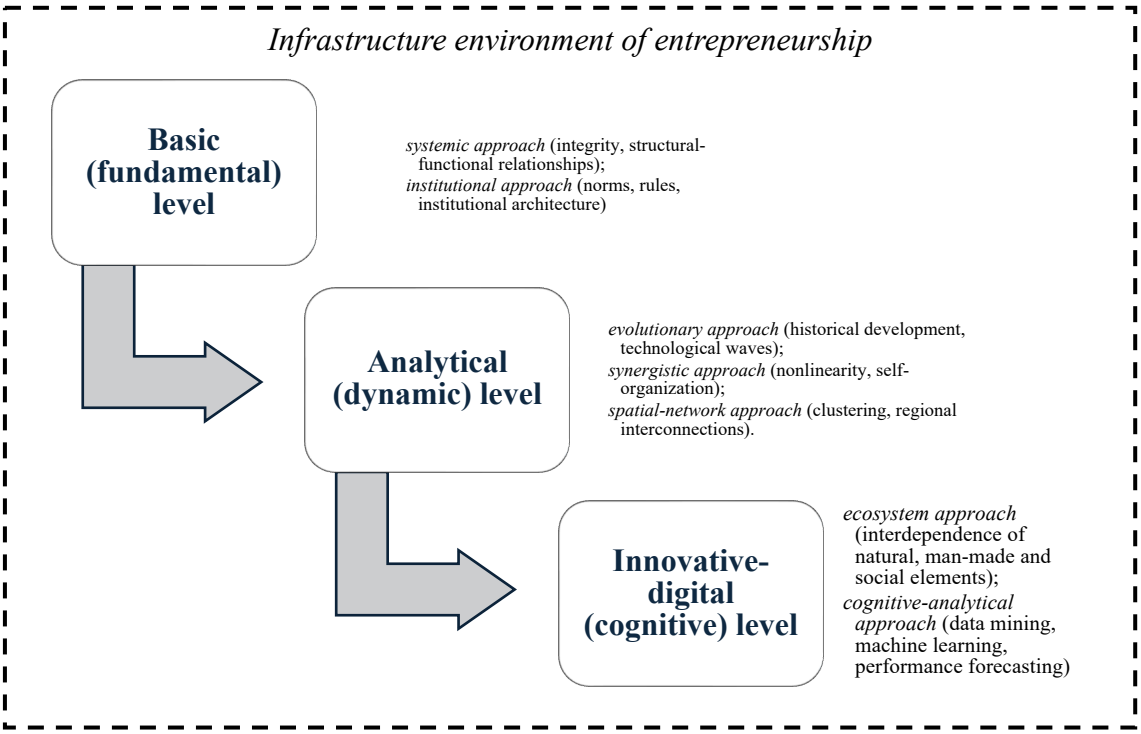


Figure 1.3. Integrated methodological model for researching the infrastructure environment of entrepreneurship

Source: developed by the author

The methodological model for studying the infrastructure environment of entrepreneurship reflects the gradual evolution of methodological approaches from systemic and institutional analysis to cognitive and analytical synthesis. The model demonstrates the integration of structural, dynamic and digital dimensions of studying entrepreneurial infrastructure.

The model has a three-level structure, reflecting the progression from classical to modern methodological approaches.

1. Basic (fundamental) level – covers approaches that determine the general structure and functioning of the business infrastructure:

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– *systemic approach* (integrity, structural-functional relationships);
– *institutional approach* (norms, rules, institutional architecture).

2. Analytical (dynamic) level – includes approaches that explain the evolution, self-organization, and spatial interaction of infrastructure elements:

– *evolutionary approach* (historical development, technological waves);
– *synergistic approach* (nonlinearity, self-organization);
– *spatial-network approach* (clustering, regional interconnections).

3. Innovative-digital (cognitive) level – reflects modern concepts of sustainable development and digital transformation of infrastructure:

– *ecosystem approach* (interdependence of natural, man-made and social elements);
– *cognitive-analytical approach* (data mining, machine learning, performance forecasting).

At the center of the model is the infrastructure environment of entrepreneurship as an integrated system of interaction of institutions, technologies and resources. The arrows between the levels show the interpenetration of approaches: from structural analysis to analytical and predictive synthesis.

The content of research on the digital infrastructure of SMEs and the digital economy indicates that infrastructure is considered as an ecosystem of interaction between the state, business, users and digital platforms. In works devoted to the digital infrastructure of small business support, it is shown that digital products and services are formed as a result of the interaction of state programs, international initiatives (EU4Business, U-LEAD, etc.), private platforms and services, which creates a multi-component environment for supporting entrepreneurship.

Based on this logic, in this section of the dissertation, it is appropriate to interpret the infrastructure environment of entrepreneurship as an ecosystem, the methodological study of which combines system-structural analysis (identification of elements and functions); institutional analysis (norms, rules, programs, strategies); network and spatial analysis (connections between actors, regional specifics); cognitive-analytical methods (indexes, maturity models, digital data panels).

3. Classification of digital infrastructure elements in the entrepreneurship support system. In the current conditions of digital transformation of the global economy, the infrastructure of entrepreneurship is increasingly acquiring a digital-network character, which changes traditional ideas about its essence, structure and functional relationships. If earlier infrastructure was considered mainly as a material and technical or

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institutional basis of business, now it is evolving towards the creation of an integrated digital environment within which financial, technological, informational and social elements of the entrepreneurial ecosystem interact.

Digital infrastructure is the core of the digital economy, ensuring the functioning of key business processes - communications, data exchange, financial transactions, resource management, access to markets and customers. It is the basis for the formation of digital business platforms, where interaction between business entities is carried out on the principles of openness, decentralization and integration.

In the scientific literature, the concept of "digital infrastructure" is interpreted in a multidimensional way. Some authors (Brynjolfsson & McAfee, 2017; Tapscott& Tapscott, 2020) focus on its technological nature, defining it as a set of information and communication systems, databases, algorithms and digital networks that provide information exchange and storage. Other researchers (Castells, 2010) consider it as a socio-institutional system that forms a new logic of economic organization based on knowledge, data and network interaction.

From the perspective of entrepreneurship, digital infrastructure is a set of interconnected elements that create conditions for the effective functioning, scaling and innovative development of business. It encompasses not only technical means, but also organizational, financial, communication and cognitive resources that form the digital competence of economic entities.

In general, the digital infrastructure of entrepreneurship is a system of technological, institutional and socio-communication elements that ensures the implementation of entrepreneurial processes in the digital environment through the creation, processing, exchange and use of data. It is not only a tool, but also the architecture of a new form of entrepreneurial interaction, in which the boundaries between the producer and the consumer, the company and the state, the market and the network are blurred.

The problem of classifying the digital infrastructure of entrepreneurship is to determine the criteria that allow reflecting its multidimensionality - technological, institutional, economic, social and environmental. Unlike traditional classifications of infrastructure (by industry, territorial or functional characteristics), digital infrastructure requires a multidisciplinary approach that takes into account:

- the dynamic nature of technological change;
- the network nature of the interaction of subjects;
- the role of information flows as a development resource;
- institutional and value dimension of digital behavior.

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The digital infrastructure of business is a complex system that combines technological, institutional and social components integrated into the processes of creation, transmission and use of data. It is a key element of the development of the digital economy, as it ensures the functioning of all spheres of economic activity based on information flows and communication technologies (Ukraiinska & Shifrina, 2023)

As noted by Ukraiinska & Shifrina (2023) the concept of digital infrastructure is inseparable from information infrastructure, because modern socio-economic processes are completely based on digital technologies that form new-type info communication networks - those that transform forms of work, management and communication (Ukraiinska & Shifrina, 2023). These networks form the environment for the emergence of new sociotechnical communities that function on the network principle. In this context, digital infrastructure appears not only as a technical framework, but also as a social system of interaction between business entities.

Shtets T. F. emphasizes that the digital economy sector consists of structural and functional components, including infrastructure, institutional, resource and functional subsystems (Shtets, 2023). The main subjects are business structures (IT companies, innovative enterprises, scientific and educational institutions, venture funds, financial organizations), the state as a regulator and consumer of digital technologies, as well as private users. This understanding allows us to attribute digital infrastructure to the class of general-purpose systems that have simultaneously production, service and regulatory functions.

In modern science, there are three main methodological approaches to classifying digital infrastructure elements:

1. System-structural approach - involves the separation of digital elements according to their functional role in the business system (information, financial, communication, analytical, management, etc.). Its essence is that the digital infrastructure acts as a holistic business support system, where each component performs a specific function, but they are all interconnected through digital data flows.

2. Institutional-network approach – focuses on the interaction of digital actors (platforms, government agencies, businesses, public structures) within a common information space. Here, digital infrastructure is viewed as a socio-economic network, where conditions are created for data exchange, trust, and co-creation of innovations.

3. Functional-value approach – focuses on the types of value that digital infrastructure creates for business, society, and the state: economic, social, innovative, environmental, institutional. This approach allows you to

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determine the priorities for the development of the digital ecosystem, taking into account the balance between efficiency, accessibility, ethics, and sustainability.

Taking into account the above approaches, the classification of elements of the digital infrastructure of entrepreneurship should be based on a three-sector analysis model, which includes:

- functional criterion – what does the element do;
- integration criterion - how it interacts with others;
- The value criterion is what benefit it creates.

This structuring allows us to define digital infrastructure not as a set of technologies, but as a multi-level system of business support that ensures sustainable business development in the digital environment.

In the modern scientific paradigm, the digital infrastructure of entrepreneurship is considered as a multi-level system of interacting components that ensure the formation, development and support of business processes in the digital environment. Its classification is a key methodological tool that allows not only to describe the structure of the infrastructure, but also to determine the mechanisms of its functioning, the relationships between subsystems and the impact on the dynamics of entrepreneurial activity.

The classification of digital infrastructure elements is based on three groups of criteria:

1. Functional – reflect the content and purpose of infrastructure elements in the business system;
2. Integration - characterize the level of inclusion of digital elements in the business ecosystem;
3. Valuable - defines the types of value created by digital infrastructures for the economy and society.

Such multidimensional structuring makes it possible to classify the digital infrastructure of entrepreneurship according to the content-functional logic reflected in Table 1.16.

The proposed classification of digital infrastructure reflects the systemic logic of its development as a complex open system in which technological, financial, informational, institutional and social elements interact. It allows us to reconcile the concept of "digital infrastructure" with the category of "entrepreneurial ecosystem", showing that digital technologies are not just a tool, but become the architectural basis of the interaction of economic agents.

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Table 1.16. Classification of elements of digital infrastructure of entrepreneurship

Classification criterion	Type of digital infrastructure elements	Content and functional purpose	Implementation examples
1. By functional purpose	1.1. Communication infrastructure	Ensuring interaction between business entities, information transfer, building digital networks	Telecommunications networks, Internet, 5G, IoT, corporate cloud communications
	1.2. Information and analytical infrastructure	Accumulation, processing and analysis of data for business decision-making	Cloud services, Big Data, BI systems, data centers
	1.3. Fintech infrastructure	Ensuring digital financial operations, transactions, and investments	Payment gateways, blockchain, digital banks, crowdfunding platforms
	1.4. Innovation and technological infrastructure	Support for innovation, development and transfer of technologies	Technoparks, accelerators, startup collaboration platforms, R&D centers
	1.5. Administrative and regulatory infrastructure	Ensuring digital governance, control and monitoring of business	Electronic registers, e-Government systems, “Diya”, electronic document management
2. By the level of integration into the business environment	2.1. Basic infrastructure	Forms the digital foundation of economic processes and communications	Internet, data centers, cybersecurity platforms, computing power
	2.2. Operational infrastructure	Supports business processes at the management, logistics, and marketing levels	CRM, ERP, SCM systems, e-commerce, cloud management platforms
	2.3. Strategic infrastructure	Creates innovative advantages, ensures the development of entrepreneurial ecosystems	Artificial intelligence platforms, digital twins, open data, analytical hubs
3. By type of value created	3.1. Economic value	Cost optimization, productivity improvement, digitalization of operations	Business automation, e-commerce, digital supply chains
	3.2. Social value	Expanding access to entrepreneurship, digital inclusion, SME participation	Online learning, business communities, crowdsourcing platforms
	3.3. Institutional value	Building trust, transparency, business ethics, risk reduction	Electronic audit systems, digital registers, open data
	3.4. Ecological value	Reducing energy consumption, monitoring sustainable production	Smart energy, “green” IT solutions, digital resource monitoring

Source: developed by the author

By functional criterion, the classification demonstrates the multi-directionality of digital infrastructure - from providing communications to regulation and control. This confirms that digitalization covers all levels of business activity - from production processes to institutional management.

The integration criterion reflects the evolutionary sequence of the development of the digital environment: from basic technological solutions (Internet, clouds) to operational business management systems (CRM, ERP)

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and strategic tools for innovative growth (AI, Big Data, digital twins). Such a structure allows you to identify the level of digital maturity of business systems and determine the directions of modernization.

The value criterion shows that digital infrastructure is a multidimensional source of value creation - not only economic, but also social, institutional and environmental. This approach correlates with the principles of ESG entrepreneurship (Environmental, Social, Governance), within which digitalization is seen as a mechanism for harmonizing profitability, sustainability and business responsibility.

Thus, the proposed classification has methodological and practical significance:

- from a scientific point of view, it forms the basis for a systematic analysis of the digital environment of entrepreneurship;
- from a practical perspective, it provides guidelines for state policy on digital transformation, the development of entrepreneurial platforms and digital business support services.

Digital infrastructure functions as a multi-level socio-technical system, where basic elements (technology, equipment, networks) interact with institutional (state regulators, associations, educational and scientific structures) and resource subsystems (human, intellectual, financial resources) (Ukraiinska& Shifrina, 2023).

L. Ukrainian and N. Shifrina (2023) showed that the effectiveness of digital infrastructure is determined by the degree of standardization and interconnection of elements, which ensures the integration of technologies, information systems and business processes. Without unified protocols, product codes and data formats, digital interaction becomes fragmented.

T. Shtets (2023) emphasizes that the functioning of the digital economy sector is impossible without resource, research and financial support, which determines the ability of business to implement new technologies and create products with high added value. That is why the classification of digital infrastructure should take into account the innovative-technological and institutional-legal dimensions.

To summarize, it can be stated that the digital infrastructure of entrepreneurship performs the following systemic functions:

- supporting – creates a technical basis for the business;
- integration - ensures interaction between entities;
- regulatory - carries out monitoring and management;
- innovative - promotes the development of new business models;
- social – forms an inclusive digital environment.

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Therefore, the classification of digital infrastructure elements not only reflects the structural organization of the digital economy, but also allows us to assess the ability of the economic system to self-organize, adapt, and develop innovatively in the context of the information society.

The digital infrastructure of entrepreneurship is formed as a multi-level socio-technical system, within which there is a constant interaction of technological, institutional, organizational and social components. Its system structure is determined by a combination of material and technical means, communication networks, digital services, management mechanisms and human capital, which ensures the adaptability and development of the business environment.

As Ukraiinska& Shifrina (2023) emphasize, digital infrastructure is not only a technical platform, but primarily a social and communication network in which market entities, state institutions and users interact. It forms a new type of socio-economic relations, where data becomes not just a resource, but a basic factor of production that determines the competitiveness of the enterprise.

T. Shtets (2023) identifies four main structural and functional components of the digital economy, which simultaneously form the digital infrastructure of entrepreneurship (Figure 1.4).

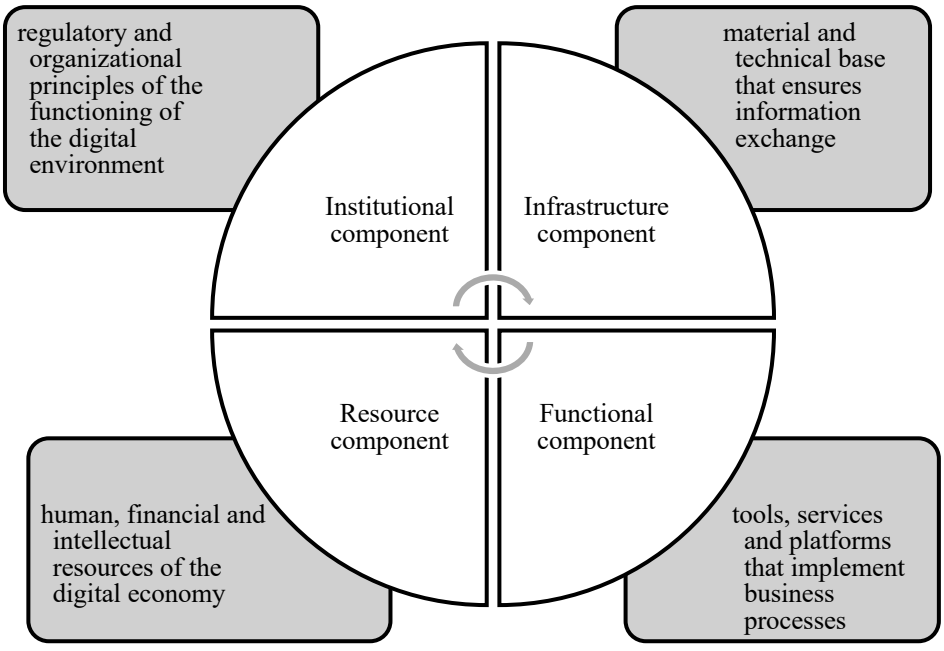


Figure 1.4. Structural and functional components of the digital infrastructure of entrepreneurship

Source: developed by the author

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In the systemic dimension, these elements interact according to the principle of information-functional synergy, where the technical base supports institutional regulation, and the resource component supports innovation processes. Such interaction ensures business adaptation to digital conditions and creates the potential for innovative development.

An important part of digital infrastructure is institutional support, which creates framework conditions for the functioning of business processes in the digital environment. Zatonatsky (2023) emphasizes the need for a unified strategic approach to the development of digital infrastructure, which covers both physical and service components. He suggests distinguishing between two interrelated categories - "hard" and "soft" digital infrastructure (Figure 1.5).

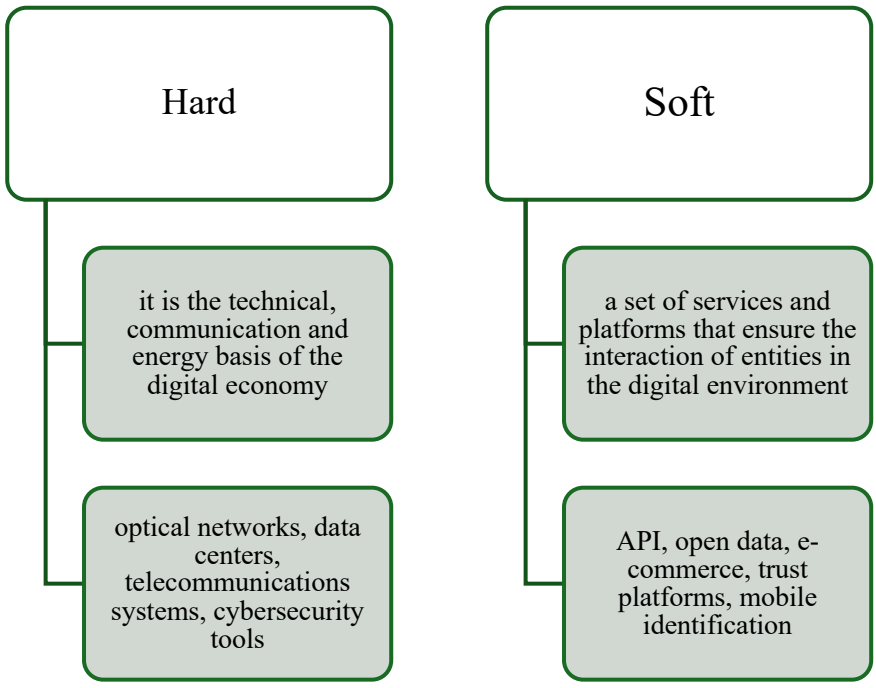


Figure 1.5. Digital infrastructure categories

Source: summarized by the author

The interaction between these components determines the level of digital maturity of the infrastructure. Without a strong “hard” foundation, trust services or digital ecosystems cannot function, while without the “soft” component, technical resources lose practical effectiveness.

Functional and role characteristics of key elements:

1. Communication infrastructure ensures information exchange between entrepreneurs, consumers and the state. It forms a digital space of

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trust, in which the key factors are data transfer speed, cyber resilience and reliability of services.

2. The information and analytical infrastructure implements the intellectual function of the system - accumulation, analysis and interpretation of data. According to the approach of T. Shtets (2023), it is this subsystem that creates the basis for making management decisions based on data (data-driven management).

3. Fintech infrastructure shapes the environment of cashless transactions, digital banking and crowdfunding. Its development is closely linked to the institutional framework, as it requires regulatory support for payment systems, blockchain platforms and the cryptocurrency market.

4. Innovation and technological infrastructure ensures the creation and transfer of innovations. It includes technology parks, startup accelerators, laboratories, R&D centers that contribute to the implementation of breakthrough technologies (artificial intelligence, machine learning, cloud computing). As noted by Ukrainska and Shifrin (2023), innovation structures are the core of the flexibility of the digital economy, ensuring its evolution and adaptation to new challenges.

5. Regulatory and administrative infrastructure coordinates legal relations between business and the state. It includes electronic government systems (e-Government), state registers, electronic document management, and services that implement the concept of one-stop service for entrepreneurs.

D. Zatonatsky (2023) proposes a "wave model" of digitalization, according to which the development of digital infrastructure occurs in stages (Figure 1.6).

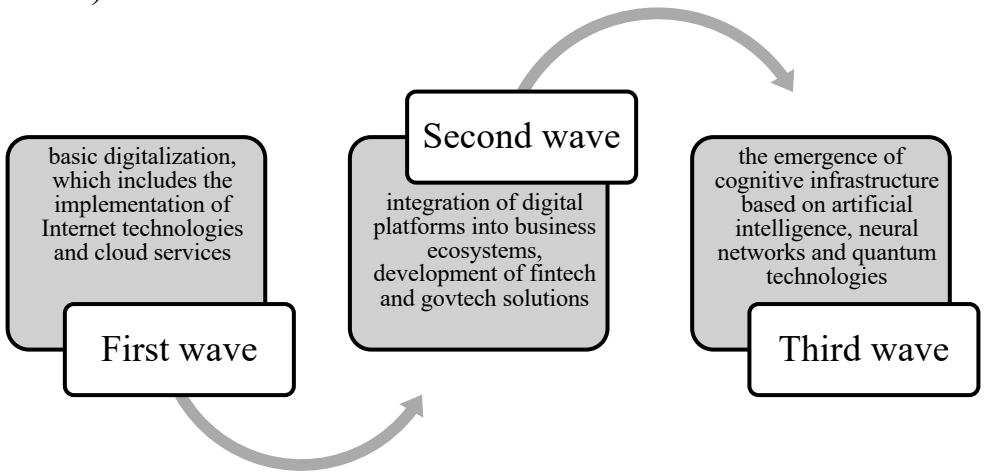


Figure 1.6. Wave model of the development of digital infrastructure of entrepreneurship

Source: developed by the author based on (Zatonatskii, 2023)

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Figure 1.6 presents the stages of the formation of the digital infrastructure of entrepreneurship, which occurs in three consecutive waves. The first wave characterizes the basic digitalization of economic processes, which includes the implementation of Internet technologies, cloud services and basic information systems. The second wave reflects the integration of digital platforms into business ecosystems and the development of financial and technological (fintech) and government digital (govtech) solutions. The third wave represents the transition to a cognitive infrastructure based on artificial intelligence, neural networks and quantum technologies, which ensure the intellectualization and autonomy of the digital environment of entrepreneurship.

Each subsequent wave means an increased level of integration between "hard" and "soft" infrastructure, an increasing role of data as an economic asset, and increased institutional interaction between the state and business.

Therefore, the systemic structure of the digital infrastructure of entrepreneurship is multidimensional: it combines technical, service and institutional levels, functions on the principles of synergy and self-organization, and its effectiveness is determined by the quality of interaction between elements, and not only by the scale of technical capabilities.

In this sense, digital infrastructure becomes an architecture of sustainable entrepreneurial development that integrates technologies, institutions, and values into a single ecosystem.

Conclusions. Based on the results of studying the theoretical foundations of infrastructure support for entrepreneurship, the theoretical foundations of infrastructure support for entrepreneurship were improved by developing a matrix model of “double multilevelness”, which combines the internal functional structure of infrastructure (institutional, financial, innovative, informational, logistical) with the external ecosystem environment (natural, technogenic, socio-economic, institutional and value). The model allows you to reflect the relationships between different types of infrastructure and levels of the environment, identify sources of synergy or systemic risks, and also provide a theoretical basis for strategic planning of the development of entrepreneurial ecosystems.

Definition provided digital infrastructure of entrepreneurship as a system of technological, institutional and socio-communication elements that ensures the implementation of business processes in a digital environment through the creation, processing, exchange and use of data. It is not only a tool, but also the architecture of a new form of business interaction, in which the boundaries between the producer and the consumer, the company and the state, the market and the network are blurred.

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It has been proven that the digital infrastructure of entrepreneurship is a system that combines technical, informational, institutional and social components, forming an environment for interaction between business, the state and consumers. It has a multi-level structure, encompassing both "hard" (hardware) and "soft" (software / service) subsystems, the interaction of which determines the level of digital maturity of the economy.

The proposed classification of digital infrastructure elements allows them to be systematized according to functional, integration and value criteria. At the same time, institutional support is a key factor in the development of digital infrastructure, as it forms the regulatory and organizational conditions for its sustainable functioning. An effective digital infrastructure contributes to the creation of a new entrepreneurial ecosystem based on innovation, trust, openness and orientation on the values of sustainable development.

Thus, the classification of the digital infrastructure of entrepreneurship not only reflects its structural and functional organization, but also determines the methodological basis for further analysis of national models of digital transformation of entrepreneurship, which will be considered in the next section of the study within the framework of assessing the current state.

The first section improves methodological approaches to studying the infrastructure environment of entrepreneurship by integrating structural and functional analysis (using the example of the digital economy sector) with institutional and network analysis of infrastructure, and develops an approach to classifying digital infrastructure as a combination of "hard" and "soft" components, which allows methodically separating technical (network, computing, security) elements from service and institutional and organizational ones.

An ecosystem framework for analyzing the infrastructure environment has been formed, in which the infrastructure of entrepreneurship is considered as the result of the interaction of state institutions, the private sector, international programs, and digital business support platforms.

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