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**NATIONAL INNOVATIVE SYSTEM:  
MODERN SCIENTIFIC APPROACHES TO ITS FORMATION**

**KRAJOWY SYSTEM INNOWACYJNY:  
NOWOCZESNE PODEJŚCIA NAUKOWE DO FORMACJI**

**НАЦИОНАЛЬНАЯ ИННОВАЦИОННАЯ СИСТЕМА:  
СОВРЕМЕННЫЕ НАУЧНЫЕ ПОДХОДЫ К ФОРМИРОВАНИЮ**

*Abstract*

The article explores modern scientific approaches to the formation and development of a national innovation system in Ukraine. The importance of solving the problem is due to the fact that the existing innovation system is at the initial stage of its formation, and its development will ensure the formation of the economy as innovative. The authors note that the use of models of national innovation systems of other countries cannot be applied in Ukraine without taking into account the peculiarities of its socio-economic

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development. Therefore, an analysis of modern approaches and their adaptation to the conditions of the country is necessary.

As modern approaches to the formation and development of the national innovation system, the ecosystem and cross-sectoral are studied. The ecosystem approach allows the formation of an innovative system based on the interactions of state, business and research structures. This allows you to use all kinds of resources in the mechanism of transformation of knowledge into an innovative product.

It is shown that the joint activity of participants in the innovation process leads to the elimination and overcoming of borders between existing sectors of the economy, which contributes to the manifestation of cross-sectoral cooperation. The authors believe that cross-sectoral cooperation occurs at all levels of government (international, state, regional, local) with the participation of all interested parties from different sectors of the economy. According to the authors, the cross-sectoral approach is an integral part of the ecosystem approach. Their use in aggregate increases the efficiency of interaction between participants in innovation.

The authors note that the effectiveness of the development of the national innovation system can be determined by the introduction of digital technologies, which are used not only in all sectors of the economy, but also to create new segments and industries. That is why the development of a national innovation system requires a transition to the digital economy as its innovative component.

**Keywords:** national innovation system, modern approaches, ecosystem approach, joint activity of participants in the innovation process, cross-sectoral cooperation, interaction between sectors of the economy, digitalization of the innovation ecosystem.

#### Streszczenie

Artykuł analizuje nowoczesne podejścia naukowe do tworzenia i rozwoju krajowego systemu innowacji na Ukrainie. Znaczenie rozwiązania problemu wynika z faktu, że istniejący system innowacji znajduje się na początkowym etapie jego powstawania, a jego rozwój zapewni ukształtowanie gospodarki jako innowacyjnej. Autorzy zauważają, że stosowanie modeli krajowych systemów innowacji w innych krajach nie może być stosowane na Ukrainie bez uwzględnienia specyfiki jego rozwoju społeczno-gospodarczego. Dlatego konieczna jest analiza nowoczesnych podejść i ich dostosowanie do warunków kraju.

W związku z nowoczesnym podejściem do tworzenia i rozwoju krajowego systemu innowacji badany jest ekosystem i sektor. Podejście ekosystemowe pozwala na stworzenie innowacyjnego systemu opartego na interakcjach struktur państwowych, biznesowych i badawczych. Pozwala to na wykorzystanie wszelkiego rodzaju zasobów w mechanizmie przekształcania wiedzy w innowacyjny produkt.

Wykazano, że wspólna aktywność uczestników procesu innowacyjnego prowadzi do zniesienia i przekroczenia granic między istniejącymi sektorami gospodarki, co przyczynia się do przejawu współpracy międzysektorowej. Autorzy uważają, że współpraca międzysektorowa odbywa się na wszystkich szczeblach administracji (międzynarodowej, państwowej, regionalnej, lokalnej) z udziałem wszystkich zainteresowanych stron z różnych sektorów gospodarki. Według autorów podejście międzysektorowe stanowi integralną część podejścia ekosystemowego. Ich łączne zastosowanie zwiększa efektywność interakcji między uczestnikami innowacji.

Autorzy zauważają, że skuteczność rozwoju krajowego systemu innowacji można określić poprzez wprowadzenie technologii cyfrowych, które są wykorzystywane nie tylko we wszystkich sektorach gospodarki, ale także do tworzenia nowych segmentów i branż. Dlatego rozwój krajowego systemu innowacji wymaga przejścia do gospodarki cyfrowej jako jej innowacyjnego elementu.

**Słowa kluczowe:** krajowy system innowacji, nowoczesne podejścia, podejście ekosystemowe, wspólna aktywność uczestników procesu innowacji, współpraca międzysektorowa, interakcja między sektorami gospodarki, digitalizacja ekosystemu innowacji.

#### Аннотация

В статье исследованы современные научные подходы к формированию и развитию национальной инновационной системы в Украине. Важность решения проблемы обусловлена тем, что существующая инновационная система находится на начальном этапе своего формирования, а ее развитие позволит

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обеспечить становление экономики как инновационной. Авторы отмечают, что использование моделей национальных инновационных систем других стран не могут быть применены в Украине без учета особенностей её социально-экономического развития. Поэтому необходим анализ современных подходов и их адаптация к условиям страны.

В качестве современных подходов к формированию и развитию национальной инновационной системы исследованы экосистемный и кросс-секторальный. Экосистемный подход позволяет формировать инновационную систему на основе взаимодействий государственных, предпринимательских и исследовательских структур. Это позволяет использовать все виды ресурсов в механизме трансформации знаний в инновационный продукт.

Показано, что совместная деятельность участников инновационного процесса приводит к устранению и преодолению границ между существующими секторами экономики, что способствует проявлению кросс-секторального сотрудничества. Авторы считают, что кросс-секторальное сотрудничество происходит на всех уровнях управления (международный, государственный, региональный, местный) с участием всех заинтересованных сторон разных секторов экономики. По мнению авторов, кросс-секторальный подход является составной частью экосистемного подхода. Их использование в совокупности повышает эффективность взаимодействия участников инновационной деятельности.

Авторы отмечают, что эффективность развития национальной инновационной системы можно определить по внедрению цифровых технологий, которые используются не только во всех секторах экономики, но и для создания новых сегментов и отраслей. Именно поэтому для развития национальной инновационной системы необходим переход к цифровой экономике как инновационной ее составляющей.

**Ключевые слова:** национальная инновационная система, современные подходы, экосистемный подход, совместная деятельность участников инновационного процесса, кросс-секторальное сотрудничество, взаимодействие между секторами экономики, цифровизация инновационной экосистемы.

**Formulation of the problem.** The formation of the national innovation system in Ukraine is at the initial stage of its formation. In this regard, considerable attention has been paid to this issue by the authorities, researchers and scientists. This is evidenced by the adoption of the «Innovative Development Strategy of Ukraine for the period up to 2030» [1] and numerous works of scientists on issues in this field. Indeed, the introduction of a developed innovation system will allow the country to move on the path of innovative development, solve many issues of socio-economic nature, taking into account the goals of sustainable development. That is why research into the formation of a national innovation system using modern scientific approaches is appropriate and by the due date.

**Analysis of the recent researches and publications.** The issue of formation of the national innovation system in Ukraine, its peculiarities and directions of development have been studied by such national scientists as L. Artemenko, V. Gryga, A. Karpenko,

O. Kovtun, Y. Plugin, O. Hort, P. Tsybuliyov, L. Shapovalova, I. Yanenko, L. Yaremko. It has to be noted that in the process of the national innovation formation system, the issues of its development within the regions whose solution depends on the effectiveness of regional innovation systems are becoming increasingly relevant. The study of this aspect of the problem has attracted the attention of the following domestic scientists: C. Bendasyuk, I. Brikova, S. Gorblyuk, I. Kornilova, I. Mushenik, M. Pashkevich, A. Poruchnyk, L. Fedulov, and many others. However, despite significant scientific developments, the question of introducing modern approaches to the formation of the national innovation system in Ukraine, such as ecosystems and cross-sectoral cooperation, has not been sufficiently investigated yet.

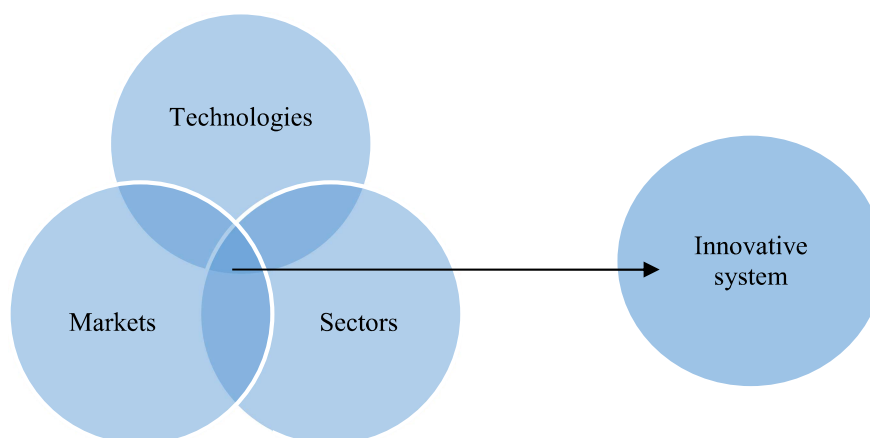
**Setting objectives** is to provide scientific justification for the use of modern approaches to the national innovation system development in Ukraine.

**Presentation of the main research**

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**material.** It is well-known that the development of the world industry is characterized by the rapid pace of new technologies introduction into production, in connection with which there is a process of global integration between existing

sectors, markets and technologies. As a result, an innovative system is formed that is devoid of the industry principle of organization of the production process and experience the insufficiency of a clear structure (Fig. 1).



*Source: compiled by the authors*

**Fig. 1. Creation of an innovative system in the global economy**

Issues on the country's innovation system development are becoming more and more urgent, as it contributes to raising the level of innovation of the national economy, creating favourable conditions for the development of the innovations and eliminating existing negative trends in Ukraine. As it is known, there are many models of national innovation systems in the world, but they cannot be applied in Ukraine completely, because they do not take into account the peculiarities of its socio-economic development. That is why studying and implementing the experience of other countries requires adaptation to national conditions in Ukraine. Therefore, it is advisable to analyze the effective scientific approaches that will help to build a national innovation system in the country. One of these approaches is the ecosystem one, which has recently received much attention from domestic and foreign researchers [2; 3; 4; 5; 6; 7].

It is necessary to point out that the concept of «ecosystem» has been borrowed by economists from biology science and means a set of living organisms that have adapted to coexistence in a particular habitat, forming with it an integral whole. It is this characteristic of

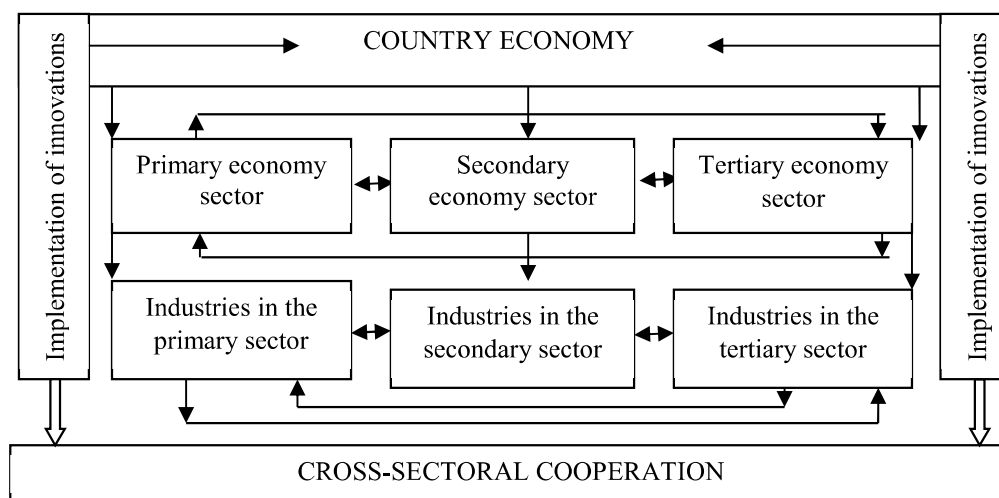
the ecosystem that contributed to the formation of the ecosystem approach to the development of innovation, resulting in the formation of the so-called innovative ecosystem.

An innovation ecosystem models economic rather than energy dynamics of complex relationships that are formed between actors or entities whose functional goal is to enable technology development and innovation [2, p. 2]. The innovation ecosystem consists of business participants, start-ups, academia, technical and support services, and the individuals that drive results. An ecosystematic approach to innovation is nothing less than a structured approach to analyzing the innovation system [3]. The term «innovation ecosystem» refers to interorganizational, political, economic, environmental, and technological systems of innovation through which an environment conducive to business growth is stimulated and supported. An innovative ecosystem is a network of relationships through which information and talent flow through systems of joint creation of sustainable values [4]. The innovative ecosystem represents the synergy of the state, business and research environment with the use of organizational,

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regulatory, educational, methodological and financial resources and introduction of the mechanism of knowledge transfer for alteration into innovative products [6, p. 258]. The innovative ecosystem involves the formation of horizontal relationships within the framework of the interactive innovation process, where the creation of zones of innovative development is based on the creation of specialized structures whose operation is aimed at supporting innovation activity [7, p. 245]. It has to be emphasized that the application of an ecosystem approach in the development of the national innovation system will increase the likelihood of transition of the Ukrainian economy to innovative development.

It is worth noting that the joint activities of the participants of the innovation process influenced the removal and eliminating of the boundaries between existing sectors of the economy and their industries, which not only extended the value chain but also contributed to the development of cross-sectoral cooperation, the introduction and development of which, in the authors' opinion, is considered expedient and actual in Ukraine (Fig. 2). Based on the above-mentioned, it can be stated that the cross-sectoral approach is an integral part of the ecosystem, which increases the effectiveness of interaction between the participants of innovation activities.



**Fig. 2. The process of forming cross-sectoral cooperation**

*Source: compiled by the authors*

It is important to take into consideration that the terms «sector», «cross-sector» and «inter-sectoral cooperation» are not used in the texts of regulatory acts in Ukraine. However, in the public administration dictionary, such definitions are given to terms that relate to the topic of the study as cross-sectoral policy, cross-sectoral interaction, inter-sectoral interaction, inter-sectoral relations.

Cross-sectoral public policy is a kind of public policy based on an approach that recognizes the need to agree on it in different areas (sectors) through the presence of common cross-cutting issues that can be addressed if all stakeholders' efforts are combined. The

reference to such a policy is present in the international legal acts and acts of some foreign countries. It is the understanding of the integrity of public policy that requires the cooperation of representatives of different spheres of public administration. Cross-sectoral interaction and coordination are considered in two aspects: first, between different sectors of the public sphere (education, healthcare, youth, culture, industry, ecology, etc.), which in Ukraine is defined as interagency, inter-sectoral, inter-ministerial cooperation, as well as cooperation between public authorities and local self-government bodies; secondly, between different public sectors (public, non-profit and business) [8,

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p. 77-78].

Inter-sectoral interaction is a joint activity of state authorities, local governments, non-governmental and international organizations at the central and regional levels in various spheres of socio-economic development of the country, which implies a change of the paradigm of public administration from the traditional bureaucratic administration, the transition from the concept of state-centrism regulation of public relations, networked form of public administration and a new way of managing on an equal basis, partnership, transparency, cooperation [8, p. 90].

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Inter-sectoral relations are a special type of relations between public authorities, business structures and non-profit organizations, in which they enter to effectively solve social (socio-economic, political, cultural) problems and achieve the goals of stable social development [8, p. 90].

Having analyzed these terms, the authors can conclude that in the field of public administration, researchers emphasize the feasibility of applying cooperation between different sectors of the economy on the basis of partnership and equality to more effectively address the problems of socio-economic nature and achieve the goals of sustainable development. This justifies the need to use an approach such as cross-sectoral collaboration, which has not been studied by researchers and scholars of different fields of knowledge in Ukraine.

Therefore, in authors' opinion, cross-sectoral cooperation is a management approach based on interaction that takes place at all possible levels (international, national, regional,

local) with the participation of all stakeholders representing different sectors of the economy (public, private) and non-profit sectors; primary, secondary, or tertiary sectors) or industry, non-profit sector. As a result of their activities, a synergistic effect is formed and goals are achieved that can meet the requirements of all participants of this cooperation on the basis of partnership and equality.

The authors believe it is advisable to use the term «cross-sectoral cooperation» in the study of innovation processes in the national economy, as well as in the development of the national innovation system.

It is worth mentioning that the term «cross-sectoral cooperation» is close in meaning to the term «inter-sectoral cooperation» since in both cases there is some interaction between the sectors of the economy or between its industries in order to solve certain common issues. However, the term «cross-sectoral cooperation» is broader in its meaning than the term «cross-sectoral cooperation», since the sector of the economy includes the relevant industries. It has to be noted that the interaction between industries that belong to different sectors of the economy will be related to cross-sectoral cooperation (or inter-sectoral cooperation within the framework of cross-sectoral cooperation). At the same time, the interaction of industries within one sector of the economy will be related to inter-sectoral cooperation (Fig. 3).

There are several different ways of dividing the economy into sectors: by historical evolution, by the hypothesis of three sectors of the economy. Thus, the existence of modern economic systems in the country, according to the hypothesis of three sectors, can be characterized by the presence of three areas of activity as follows:

the first sector of activity, represented by the primary sector of the economy, its composition includes those industries whose products are raw materials for other industries (e.g. agriculture, forestry, mining);

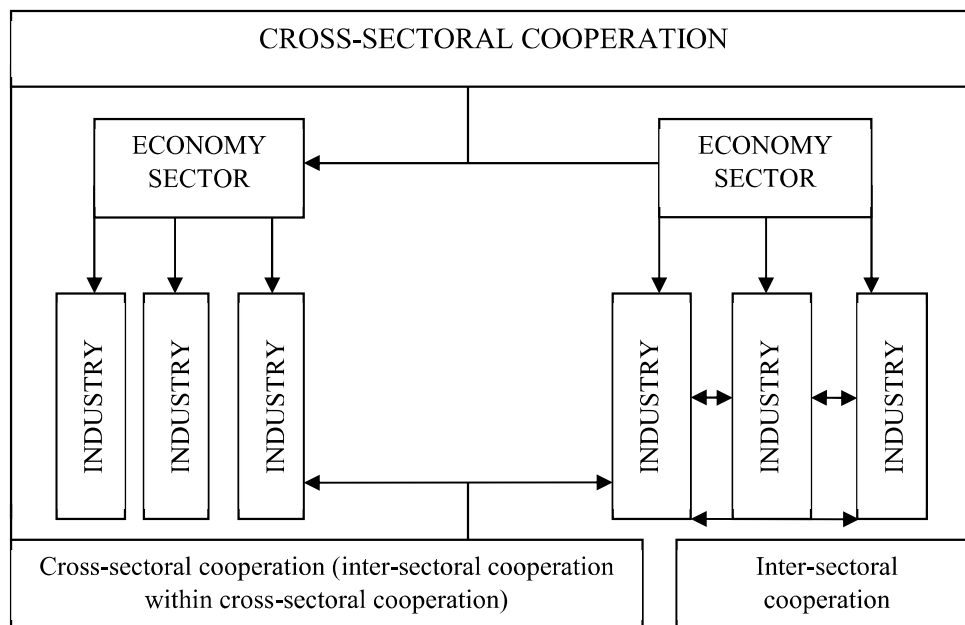
the second activity, which is formed by the secondary sector of the economy, which includes industries capable of converting raw materials (products of the primary sector of the economy) into a finished product suitable for

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consumption (e.g. construction and manufacturing);

the third sector of activity, formed by the tertiary sector of the economy, namely the provision of services, includes activities that contribute to the production process, such as financial and banking institutions, transport and information, education and medicine.

For instance, according to some researchers, there is also a forth sector, to which information technologies belong. Others argue that it is necessary to divide the existing tertiary sector into constituents, thereby allocating five sectors in the economy. In addition to these sectors, the economy is divided according to public, private or non-profit sectors.



Source: compiled by the authors

Fig. 3. The difference between the terms «cross-sectoral cooperation» and «inter-sectoral cooperation»

The main parameter for the innovative ecosystem efficiency is the quality of interaction between its participants, which is largely determined by the level of digital technologies implementation. Digital technology permeates all sectors of the country's economy and dramatically changes them, as well as change the very structure of the economy, creating new segments and industries. Therefore, the transition to the digital economy in Ukraine is appropriate and actual, as evidenced by the content of the project Ukraine 2030 – a country with a developed digital economy [9], which is an integral part of the Economic Strategy of Ukraine 2030 [10]. This Strategy identifies two scenarios for the

development of the digital economy in Ukraine, depending on the criticality assessment and the need for rapid and profound changes in the traditional economic environment: inertial (evolutionary) and target (forced). If the first scenario is implemented, Ukraine's economy will remain inefficient, labour migration will continue, and the manufactured products will be uncompetitive in foreign markets. If the second scenario predominates, which lasts for 5-10 years, there will be a transition to the digital economy, making Ukraine a leader among the European countries in the field of innovation development and introduction of new technologies by 2030, thus becoming an intellectual hub, which will create favourable

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conditions for the human potential development. According to the Digital Agenda of Ukraine 2020 [11], the impact of digital transformation will be most significant in sectors such as energy, engineering, agriculture, health care, education, government, services, retail, transportation and logistics.

It is worth noting that in August 2019, an evaluation mission of the European Union was launched in Ukraine to assess the readiness of Ukraine's telecommunications sector to integrate with the EU Digital Single Market (DSM) [12]. The DSM Strategy is seen as Europe's main asset, aiming at adapting European society and the business environment to new conditions in the international arena. The use of this strategy will facilitate the effective development of various sectors of the country's economy that use digital technologies for

innovation, which will allow them to remain competitive globally. According to European experts [12], a single digital market can bring the EU an additional € 415 billion annually, creating hundreds of thousands of jobs. In connection with what the new Committee of Digital Transformations of the Verkhovna Rada of Ukraine is being formed in Ukraine, the corresponding bill «On Electronic Communications» is being prepared, which certifies the intention of Ukraine to enter the single digital market of the EU countries.

Unfortunately, official statistics in Ukraine do not have data on the size of the digital economy. Such data are estimated by researchers, in particular based on numerous studies by international organizations on the impact of digitalization (Table 1).

**Table 1. Impact of the digital economy on Ukraine's GDP (projected values)**

Indicator	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Internal market for information and communication technologies (ICT consumption), billion USD	2.0	2.5	3.0	4.5	6.0	8.0	10.0	12.0	14.0	16.0
Impact on GDP, percentage of growth	+0.5	+1	+2.0	+3.5	+4.5	+6.0	+7.5	+9.0	+11.0	+14.0
Digital economy share of total GDP, %	3	5	8	11	15	20	28	40	52	65

Source: systematized by the authors according to the data given in [9; 11].

Consumption of ICT products and services allows concluding on the level of modernization, productivity and efficiency, which also testifies to the country's competitiveness. Thus, according to forecasts [11], ICT consumption will increase by 14 billion USD in 2030, compared to 2021, which will lead to a GDP growth of 14.0%.

The impact of digitalisation at the macro-level is determined by the added value created for each industry or sector, or for a particular product or service at the micro-level. Thus, at

the macro-level, this added value represents a corresponding share of the increase in the total GDP, which indicates a part of the digital within the traditional-analogue economy. In this regard, the digital economy is not the ICT industry represented by ICT companies, but all other industries and sectors of life that perform as consumers of ICT technologies: industry, financial sector, agricultural sector, transport, medicine, education, insurance, tourism and others.

Taking into account the forecast data [11],

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the share of the digital economy in the total GDP of Ukraine will increase from 3.0% in 2021 to 65.0% in 2030, which indicates the effectiveness of the transition to such an economy. This will help create favourable conditions for the development of the innovative ecosystem using cross-sectoral cooperation in Ukraine.

**Conclusions from the conducted research.**

The development of an innovative system in Ukraine is a priority task, which is enshrined at the legislative level and aims at modernizing the country's economy. The necessity to use the ecosystem approach for the effective development of the innovation system in the country has been substantiated in the article. It has been determined that cross-sectoral cooperation has to be applied within the ecosystem approach. Thus, it has been noted that the activities of participants in the innovation process resulted in the removal and

closing of the boundaries between the existing sectors of the economy, as well as their industries. Such processes have contributed to the cross-sectoral cooperation development, the introduction and advancement of which, in the authors' opinion, is appropriate and actual in Ukraine. Therefore, it is possible to resolve many issues of socio-economic nature, taking into account the goals of sustainable development. Attention is drawn to the fact that the effectiveness of the innovation system development in the country can be determined by the introduction of digital technologies that not only permeate all sectors of the country's economy leading to their changes but also create new segments and industries. This is why the transition to the digital economy is very important. Due to this, by 2030, Ukraine is expected to become a leader among European countries in the field of innovation development and introduction of new technologies.

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