

# МАКРОЕКОНОМІЧНІ АСПЕКТИ СУЧАСНОЇ ЕКОНОМІКИ

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## **Розбудова екосистеми національної економіки в умовах технологічних трансформацій**

У статті висвітлено сутність поняття технологічних трансформацій та їх види. Розглянуто основні виклики Індустрії 4.0 та визначено інструментарій формування інноваційної екосистеми економіки. Обґрунтовано пропозиції щодо державного сприяння створенню нової парадигми розвитку економіки країни.

**Ключові слова:** екосистема економіки, технологічні трансформації, науково–технічний прогрес, бізнес–інкубатори, технопарки, індустриальні парки.

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## **Формирование экосистемы национальной экономики в условиях технологических трансформаций**

В статье изложено суть понятия технологических трансформаций и их видов. Рассмотрено основные вызовы Индустрии 4.0. и определено инструментарий формирования инновационной экосистемы экономики. Обосновано предложения по государственному содействию в создании новой парадигмы развития экономики страны.

**Ключевые слова:** экосистема экономики, технологические трансформации, научно–технический прогресс, бизнес–инкубаторы, технопарки, индустриальные парки.

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## **Development of the national economy ecosystem in conditions of technological transformation**

The article deals with the concept of the technological transformation and its forms. Made an overview of the main Industry 4.0. challenges and defined an economy innovation ecosystem instruments. Also, the author justification proposals of the state assistance to create a new paradigm of country economic development.

**Keywords:** economy ecosystem, technological transformation, science and technical progress, business incubators, technoparks, industrial parks.

**Problem definition.** A decisive feature of the modern world is a number of long-term transformations characterized by extremely fast and profound transformations of socio-economic life, conditioned both by fundamental technological innovations and by powerful socio-cultural shifts of a global scale. That leads not only to changes in the economic and social conditions of life, but also to a new philosophy of life and ways of world civilization development, which also requires the coordination of technological, innovation and industrial policies with the use of modern approaches and tools.

**Analysis of the latest works and publications.** Challenges that generate transformational processes and tools used by the state to regulate these processes are currently at the focus of domestic and foreign scientists. The fundamentals of the methodology of these questions are laid down in the works of J. M. Keynes, R. Harrod, J. Robinson, K. Wicksley, A. Spitoff and J Schumpeter. Domestic scientists also examine various aspects of scientific and technological changes and the levers of state regulation of these processes, in particular, the works of V. Heyets, O. Bilous, I. Burakovsky, A. Khodzhaian, T. Romaniuk, Z. Galushka, L. Karanatova, L. Musina are devoted to this issues. However, a significant range of theoretical and practical issues concerning the justification and effective measures of state governance of the process of developing the ecosystem of the country's economy remains unresolved.

**The purpose of the** article is to justify the proposals on the use of certain levers of state regulation of technological transformations of the country's economy in order to develop the innovation ecosystem.

**Statement of the main materials.** Technological and transformational shifts are a rather complicated and painful process, as they occur unevenly, thus creating gaps between countries in economic development and global imbalances. This process is extremely controversial and conflictual and can lead to the emergence of completely unpredictable new world leaders who are best absorbed and mastered in the future by the latest technologies and new principles of social and economic activity organization and will be able to effectively manage the change in the social structure.

The essence of the technological transformation concept lies in the fact that this is a continuous process of development of science and technology, which

leads to a qualitative change in economic and social development. Technological transformations can take place in evolutionary and revolutionary forms.

The evolutionary form of technological transformation involves the production of techniques and technologies, which are improved on the basis of already known scientific knowledge. An example of this form of transformation is the development and improvement of steam energy, electricity or atom, and so on.

The revolutionary form is based on a completely new scientific ideas transition to techniques and technology. An example is the transition from hand tools to machines, the replacement of steam energy by electric or atomic, the use of laser and other modern technologies, etc.

At the present, powerful country leaders, leading scientists and economists talk about the transformation of society, looking at them from different angles. According to international organizations, in particular the United Nations (UN), the Organization for Economic Cooperation and Development (OECD), the International Energy Agency (IEA) and many experts, the world is at the beginning of a major technological transformation [1], which is given a completely different name: a third industrial revolution, industry 4.0, fifth technology revolution, sixth long wave of economic development, Society 5.0.

In response to these challenges, technological country leaders, supported by international organizations, are striving to ensure the manageable development of advanced technologies, while simultaneously improving the efficiency of existing technologies and processes. Organizational and economic principles of national scientific, technological and innovation systems are being improved and coordination of technological, innovation and industrial policy is being strengthened.

The consequence of the entry of countries into the 4th industrial revolution is controversial – it has both significant advantages and threats. In particular, in Davos, 2016, global economists predicted that «the rich country will become richer, and the poor (who do not have the technology or do not have time for them) – even poorer» [2].

Thus, the question arises of overcoming the technological lag of production and the transition to a knowledge economy that is possible on the basis of a developed innovation ecosystem, which includes a knowledge generation environment based on fundamental research, an effective system of educa-

tion, science, research communities, innovation infrastructure, venture capital investments, sustainable demand for innovations, etc. Innovative ecosystem is a network community whose members combine their resources on mutually beneficial terms to achieve innovative results; represent adaptive organizations that create and use knowledge, transform them into innovative products, new technologies and possess the characteristic features of network interaction, the presence of a common innovation infrastructure, the combination of goals and values. An important trend in the evolution of organization models of innovation processes is the transition to a model of open innovation, based on the use of internal and external sources of innovation.

Without rejecting the ideas of national technological development at the expense of technology diffusion, domestic scientists warn about the deliberate restriction of the developed countries' access to potential technologies to the new technologies at the stage of their implementation and growth. In spite of copying transformational economies and countries with emerging markets, borrowed technologies, the technological gap between countries continues to be substantial, and between individual groups of countries it is even growing. While in developed countries' 70–85% of their GDP is formed by high-tech manufacturing, in Ukraine this share is less than 6%. When producing 0.49% of world GDP, the share of science-intensive products of Ukraine in the world market is 0.05 – 0.1% [3].

Despite the sufficient world experience in the building of innovative ecosystems, there is no exhaustive list of sufficient conditions for the success of a national innovation ecosystem, as each country has individual characteristics (climatic, geopolitical, socio-cultural, resource, etc.). Each country,

territory, corporation, institution must define individual methods of managing the formation and development of innovative processes to achieve success in innovation activities.

But at the same time, based on the evolutionary approach to the development of innovations, the necessary conditions for the formation of innovative ecosystems are known: the society's awareness of the need for innovation, the choice of strategic priorities, the high level of financing of science (at least 4% of GDP per year), high (world) education level, relevant legislation in the field of financing, taxation, institutions of innovative organizations, as well as reduction of bureaucratic procedures in the field of innovation business, commercialization and technology transfer [4].

The analysis of the research and development that existed in the industrial society, and models of strategic innovation systems of the corresponding post-industrial societies, reveal the main stages of the formation of innovative ecosystems (see Table).

1. The stage of resource concentration is characterized by an increase in research and development potential and the formation of an appropriate innovation and entrepreneurial climate, primarily for start-ups and small innovation companies, deforming the innovation ecosystem, overcoming contradictions between research centers and industry.

The result of this stage is the formation of the starting elements of the innovation ecosystem – the emergence of a network of personal contacts and joint projects between representatives of scientific, government and business communities.

2. The stage of transformation of the region's economy and the formation of an innovative ecosystem.

This stage is characterized by a symbiosis of technological start-ups, small innovative enter-

**Stages of the formation of innovative ecosystems**

Stage Name	Essence of the stage
1. Resources concentration	Increase of research potential and formation of innovative climate
2. Transformation of the region's economy and the formation of an innovative ecosystem.	Integration at the regional level of technological start-ups of small innovative enterprises of large high-tech business and formation of clusters of high-tech companies and innovative competencies, development of regional innovative policy of support of innovative entrepreneurs
3. Innovative and technological breakthrough	The growth of large high-tech companies, technological start-ups, the formation of the market for venture investments and the mechanism of risk sharing
4. The maturity of an innovative ecosystem	The created innovation infrastructure becomes more technological and scalable; development of own brand of innovation ecosystem, creation of new technological chains on the basis of international co-operation

Source: [4]

prises and a large high-tech business; in addition, stable clusters of high-tech companies are created; regional governance is moving into an active policy of supporting innovation entrepreneurship and creating the necessary innovation infrastructure for this; Large-scale advertising and PR-campaigns are being held to create a new brand of the region as an innovation center.

3. The stage of innovation and technological breakthrough is the rapid growth of turnover of large high-tech companies and their transformation into global players; a significant increase in the number of technological start-ups; formation of the market of venture investments and the mechanism of division

4 The maturity of an innovative ecosystem.

The created innovation infrastructure of innovative enterprises support works efficiently, becomes more «technological» and scales; the development of its own brand of innovation ecosystem; embedding in existing and creating new technological chains based on international cooperation.

The global scale of the changes actualizes the task of creating a modern innovation ecosystem capable of ensuring the competitiveness of industrial production on the basis of a breakthrough in high technology, national security and ensuring sustainable socio-economic development [4].

However, the effectiveness of the ecosystem of the economy depends primarily on the number and status of small and medium-sized enterprises, hence, one of the important tasks of the economic policy of development of the ecosystem is support for small businesses, including those that have the power to grow into medium and large, as a rule it is an innovative high-tech business [5].

Innovative business is, first of all, the need for financial resources, in particular venture capital. In fact, the venture capital is the main source of funding for the development of innovative entrepreneurship. In the absence of a sufficient volume of venture capital in the country, provision of innovative development is impossible. Contrary to world practice, in Ukraine, only the finance is understood by the notion of venture capital. But this is, above all, a technological and risky business, which is related and depends on the availability of certain infrastructure. This infrastructure includes technoparks, business incubators, industrial parks, technology transfer centers and information support for innovation, and

the relevant ideology and culture, special entrepreneurial resources that enable the realization of human and scientific capital, and the construction of business, which would become competitive not only on the national but also on the world markets. In the conditions of the latest innovation model, the state should act as an innovative entrepreneur and venture capital investor, in addition to the main function – regulation (legislative, regulatory acts aimed at supporting innovation activities).

In Ukraine, due to the domination over the years of resource and energy-intensive industries and technologies, raw orientation of exports and excessive concentration of production in industrial regions, a development management structure has been formed that is generally ineffective. Structural and technological changes that are currently occurring must be subject to continuous and qualified monitoring and scientific analysis, which can professionally be exclusively provided that an appropriate strategically oriented economic and scientific and technological policy is carried out.

Ukraine's attempts to follow the main tendencies of transformational shifts namely Industry 4.0. is a rather provocative topic. Reducing the share of industry in GDP during 2006 – 2016 years from 28% to 14%, an increase in depreciation of fixed assets till 80%, increase in the share of commodities in exporting countries (50% in 2015), a decrease of volumes of engineering exports fell from 12 billion in 2011 to 4.7 in 2015, all these are the main consequences of de-industrialization scenario Ukraine, which shall really dangerous. At the same time, low rates of innovation and investment attractiveness testify to this scenario.

Such trends will lead to a complete transformation of Ukraine into a raw material state, a threatening fall of the domestic market for industrial automation products, ICT and other high-tech products. The domestic consumption of high-tech goods is less and less, which leads not only to a re-orientation of exports (in the volume of IT is already 90%), but also to the outflow of the country's most skilled personnel. If do not change the structure of the economy in the coming years the country will be waiting for the economic fading and the final consolidation of the place of raw material appendage of Europe and the World.

We can observe the reverse policies in the EU member states. According to the Industry 4.0

document from the European Parliament, the industrial sector generates up to 80% of exports and employs 80% of its R&D capacity [6]. Europeans and the US are talking about re-industrialization and returning industrial production from China to their countries. The EU is also planning to target the 4.0 R&D potential to compete equally with the US and Asian countries and earn an additional 1.4 trillion euros by 2025 and create more than 600 thousand new jobs. Eurofunds for 4.0 already reach more than 1 billion euros today.

Another example of an already functioning innovation ecosystem is Turkey with its full cycle of «growing» businesses to the size of large powerful companies. Turkey's policy is shaped in such a way that business incubators, technoparks and industrial parks are interconnected and create favorable conditions for the development of innovative entrepreneurship and the growth of small and medium-sized businesses.

A particular advantage of the Turkish system is the provision by the state of tax benefits for firms operating in the technoparks and industrial parks. Tax privileges relating to the taxation of technological parks and industrial parks will be in place by the end of 2023, and then their operation will be revised, although they have already been reviewed and prolonged for 10 years. Firms operating in the technological parks and industrial parks are exempt from corporate tax, VAT and stamp duty. Employees employed at the technopark companies are exempted from paying income tax, and employers pay only 50% of the established insurance premiums, which must be paid into social funds. In addition, with the introduction of new rules relating to the activities of technology parks, the scope of the opportunities offered to firms operating in the technoparks area have been expanded. For example, if technological parks have available insufficient funds, the Ministry of Industry of Turkey pays financial assistance to the workers of these firms in order to support new firms registered on the territory of technoparks [7].

That is, based on the above, we can observe trends in the development and building-up of innovative ecosystems around the world, the formation of appropriate state policies and the attraction of necessary domestic and foreign investment.

Ukraine is currently beginning to catch up with developed countries with a delay of 5–7 years [2], despite the fact that there is no financial basis for the implementation of the planned initiatives. Such

a «catch-up» pathway can lead to an eternal lag behind the highly developed countries and, in the long run, will lead to even more impoverishment and economic decline.

Analyzing the current situation in Ukraine, it is worth to note that there is still a shift in this direction. In Ukraine, there are more than 30 industrial parks, such as IP «Myrotske», Industrial Park «Vinnitsa cluster of refrigeration engineering», Industrial Park «BIONIC HiLL», Industrial Park «Central» is initiated, also exist more than 20 technoparks, namely «Kyiv Polytechnic», UnitFactory, Institute of Electric Welding named after. E.O. Paton, Institute of Single Crystals and the Institute of Semiconductor Physics named after. V.E. Loshkarev.

In addition, for their functioning and development in Ukraine there is more than 60 proactive investors, represented in various forms, including venture companies, venture funds, as well as expert support at primary level – association of business angels, startup incubators and business-accelerators. Their representatives are BorschVenture, EY Start-up Accelerator, Growth Up, StarUp Marani, 408 Ventures, SMRK VC Fund, UAngel and others.

This infrastructure provides some very slow shifts in the development of the innovation ecosystem, which in turn would create conditions for the state competitiveness on the world market and the introduction of a new paradigm of economic development.

Despite the presence of at least insignificant innovation infrastructure in Ukraine, the problem of innovation development still appears. These barriers and low competitiveness in comparison with other countries arise from the lack of scientifically grounded innovation and industrial policies and tools of state support, not regulation, namely support, win-win promotion on partner terms.

Therefore, on the basis of the analysis of world development trends, a number of state support measures are defined that need to be implemented in order to develop an innovative ecosystem, in particular:

Identify the priority sectors of the country and the fields of the national economy and provide them with financial resources as an integral part of this direction and to improve the legislative regulation of the venture industry.

Stimulate high-tech production and innovation through the development of innovative infrastructures.

The industrial infrastructure consists of industrial parks, which will ensure the sustainable econom-

ic growth of the regions, increase the well-being of local residents by creating favorable conditions for attracting domestic and foreign investments into the regional economy, introduction of modern technologies and the best world experience in the organization of industrial production, efficient functioning and development of industrial enterprises, increase revenues to local budgets and the State Budget of Ukraine, creation of modern industrial, transport and logistic and market infrastructure.

Research activities of Industrial Parks should focus on innovative startup incubators or business accelerators. Their creation involves the formation of an effective interaction between science and business in order to bring the latest scientific and technological developments to practical application and commercialization, to implement the original scientific and technical ideas of domestic small and medium enterprises. And the last component should be business angels who will act as mentors.

To develop an effective mechanism of state aid for innovative entrepreneurship with the use of state-commissioned instruments, tax breaks, financial support for wages, preferential connections and utilization of communications, etc. [8].

At the same time, to support the policy of a green economy: water-saving, clean energy, the use of modern high-energy saving technologies and materials, modern alternative energy sources and high-tech engineering equipment, etc.

To increase the stability of the economy and to disable the scenario of economic development based on the model of «impoverishment».

### Conclusions

Considering the world transformational tendencies, it is necessary to introduce unique approaches in the national scientific-technological, innovation and investment spheres of state regulation taking into account the experience of high-tech economies of the world, taking into account the characteristics of resource, technological and innovation base of the country. Such an approach will provide an econom-

ic and social breakthrough, in particular a shift away from raw materials to high-tech, GDP growth, welfare improvements and, more importantly, will provoke changes in the paradigm of economic development.

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