

1. INNOVATION FACTORS AND POLICY FOR NATIONAL DEVELOPMENT

1.1 Innovation policy within the sustainable development framework

Acceleration of globalization processes and intensification of international competition at the beginning of the XXI century require the world's leading countries to seek and implement new options for innovation policy as a means of improving the quality of economic growth.

The goal of sustainable development is to make the most efficient use of limited resources and to create more compact and sustainable communities that meet security requirements¹. Sustainable development can also be defined as «creating the conditions necessary to maintain the function of the organization indefinitely»². The authors consider human capital, financing, natural resources and technology. The security approaches also consider increasing energy efficiency, reducing costs and resource consumption, as well as developing sustainable products / materials and «net-zero» energy consumption, in particular through product life cycle assessment³.

The analysis of the positions given in Resolution of the OSCE Parliamentary Assembly «Strategic forecasting in the field of science, technology and innovation in the interests of sustainable development», allows us to identify the main tasks of managing the innovation component in the context of sustainable development:

- use of new technologies, digital economy and science in solving global environmental problems;
- the use of new technologies as a tool for creating new jobs and development opportunities that increase the demand for digital skills and knowledge, which in turn creates the need to master digital skills and knowledge, so that societies can adapt and benefit from technological change;
- strategic forecasting to ensure that technologies meet the demands and

¹ Goran W., Napier Th., Schneider R. and Stumpf A. Building Green. In Hartman J., Butts K., Bankus B., Carney S. (ed.). Sustainability and National Security. Center for Strategic Leadership United States Army War College Carlisle, Pennsylvania. 2012. pp. 447-482.

² Hughes K., Bankus B. Sustainability: A Lens for National Security. In Hartman J., Butts K., Bankus B., Carney S. (ed.). Sustainability and National Security. Center for Strategic Leadership United States Army War College Carlisle, Pennsylvania. 2012. pp. 29-56.

³ Cockerill K. (2012). The Department of Defense offers a Strong Offense for Promoting Sustainability. In Hartman J., Butts K., Bankus B., Carney S. (ed.). Sustainability and National Security. Center for Strategic Leadership United States Army War College Carlisle, Pennsylvania. pp. 57-84.

needs in different areas;

– strategic forecasting and evaluation activities should assist policy makers and stakeholders in implementing the 2030 Agenda for Sustainable Development by identifying difficulties and opportunities that can be considered from a strategic point of view, and that trends in innovation should be analyzed taking into account the broader socio-economic conditions.

State innovation policy, through the use of political, economic and administrative instruments, was mainly aimed at improving the functioning of society, creating new sectoral segments of the national innovation system, developing the institutional environment, stimulating innovation behavior of individual firms.

However, modern theory and practice of state regulation states that innovation policy can not ignore economic regulation and at the same time can not be a continuation of industrial policy or policy in education and science, but is an interconnected system of measures of three policies (Fig. 1.1).

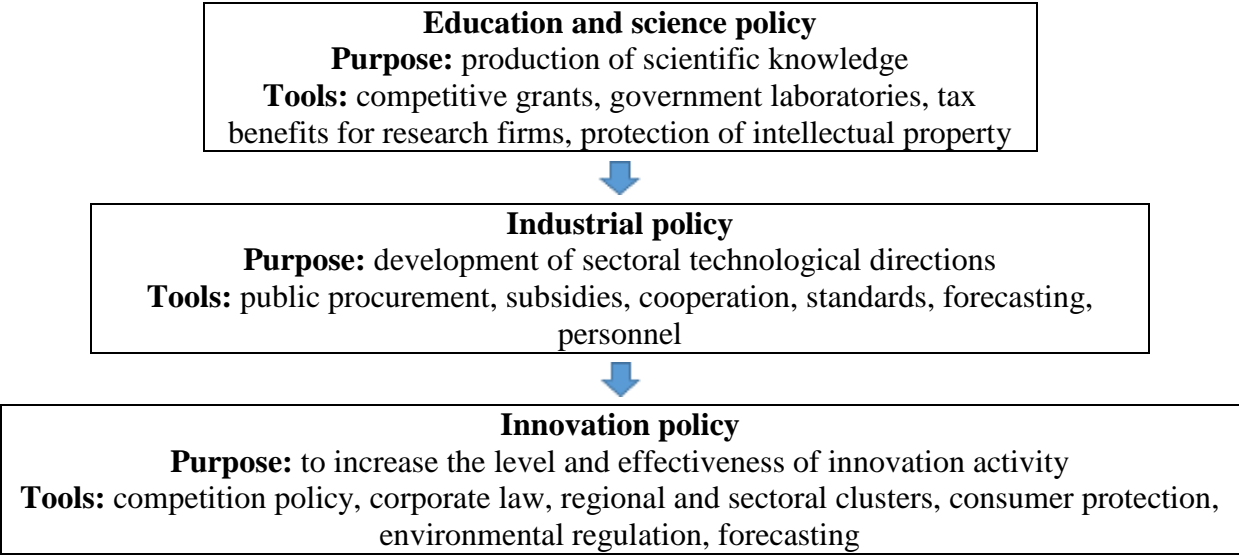


Fig. 1.1. Scheme of innovation regulation

Therefore, the development of innovation policy requires coordination and coordination of decisions between different participants in economic and social life. The implementation of a balanced set of measures within the three components of innovation regulation is an important task of state regulation of innovation development depending on the socio-economic challenges facing the country and a key condition for efficiency. In the light of modern challenges of innovative development, the center of gravity in the complex of state regulation

in Ukraine is shifting towards technological (or industrial) policy.

Innovation policy in the narrow sense is a set of government decisions that directly stimulate innovation processes in the business sector of the economy. It involves the use of mechanisms such as:

- state financial assistance to enterprises through the provision of grants, loans, subsidies for the development of innovative products, technologies, services;
- financing of programs or projects designed for the development of cooperation and interaction of participants in the innovation process, and, consequently, to improve the functioning of the national innovation system as a whole;
- simplification of access and dissemination of information on specific aspects of the national innovation system (development of sectoral, regional strategies, forecasts, dissemination, replication of the experience of the best innovation enterprises, etc.);
- improving the legislative support of innovation (the right to intellectual property, legislative regulation of the creation and operation of innovative firms, tax incentives, etc.);
- financing of innovation infrastructure (innovation centers, business incubators, technology transfer centers, etc.).

But these measures of the state and instruments of its influence alone, without taking into account the economic climate in the country, the level of development and the relationship between science and industry, etc., can not lead to the expected results. The coordination of the interests of all participants in the innovation process is often solved by developing a national program, i.e. development strategy, and then there is a process of embedding various mechanisms to achieve these national goals in the policy of each ministry or agency. In Ukraine, the order of the Cabinet of Ministers of Ukraine of July 10, 2019 approved the Strategy for the development of innovation for the period up to 2030, which identifies the main barriers to innovation in Ukraine, formulates directions and ways to solve problems, outlines the timing and expected results and an assessment of the implementation of the Strategy¹.

Another problem of innovation policy is to determine the responsibility of various participants, which ensure the dynamic nature of innovative

¹ On approval of the Strategy for the development of innovation for the period up to 2030 Order of the Cabinet of Ministers of Ukraine № 526-r of July 10, 2019. <https://zakon.rada.gov.ua/laws/show/526-2019-%D1%80>

development and the introduction of new methods of interaction between business and the state. It is important in this process to bring domestic business, both large and small, to the realization of the need for more active participation in the innovation process as a whole, including research. Thus, the creation of a favorable business environment is seen as a prerequisite for stimulating innovation.

Due to the revision of the principles and philosophy of innovation policy, a more rational attitude to priorities in the context of limited budget resources in most developed countries there is a reduction in the role of large, expensive government programs, and sometimes a complete abandonment of them in favor of supporting institutions and mechanisms participants in the innovation process: scientists, inventors, entrepreneurs, managers. The role of the system of financial and economic incentives that ensure the mutual interest of producers and consumers of innovations in national innovation systems is increasing. This course is achieved by a set of measures of industrial and policy in the field of science, as well as selective impact on certain infrastructural elements of the technological process. Government instruments for influencing technological trends are not so much the proclamation of priorities as government procurement with a large share of IP in industries that meet government needs, direct and indirect subsidies to socially significant science and education, support for fundamental interdisciplinary projects, forecasting, economic and political support for national high-tech manufacturers.

In particular, the priority should be given to the development of basic research, which is a component of public policy not only in developed but also in dynamically developing countries. The responsibility of the state's political institutions for the development of science is connected both with its mainly budgetary funding, which has historically tended to grow, and with the significant multiplier effect of research results that determine long-term progress in all spheres of life. An example of the implementation of the priority of basic research is the public policy of China, where the growth rate of spending on science was twice as high as GDP growth. Due to significant financial infusions, as well as increasing requirements for basic and applied science in China (publications in international journals, international cooperation, etc.), there has been a strengthening of many scientific areas and in general – the role of China in world science. 16,2% – China's share in global nominal GDP in 2019 (IMF estimate), which is 95 times higher than in Ukraine and almost 7 times higher

than Russia's GDP¹.

With the intensification of global rivalry in all spheres of world development – from economics and politics to values and ideology, demography and the environment – the influence of external factors that shape the functioning of national innovation systems is growing.

Until recently, for the advanced countries of the world – the leaders of innovative development, the task of strengthening their own competitive advantages was solved either nationally or in cooperation with developed countries with similar social and institutional foundations of science and technology. In the new environment, when industry, science, technology, information and even management become global, there are conflicts and contradictions of a fundamentally new nature. And these contradictions are not always removed by traditional methods of innovation policy.

Thus, any state must adapt its national innovation system from «national» policy to the rapidly changing realities of globalization, strengthen its own non-state key advantages for «asymmetric» response to competitors, link «open innovation» strategies with new mechanisms to support its own radical innovations, compensation for «failures» of both the market and the state itself. The sooner this complex adaptation occurs, the greater the potential risk and possible success. The current stage of development is characterized by fierce competition of national policies, the effectiveness or failure of which depends not so much on internal factors, but largely on external conditions of development.

1.2 European experience of development and implementation of innovation policies for the development of economic systems

Today's globalized world continues to face significant social, economic and environmental challenges, and the economy encourages governments to seek new approaches to innovation. A key condition for the accelerated socio-economic development of countries in the XXI century is an effective innovation policy, the ultimate goal of which is to implement scientific and technological progress (priority fundamental and applied R&D, invention), new,

¹ Mishin O. Ukraine's place on the map of China: a comparative analysis of GDP. Retrieved from https://zik.ua/blogs/mistse_ukrainy_na_karti_kytaiu_porivnialnyi_analiz_pokaznykiv_vvp_966742.

advanced, revolutionary technologies, technology, new forms of labor organization and management, innovative inventions.

Every developing country, including Ukraine, now faces an innovative challenge. The share of expenditures for scientific and scientific-technical work in the gross domestic product of Ukraine in 2017 was only 0,45%¹. Today there is a choice: either the reduction of economic, industrial and production potential of the country will be compensated at a high scientific, technical and technological level, i.e. due to a sharp increase in innovation activity, or the country will be pushed back not only by GDP but also by technological capabilities. by the level of economic development from highly developed countries. Therefore, the study of positive European experience in the development and implementation of innovative policies for economic systems is appropriate and important to reduce the vulnerability of the domestic economy to global challenges such as depletion of natural energy resources, aging populations, increasing income differentiation, environmental degradation. These challenges require rational response measures at the level of innovation policy, the launch of fundamentally new innovative strategies for the development of the national economy.

The share of the world's leading leaders in R&D spending, which is defined in dollar purchasing power parity, which reflects the real value of investment and allows for greater comparability by eliminating differences in price levels between countries, is shown in Fig. 1.2.

In the 1980s, the countries of the European Union proclaimed a policy of closing the innovation gap between Europe, America and Japan. However, according to experts, they did not achieve real results even with the existence of a significant number of programs for the development of basic science in these countries, the mechanism of transforming scientific ideas into commercial products in demand by markets did not work. EU countries have paid considerable attention to the development of basic science, contrary to the process of innovation that existed in Japan and the United States. The policy of technological protectionism has led to the exact opposite results. According to experts from the National Academy of Engineering, Europe is 2 times behind

¹ On approval of the Strategy for the development of innovation for the period up to 2030. Order of the Cabinet of Ministers of Ukraine. № 526-r. July 10, 2019. Retrieved from <https://zakon.rada.gov.ua/laws/show/526-2019-%D1%80>

the pace of renewal of US production processes, Japan – 3 times¹.

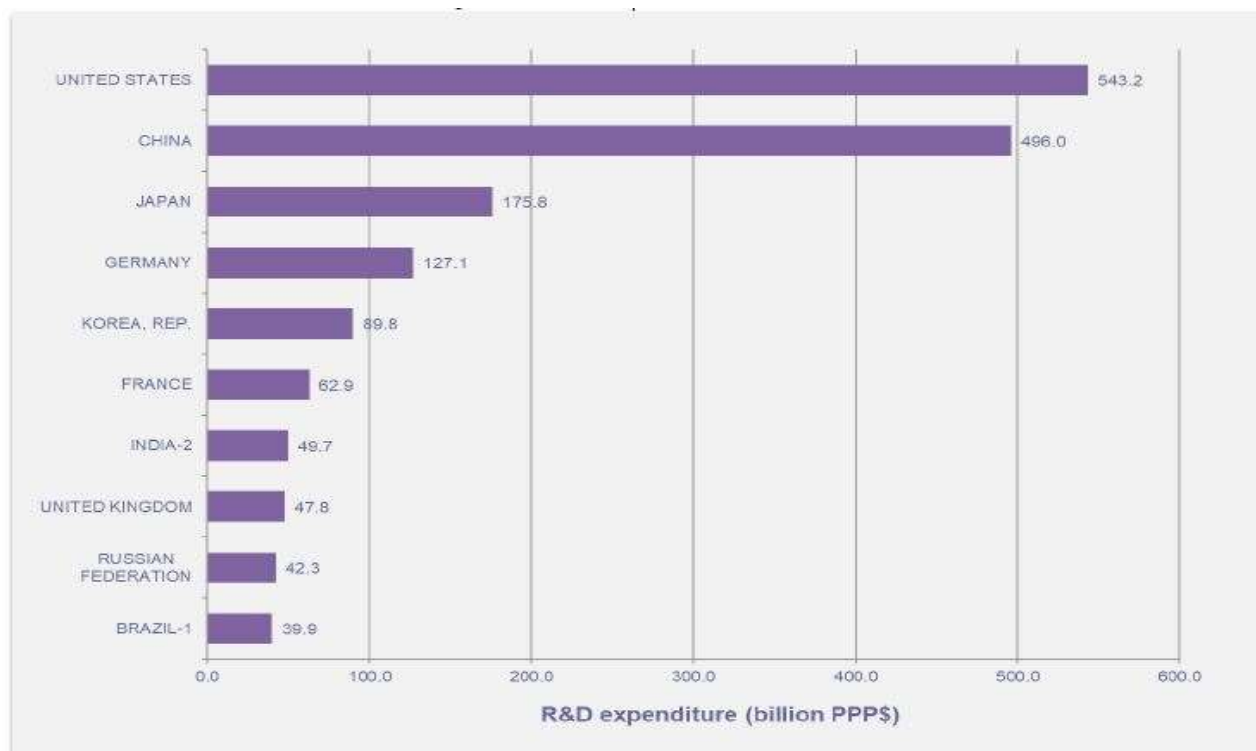


Fig. 1.2. Ranking of 10 world leaders in R&D investment in 2017 (billion, USD)

Table 1.1. The share of expenditures for scientific and scientific-technical work in the gross domestic product in 2016²

Regions of the world	Weight, %
Countries of North America and Western Europe	2,4
Countries of East Asia and the Pacific	2,1
Countries in the world	1,7
Central and Eastern European countries	1,0
Latin America and the Caribbean	0,7
Arab countries	0,6
Countries of South and West Asia	0,5
Southern Sahara countries	0,4
Central Asian countries	0,2

¹ Nikonova Ya.I. Innovation policy in the system of state regulation of sustainable development of the national economy. Novosibirsk: NGTU Publishing House, 2010.

² Global Investments in R&D. UIS Fact Sheet No. 54. June 2019. Retrieved from <http://uis.unesco.org/sites/default/files/documents/fs54-global-investments-rd-2019-en.pdf>.

By the way, in Europe less than in the USA and Japan, small venture business is developed and the ideology of centralized (state and banking) support dominates. For banks that finance, as a rule, individual industries, the possibility of project failure is unacceptable.

Thus, the lack of significant progress in innovation development, the backwardness of the main competitors in terms of R&D expenditures (USA, Japan), the problems associated with EU enlargement, population aging - these factors have formed the basis for a competitive innovation economy. At the EU summit in Lisbon in 2000, the «European Innovation Policy» was formulated for the first time, setting out priorities for innovation¹:

- improving the innovation environment by strengthening the innovation component of all areas of national policy and their integration;
- stimulating market demand for innovation and the use of the concept of «leading» markets, which provides support for markets that are most receptive to innovation;
- stimulating innovation in the public sector, overcoming the bureaucratic conservatism of the state administration;
- strengthening regional innovation policy.

Among the principles of the Lisbon innovation reform, the most important provisions are:

- development of services in the field of technology dissemination and transfer;
- development of cooperation between different subjects of the national innovation system with the creation of growth points and networks;
- development of the system of international knowledge transfer;
- development of broad public support for the purchase of innovative products and services;
- facilitating access to internal and external financing;
- strict observance of intellectual property rights;
- strengthening the innovation potential of SMEs.

New strands of the EU's innovation policy strategy are reflected in the Sixth R&D Framework Program, which aims to create a dynamic and competitive intellectual economy in Europe. The program identified 7 priorities:

¹ European Trend Chart on Innovation. 2002 European Innovation Scoreboard: Technical Paper No 3. EU Regions. November 28, 2002. Retrieved from https://ec.europa.eu/regional_policy/archive/innovation/pdf/library/trendchart_en.pdf.

- creation of an information society;
- nanotechnologies and nanoscience, multifunctional materials, new devices and production processes;
- quality and safety of food;
- protection of the environment and creation of ecosystems;
- the population of large cities and the problems of knowledge-based management in society.

Thus, innovation reforms have been aimed at developing a «knowledge economy» in Europe by stimulating research, improving education policy, developing information technology and creating a favorable innovation climate. In addition, the goal of innovation policy is to liberalize the European system of services, transport and energy markets. At the same time, the main emphasis is on the need to modernize the European model of social security, increase employment, reform the social security system and reduce social benefits. The task of achieving sustainable development was further included in the agenda of the Stockholm Summit in March 2001. At the Barcelona Summit in March 2002, EU leaders formulated a number of specific tasks in the field of stimulating innovation development, which were set out in 2003 in the European Commission's Communication «Innovation Policy: Modern Approaches in the Context of the Lisbon Strategy» and decided that investment in R&D, as a share of GDP, should increase from 1,9% in 2000 to 3% in 2010¹.

In the EU countries, the European Research Area (ERA) was created in 2000 as part of innovation policy, as a system of research programs that combine the scientific resources of the European Union. ERA includes European technology platforms through which industry and other stakeholders develop joint long-term visions and strategic research programs in areas of interest to business.

Framework programs for research and technology development are a powerful tool for implementing innovation policy within the ERA. Funding volumes and mechanisms for the implementation of framework programs provide ample opportunities for international cooperation with non-EU countries to participate in program competitions in order to obtain funding for joint research projects in all thematic sections and areas.

One of the key mechanisms for implementing the Europe 2020 program is

¹ Innovation policy: updating the Union's approach in the context of the Lisbon strategy. https://ec.europa.eu/growth/content/innovation-policy-updating-unions-approach-context-lisbon-strategy-0_en.

the framework programs, which include basic research and commercial technological development (pre-competitive research), which combine the components of R&D. Each of the eight Framework Programs of the European Union has specific objectives and measures for their implementation.

At the beginning of the 21st century, EU countries have succeeded in implementing the Lisbon Strategy. The next step towards the creation of a single European Research Area was the European Union's Seventh Framework Program for Research, Technological Development and Innovation (2007-2013), which used the experience of previous framework programs and aimed to increase the impact of knowledge on Europe's economy and society. . The European Commission published a Green Paper in 2007 entitled «The European Research Area: New Perspectives»¹, which contains six priority areas for the development of the European Research Area:

- joint use of knowledge (open access of scientists to the results of other scientific research), first of all applied research of commercial direction;

- development of the state infrastructure of world-class scientific research (improvement of the legislation for the purpose of increase of volumes of investments);

- strengthening of state research institutions (increase of financing, autonomy, improvement of legislative and normative norms of cooperation with the private sector);

- optimization of European research programs and priorities (simplification of normative rules and procedures of EU research funding systems, harmonization of national funding programs, etc.);

- openness of the world: international cooperation (formation of common research priorities for all EU countries and improvement of cooperation conditions for researchers from non-EU countries).

- formation of a single European labor market for researchers from different countries (improvement of conditions in order to increase the level of mobility of research potential).

On January 1, 2014, the implementation of the eighth Framework Program Horizon 2020 began, the budget of which is about 80 billion euros. The program provides for the implementation of measures in the following priority areas:

- 1) generation of advanced knowledge to strengthen the position of the

¹ The European Research Area: New Perspectives. Green paper. Brussels, 2007. <https://eur-lex.europa.eu/legal-content/GA/TXT/?uri=celex:52007DC0161>

European Union among the world's leading scientific powers (funding by 2020 – 24,4 billion euros);

2) achieving industrial leadership and business support, including small and medium-sized enterprises and innovation (funding – 17 billion euros);

3) solving social problems in response to modern challenges (funding – 29,7 billion euros);

4) research related to non-nuclear energy, «low-carbon economy», «green energy» (funding – 1,6 billion euros)¹.

The Horizon 2020 Framework Program aims to strengthen Europe's global competitiveness, economic growth and job creation.

In addition, the EU program has new features compared to the previous ones, in particular:

- simplification of the program structure, development of one set of rules, reduction of bureaucratic red tape due to a simple reimbursement scheme, introduction of a single approach for participants, etc. with the general goal to reduce the average grant period to 100 days;

- interaction of research and innovations by providing funding from idea to market entry;

- increasing support for innovation and activities close to the market, leading to direct economic stimulation;

- focus on developing business opportunities related to societal challenges;
- providing greater opportunities for new participants and young promising scientists to promote their ideas and obtain funding².

Global competition is intensifying and Europe needs to deepen its innovation and risk-taking capability to compete on a market increasingly defined by new technologies.

That is why the Juncker Commission is introducing a European Innovation Council to turn Europe's scientific discoveries into businesses that can scale up faster. Currently in its pilot phase, the European Innovation Council will become a full-fledged reality from 2021 under the next EU research and innovation programme Horizon Europe.

The Commission launched in 2017 the pilot phase of the European Innovation Council, introducing open competitions and face-to-face interviews

¹ Strategic plan 2016–2020. Joint Research Centre. Retrieved from https://ec.europa.eu/info/publications/strategic-plan-2016-2020-joint-research-centre_en

² Horizon 2020: EU Research and Innovation Framework Program. Retrieved from <https://www.kmu.gov.ua/storage/app/media/uploaded-files/broshura-gorizont-2020-1201.pdf>

to identify and fund Europe's most innovative start-ups and SMEs. Since then, 1276 highly innovative projects have already benefitted from an overall funding of over €730 million.

Today the Commission announces important steps that will ramp up the remaining two years of the pilot phase of the European Innovation Council:

- over €2 billion of funding in 2019-2020: covering the innovation chain: «pathfinder» projects to support advanced technologies from the research base (opens tomorrow); and «accelerator» funding to support startups and SMEs develop and scale up innovations to the stage where they can attract private investment (open in June). Under the «accelerator» funding companies will be able to access blended financing (grants and equity) of up to €15 million.

- Commission will appoint 15 to 20 innovation leaders to an European Innovation Council Advisory Board to oversee the European Innovation Council pilot, prepare the future European Innovation Council, and champion the European Innovation Council globally. Innovators from across the ecosystem are invited to come forward by 10 May.

- Commission will recruit a first set of «programme managers» with leading expertise in new technologies to provide full-time, hands-on support for projects. The call for recruitment will be published shortly.

- also today, the Commission announces 68 additional startups and SMEs selected for an overall funding of €120 million under the existing European Innovation Council pilot. The companies are for instance developing a blockchain-based online payment technology, new energy efficient screens and a solution to fight traffic noise (breakdown of beneficiaries per country and sector).

Given the growing economic importance of breakthrough and disruptive innovation, and based on the early success of the European Innovation Council pilot, the Commission has proposed to dedicate €10 billion to the European Innovation Council under Horizon Europe, the EU research and innovation funding programme for 2021-2027¹.

Thus, the goal of innovation policy is to transform the EU into a leader in research, change the structure of public-private sector interaction by creating innovation partnerships, creating an internal market for patents, venture capital, innovation, developing standards for rapid market introduction.

¹ European-innovation-council. Empowering European innovators/ Retrieved from https://ec.europa.eu/commission/news/european-innovation-council-2019-mar-18_en.

On March 20, 2015, Ukraine signed an Agreement on Associate Participation in Horizon 2020¹, which will allow our country to reach a new level of partnership with the EU in the field of science and technology and significantly increase the involvement of domestic scientists, universities, research organizations and institutions. to joint European research, as well as create a basis for structural reforms in the field of research and innovation in Ukraine.

The German economy is investing more and more in innovative products and services. In 2017, allocations for research and development increased by 9,3 percent year on year to 68.6 billion euros².

In 2016, the federal government and German business spent 92.2 billion euros for investment in research and development. This is 2,94% of German gross domestic product (GDP). For comparison: 28 countries of the European Union used research and development on average 2,03% of their GDP. By 2025, Germany will invest 3.5% of GDP annually in science and development.

In terms of the number of patents introduced on the market per one million inhabitants, Germany was ahead of the United States and China in 2015 (371 against 200 and 27, respectively), behind Switzerland (612), Sweden (445) and Japan (387). Investments of German companies in 2016 amounted to 158.8 billion euros. The industrial sector accounted for more than 3/4 of this volume³.

Thus, innovation plays a key role in a globalizing world, and in order to build an innovative economy, the EU is developing an innovation policy aimed at ensuring sustainable socio-economic development and a high level of national competitiveness. under the influence of a high level of competition.

Europe, as a result of the creation and enlargement of the European Union, is gradually losing its heterogeneity, but convergence at the level of institutions and strategic plans is still quite slow. Despite the fact that new forms and methods of stimulating innovative development have been tested over the last 20 years, innovation policy has become comprehensive, systematic and long-term

¹ On ratification of the Agreement between Ukraine and the European Union on Ukraine's participation in the European Union Framework Program for Research and Innovation "Horizon 2020". Law of Ukraine, 2015, №604-VIII. Retrieved from <https://zakon.rada.gov.ua/laws/show/604-19>

² German economy increases investment in innovation. Retrieved from <https://www.dw.com/ru/%D0%BD%D0%B5%D0%BC%D0%B5%D1%86%D0%BA%D0%B0%D1%8F-%D1%8D%D0%BA%D0%BE%D0%BD%D0%BE%D0%BC%D0%B8%D0%BA%D0%B0-%D1%83%D0%B2%D0%B5%D0%BB%D0%B8%D1%87%D0%B8%D0%B2%D0%B0%D0%B5%D1%82-%D0%B8%D0%BD%D0%B2%D0%B5%D1%81%D1%82%D0%B8%D1%86%D0%B8%D0%B8-%D0%B2-%D0%B8%D0%BD%D0%BD%D0%BE%D0%B2%D0%B0%D1%86%D0%B8%D0%B8/a-46257141>

³ Johannes G. Five reasons for the innovative success of Germany. 07.25.2018. Retrieved from <https://www.deutschland.de/ru/topic/ekonomika/innovacii-v-germanii-pat-vaznyh-faktorov>

with clear quantitative and qualitative guidelines, and a single EU innovation policy has become a «locomotive» for national governments and private businesses. .

Well-planned innovation policy at all levels (regional, national and supranational) will allow EU countries to increase the competitiveness of products on the world market, will produce goods and services in line with scientific and technological progress and informatization, and will achieve the EU's main goal – to create favorable environment for the introduction of innovations in various sectors of the economy. As a result, the EU will be able to create a single pan-European innovation space with a flexible governance and coordination structure.

1.3 Applied aspects of innovation policy development

For practical implications of innovation policy development it is important to emphasize the growing role of technology in the life of society makes active state regulation (through coordination and stimulation) in this area necessary. In leading countries and in a number of studies, the public-private policy is considered as a coordinated, state-funded initiative to mobilize national resources to accelerate targeted technological changes and maintain leadership in global competition through the innovations¹.

Thus, our thesis is that there are a number of factors that prove the necessity of integrated assessment of the industrial production technological development. The proposed practical implications are based on the hypothesis about the necessity to adapt the institutional management mechanisms to the main trends (technological trajectory) in the innovation sector (open innovation process, strengthening the processes of intersectoral technology transfer and business processes virtualization). This leads to the creation of a huge number of organizations and systems, that have a significant potential for development; development of innovation systems, including national and regional, deepening and expanding various forms of integration; the formation of national innovation system as a complex multilevel and intersectoral structure.

¹ Kudrina, O., Omelyanenko, V. (2018). Research framework for system security of technological & innovation systems. *Baltic Journal of Economic Studies*, 4(1), 248–254. DOI: 10.30525/2256-0742/2018-4-1-248-254.

Cervantes M. & Meissner D. (2014)¹ describe the latest trends the knowledge and technology transfer from universities and public organizations to industry. The authors also underline that in recent times the requirements for state policy have significantly increased, as global competition changes the usual state of policy. It is necessary to strengthen national and regional innovation systems by supporting the development of small and medium-sized enterprises, which are more difficult to compete with international corporations. This requires the framework conditions for innovation that contribute to effective investment. Our approach can be used for applied purposes considered in studies of Marks & Gerrits (2017)² and Gajdzik & Gawlik (2018)³.

So it is also necessary to take into account the idea that the development of high technologies is inextricably linked with a strong industrial base and an active industrial policy based on the unification of science, production and education into a single system. Under these circumstances, the main challenge is to create inter-sector interaction tools and jointly direct the overall move towards faster modernization of industry by massively and rapidly implementing new technologies.

As a result of the analysis, we can note the lack of domestic practice-oriented research concerning the harmonization of innovation policy and the strategy of ensuring the national security in developing countries (innovation-synergetic methodology), which makes the studies in this field relevant and focused on a real scientific and practical tasks.

Fig. 1.3 illustrates how integrated assessment of the industrial production technological development can be used within the innovation policy management.

The differences of methodology of formation of innovation-technological systems deal with such points, that are based on assessment of the industrial production technological development.

First is connected with the availability of significant volumes of analysis data, which allows us to identify and assess the impact of technological

¹ Cervantes, M., Meissner, D. (2014). Commercialising Public Research under the Open Innovation Model: New Trends. *Foresight*, 8(3), 70–81.

² Marks, P., Gerrits, L. (2017). Evaluating technological progress in public policies: the case of the high-speed railways in the Netherlands. *Complexity, Governance & Networks – Special Issue: Complexity Innovation and Policy*, 48–62. DOI: 10.20377/cgn-42.

³ Gajdzik, B., Gawlik, R. (2018). Choosing the Production Function Model for an Optimal Measurement of the Restructuring Efficiency of the Polish Metallurgical Sector in Years 2000–2015. *Metals*, 8, 23. DOI: 10.3390/met8010023.

trajectory factors, that were not previously subjected to direct measurement methods.

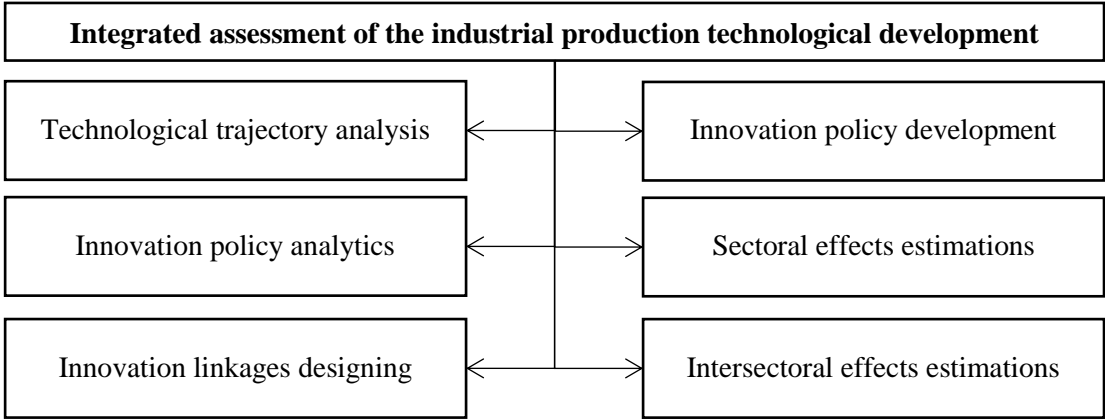


Fig. 1.3. Integrated assessment of the industrial production technological development application (author’s development)

Secondly, the emergence of new economic models and approaches, such as innovation networks, venture financing, energy service contracts, various technological development programs, innovation initiatives, scientific and educational projects, etc.

Within the third point we propose to consider synergetic effects within the technological trajectory (dynamics of industrial production technological development) as the most important factor of accelerated development in economic systems and the main task of management in the current conditions is connected with development the competences in technologies of the synergistic effects formation.

These tools affect both the process of substantiating the innovation policy and the sources of funding for programs.

From the theoretical point of view, these ideas are in line with the latest trends in the development of world economic theory and applied economics, reflecting the transition from a fragmentary study of certain aspects and objects of the economy in general and the innovation system in particular, which is the neoclassical tradition characteristic, to systematic study of their mutual impacts, which is characteristic of institutional, evolutionary and systemic economic theory. Thus, comparing with existing analogues the authors approach is systemic and takes into account the specificity of modern innovation activities and cover the whole spectrum of tasks for management the innovation networks development at different levels.

Proposed methodology can be an addition to some investigations, e.g. the relationship between technological progress in the energy sector and carbon emissions based on Environment Kuznets Curve (Jin, Duan, Shi, Ju, 2017)¹. This study is based on research and development investment in energy industry as the quantitative indicator of its technological progress. Our results allow to consider the other factors of technological progress, which is based on the understanding the technology as a factor which unites economic resources.

New approaches for technological trajectory analytics additionally to technology development gives new possibilities to manage innovation projects based on infrastructure, informational, scientific and technological, infrastructural and producing elements to solve technologies development and transfer. Technological trajectory analysis creates an effective field of innovation communications, the main task of which is to stimulate the dialogue of innovation activity stakeholders and their cooperation with the help of specialized approaches.

In summary, technological trends analytics and analytics-based management can be implemented to provide the transition from an extensive export-raw material model of economic development to a model of ecologically balanced (adapted) modernization of economic development. So the practical application of proposed of technological development assessment methodology will allow more coherently coordinate the implementation of national innovation priorities and enhance the competitive advantages in the «development-security» system on the basis of synergy.

¹ Jin, L., Duan, K., Shi, C., Ju, X. (2017). The Impact of Technological Progress in the Energy Sector on Carbon Emissions: An Empirical Analysis from China. *International journal of environmental research and public health*, 14(12), 1505. DOI: 10.3390/ijerph14121505.



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NATIONAL DEVELOPMENT GOALS: INNOVATION FRAMEWORK

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Monograph is devoted to the research of theoretical and practical aspects of innovation based national development issues. Different methodic approaches and economic mechanisms to provide innovation development at the regional, national and international levels are considered. Scientifically based recommendations to achieve economic, financial, social and ecological aims of the national development are given.

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INTRODUCTION

Analysis of formation and coordination of innovation development policy is one of the most relevant areas of modern economic studies. In a number of developing countries, there are no systematic strategies of innovation development that would coordinate the actions of various government agencies to support and balance the development of the components of the «triangle of innovation success» (business environment, regulatory environment, innovation policy). This aspect also includes the optimization of resource base (maximizing the efficiency of limited resources). Despite the presence of a number of initiatives and separate sectoral strategies, the task of identification the objectives of innovation policy deals with the problem of high degree of unsystematic functioning of innovation structures and initiatives, including their intersectoral level as well as their lack in long-term plans.

Therefore monograph is devoted to the research of theoretical and practical aspects of innovation based national development issues. Different methodic approaches and economic mechanisms to provide innovation development at the regional, national and international levels are considered. Scientifically based recommendations to achieve economic, financial, social and ecological aims of the national development are given.

The monograph comprises nine parts.

In part one «**Innovation factors and policy for national development**» the significance of innovation policy in wider context through the use of political, economic and administrative instruments, was mainly aimed at improving the functioning of society, creating new sectoral segments of the national innovation system, developing the institutional environment, stimulating innovation behavior of individual firms is discussed. For practical implications authors note that it is important to emphasize the growing role of technology in the life of society makes active state regulation (through coordination and stimulation) in this area necessary. In leading countries and in a number of studies, the public-private policy is considered as a coordinated, state-funded initiative to mobilize national resources to accelerate targeted technological changes and maintain leadership in global competition through the innovations.

The second part «**International economic security management within the advanced innovative development paradigm**» deals with the development

of theoretical and methodological approach to the management of innovative progress, which allows to take into account: positive results determined by changes in the eco-destructive load on the environment and recipients; the possible cost level for the implementation of the direction (option) depending on the type of innovation, the stage of the ecological and economic cycle of innovation, which increases the level of substantiation of management decisions at the initial stages; market optimality of the direction (option), which allows to reduce investment risks at the early stages and determine its market perspective in the long and short term benefits. The theoretical and methodological approach suggested by the authors to the formation of strategies, as well as to the system of measures ensuring international economic security, allows to increase the overall level of international economic security, stimulate the government to implement measures aimed at the rational use of the national resources, the choice of optimal market for distribution of their products, as well as the choice of the kind of activity that will fully meet the existing needs of the international market.

The aim of the third part «**The impact of human capital on innovative development of society: a socio-economic analysis**» is to carry out social and economic analysis of the impact of human capital on the innovative development of society. Methods of research: generative, empirical, system-structural, methods of economic analysis and case-method. The main results: the theory of human capital is identified, the interrelation between human development concept and the theory of human capital is shown, the investment of the state in the development of human capital is characterized, the role of non-formal education is analyzed. Scientific novelty: the most effective innovative techniques and methods of social and economic analysis of the impact of human capital on innovative development of society in conditions of society reform have been formulated.

The fourth part «**Adult education as an economic priority**» deals with the adult education as a pressing issue in society as it is directly linked to the level of human capital. Lifelong learning issues and trends as an ongoing process that stimulates and empowers people to acquire all the knowledge, values and skills they will need throughout their lives and to apply them with confidence, creativity and enjoyment in all roles, circumstances and environments are considered. International experience in adult education confirms that it can be considered as an efficient direction of national competitiveness within the reorientation of the economy to human development should become a crucial

feature of the future socio-economic development.

The reform of the decentralization of power that is taking place in Ukraine makes it necessary to study the processes of ensuring innovation development at the regional level. As world experience shows, the regions contain a significant potential for innovation development and that's why the task of fifth part «**Innovation framework for the regional innovation development in Ukraine**» is to identify leverage to use this potential, considering the paradigm shifts in the global economy and transformation of regional policy in Ukraine in terms of innovation-based economy. The important conclusion deals with the fact that modern economic processes requires a change in the paradigm of national and regional innovation policies, which consists in moving away from the distribution of financial resources and the widespread creation of innovation infrastructure to stimulating activity related to the concentration of human and social capital, the formation of a favorable business climate and institutional environment, the integration of regional innovation systems into global networks. The applied aspect of regional innovation development is considered on example of regional environmental system is based on the interaction between the control and managed subsystems through the implementation of the regulation, control, stimulation, and preventive functions.

In the sixth part «**Impact of flexibility on organizational innovation and management**» the issues of permanent changing of environment, framework requirement and system conditions, which require to measure and manage all components of a production system taking into consideration that needed changes should be done fast and with the minimal efforts, are considered. Author notes, that the plurality of the definitions of flexibility creates the demands for a clear and consistent understanding of flexibility especially in understanding of quantifying flexibility. Therefore flexibility is used as a complex framework of management variables with characteristics of objective, actuating and control variable as well as with the character of dichotomy of operative and strategical management. As an intermediate step advanced knowledge is required in advanced mathematical approaches based on quantum mechanics solutions, screenplay based modelling set-up of decisions making situations, cross-functional and interdisciplinary multi methods handling in cybernetic management.

In the seventh part «**Fundamentals of the management mechanism of innovative production commercialization of industrial enterprise**» authors

present the methodological and theoretical and methodological foundations of the formation and functioning of the organizational and economic mechanism of commercialization of innovative products of industrial enterprises (OEMCIPIE). The essence and content of the OEMCIPIE components, the main functions, principles of functioning and structure, instrumental and methodological support, organizational aspects of functioning are determined. An approach to developing a market-oriented concept of an innovative product, as well as an approach to managing its commercialization strategies, are proposed and substantiated. The obtained results deepen theoretical and methodological foundations of innovations' management in terms of forming the principles of the organizational and economic mechanism of commercialization of innovative products of industrial enterprises. Further research should aim at improving the system of management tools, according to formalized procedures of strategies for commercializing innovative products.

The eighth part «**Research of conditions of tax planning of the industrial enterprise**» covers issues of improving the planning of tax transaction costs in the enterprise in the context of recognizing taxes as a type of transaction costs is a way to increase the efficiency of the enterprise. Authors underline, that planning of tax transaction costs at the enterprise provides the owners of capital and management of the enterprise with the necessary information, which fully characterizes the impact of the tax system on the internal and external environment of the enterprise and allows to make more informed management decisions.

The last part «**The development of green tourism in Ukraine on the basis of ecological marketing**» extensively covers a very important problem of the innovative mechanisms, providing solution to the problem of maintaining population health in the sphere of tourism industry and its new form – green tourism, combining outdoor activities with preservation of the natural habitat. The purpose of this part is to analyze content of green tourism in its various modifications and specifics of environmental monitoring in tourism industry. Authors note, that tourism industry is one of the largest highly profitable and most dynamically developing industries in Ukraine. Ecologically oriented green tourism is developing especially rapidly in its various forms: natural, rural, along ecological paths, confined to protected natural areas. Marketing in the tourism industry is an interconnected system of tools used by a travel company for targeted management of demand for travel services. The importance of

environmental marketing is associated with its complexity: tourism combines a complex of material and social components and therefore requires a competent and innovative approach for economic and substantial success.

The authors of this monograph are scholars and practitioners from different countries, including **Poland, Estonia and Ukraine:**

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