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Management of innovative activities

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Executive summary

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The modern world economic system is characterised by a number of specific features that determine the peculiarities of the functioning of its subjects, in particular: increased instability of factors of the internal and external business environment; qualitative changes in consumer preferences and preferences towards knowledge-intensive goods and services; significant reduction of time for making managerial decisions and adapting to new conditions; and limited internal opportunities to attract additional resources. Under such circumstances, the problem of identifying the main factors of competitiveness of enterprises in both domestic and foreign markets becomes urgent. Obviously, today there are no universal algorithms for ensuring the economic sustainability of companies in various industries that would ensure their optimisation and flexible adaptation to changing market conditions. At the same time, the results of scientific research and the achievements of leading companies in the global market suggest that their success is ensured by a clear business focus on the demands and needs of potential consumers and high innovation activity.

The manual "Innovation Management" edited in the framework of the EU Erasmus+ project "Enhancing capacity of universities to initiate and participate in cluster development on innovation and sustainability principles" (UniClaD) is an attempt to provide a comprehensive and systematic analysis of main aspects of state regulation of innovation in the EU, Moldova, Azerbaijan and Ukraine, components of innovation management at the level of business structures, as well as outlines the peculiarities of organising and managing the innovation activities of agribusiness companies, taking into account the principles of sustainable development and best practices that are common in agriculture in the countries whose institutional structures are part of the project consortium.

The main task that the authors of the manual intended to solve is to help students to develop a global vision of the concept of innovative management and an understanding of the need to increase the flexibility and adaptability of agricultural companies' management in changing environment with the obligatory observance of the sustainable development principles.

The first chapter is devoted to the theoretical bases of innovation management, which highlights the essence of innovation activity, its features, classification of innovations and their types. The part summarises the essence of innovation management, its functions, components of the management system in innovation area and features of decision-making in the innovation management of agricultural producers.

Chapter Two of the manual is unique. It systematises the mechanisms and instruments of state regulation and support for innovation in Ukraine, Moldova, Azerbaijan and the EU, highlights the components of the national innovation system in these countries, and pays special attention to the generalisation of approaches to intellectual property management, which is valuable in terms of knowledge formation and understanding of the areas of their practical application.

In the third chapter we consider the peculiarities of innovation management on the basis of allocation of specific characteristics of entrepreneurship in innovation activity, highlighting the sources of innovation and organisation of transfer of innovative technologies. This chapter provides the systemizing of the evolution of approaches to innovation management, it characterises the stages of innovation activity at an enterprise and presents the process of innovation management in a logical sequence of stages, as well as highlightes the issues related to peculiarities of innovation management at agricultural enterprises.

Chapter four analyses in detail the organisational forms and structures of innovation development and implementation, in particular, territorial clusters, technology parks and technopolises, innovation incubators, consulting firms, venture capital firms and strategic alliances. A particular attention is paid to the European approach to creating networks and technology transfer platforms, as well as information systems to support start-ups.

Chapter five is of great importance for students of various educational programmes. It presents the concept of research project and its features, the development of research project design and the justification for choosing priority areas of research activity. The authors have summarised the requirements for the preparation of research projects under the Horizon Europe and Cost programmes, with special attention paid to the development of a research project budget and the specifics of human resource management in research organisations and it is very valuable.

I would like to highlight as a feature of the manual the fact that two sub-chapters address the issues of innovations for sustainable development of the agri-food sector and approaches to the formation of climate-smart and sustainable agri-food systems. In particular, sustainable innovations in the agri-food sector and factors of their implementation environment are described, approaches within the circular economy and environmental innovations in green growth strategies are summarised, the system from ‘farm to fork’ to ‘industry to fork’ is covered in detail, the principles of forming sustainable agri-food systems and their features are highlighted, and the directions of innovation implementation in terms of ensuring sustainable development of agri-food systems are substantiated.

Chapter eight deals with the issues of managing innovations in the field of knowledge-intensive technologies, in particular, it considers foresight technology as a tool for technological forecasting, highlights the specifics of entrepreneurial activity in the field of knowledge-intensive technologies, namely, the specifics of developing business plan for an innovation project, organising financial support and risk management.

The manual “Innovation Management” contains theoretical material systematised by the participants of the EU Erasmus+ UniClaD project and practical cases, which will facilitate the development of the discipline at the bachelor's, master's and doctoral levels. I wish the team of authors and the consortium of participants of this project positive feedback from university communities, and the consortium to continue international cooperation aimed at creating the values for the institutional structure of each participant.

Chapter 1. Bases of innovation activities management

1.1 Innovative activities, pecularities and caracteristics

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In the broad sense, innovation is the profitable using of ideas, inventions in the form of new products, services, socio-economic and organizational-technical solutions of a production, financial, and commercial nature. In the process of innovation:

- phenomena and new products and services are formed, which are commercialized in economic activity;
- objects of the material sphere already, are created by man are being improved;
- organizational, economic, social and legal methods, means, and forms are being developed.Consequently, innovative activity is a process of constant renewal of various aspects of the enterprise's activity. It includes not only technical and technological developments, but also any changes that improve all spheres of enterprise activity, as well as developments in the management of the process of new knowledge and ideas.

Among the peculiarities and characteristics of innovative activity, the following are distinguished:

1. Patterns of dynamic equilibrium. Innovations disturb the equilibrium of the system, so it is important to find a balance between the trends of functioning and changes to ensure a flexible equilibrium of the organizational system.
2. Patterns of adaptation of innovation and environment. Necessary take into account the most important various parameters of innovations to ensure the effectiveness of its numerous transformations in various areas of implementation.
3. Patterns of complication of organizational structures. The introduction of each innovation causes a number of consequences that need to be predicted, which calls for the need to form optimal innovative organizational structures in order to best perceive the corresponding changes.
4. The regularity of the primacy of product innovations in relation to providers. In the system of management of innovative activities, the main emphasis should be placed on the renewal of manufactured products, which, in turn, will lead to changes in the means of labor, management structures, methods of evaluating the work of managers, etc.
5. Patterns of changes in the innovative effect. The result of an innovation at the stage of the experiment is usually higher than in the conditions of its replication, since the effect of special control and psychological improvement during experimentation is manifested here.
6. Patterns of potential regression. It must always be remembered that the failure of the first implementation of an innovation discredits the subsequent ones.
7. Patterns of complexity of the innovation process. Experience proves that there are no purely technical or economic innovations, as each of them has its own social, psychological and other aspects and consequences.

8. Patterns of social discomfort. The success of innovations requires certain conditions of social discomfort and the desire to overcome it. The situation of imperfection of the activity process manifests a contradiction between what the organization could do thanks to its capabilities and what it actually does in terms of using these capabilities.

9. Regularity of irradiation. An innovation in one sphere causes a chain of changes in other, related spheres of activity.

High level of technical and technological achievements, cooperation with by consumers, forecasting future market needs allows enterprises to develop a development strategy based on innovative activities. Thus, in the modern world, it is possible to distinguish three tendencies that influence on the development of the innovation process and are closely intertwined:

- development of new technologies;
- globalization of supply and demand;
- individualization and dynamism of consumer behavior.

Innovation processes play an important role in the activities of enterprises, their effect is a long-term ability to create, implement and diffuse – actions that lead to an increase in value (Fig. 1.1).

Fig. 1.1. **Role of innovative activities for enterprises**

Source: own

Thus, innovative activity is the decisive factor in competition, which provides conditions for long-term development of any enterprise on the sustainable basis.

1.2 Innovations and their forms (technological, organisational, marketing innovations, etc.)

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> ***"The great wave of innovation that has swept from industries such as electronics, software development, telecommunications, chemistry and biology has affected all industries in all places of the planet. Previously, there was a rule: "Do not innovate until you are forced to do so." The rule of the day is "Innovation or doom!" by J. Christiansen***

In the world economic literature, "innovation" is interpreted as the transformation of potential scientific and technological progress into a real one, embodied in new products and technologies. The problems of innovation in our country have been developed for many years within the framework of the economic research of the scientific-technical progress.

The concept of "innovation", derived from the English invention, is usually defined as a new idea, which in the development process can be implemented into a new product, new technology, new method, etc.

The key direction for achieving economic growth and improving the quality of life of the population in the modern world is the development of innovative activities, the widespread dissemination of innovative technologies, products and services.

Currently, in developed countries, 70-85% of the increase in gross domestic product is accounted for by new knowledge embodied in innovative production and management technologies. This allows sociologists to draw a conclusion about the formation of a society based on knowledge.

The knowledge embodied in innovative products becomes the main one capital in society at the post-industrial stage of its development. Therefore, they talk about the emerging new civilization as a civilization of innovation.

Innovations are closely related to scientific and technological progress, being its result. STP is an essential factor in the production of products, which ensures, through the improvement of means of production and technologies based on the discovery by science of new patterns of phenomena and properties of the surrounding world and an increase in labour productivity.

STP is an interconnected progressive development of science and technology, manifested in the constant impact of science, inventions and discoveries on the level of technology and technology on the one hand and in the application of the latest devices and equipment in scientific research.

STP stimulates qualitative transformations of material production and the non-productive sphere, leads to an increase in labour productivity and is part of social progress.

Various authors, mainly foreign (N. Monchev, I. Perlaki, Hartman V. D., Mansfield E., Foster R., Twist B., I. Schumpeter, Rogers E., etc.) interpret this concept depending on the object and subject of their research.

Essence of innovation.

Modern scientific and technological progress is unthinkable without an intellectual product obtained as a result of innovative activity.

The concept of "innovation" in economics was introduced by Joseph Schumpeter. By innovation, Schumpeter meant "new combinations, changes in development." In his seminal work "The Theory of Economic Development" (1912), he identifies five cases of innovation (the scientist began to use the term "innovation" only in the 1930s):

- the use of new technology or new technological processes;
- introduction of products with new properties;
- use of new raw materials;
- changes in the organization of production and its logistical support;
- the emergence of new markets.

In the world economic literature, the term "innovation" is understood as the transformation of potential scientific and technological progress into a real one, embodied in new products and technologies.

In accordance with international standards, innovation is defined as the final product of innovative activity, embodied in the form of a new or improved product that has been introduced to the market.

There are two main reasons for the emergence of innovation:

- internal – the growth and complexity of human needs forces us to invent new and more advanced ways to meet these needs;
- the external environment of a person is constantly changing, so a person has to exert intellectual strength and use practical experience to stand up in a competitive struggle.

It is worth noting that an innovation cannot be an innovation if it is not commercialized.

Functions of innovation.

Innovation performs three functions:

- reproductive means that innovation is an important source of financing for expanded reproduction;
- investment – the profit earned through the implementation of innovation can be used in various ways, including as capital;
- stimulating – the entrepreneur receives profit at the expense of the implementation of innovation directly corresponds to the main goal of any commercial organization. Profit serves as an incentive for an entrepreneur to introduce new innovations; it encourages him to constantly

study demand, improve the organization of marketing activities, and apply modern financial management methods.

Properties of innovation.

The main properties of innovation are:

- scientific and technical novelty;
- practical embodiment (industrial applicability), i.e. use, for example, in industry, agriculture, healthcare, education or other fields of activity;
- commercial feasibility means that the innovation is "perceived" by the market, i.e. it is marketable; which, in turn, means the ability to satisfy certain consumer needs.

Classification of innovations.

1. Depending on the technological parameters, innovations can be:
   - product innovations – include the use of new materials, new components and the production of fundamentally new products.
   - process – means new methods of organizing production and new technologies, that is, more efficient technologies are used to produce existing goods or services.
2. According to the type of novelty for the market, innovations are divided into:
   - new to the industry in the world – global;
   - new to the industry in the country – national;
   - new for a particular region or regional;
   - new for this enterprise – point innovations.
3. Depending on the depth of the changes being made, innovations can be:
   - radical – implement the largest inventions and become the basis for revolutionary revolutions in technology, the formation of new directions, the creation of new industries;
   - improving – implement medium-level inventions and serve as a base to create new models and modify this generation of equipment and technology, replacing outdated models with more efficient ones, or expanding the scope of this generation;
   - modification – innovations aimed at improving individual production or consumer parameters of manufactured models of equipment and applied technologies based on the use of small inventions, which contributes to more efficient production of these models, or increase the efficiency of their use;
   - pseudo-innovations (false) – aimed at partial improvement models of machines and technologies representing "yesterday's technology" (i.e. outdated and obsolete).
4. According to the fields of activity of the enterprise, innovations are distinguished:
   - production – embodied in new products, services or technologies of the production process;
   - managerial – new knowledge embodied in new management technologies, administrative processes and organizational structures;
   - technological – arise when using improved, more advanced methods of manufacturing products;
   - social – aimed at improving working conditions, solving problems health, education, culture;
   - economic;
   - trade , etc.

Innovation is the final result of innovative activity, embodied in the form of a new or improved product introduced on the market, a new or improved technological process used in practice, or in a new approach to social services.

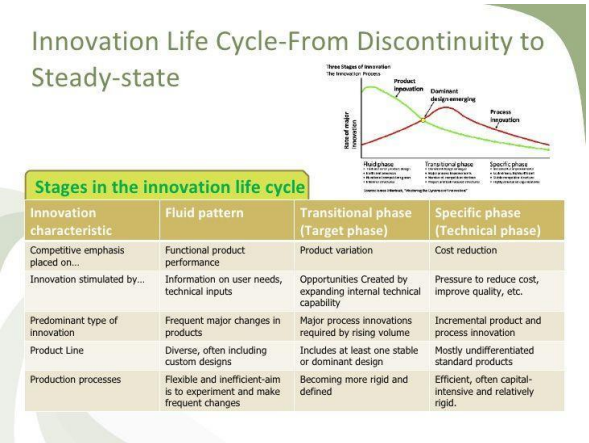
Innovation is the result of investing an intellectual solution in the development and acquisition of new knowledge, an idea that has not been used before to update people's spheres of life (technologies; products; organizational forms of society, such as education, management, labour organization, service, science, information, etc.) and the subsequent process of implementing (producing) this, with a fixed receipt of additional value (profit, advance, leadership, priority, fundamental improvement, qualitative excellence, creativity, progress).
Thus, a process is needed: investment — development — implementation process — getting a qualitative improvement.

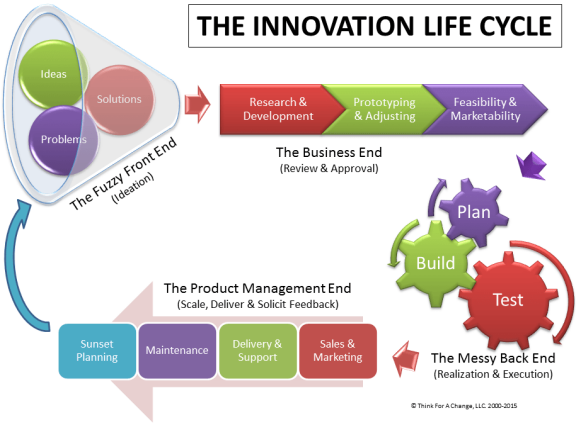
The concept of innovation refers to both radical and gradual (incremental) changes in the products, processes and strategies of the organization (innovation). Based on the fact that the purpose of innovations is to increase efficiency, efficiency, quality of life, and customer satisfaction of an organization, the concept of innovativeness can be identified with the concept of entrepreneurship – vigilance to new opportunities to improve the work of an organization (commercial, government, charitable, moral and ethical).

The essence of the concept of ILC is as follows:
1) the head is forced to analyse the economic activity of the real-time position in the perspective of its development;
2) argues for the need for systematic research on planning the release of innovations, as well as on the acquisition of innovations;
3) The concept is the basis for the analysis and planning of innovation.
ILC vary by type of innovation. These differences affect, first of all, the total duration of the cycle, the duration of each stage within the cycle, the peculiarities of the development of the cycle itself, and the different number of stages. The types and number of stages of the life cycle are determined by the characteristics of a particular innovation. However, for each
innovation, it is possible to define a "core", that is, the basic basis of the life cycle with clearly defined stages.

The ILC consists of seven specific stages, such as:
1) development of a new product – organization of the innovation process, investment of capital;
2) entering the market – the product makes a profit during the implementation period;
3) market development – an increase in the volume of sales of products on the market, an analysis of the time when a new product is actively sold and the market reaches saturation with this product;
4) market stabilization – sales growth has stopped;
5) a decrease in the market – there is a decline in sales of the product, but there is demand for this product, which means that there are objective prerequisites for an increase in the volume of sales of the product;
6) the rise of the market – demand exists, the manufacturer studies the conditions of demand, changes its personnel and pricing policy, applies various forms of material incentives for the sale

of the product, activates advertising. This allows you to increase the volume of sales for a certain period of time;
7) market decline – there is a complete sale of the product or a complete cessation of the sale of the product due to its lack of demand from the buyer.





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1.3 Essence and content of innovation management

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In the Merriam-Webster dictionary, innovation is simply called "the introduction of something new" – it is not the same as simply inventing something new, such as a product, because it also needs to be launched and presented to the world[1]. So, innovation management refers to performing all the actions necessary to introduce something new, which in practice means: proposing ideas, developing, prioritizing and implementing them, as well as applying them in practice (for example, launching new products or by implementing new internal processes) .

Innovative management is a system in which factors interact with each other, which are aimed at achieving or maintaining the required level of viability and competitiveness of the enterprise with the help of mechanisms for managing innovative processes.

Innovation management is the process of developing and implementing new things and business development.
For businesses, innovation management serves as a key driver of competitive advantage.
In the realm of business, the management of innovation plays a vital role in securing a competitive edge. This encompasses a range of activities and phases, such as generating ideas, assessing and choosing the most promising ones, developing and creating prototypes, bringing them to market, and continuously enhancing them. It entails cultivating an atmosphere that fosters and nurtures innovation, while also implementing efficient processes and structures to effectively oversee and propel innovation endeavors.

Figure 1.2 highlights the content of innovation management. One of these components is Innovation Strategy, which involves establishing the innovation goals, objectives, and priorities of the organization. This includes identifying the specific areas of focus for innovation, such as product innovation, process innovation, or business model innovation.

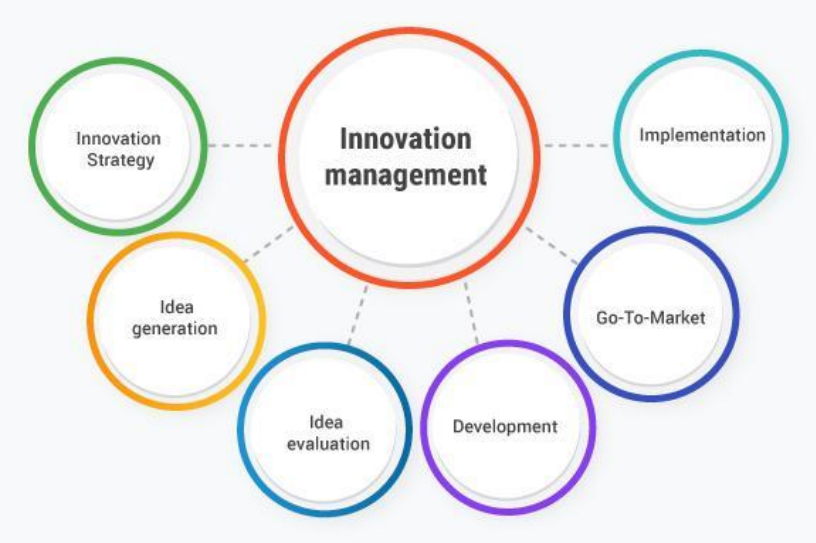

Fig. 1.2. **Content of innovation management**

Source: [2]

Idea Generation: the process of generating new ideas is fostered through a combination of internal and external sources. Various methods, including brainstorming sessions, employee suggestion programs, customer feedback, market research, and collaboration with partners or experts, can be employed to encourage this creative process.

Idea Evaluation and Selection: the process of evaluating and selecting ideas involves assessing their potential for further development. Feasibility, market potential, technical requirements, and alignment with strategic goals are all factors that are taken into consideration. To evaluate ideas,

a range of tools and methods, including feasibility studies, market research, and business case evaluations, are utilized.

Development and Prototyping: the process of development and prototyping entails the conversion of chosen concepts into physical prototypes or minimum viable products (MVPs). This crucial phase encompasses the enhancement of the idea, research and development, rigorous testing, and iterative improvements in order to produce a workable solution.

Go-to-Market: the Go-to-Market strategy involves introducing the groundbreaking product, service, or process to the market. This encompasses various activities like marketing, sales, distribution, and the launch of the innovation. It also entails the careful consideration of intellectual property safeguarding, adherence to regulatory requirements, and the exploration of potential partnerships or collaborations.

Implementation and Adoption: achieving successful implementation and adoption of the innovation within the organization is crucial. This could be accomplished through effective change management, comprehensive training, and fostering a culture that embraces innovation.

To effectively manage innovation, an organization must cultivate a culture that encourages creativity, risk-taking, and collaboration. This entails involving employees at every level, fostering cross-functional teamwork, and offering the essential resources, tools, and incentives to drive innovation initiatives.

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1.4 Functions of innovation management

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The functions that reflect the content of innovative management include those shown in Fig. 1.3. The named functions outline the subject areas of managerial activity, each of which is aimed at solving specific and diverse issues of interaction between separate divisions of the enterprise, which require the implementation of a large number of specific measures.

1. Forecasting (prediction). The function of forecasting in innovation management is aimed at developing forecasts of scientific and technical development for the long term. A forecast is a

scientifically based opinion about possible changes in the technical, economic, technological, and social state of the management object as a whole and its individual parts. The main task of the forecasting function is to find the most effective ways of development of the object under study based on a comprehensive retrospective analysis and study of trends in its changes.

2. Forming of innovative goals. The process of forming innovation goals is one of the important procedures of innovation management and a component of all planning calculations in the innovation field. Innovation goals are related to the enterprise's mission, strategies, the life cycle of innovations and the organization as a whole and are a reference point for innovative activities for given periods. The ultimate goal of innovation management is to ensure the long-term functioning of the enterprise based on the effective organization of innovation processes and the competitiveness of innovative products.

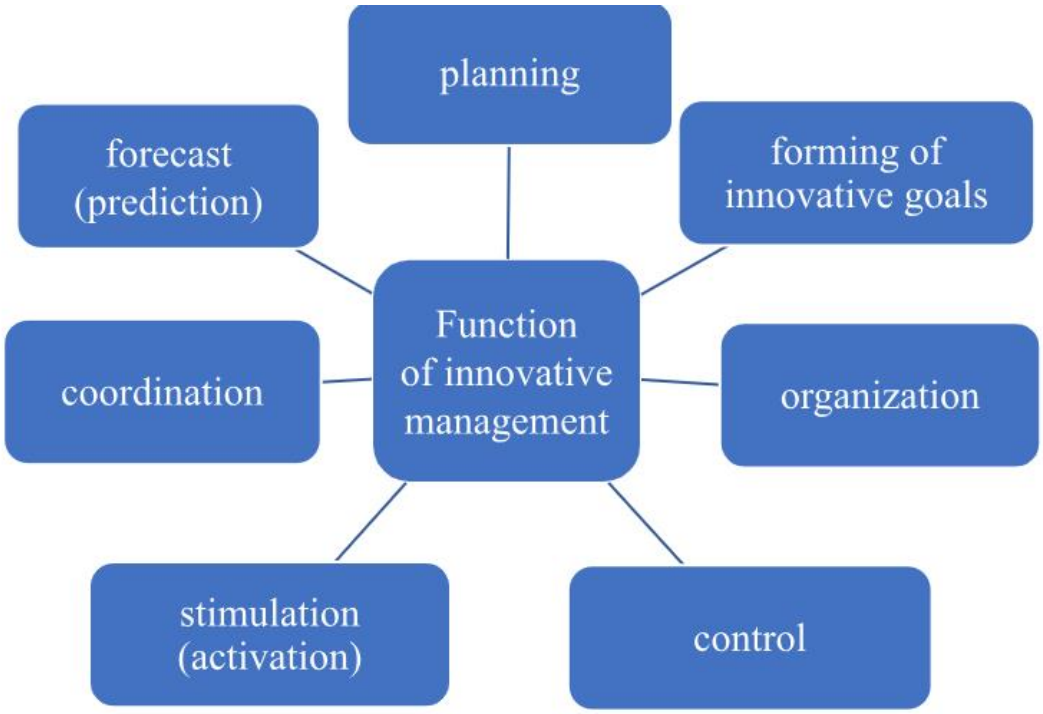

Fig. 1.3**. Function of innovative management**

Source: own

3. Planning as a function of innovation management consists in substantiating the main directions and proportions of innovative activity in accordance with the accepted forecasts and development goals, the possibilities of resource provision, the innovative potential of the organization, and market demand. The planning function covers the entire range of measures both for the development of planned tasks in the innovation process and their practical implementation. The

importance of the planning function lies in the fact that in the process of planning calculations, the details of the goals of innovative activities are ensured, their delivery to individual structural divisions and executors, the determination of the composition of the necessary resources, the coordination of the sequence and deadlines for the implementation of projects, programs and individual works established for a certain period. The necessity of the planning function and strengthening of its role in ensuring the competitiveness of organizations in modern conditions are related to the expansion of the scale and complexity of innovation projects, the multivariate and probabilistic nature of innovation processes, and the expansion of cooperation in the innovation sphere.

4. Coordination. The function of coordination in innovation management means the process of coordinating the activities of all links of the management system, the management apparatus of R&D units and individual specialists. Coordination ensures the unity of relations between the subject and the object of management. Coordination is the basis of the structure of the organization, which is usually defined as a set of permanent connections in the organization. Without interrelationships and actual interaction of parts, there can be no organizational whole. Connections are the condition of interaction. Communications between organizational divisions and its parts are carried out through communication channels.

5. Organization. The essence of this function in innovation management is to ensure the fulfillment of planned tasks and the unification of people who jointly implement innovative plans, programs, projects based on relevant rules and procedures. The latter includes the creation of management bodies, the appropriate organizational structure of management, establishment of relationships between divisions, distribution of information by management subsystems. The function of the organization ensures a rational combination in space and time of all elements of the innovation process, which enables the most efficient execution of planned tasks and determines the conditions in which they will be performed. This is important because the organization needs flexibility and dynamism depending on the subject of R&D. The modern theory and practice of innovation management is characterized by a wide variety of forms and types of innovation organization.

6. Stimulation. The function of stimulation in innovation management is manifested in encouraging employees to be interested in the results of their work on the creation and implementation of innovations. Stimulation involves the creation of a system of moral and material incentives for employees of the organization to increase their professional level, promotion, and improve the psychological climate, which makes it possible to increase the productivity of both individual and collective work, to ensure the competitiveness and prosperity of the organization in the long term. The main prerequisite for successful management in innovation is the harmonization of relations between people participating in innovative activities at the enterprise (organization), the creation and maintenance of a favorable industrial and psychological climate. This is largely achieved by various means of motivating the work of performers.

7. Control. The control function is one of the important functions of innovation management. It consists in checking the organization of the innovation process, the implementation plan for the creation of new products, and the implementation of innovations. Control methods vary widely

depending on the type of production and products produced. In the system approach, control performs the function of feedback in the innovation management process: information flows in it are directed from the object to the subject of management. Availability of feedback is a necessary condition for the completeness of the management system. The following features are of fundamental importance for the organization of control: the purpose of control, subject area, scope and forms of control.

1.5 Management system in innovative sector Management system in innovative sector

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Management of the innovative activity of the enterprise.
Innovative activity is a set of activities that can turn certain knowledge and skills into financial benefits for the company. Innovation management is a kind of art, because not every idea can become a source of income for an enterprise. Many developments remain on paper because modern technologies do not allow them to be implemented.

The management of an enterprise's innovation activity includes the application of new forms of management. Innovation requires precise planning and control. Innovation management is a creative process fraught with many surprises.

The development of any economic system includes innovative components that transform the production sector. These include new types of equipment, advanced technologies, the corresponding organization of labor and production, changing motivation and entrepreneurship.

In the conditions of market relations, due to a number of objective reasons, conditions and factors (complication of social needs, rapid updating of innovations, their knowledge intensity, etc.), regardless of the degree of perfection of the management system of the national economy, public production, an additional special mechanism for influencing the innovation process is needed. This means that there are two interrelated systems of innovation process management in social production and the national economy.

The first system is the general management system of public production. In this case, the management of the innovation process is considered as an integral part of the national economy management system. This system, designed to solve the problems of social production as a whole, at the same time, to a certain extent indirectly (indirectly) stimulates the development of the innovation process. It can be called an exogenous (external) innovation process management system. The second system is the management system of the innovation process itself. It can be called an endogenous (internal) innovation process management system.
The management system of the innovation process itself differs significantly from the management of other socio-economic processes in terms of its goals, content, functions, principles and methods.

The objectives of innovation process management are:

- continuous updating of the range and nomenclature of products, as well as the equipment, technology, and methods of production organization used;
- further development of the scientific and scientific-technical potential of the country, creation of a scientific reserve.

The essence of innovation process management (in a narrow sense) is the purposeful impact on the process of research, design (design and technological) developments and the development of innovations (innovations) in order to reduce costs and deadlines and ultimately increase efficiency (economic, social, environmental). In general, the essence of management can be disclosed from the point of view of an exogenous innovation process management system.

The management of the innovation process is carried out on the basis of general management principles and specific principles determined by the peculiarities of innovation and the content of innovative activity. The latter are important for the formation of the innovation process management system itself, i.e. for the construction of an endogenous management system. The specific principles of innovation process management include the principles of flexibility, taking into account the time factor, complexity, taking into account the uncertainty of innovative works, taking into account their creative nature.

The most important principle is the principle of flexibility. It is due to the cyclical nature of scientific and technological progress, the difficult predictability (or even unpredictability) of the results of scientific research. The principle of flexibility requires the use of special types of planning (for example, not for specific detailed tasks, but for certain areas of research) and forms of financing, affects the composition of scientific and technical personnel and the choice of management methods.

The principle of taking into account the time factor is due to the significant duration of the innovation cycle, the uneven time period of its individual stages and stages. Traditional calendar periods in production management (quarter, year, etc.) cannot be taken as a basis (with rare exceptions) for managing the innovation process. This principle is related to the prospects of innovation, which means the need to take into account the long-term consequences of management decisions.

The principle of complexity presupposes technical, economic, organizational and informational unity in all links, at all stages and stages of the innovation process. Such unity affects all components (elements) of the innovation management system: planning, financial and organizational support, etc. In addition, complexity means ensuring a close connection between different fields of science and between management functions.

The principle of taking into account the uncertainty of innovative works and their risky nature finds expression in forecasting and planning, financing and methods of evaluating the effectiveness of innovations. It requires, for example, the creation of financial reserves to eliminate (or reduce) possible negative consequences from risk or adjust the timing of individual innovative works (stages, stages) during their planning.

The principle of taking into account the creative nature of innovative works is based on the fact that the creative nature of the creation and implementation of innovations has an impact on the innovation process management system. It is taken into account when organizing the work process, building the structure of management bodies, determining the mode of operation and leadership style, evaluating the effectiveness of innovative work, and especially when stimulating (material and moral) employee labor.

The management of the innovation process in compliance with the above-mentioned and other principles is carried out on the basis of the application of various methods. The methods of managing the innovation process are divided into administrative, organizational and planning, financial and economic, and socio-psychological. These methods are very specific in their content, they differ from traditional methods used in production management, since innovative products (product innovations, technologies, methods) are a special kind of product, and information, organizational, ethical and moral-psychological aspects of innovation play an important role. It should be noted that at the final stages of the innovation cycle, the importance of financial and economic management methods increases significantly. These methods cover many aspects of innovation process management.

Effective management of the innovation process is implemented through an innovative mechanism. An innovation mechanism is a set of organizational, managerial, financial, economic, legal, informational, technical and moral-psychological factors, their interrelationships and interactions that contribute to the successful implementation of innovative activities and increase the effectiveness of its results. It follows from this definition that the elements (components) of the innovation mechanism are:

1) organizational forms of innovative relations;
2) Innovation management methods;
3) methods of financing innovations;
4) methods for evaluating the effectiveness of innovation results;
5) the procedure for the formation and use of innovation funds (centralized and decentralized, federal and regional);
6) innovative legislation;
7) moral and psychological methods of influencing innovation activity;
8) measures of information and technical equipment of the innovation process.

The well-functioning of the innovation mechanism, the joint functioning of these elements are largely determined by their interdependence and correlation, proportionality. The correlation and structure of these elements, the importance and optimality of forms, methods and measures should correspond to the level of management at which innovation policy is implemented.

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1.6 Peculiarities of decision-making in the innovation management of agricultural producers

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The decision-making process in the field of innovative management by agricultural producers is characterized by a number of features that are determined by the specifics of the agricultural industry, which can be reduced to three groups of factors.

The first group refers to the conditions for the functioning of markets in agriculture, which are close to pure competition and involve the presence of a significant number of producers who sell their products, which are standardized or homogeneous, which makes non-price competition impossible, the ability of the producer to influence the level of the market price of his products, free entry and exit from the market. Of course, attributing the industry to pure competition is largely conditional, because none of the named factors exist in a pure form in the real economy. Understanding this feature of the functioning of agricultural markets is necessary for a manager to develop a strategy for the development of an enterprise and current plans for its development, as well as for making appropriate management decisions. In particular, this applies to marketing decisions, because the manager's actions in this area of his activity are to some extent limited precisely by the specifics of price formation for agricultural products.

The second group of factors is related to the so-called long-term problem in agriculture and consists in low incomes of agricultural producers compared to employees of enterprises in other industries. The main reasons for this problem are the price inelasticity of demand for agricultural

products, the imbalance of demand and supply (supply exceeds demand), as well as the relative immobility of agricultural resources. The totality of the factors of the second group determines the tendency to lower prices and incomes in agriculture against prices and incomes of other sectors of the economy. Under these conditions, the manager is obliged to take care of the diversification of his production, the organization of processing of agricultural products, participation in the development of rural infrastructure as an additional source of income from non-agricultural activities, etc.

The third group of factors refers to the short-term problem, the essence of which is the instability of the incomes of agricultural producers and is manifested in the fluctuation of prices for agricultural products and, accordingly, incomes over the years. The reasons for this situation are both the inelasticity of the demand for agricultural products and fluctuations in the volume of production and demand for it.

In general, agriculture is a specific industry. It is significantly different from other branches of the national economy, which determines the peculiarities of both agricultural management in general and innovative management in the agricultural sector in particular.

It is possible to single out such features of this industry that have a direct impact on the implementation of innovative management. The main means of production in agriculture is land, while in industry it is equipment, mechanisms, buildings, etc. Agriculture, like no other branch of the national economy, depends on climatic conditions that directly affect the organization of production and its management. In agriculture, part of the produced products is used in further production. Therefore, not all products produced in this industry are marketable. This determines the peculiarities of planning production volumes and product distribution, as well as the organization of production processes. Unlike industry, in agriculture the working period does not coincide with the production period. This is explained by the fact that the production period here is the time when the process is carried out with the direct participation of a person and time passes under the influence of natural factors. Seasonality of production in crop production, when the production process has the highest and lowest intensity. Complementarity of its main branches of crop production and animal husbandry.

The production of agricultural products and the formation of prices for them are carried out under conditions close to perfect competition, while the prices of resources for agriculture and the products of processing industries are formed under conditions of imperfect competition.

In general, according to Duke University (the USA), decision-making is a “cognitive processes that help people make sense of complex information”, involving also investigation of “how emotion, motivation, and information-processing shortcuts interact with careful, rational weighing of information”. If we analyze the peculiarities of management decision-making by representatives of the agrarian sphere, Figure 4 demonstrates this process quite informative.

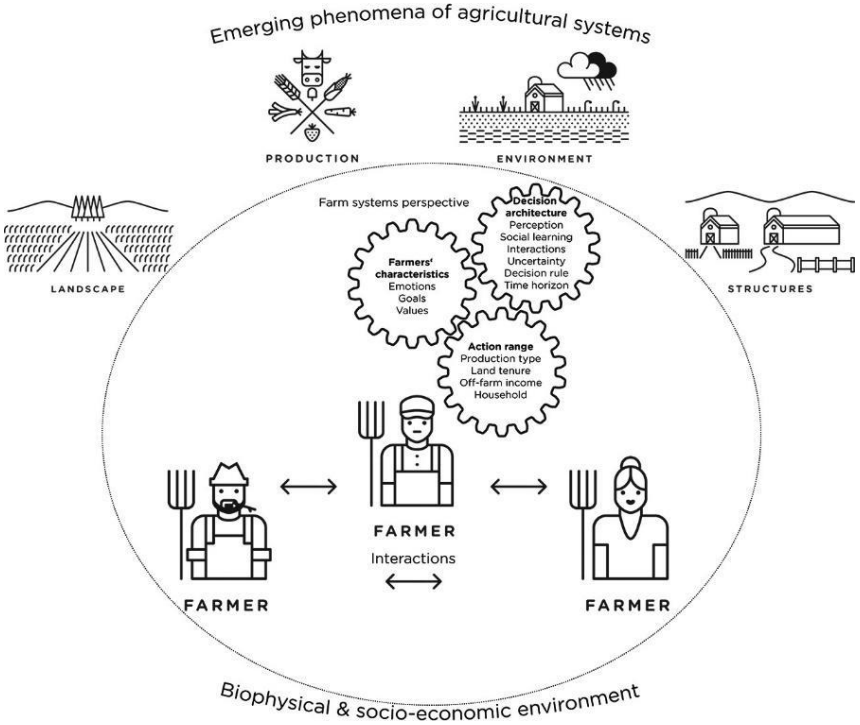

Fig. 1.4. **Dimensions of farmers' decision-making and simulated emerging phenomena in European agricultural ABM**

Source: Huber, R.; Bakker, M.; Balmann, A.; Berger, T. Representation of decision-making in European agricultural agent-based models. Agricultural Systems. p. 143-160. DOI:10.1016/j.agsy.2018.09.007

The three dimensions of the decision-making elements by the agricultural producers: action range, the agricultural producers' characteristics and the decision architecture are distinguished:

- action range should reflect the multi-output decision context of the agrarian enterprises including non-agricultural activities, land tenure and/or whether household characteristics are considered;
- the agricultural producers' characteristics describe the ability of the models to distinguish the different farmeror family-specific individual traits such as goals, values, and emotions. These criteria reflect the importance of the various socio-psychological and motivational factors that influence the agricultural producers decision-making, assuming household members share goals values and emotions;
- the decision architecture reflect those criteria to be of importance in the agricultural producers' decision-making and reflect the influence of the family household and its characteristics on the agricultural producers' decision-making beyond income maximization under a short and longterm perspective. It includes perception, interpretation and evaluation as a basis for individual learning, social learning (from the behaviour and opinions of other relevant actors), uncertainty in the decision-making process, the type of decision-making rule, time horizon (annual vs. investment

decision) and consideration of exit entry decisions in the decision-making process as well as the underlying social interactions (i.e., agent-agent interactions through social networks and social norms)[1].
Thus, it is necessary highlights the interconnectedness of these elements, as demonstrated by the integration of the biophysical and socio-economic environment as the foundation for agricultural producers' decision-making.

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Chapter 2. Regulation of innovation activities in Ukraine / Moldova / Azerbaijan and the EU

2.1 State support for innovation activities in Ukraine / Moldova / Azerbaijan

2.1.1 State support for innovation activities in Ukraine

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Innovation activity in Ukraine is less developed than in the leading countries of the world, and its intensification requires improvement of instruments of state support and stimulation of innovation. With this purpose, it is advisable to analyse the current system of legal and regulatory framework for innovation and identify instruments of state support. Thus, the current legal framework (laws, presidential decrees, bylaws in the form of government resolutions, orders of central executive authorities, etc.) for scientific, technical and innovation activities includes about 200 documents.

Article 54 of the Constitution of Ukraine[1] guarantees citizens the freedom of scientific and technical, as well as other forms of creativity, protection of intellectual property and their copyright.

The Law of Ukraine "On Scientific and Scientific-Technical Activities"[2] provides the legal, organisational and financial framework for the functioning and development of scientific, scientific – technical activities and creates conditions for scientific, scientific – technical activities to meet the needs of society and the state in technological development through the interaction of education, science, business and government.

The Concept of Scientific, Technological and Innovative Development of Ukraine[3] provides for the main objectives, priority directions and principles of the national scientific and technological

policy, mechanisms of accelerated innovative development, guidelines for structural processing of scientific and technological potential and its resources. This document defines the basis of relations between the state and scientific and technical entities, taking into account the areas of priority state support for science, technology and innovation as a source of economic growth, a component of national culture, education and the citizen sector, and the realisation of intellectual potential.

The Law of Ukraine "On Innovative Activities"[4] regulates the legal, economic and organisational foundations of the State regulatory framework for innovation in Ukraine, defines the forms of state stimulation of innovation processes and is aimed at supporting the innovative development of the Ukrainian economy.

According to the definition provided in this Law, innovation is an activity aimed at the use and commercialisation of research and development results and leading to the introduction of new competitive goods and services to the market. The Law also defines "innovation project" as a set of measures and procedures necessary for the development, creation and sale of an innovative product and/or innovative products, which are reflected in a set of documents drawn up in accordance with the requirements of the law.

The Law of Ukraine "On Investment Activity"[5] provides for general legal, economic and social conditions for investment activity in Ukraine. It is aimed at ensuring equal protection of the rights, interests and property of investment entities regardless of their form of ownership, as well as at effective investment in the Ukrainian economy, development of international economic cooperation and integration. Article 3 of the Law defines innovation activity as a set of measures aimed at creating, introducing, disseminating and implementing innovations in accordance with the Law of Ukraine "On Innovation Activity" in order to obtain commercial and/or social effect, which are carried out through the implementation of investments made in the objects of innovation activity.

The Law of Ukraine "On Priority Areas of Innovation Activity in Ukraine"[6] is aimed at an innovative model of economic development by concentrating state resources on priority areas of scientific and technical renewal of production, by increasing the competitiveness of domestic products in the domestic and foreign markets. The priority areas of innovation in Ukraine require the executive authorities at all levels to establish a regime of maximum possible promotion of activities aimed at implementing the relevant priority areas and to concentrate financial, economic and intellectual resources on them.

The Law of Ukraine "On the Special Regime of Innovative Activities of Technology Parks"[7] provides the legal and economic basis for the establishment and operation of a special regime of investment and innovation activities of technology parks. According to the current law, state promotion of innovation activities of technology parks is carried out through state financial support and targeted subsidisation of technology park projects.

The Law provides for a special budget programme that allocates funds for full or partial interest-free lending to technology park projects, compensation of interest paid by technology park project

implementers to commercial banks and other financial institutions for lending to technology park projects.

Targeted subsidies are provided in the form of import duties charged in accordance with customs legislation on the importation of new equipment, machinery and components, as well as materials that are not produced in Ukraine for the implementation of technology park projects. The law also contains a list of expenses for which targeted subsidies may be used. It is worth noting that the first version of the Law "On the Special Regime of Innovative Activities of Technology Parks" was the most favourable for the development of technology parks, as it provided for the exemption of technology parks, their participants, joint ventures and subsidiaries from value added tax and profits generated from the implementation of innovative projects. The saved funds were credited to a special account and could be used only to finance innovation activities. In addition, under certain conditions, these entities were exempted from paying a fee to the State Innovation Fund and enjoyed a special customs procedure for importing the necessary raw materials, equipment and machinery into Ukraine. However, most of these preferences have been cancelled. Although a number of benefits and incentives are still available to technology parks, it cannot be said that they are being used in full by technology parks.

In 2021, the Law of Ukraine "On Amendments to Certain Laws of Ukraine on Intensification of Science Parks" was adopted[8]. The purpose of the document is to increase the efficiency of innovation activities by science parks and commercialisation of the results of scientific research, scientific and technical (experimental) developments. Science parks should become an effective tool for influencing the development of innovation processes.

This document proposes to provide the following powers to higher education and research institutions:

- the right to establish science parks without the approval of the Ministry of Education and Science of Ukraine, as well as to independently determine the areas of their activities;
- the right to be founders of several science parks;
- the right to rent premises for science parks on favourable terms.

According to the analysis of the current legislation of Ukraine, the following instruments should be highlighted as instruments to stimulate innovation:

- full interest-free lending to priority innovation projects and technology parks;
- partial (up to 50%) interest-free lending to innovative projects, including technology park projects, provided that the remaining funds required to finance the project are raised by the project implementer and/or other innovation entities;
- full or partial compensation of interest paid by innovation entities, including technology parks, to commercial banks and other financial institutions for lending to innovation projects;
- providing state guarantees to commercial banks that lend to priority innovation projects;
- direct funding: implementation of individual innovation projects, implementation of state, sectoral, regional and local innovation programmes, support for the functioning and development of modern innovation infrastructure; state orders, including priority consideration of applications

from science parks for state orders for the supply of products, works and services to meet priority state needs.

The tax incentives for innovation in Ukraine include:

- exemption from transferring import duties to the budget for innovation entities of technology parks and science parks;
- a tax bill with a maturity of 720 calendar days for taxpayers implementing technology park projects in accordance with the Law of Ukraine "On the Special Regime of Innovative Activities of Technology Parks", when importing new equipment, machinery, and components, is provided to the customs authorities, and when importing materials that are not produced in Ukraine, a tax bill for the amount of tax liability with a maturity of 180 calendar days from the date of provision of the bill to the customs authorities is provided;
- application of a 20 per cent accelerated depreciation rate for fixed assets of groups 3 and 4 for technology parks; exemption from taxation of 80% of profits received from the sale of own-produced goods in the customs territory of Ukraine according to the list established by the Cabinet of Ministers of Ukraine; exemption from taxation of 50% of profits received from energy efficiency measures and implementation of energy efficiency projects of enterprises included in the State Register of Enterprises, Institutions, Organisations engaged in the development, implementation, and use of energy efficiency measures and energy efficiency projects (Article 158 of the Tax Code)[9].

The Cabinet of Ministers of Ukraine has approved the Strategy for the Development of the Innovation Sector for the period up to 2030[10]. According to this Strategy, the development of innovation potential is necessary for dynamic development, ensuring the security and sovereignty of the state, and its competitiveness. Successful development of the state economic system is closely linked to leadership among other countries in research and development, production of new knowledge, development of innovations and high-tech production.

Ukraine currently has a number of programmes in place to support innovation, which are described in detail below.

1. *The state support programme "Affordable Credits 5-7-9%"* provides for the provision of loans for the purpose of:

- entrepreneurship development, in particular, promoting the development of business entities, increasing production, exports, import substitution, high-tech production, energy efficiency, innovation, as well as facilitating the creation of new jobs and enterprises, and the return of labour migrants to Ukraine;
- preventing the occurrence and spread, localisation and elimination of outbreaks of epidemics and pandemics of acute respiratory disease COVID-19 caused by the SARS-CoV-2 coronavirus, as well as preventing and overcoming their consequences;
- refinancing of existing debt with Ukrainian banks on loans to business entities.

Financial state support to business entities is provided by the Entrepreneurship Development Fund through authorised banks.

2. *The Ukraine: Sustainable Bioenergy Value Chain Innovations Programme*, funded by the European Bank for Reconstruction and Development in partnership with the Global Environment Facility (GEF).

The programme will facilitate investments in innovative bioenergy technologies and practices related to the use of agricultural residues and waste by promoting and developing sustainable bioenergy value chains.

3. Pilot project on providing financial support to start-ups in Ukraine, including in the field of information technology, on a competitive basis[11] The Law provides for the implementation of a pilot project on providing financial support to start-ups in Ukraine, including in the field of information technology, on a competitive basis by 1 July 2024.

The pilot project envisages organising and conducting a competitive selection of early-stage start-ups for financial support, identifying and deciding on the winners of the selection and providing them with financial support, and monitoring the use of financial support funds.

Having analysed the Ukrainian legislation, it can be concluded that our country is taking certain steps to stimulate innovation, but the tools provided do not contribute to the intensification of innovation. This is due to the fact that certain instruments to stimulate innovation, such as tax and other benefits, have been cancelled, and state guarantees of innovation are declarative in nature.

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2.1.2 State support of innovation activities in Moldova

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Research and innovation represent the driving forces behind economic growth and are key to generating solutions and development levels that directly influence both a country's economic competitiveness and the resilience of its population against the consequences of global changes. Innovation is crucial for any transition to a circular economy, as this transition requires new approaches to value creation and consumption, which involve improving existing products, services, and processes, as well as creating new products, services, and processes.

A National Innovation System (NIS) is the foundation for experimenting with new ideas at a national level. This system can vary from country to country but typically comprises several key subsystems operating within a given economy, namely:

- The market (national and international) for innovative products and services;
- Firms and entrepreneurs (both national and international);
- Knowledge-generating activities, such as universities, public research organizations (PROs), and research and development (R&D) institutions;
- Innovation intermediaries that provide support services; and
- Framework conditions that shape the incentives and constraints for innovation.

The vibrant connections between all actors in the national innovation system are essential for the system's effectiveness in generating and experimenting with new ideas. It is these complex interactions and linkages among various actors within the national innovation system that influence the generation and diffusion of innovation in the economy and the efficiency of the innovation process (i.e., how quickly an innovation moves from being an idea to being on the market as a new product, service, or process).

In the current context, besides addressing ongoing crises, to enhance resilience to future crises and lay the foundation for sustainable and inclusive development, the Government has developed the "European Moldova 2030" National Development Strategy (SND) – a long-term national strategic vision document that outlines the country's development directions and adapts the priorities, objectives, indicators, and targets of international commitments assumed by the Republic of Moldova to the national context.

The SND proposes a human-centered development vision, where people are beneficiaries, not resources or tools of development. The strategy will contribute to defining a series of priority interventions – regulatory, institutional, budgetary, investment, and educational – that will have a direct positive impact on well-being and will harness the potential of people in entrepreneurial, educational, cultural, and productive domains.

The SND is Moldova's contribution to the achievement of the 2030 Agenda for Sustainable Development, adopted by the United Nations member countries in September 2015. Thus, the SND translates the targets and indicators of the 2030 Agenda, adjusted to the national context of the Republic of Moldova. The government is not the only agent of societal change but has a key role in coordination, leadership, mobilization, and inspiring other social actors. The SND will contribute to fulfilling these roles by defining a series of priority interventions – regulatory, institutional, budgetary, investment, and educational – that will have a direct positive impact on well-being and will contribute to unlocking people's potential in entrepreneurial, educational, cultural, and productive areas.

The development objectives established in the SND derive from the modern concept of quality of life and the major issues identified at the national level, drawing a direct link between well-being aspirations and the policies that will contribute to achieving these 10 objectives.

Objective 1: Increase income from sustainable sources and mitigate inequalities;

Objective 2: Improve living conditions;

Objective 3: Ensure relevant and quality education for all throughout life;

Objective 4: Raise the level of culture and personal development;

Objective 5: Improve the physical and mental health of the population through the active contribution of a modern and efficient health system that meets the needs of each individual;

Objective 6: Build a strong and inclusive social protection system;

Objective 7: Ensure efficient, inclusive, and transparent governance;

Objective 8: Establish a fair, incorruptible, and independent justice system;

Objective 9: Promote a peaceful and secure society;

Objective 10: Ensure a healthy and safe environment.

According to the study "The Economic Rationale for Public R&I Funding and Its Impact," commissioned by the European Commission in 2017, approximately two-thirds of economic growth in Europe is attributed to investments in innovation[1].

The research and innovation system in Moldova faces several vulnerabilities that limit its functionality and relevance, the most important being:

1. The modest role assigned to research and innovation activities within the public policy framework;
2. Insufficient funding for the research and innovation system, with low value assigned to research and innovation in government policies and sectoral programs;
3. Low efficiency of research and innovation activities and sporadic implementation of research results;
4. Insufficient number of researchers and a small proportion of young researchers;
5. Outdated material base and research infrastructure disconnected from international standards;
6. Lack of convergence between public research and innovation priorities and the country's socioeconomic needs;
7. Low visibility of research and innovation at the societal level and the results of national scientific research at the international level;
8. Relatively modest participation in international projects and initiatives[1].

Overall, the return on public investment in research and innovation is estimated at around 20%, with a 10% increase in these investments resulting in a 1.7% increase in total factor productivity, leading to a higher economic growth rate. The importance of tangible and intangible results obtained from research and innovation activities has led to the recognition of these fields as strategic by most European countries.

In the context of enhancing the impact of research and innovation outcomes on the business environment and society as a whole, the National Program aims to adopt and implement the principles of smart specialization. The National Program aims to increase the efficiency of the national research and innovation system and provide optimal conditions for generating new knowledge based on fundamental and applied research and implementing it to enhance the competitiveness of the national economy and the overall level of well-being.

The National Program will promote excellence in research and innovation, contributing to the implementation of national policy, stimulating productivity and competitiveness, and fostering the development of the national economy through the promotion of national values. Thus, the National Program is the main policy document that establishes both the priorities and strategic directions, as well as the development objectives in the fields of research and innovation. Smart specialization identifies priorities in a participatory manner to create a competitive advantage by developing the research and innovation strengths and aligning them with the needs of the business environment to coherently address emerging opportunities and market developments, avoiding overlap and fragmentation of efforts[2].

The implementation of the National Program is overseen by the Ministry of Education and Research. The EU provides funding for a range of projects and programs. Moldova is the first country in the Eastern Partnership and Central Asia to demonstrate its intention to integrate into the European Research Area (ERA) by associating with the European Union's framework programs.

During the implementation of the Science and Innovation Code of Moldova No. 259/2004 and the partnership agreements between the Academy of Sciences of Moldova and the Government of Moldova, the system of organization and management of science, research and innovation financing has radically changed. The tactical and strategic goals in research and innovation have been fundamentally redirected, with a primary focus on increasing and concentrating budgetary resources on the most important research and innovation directions, ensuring competitiveness and high quality of national scientific output in international cooperation.

In this context, existing strategic documents in the fields of research and innovation have established the development and deepening of collaboration within regional and international scientific programs, including participation in European community programs, which is one of the most important strategic tasks in the country's research and innovation policy.

Based on the primary goal – integration into the ERA – Moldova has revised all national and European documents to develop the National Roadmap for Integration into the European Research Area, a document of national interest that will contribute to achieving ERA priorities and promoting the positive image of the national research and innovation system at both the national and European levels.

In the process of developing the National Roadmap for Integration into the European Research Area, the experiences of developed European countries such as Germany, Norway, Romania, and others were taken into account[3].

The analysis of the Moldovan research and innovation system, carried out within the framework of the Horizon 2020 Policy Support Mechanism of the European Union in 2016, identified seven policy areas with corresponding recommendations:

1. **Integration of Research and Innovation Policy**: Incorporate research and innovation policy into the country's overall economic policy strategy.
2. **Improving Governance**: Enhance the political governance of the national research and development system by assigning specific responsibilities to specific ministries.
3. **Establishing an Independent Agency**: Create an independent, transparent, and accountable research and development implementation agency that concentrates and allocates all available R&D funds based on international standards.
4. **Addressing the Binarity of the Research and Education System**: Revise the binary research and education system in Moldova, where universities primarily focus on "teaching" and institutes on "research."
5. **Protecting Public Research and Innovation Capacity**: Ensure the maintenance and strengthening of the physical, intellectual, and human capital of Moldova's research institutes.
6. **Improving Employment and Funding Opportunities**: Take decisive measures to improve employment and funding opportunities, working conditions, and career prospects for researchers, particularly focusing on young and female scientific talents.

7. **Creating a Favorable Environment for Enterprise Involvement**: Introduce a coherent set of policy measures to create and stimulate a favorable environment for enterprise involvement in research and innovation activities. This includes both non-financial tools (such as a favorable legal framework for spin-off companies and knowledge transfers) and better opportunities for financing high-risk projects, as well as increasing the use of public funds to stimulate commercial research and innovation activities.

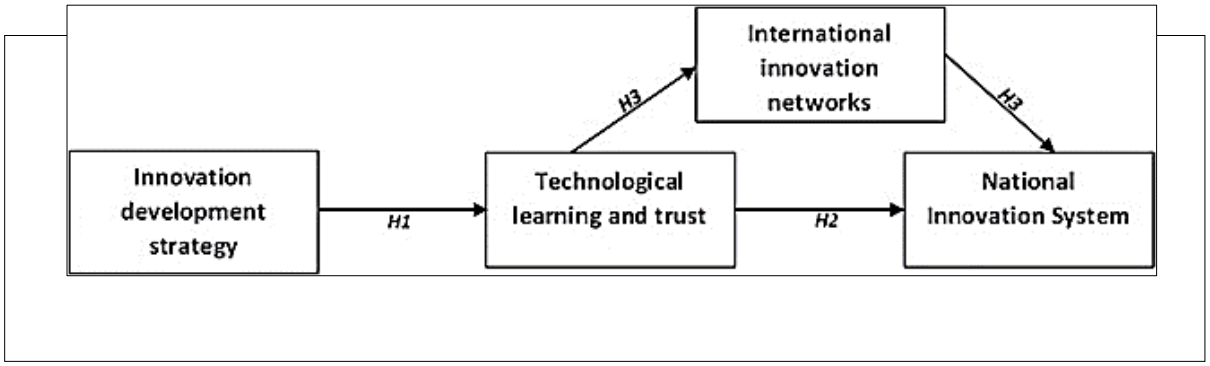
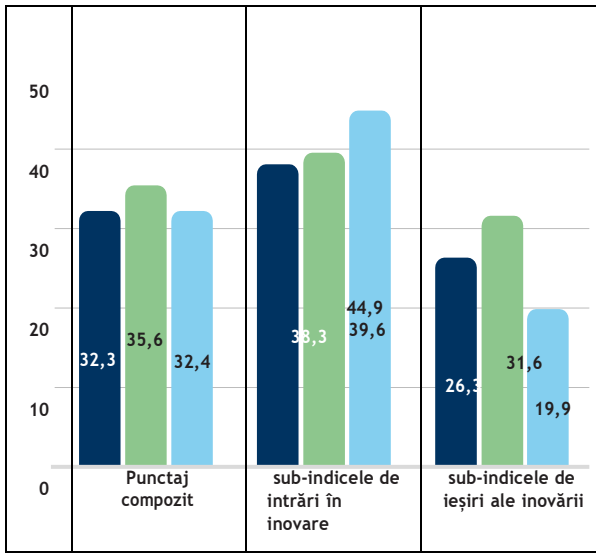


Fig. 2.1**. Operational Study Model ***

*https://www.sciencedirect.com/science/article/pii/S0040162522003973



Solicitări de brevet, 2020 (număr, total)	246
Adoptarea tehnologiilor (1-7, cel mai bun) Utilizarea TIC (1-7, cel mai bun) Infrastructura (1-7, cel mai bun) Gradul de sofisticare al afacerii (poziţie, IGI)	4,1 5,1 3,7 8,8
C&D și educatie	
Calitatea instituţiilor de cercetare științifică (1-7, cel mai	2,9
bun)	3,8
Utilizarea eficientă a talentelor (1-7, cel mai bun)	3.8
Calitatea educaţiei (1-7, cel mai bun)	5.4
Cheltuielile publice pentru educaţie ca procent	
din PIB)	
Clasamentul QS al universităţilor, punctaj mediu top 3*	77
(poziţie, IGI)	

Fig.2.2. **Global Competiveness Index, 2018d**

Although Moldova has substantial potential to benefit from innovation across many areas of socioeconomic activity, several obstacles prevent the adoption of new ideas, products, and processes as key drivers of sustainable domestic development in the coming decades (see Fig. 2.1). These obstacles vary, whether due to a lack of capacity to absorb new ideas or a shortage of funding for research and development, but each contributes to missed opportunities for growth and development in line with national goals and priorities. Creating and fostering more numerous and better connections between science and the business environment should be central not only to

research policy but also to private sector development policy. These changes need to be made in relations with efforts to address the skills gap through better alignment of educational investments with private sector needs so that the sector can act on the opportunities it has identified.

It has been established that TLT (Technology-Led Transformation) does not have a direct connection with the NIS (National Innovation System) network, as both path coefficients are close to zero and insignificant, but are mediated by other types of networks, including ICUN (International Collaboration and University Networks), IUN (Innovation and University Networks), and NRD (National Research and Development) networks. Secondly, IDS (Innovation-Driven Strategy) does not have a direct impact on the NIS network. This relationship is mediated by TLT and a variety of networks. The modeled relationships are presented below in the structural model [https://www.sciencedirect.com/science/article/pii/S0040162522003973].

In recent decades, the Government of the Republic of Moldova has increasingly recognized the role of innovation as a key factor for a competitive and sustainable economy. This has led to the implementation of digitalization reforms in public administration and services, as well as broad efforts to strengthen various aspects of the national innovation system. Notably, there has been a clear shift towards more competitive state funding for innovation and research under the new National Agency for Research and Development. Additionally, there have been several other initiatives aimed at strengthening the country's innovation infrastructure, particularly in promoting science and technology parks, incubators, and clusters.

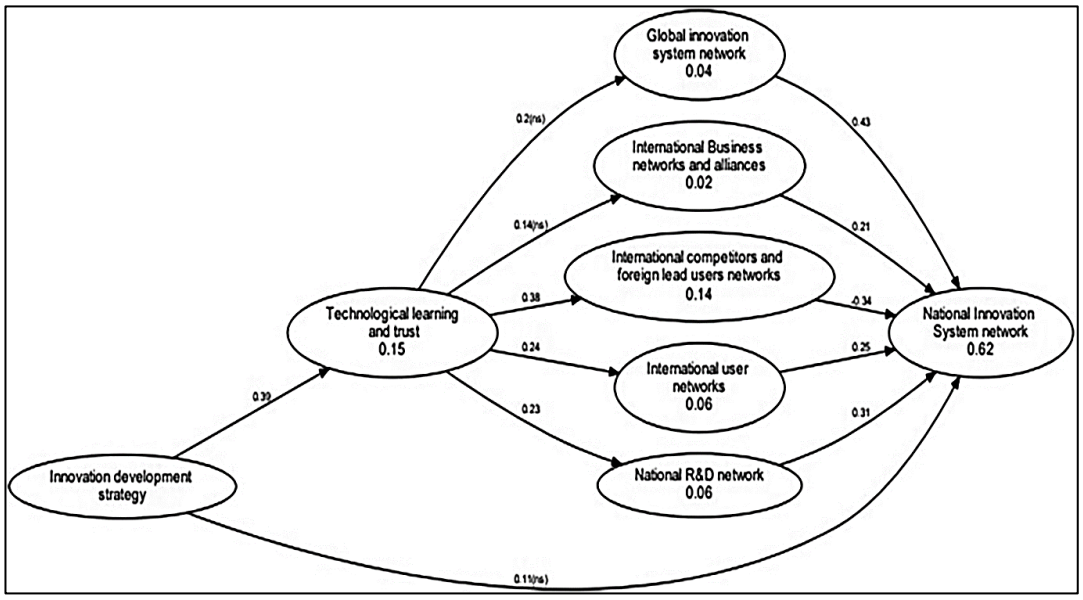


*Fig. 2.3. **Structural model: The role of international networks in enhancing the capacities of national innovation systems"**

***** https://www.sciencedirect.com/science/article/pii/S0040162522003973

However, innovation in Moldova remains far below its potential. Systemic innovation requires the systematic involvement of all stakeholders who cooperate and learn from each other. Facilitating, developing, and promoting such a system is particularly important for innovation in relatively small, open, transitional economies like that of the Republic of Moldova.

The Law provides for a special budget programme that allocates funds for full or partial interest-free lending to technology park projects, compensation of interest paid by technology park project implementers to commercial banks and other financial institutions for lending to technology park projects.

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2.1.3 State support for innovation activities in Azerbaijan

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Analysis of the current state of government regulation of innovation activity

In the context of Azerbaijan's integration into the world economy, the problem of innovation and competitiveness of the country's economy emphasizes the need to understand and adapt the criteria of the world market and the process of globalization, namely the formation of international innovation networks for the modern world, as well as joint scientific and technical research and development of various countries and corporations.

Countries that introduce the latest technologies in the global world and invest in human development will be more competitive in the future. The modernization of the nation and its competitiveness are an imperative requirement of the time. If the state wants to meet the growing demands of modern history and achieve even greater prosperity in Azerbaijan, it must take this requirement into account.

It is known that Azerbaijanhas the potential to produce competitive products in many areas. However, some technological advances do not replace foreign ones.
A new economy is being formed in Azerbaijan based on a model of innovative development based on a highly competitive economy, innovations, wise public administration, and the formation of close relations between business, science, the state and society. Of course, the development of deposits and the establishment of intersectoral links in an innovation-oriented model of economic development are crucial. From this point of view, the creation of technology centers in Azerbaijan can give positive results. The creation of such scientific and educational structures (for example, the Sumgait Technopark) and the development of scientific and technical activities is ensured by the creation and development of small innovative enterprises, commercialization and development work for industry.

Azerbaijan's national interests require strict measures to form and implement an innovation policy, which is an important part of the scientific and technical strategy as a whole, responding to new economic and socio-economic realities and providing a huge inflow of capital for the modernization of production.

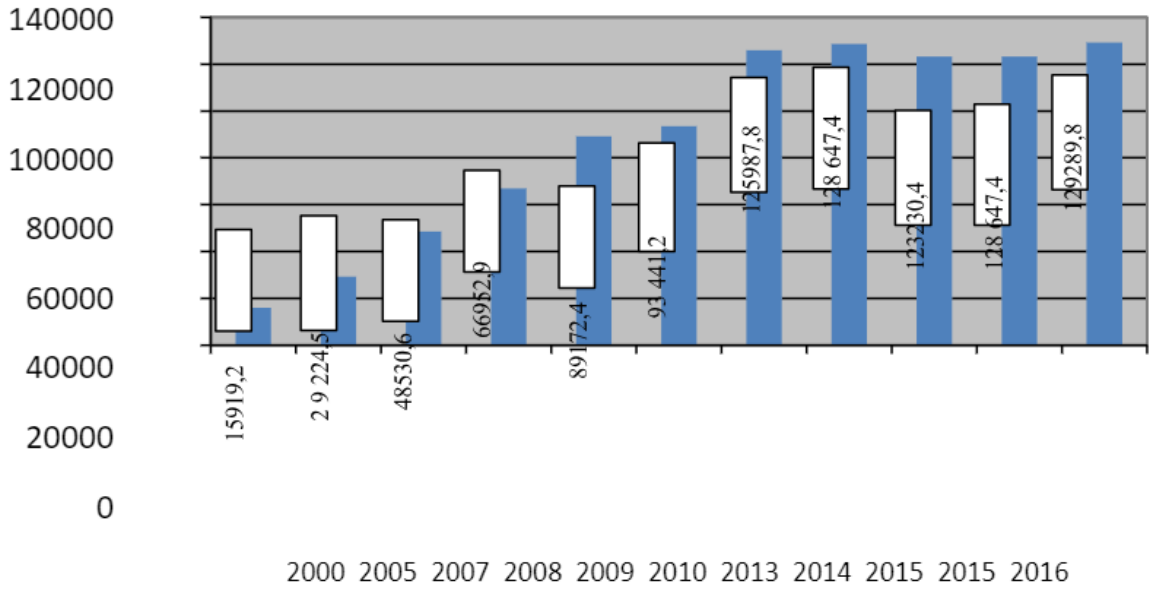
The direction of Azerbaijan's activity is not only a political symbol of the desire to move from an economic structure to another, but also the embodiment of the desire to transform from the modern postmodern, industrial world into a post-industrial order.

Undoubtedly, in order to reach the necessary point of development, it is necessary to improve the vector of development, free the economy from dependence on oil exports and create a knowledge economy, knowledge-intensive industries, high technologies and innovations." At the same time, the only way to be at the forefront and achieve goals is to learn how to use innovative mechanisms, put into practice new knowledge based on achievements in the fields of energy, biotechnology, nano-technologies and other scientifically based industries.
Innovative technologies are the most important source of labor productivity and the development of certain areas of the economy.

The elimination of scientific and technical tensions in developed countries and their integration into the global innovation environment, as well as its full-fledged partner, largely depends on the rapid development of the national innovation system. In this regard, when developing an appropriate development program for Azerbaijan, the need for constructive solutions to many problems is emphasized, the need to develop an effective, efficient structure of innovation systems, which is extremely important for managing the decision-making process.

In recent years, serious economic and industrial reforms, consistent government programs, accumulated financial opportunities and extensive foreign economic relations have created a solid foundation for building a better future for Azerbaijan. However, this key element of future success depends on the ability to create new ideas and the ability to implement these ideas through innovative and successful products, services and new types of companies. This is a direct confirmation of the goal of the Azerbaijani state to build a new generation of Azerbaijan is who are confident in their power to explore new opportunities and achieve success.

It should be noted that the programmatic organization of scientific research is carried out through the provision of grants by donor organizations to various scientific projects and through direct financing of specific projects. In general, this approach involves financing a research project rather than any scientific organization, so it can be argued that scientific research conducted in the private sector is conducted on a programmatic basis in general, as well as when analyzing the external experience with which they were associated.



Graph 2.1. **Total research and development costs in thousands of manats**
Source: State Statistics Committee of Azerbaijan https://www.stat.gov.az/source/education/ (16.05.2019)

Modern problems of national innovation activity
The national innovation system is the totality of all participants in the production and dissemination of new knowledge and technologies, as well as the range of relationships that exist between them during a reasonable process.

The reason why the national innovation system is founded is that the market economy is not perfect in all respects. This is due to the fact that the efficiency of economic activity is not sufficiently reflected in the operational activity or the risk of economic activity. At the same time, it often comes from technology transfer from abroad.

The corresponding process, as in many countries, includes the selection of new technologies, adaptation to local conditions, and repair of imported technologies in our republic. It should be noted that the technological capabilities achieved at the end of this stage play a key role in the creation of new technologies, products and production systems. To achieve this, the state must support small and medium-sized businesses.

The state forms priorities in the field of innovation, goals and principles of its policy. At this stage, it is necessary to distinguish between scientific and technical and innovation policies. In the first case, the state pursues the goal of creating and using innovations that pay for new scientific knowledge and, secondly, individual and social needs. The state innovation policy is a key part of the socio-economic policy, which illustrates the forms of activity, directions, goals of state bodies in the field of science and technology, the attitude of the state to innovation. This policy is a set of measures that enhance the effectiveness of innovation to meet the socio-economic development of the country and fully meet public needs.

The innovation program (innovation portfolio) is based on the objectives of the innovation strategy and the selection of key innovative projects from the innovation program or the core of key financial instruments of the innovation portfolio by implementing their strategic goals for the medium term. At the same time, the deadlines and volumes of implementation of certain realistic innovative projects aimed at achieving the goals of the innovation strategy in the short term have been determined. Realistic innovation projects and operational management of an innovative portfolio of financial instruments are focused on the innovation program and innovation portfolio formed by the enterprise, and its short-term management goals include the development of operational innovative solutions for various realistic innovations and financial instruments and, if necessary, program (portfolio) restructuring.

The emergence of innovative activity should be considered as an evolution of the complexity of the external environment of the management system of economic entities. When deciding on the application of innovations, it is important to take into account such strategic factors as environmental analysis, resource allocation and corporate strategy. The development of new technologies is an important aspect of strategic decision-making. Thus, the implementation of the strategy, as a rule, leads to changes in the organization's activities, such as the development and launch of new products or the introduction of new technologies. However, any changes are considered innovations.

Thus, at present, innovative projects determine the promising directions of the company's development, and the innovative and strategic indicators of the enterprise are fully integrated with the development of the market. Promotion of innovation-based management (management), taking into account development trends based on the generalization of the functions of strategic and innovative management in the process of enterprise management and timely registration of all factors of external market conditions, as well as product competitiveness and its transition from its functional level to the corporate level.

Stimulating the implementation of innovative projects in the context of increasing the role of new technologies as a factor of economic growth and development should be a common strategic goal, not a specific functional task.

In recent years, the cost of scientific and technical work in Azerbaijan has significantly decreased. At the same time, existing government spending on research and development has been focused on synthesizing existing research institutions, regardless of whether the benefits of promoting

sound fundamentalist research are the basis of policy priorities.
Thus, government funding for scientific research and experimental design work was focused on helping the existing infrastructure of research organizations, rather than on obtaining more relevant results.

In the following five groups, it is possible to present a system of innovative mechanisms that activate the implementation of innovative projects at the enterprise level, which ensures the implementation of state and regional innovation strategies at the micro level:

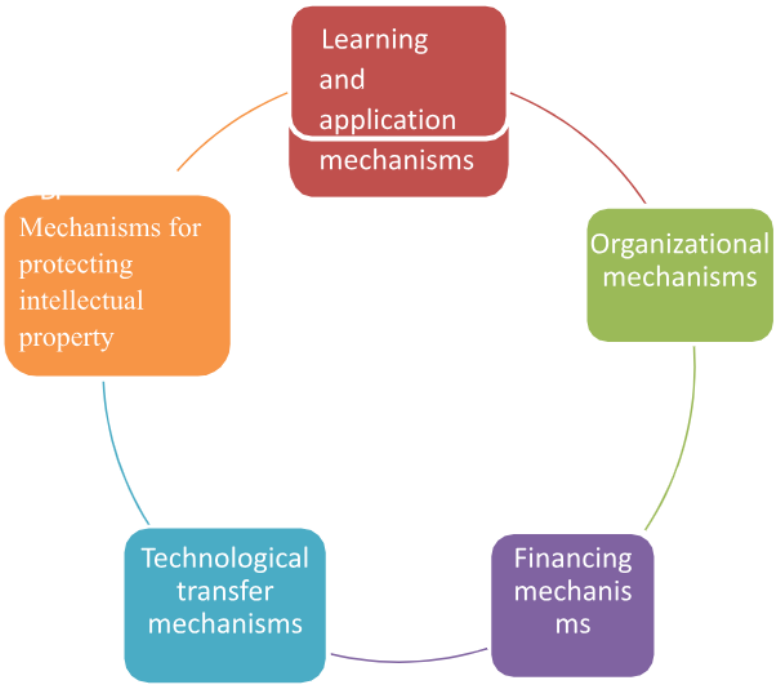


Fig. 2.4. **Groups activating the implementation of innovative projects.**

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[5]*https://president.az*

2.2 National innovation system of Ukraine / Moldova / Azerbaijan

2.2.1 National Innovation system of Ukraine

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The concept of "national innovation system" (NIS) was first proposed by Professor K. Freeman, who considered it as a set of organisational and institutional structures in the public and private sectors of the economy within national boundaries, whose activity and interaction initiate, create, modify and facilitate the dissemination of innovations[1].

The synthesis of scientific literature has revealed that in the modern theory of innovation development, the National innovation system is defined as a set of interconnected organisations of the public and private sectors of the economy that are directly involved in the innovation process, and institutions that ensure and regulate innovation activities at the national level.

A similar approach is found in the Strategy of Innovative Development of Ukraine until 2030[2], which defines the National innovation system as a set of institutions, relations, and various types of resources involved in the process of creating and applying scientific knowledge and technologies that ensure the development of innovation), the formation of an innovative culture in the state, using other mechanisms for the development of innovation, in addition to financial ones.

Thus, the National innovation system is a complex system of institutions of education, science, business and the state, the functioning of which is based on state organisational and economic regulation and market self-regulation, resulting in the creation of innovative products and ensuring the effectiveness of their commercialisation in the domestic and foreign markets of innovative products and services. Hence, the structural components of the NIS include the following elements:

1. *Normative and legal regulation of innovative development of the Ukrainian economy,* namely, the current legislative norms regulate issues exclusively on the interpretation of the essence of innovation, innovation activity, innovative product, innovative and priority innovation project, innovative enterprise, innovative infrastructure, high knowledge-intensive technologies, high-tech products and high-tech production, and a project for the development of knowledge-intensive technologies. However, the Ukrainian legislation in force in the field of innovation is not aimed at stimulating the innovation activities of business entities, as there is no recording of scientific and technical achievements in the field of high technologies in Ukraine; statistical recording of the number of new technologies created and used in the economy has been suspended; the area of high-tech production has not been structured, and the production of high-tech goods and scientific services is not monitored.

In this regard, it is advisable to provide financial and economic mechanisms and tools for stimulating innovation and high-tech activities based on the study and implementation of effective

elements of leading international practice and positive domestic experience. It is undoubtedly difficult to strengthen the effectiveness of the instruments of state regulation of innovation activity in the context of war due to the limitation of the state budget funds and the state's priorities in financing the Armed Forces of Ukraine, as well as the post-war restoration of the frontline and liberated territories of the country.

2. *Educational institutions*, which should include higher education institutions, scientific and methodological institutions, research and production enterprises, state and local education authorities, as well as educational institutions that provide training, retraining and advanced training;
3. Knowledge generating organisations, which should include scientific institutions and organisations regardless of ownership that carry out research and development and create new scientific knowledge and technologies; state research centres, academic and industry institutes, research departments of higher education institutions, research and development departments of enterprises;

4. Innovative infrastructure facilities consisting of production and technological, financial, information and analytical, expert and consulting components, as well as technopoles, technology and science parks, innovation and technology transfer centers, business incubators and other types of innovative structures; networks of scientific and technical information, expert consulting and engineering firms, institutional public and private investors;

5. Capacities for the production of innovative products and services, which should include organizations and production structures that are producers of innovative products and (or) consumers of technological innovations[3].

We believe that despite the existence of certain elements of the national innovation system, its integrity is not ensured today, i.e. the structural elements of the national innovation ecosystem and the regulatory framework for their functioning do not provide a synergistic effect, which should mean the increase of national production of goods (services) efficiency and strengthen their competitiveness through the large-scale implementation of the results of scientific research and scientific and technical (experimental) products.

One of the unresolved challenges in the development and implementation of innovations is the so-called disconnect between science and practice, the low percentage of practical use and/or commercialization of scientific inventions and products. In domestic practice, very often results of scientific research and development are unclaimed by business structures. This is evidenced by the fact that only 9% of the total number of new equipment samples were used in the development process[3].

It should be noted that the main reasons for unsatisfactory innovation development in Ukraine are related to the following:

- insufficient level of state support for scientific and technical developments;
- limited funding of scientific research and its low investment attractiveness;

weak protection of intellectual property rights;
migration of leading specialists to foreign countries;
bureaucracy and corruption;
lack of integration between research, education and business structures;
insufficient development of innovation infrastructure[4];
military aggression of Russia;
lack of breakthrough scientific and technical developments;
insufficient scientific support for the implementation of innovative developments at the level of business structures, etc.

Let's consider in more detail the newly created elements of the national innovation system, whose development is considered in Ukraine in terms of enhancing innovation activity.

1. **The Ukrainian Startup Fund** was created on the initiative of the Cabinet of Ministers of Ukraine, whose mission is to promote the creation and growth of early-stage technology startups in Ukraine in order to increase their global competitiveness[5].

The main objectives of the Fund are:

- providing, on a competitive basis, non-repayable financial support to private sector business entities engaged in innovative activities with a view to commercialising its results, or financing, on a competitive basis, innovative projects that demonstrate a high potential for commercial success;
- attracting funding for innovations from Ukrainian non-governmental organizations, enterprises and institutions, international and foreign governmental and non-governmental financial and non-financial organizations, and individuals;
- organizing and conducting competitive selections of innovative projects to provide financial support and/or technical assistance for their implementation;
- promotion of innovative developments of private economic entities among Ukrainian and foreign potential consumers and buyers of innovative products;
- support of innovative projects and monitoring of their effective implementation and targeted use of provided funds.

It should be noted that in 2022-2023, the Innovation Development Fund evaluated 440 startups, financed more than 250 startups, and allocated UAH 6.3 billion[6].

2. **The State Financial and Credit Institution for Innovations** was established to provide financial support for the innovative activities of business entities of various forms of ownership, as well as to attract domestic and foreign investment for the development of the real sector of the economy, increase domestic potential for exporting products manufactured by national enterprises, protect and support national producers[7].

3. National Research Foundation of Ukraine (NRFU). The main task of the Fund is to provide grant support to:

fundamental research in the field of natural, technical, social and human sciences;

applied research and scientific and technical (experimental) products in the priority areas of science and technology development[8].

In 2021, the agreements were signed to finance 208 winning projects. In 2021, the total amount of planned funding for grant projects under the concluded agreements was UAH 660.8 million. Compared to 2020, the total amount of funding for grant projects in 2021 increased by UAH 405.5 million.

In 2021, the funding was received by research institutions for 116 projects totalling UAH 402.8 million, higher education institutions for 97 projects totalling UAH 256.9 million, other institutions for one project in the amount of UAH 988.1 thousand.

4. Technology and Innovation support centres (TISCs). The network of Technology and Innovation Support Centres (TISCs) is an international project of the World Intellectual Property Organisation, which has been implemented in Ukraine since 2018 on the basis of the Memorandum of Understanding between the Ministry of Economic Development and Trade of Ukraine and the World Intellectual Property Organisation (WIPO) on the establishment of Technology and Innovation Support Centres in Ukraine dated by 26.07.2018[9].
The purpose of the TISCs is to provide applicants with convenient and comprehensive advice and support in the field of intellectual property law in Ukraine and abroad, as well as to raise awareness of the acquisition, use and protection of intellectual property among small and medium-sized businesses, start-ups, inventors and creative industries.

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2.2.2 National innovation system of Moldova

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Innovation governance refers to the rules, institutions, and processes that determine the role of the public sector in facilitating and promoting innovation and in advancing the national innovation system. The aim of this innovation governance framework is to develop, implement, and then evaluate policies and measures to promote innovation.
This allows the government to monitor how relevant decision-making rules affect the innovation process and the impact they have on the interactions among the actors involved in innovation. Given the complex nature of the national innovation system, the relevant policy areas extend beyond public research and digitalization. This highlights one of the largest and most immediate challenges in achieving effective innovation governance, namely, implementing effective mechanisms for coordinating and harmonizing policies across a diverse range of areas so that they are targeted, cost-effective, synergistic, and complementary.
The national innovation system of Moldova, according to the latest update in September 2021, involves various entities and mechanisms intended to promote innovation, research, and development in the country. The main components of Moldova's national innovation system are:

- **Ministry of Education and Research (MEC)**: The MEC plays a central role in coordinating educational, cultural, and research activities in Moldova. It often oversees policies and initiatives related to innovation and research.
- **Academic and Research Institutions**: Universities and research institutions contribute significantly to Moldova's innovation ecosystem. They conduct research, collaborate with industry, and contribute to knowledge creation.
- **National Agency for Research and Development (ANCD)**: The ANCD is responsible for implementing state policies in scientific research and technological development.
- **Industry Collaboration**: Collaboration between the private sector and research institutions is crucial for innovation. Initiatives that encourage partnerships, technology transfer, and joint projects contribute to a vibrant innovation landscape.
- **Innovation Hubs and Incubators**: The establishment of innovation hubs and incubators provides a supportive environment for startups and innovative businesses. These centers offer infrastructure, mentoring, and networking opportunities.
- **Funding Programs**: Governmental and non-governmental organizations provide funding for research and innovation projects. These programs aim to support businesses, startups, and
- **Intellectual Property Protection**: Legal framework for protecting intellectual property, including patents and trademarks, is essential for fostering innovation by ensuring that innovators can protect and benefit from their creations.
- **Education and Skills Development**: Investment in education and skills development, particularly in science, technology, engineering, and mathematics (STEM), is fundamental for cultivating a skilled workforce that can drive innovation.

- **EU Programs**: Moldova participates in various European Union programs, such as Horizon 2020 and its successor, Horizon Europe. These programs provide funding and collaboration opportunities in research and innovation.
- **National Innovation Strategy**: Moldova has a national strategy outlining the objectives, priorities, and actions for promoting innovation and technological development in the country.
- **International Collaboration**: Collaboration with international organizations, other countries, and participation in global innovation networks contribute to Moldova's integration into the broader innovation landscape.

Table 2.1. **Basic Knowledge Flows in National Innovation Systems**

Type of knowledge flow	Main indicator
Industry alliances	
Inter-firm research co-operation	Firm surveys Literature-based counting
Industry/university interactions	
Co-operative industry/University R&D	University annual reports
Industry/University co-patents	Patent record analysis
Industry/University co-publications	Publications analysis
Industry use of university patents	Citation analysis
Industry/University information-sharing	Firm surveys
Industry/research institute interactions	
Co-operative industry/Institute R&D	Government reports
Industry/Institute co-patents	Patent record analysis
Industry/Institute co-publications Industry	Publications analysis
use of research institute patents	Citation analysis
Industry/Institute information-sharing	Firm surveys
Technology diffusion	
Technology use by industry Embodied	Firm surveys
technology diffusion	Input-output analysis
Personnel mobility	
Movement of technical personnel among	Labour market statistics
industry, universities and research	University/Institute reports

* https://www.oecd.org/mena/47563588.pdf

The National Research and Innovation Program (PNCI) for 2020-2023 is the key document guiding innovation policy in Moldova, focusing primarily on public sector research. However, the absence of a comprehensive strategic vision and holistic governance limits the potential broad, catalytic effects of government support. To address these issues, there is a need for an intergovernmental coordination mechanism, such as a National Innovation Council, to guide and align innovation policy efforts.

Governance of Innovation

In Moldova, the Ministry of Education and Research (MEC) is responsible for developing and overseeing the National Research and Innovation Program (PNCI) for 2020-2023. The MEC sets objectives, defines roles, and allocates responsibilities for innovation policy. Within the MEC:

- The National Agency for Research and Development (ANCD) oversees state funding for R&D projects.
- The National Agency for Quality Assurance in Education and Research (ANACEC) is tasked with evaluating national institutions in science, research, and innovation.

Challenges

Governance of innovation in Moldova is complex and fragmented among various ministries and agencies, lacking systematic synergies and institutional capacity for effective policy design, implementation, and monitoring. The innovation policy requires a more strategic intergovernmental coordination mechanism to guide and align policy efforts for effective promotion and support at both national and sub-national levels.

Public-Private Dialogue

The public-private dialogue to ensure inclusive and relevant policies is not yet systematic and could be strengthened. There has been progress in digitalizing public sector services and processes, but there is significant room for further e-Governance reform and stimulating innovation demand through public procurement.

Current State

Innovation governance in Moldova remains somewhat underdeveloped and less rationalized than it could be. Essential legislative and institutional elements are in place, but policy efforts are scattered across various ministries and agencies without systematic synergies. Additionally, all levels of government and institutions involved in innovation lack the capacity to design, implement, and monitor inclusive innovation policies that systematically include all relevant stakeholders.

Subnational Innovation Potential

While regional smart specialization initiatives partially address subnational innovation potential, it remains largely untapped. Enhancing the capacity of local authorities to systematically experiment with, facilitate, and promote innovation is essential. These efforts should build on recent decentralization reforms, clustering efforts, and donor-supported pilot projects (e.g., StartUp City Cahul, Tekwill) and involve subnational authorities in national-level governance through a National Innovation Council.

Innovation governance in Moldova is still evolving and, at present, is somewhat underdeveloped and not as rationalized as it could be. While essential legislative and institutional elements are in place, policy efforts are fragmented across various ministries and agencies that lack systematic synergies. Additionally, all levels of government and institutions involved in innovation lack the capacity to design, implement, and monitor innovation policies effectively, including and systematically engaging all relevant stakeholders.

Subnational innovation potential, although partially addressed by regional smart specialization initiatives, remains largely untapped. Enhancing the capacity of local authorities to systematically

experiment with, facilitate, and promote innovation—by building on successful existing initiatives—will be crucial. These efforts should leverage recent decentralization reforms, clustering efforts, and donor-supported pilot projects (e.g., StartUp City Cahul, Tekwill) and involve subnational authorities in national-level governance through the National Innovation Council.

Global Innovation Index (GII)

The Global Innovation Index (GII) ranks global economies based on their innovation capabilities. Consisting of approximately 80 indicators, grouped into inputs and outputs of innovation, the GII aims to capture the multidimensional aspects of innovation. Table 2.2 shows Moldova's rankings over the past four years. Data availability and changes in the GII model framework influence year-on-year comparisons of GII rankings. The confidence interval for Moldova's GII ranking in 2023 is between positions 53 and 65.

Table 2.2. **Rankings for Moldova (2020–2022)**

GIIYR	GII	Innovation inputs	Innovation outputs
2020	**59th**	**75th**	**48th**
2021	**64th**	**80th**	**54th**
2022	**56th**	**78th**	**46th**
2023	**60th**	**81st**	**50th**

Table 2.3. **Strengths and Weaknesses of Innovation in Moldova**

Puncte forte			Puncte slabe		
Rank	**Cod**	**Indicator name**	**Rank**	**Cod**	Indicator name
5	**6.1.3**	Utility models by origin/bn PPP$ GDP	**121**	**5.2.2**	State of cluster development
6	**7.1.4**	Industrial designs by origin/bn PPP$ GDP	**116**	**4.3.3**	Domestic market scale, bn PPP$
7	**4.1.3**	Loans from microfinance institutions, % GDP	**108**	**1.3.1**	Policies for doing business
11	**7.1.2**	Trademarks by origin/bn PPP$ GDP	**105**	**5.2.1**	University-industry R&D collaboration
13	**6.3.4**	ICT services exports, % total trade	**89**	**3.2.2**	Logistics performance
14	**7.3.4**	Mobile app creation/bn PPP$ GDP	**74**	**7.1.3**	Global brand value, top 5,000
14	**4.3.1**	Applied tariff rate, weighted avg., %	**74**	**5.1.3**	GERD performed by business, % GDP
20	**2.1.1**	Expenditure on education, % GDP	**71**	**2.3.4**	QS university ranking, top 3
28	**6.2.1**	Labor productivity growth, %	**48**	**6.2.2**	Unicorn valuation, % GDP
30	**3.2.3**	Gross capital formation, % GDP	**40**	**2.3.3**	Global corporate R&D investors, top 3, mn US$

Moldova demonstrates a clear commitment to supporting innovation, both politically and through various support mechanisms. However, the national innovation system (NIS) remains in its early stages and requires stimulation.

The NIS continues to develop, with fragmented innovation policy governance that needs strategic direction, coordination, and flexibility. Innovation policy is often seen as part of research policy, lacking the broader innovation potential in the private sector and governance.

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2.2.3 National Innovation System in Azerbaijan

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The innovation policy of Azerbaijan, being an integral part of socio-economic policy, is aimed at developing and stimulating innovative activities and is characterized by the creation of new or improved products based on a technical process.

In the impact of the state on innovation processes, tools for stimulating cooperation between industrial enterprises are of particular importance. There is already established foreign experience in this area. For example, in Canada, as a direct tool to stimulate innovation, government

guarantees are used when obtaining loans from commercial banks or government direct financing of the innovation process. In Japan, budget subsidies and concessional lending are applied to state corporations and centers, state-owned industry research institutes that create innovations together with private firms based on the principle of public-private cooperation. In Germany, direct funding is provided for long-term research in priority scientific areas characterized by a high degree of uncertainty.

High economic activity is ensured by the leading role of the state in the scientific and technical market, reflected in the definition of national priorities and active influence on the process of innovative development through a system of incentive mechanisms. Therefore, the system of stimulating innovation activity should help solve two problems in the field of economics:

- improving the competitiveness of high-tech sectors of the economy, taking into account the general activation of the innovation component;
- opportunities to enter the global market.

It should be noted that another important factor that plays a decisive role in the innovation process is a patriotic, hardworking, dedicated to the state, technically and socially literate leader – innovator.

Over the past 16 years, Azerbaijan has achieved a revolutionary renewal of its economy for the practical implementation of innovative projects. And it becomes an innovation hub for the implementation of innovations.

The connection of innovation hubs with their creative ideas and proximity to academic centers is useful and determines the success of these innovations. An ecosystem that ensures the interaction of academic and research institutions and with strong multinational companies (such as SOCAR) plays an important role in the success of innovation hubs (Technoparks, clusters).

In modern conditions, the creation of a national investment system and its effective operation are becoming a decisive factor in the dynamic and sustainable development of the national economy of the country. Thus, the formation of a policy aimed at modernizing society and the transition of the economy to an innovative type of development require the development of a system of appropriate measures and their effective implementation. In other words, the country faces the task of building a future qualitatively new knowledge-based economy. According to UN experts, a knowledge–based economy is an economy created for economic growth and sustainability of a country, influencing international competition, spreading and using knowledge.

In conditions of active integration of our country into the world economy, increasing the competitiveness of the economy, the need to transition to a model of innovative development require the creation of a national innovation system involving the existing resource balance of the country, the degree of their use, the possibilities of scientific and technological progress, including the structure of economic growth factors, as well as other objective and subjective factors. To create an innovative economy in the country, it is necessary to strengthen the links between science

and production, introduce scientific and technical achievements, including the creation of a new mechanism for matching scientific research to market needs.

In this regard, I would like to note the Decree of the President of the Republic of Azerbaijan "On ensuring coordination in the field of innovative development in the Republic of Azerbaijan" dated January 10, 2019, which provides for the preparation of a Strategy for the innovative development of Azerbaijan.
Increasing innovation activity implies the formation of effective market and government mechanisms to stimulate the production of competitive products and the effective realization of innovative potential, including relevant legislation and regulatory framework.

The creation of special territories on the territory of Azerbaijan for the implementation of innovations and the development of the non-oil sector has been declared a strategic task in Azerbaijan. The Government of the country creates favorable conditions for innovative investments. It strives in every possible way to bring the manufacturing and digital sector, to instill in business the desire to innovate. There are also direct public investments and incentives for entrepreneurs to work more actively in the applied and digital economy. In order to ensure dynamic sustainable development, competitiveness and security of the state, it is important that investments have an innovative character and generally contribute to the successful implementation of the entire process. Of the existing innovation processes, the missing link is venture finance. Therefore, in order to regulate the entire innovation process, it is necessary to adopt laws "On Venture activity" and "On Innovation activity". Since innovation platforms have been created, tax and customs privileges have been determined, innovators want to enter the national economy, but it is difficult to find venture capital money. It is necessary to create venture and innovation funds. Without this, it will be difficult to ensure the activity and mass character of this event.

At the moment, the national innovation strategy of Azerbaijan has not yet been approved. Since there is currently no single strategic document that clearly sets out priorities in the field of STI, policy targets are dispersed across numerous strategies. The main economic strategy of the country is aimed at diversifying the economy and developing non-oil sectors. For example, the development concept "Azerbaijan 2020: A Look into the Future", which was adopted in 2012, says: "In the last decade, the factor of hydrocarbon exports has been the main driving force of economic growth, but the main task at the current stage is to achieve advanced development of the non–oil sector, increase the efficiency and competitiveness of the economy, and ensure its progress on an innovative basis. In other words, the foundations for the transition from the traditional economy to the "knowledge economy" should already be laid, and the adequate development of human capital, which is crucial for this, should be brought to the fore."1 In order to achieve this goal, the development concept establishes as one of its top priorities the expansion of the use of information and communication technologies (ICT) at the level of central and local authorities, strengthening information security, increasing the competitiveness of export-oriented ICT enterprises, training and employment of highly qualified specialists and scientific staff.

These common goals were confirmed in the Strategic Roadmaps for the National Economy and the main sectors of the Economy of the Republic of Azerbaijan, approved by Presidential decree

dated December 6, 2016. Innovation is recognized as an essential element for ensuring the sustainability of economic policy and the development of a globally competitive economy. As stated in the roadmap, "the economy of Azerbaijan will make the transition from an efficiency-based model to an innovation-based model. Physical, human, institutional and social capital will be created to develop an innovative model 2."

The main strategic documents in the field of STI

As mentioned earlier, the innovation policy in Azerbaijan remains fragmented, as it is reflected in a number of different legal and strategic documents, and different bodies are responsible for this policy with weak coordination and coherence of their activities. To eliminate the gaps in innovation By the decree of the President of the Republic of Azerbaijan dated January 10, 2019, the Presidential Administration was instructed to develop a national innovation strategy and an appropriate action plan. The Boston Consulting Group (BCG) was involved in the development of the national innovation strategy of the Republic of Azerbaijan, but this process has not yet been completed.

The National Strategy for the Development of the Information Society in the Republic of Azerbaijan for 2014-2020, approved by Presidential decree dated April 2, 2014, defines the main goal of STI as strengthening the export-oriented sector of competitive high technologies and the formation of an innovative system that ensures the development and application of high-tech and high-tech products. Among other tasks, there are provisions concerning the support of innovative entrepreneurship and the development of technoparks, business incubators and innovative structures.

To ensure the implementation of the strategy, on September 20, 2016, the President signed an order approving the "State Program for the implementation of the National Strategy for the Development of the Information Society in the Republic of Azerbaijan for 2016-2020". This program defines specific targets and responsibilities of numerous government agencies charged with organizing educational and information work with small and medium-sized enterprises (SMEs), expanding the use of ICT solutions, developing innovative entrepreneurship in the field of ICT, as well as supporting the creation and implementation of knowledge-intensive and high-tech products.

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2.3 Regulation of innovation activities in the EU

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Important regulations of Innovation Activities for Agri-food Clusters in the EU

EU Framework for Innovation in Agri-food Clusters

The European Union (EU) has long recognized the pivotal role of innovation in driving economic growth, sustainability, and global competitiveness. This is particularly true in the agri-food sector, which faces the dual challenge of increasing productivity while also embracing sustainable practices for reducing negative environmental impact and social challenge e.g. aging rural population, labour shortages due to efflux of workers to urban areas or other industries. Agri-food clusters, as concentrations of interconnected businesses, suppliers, and associated institutions, are important ecosystems that can transform the EU's agricultural landscape through innovation. This article delves into the regulations and policies shaping innovation activities of the agri-food clusters, highlighting their importance for future development of agri-food sector in the EU. The EU framework consists of strategic assumptions, implementing directions, supporting schemes and ongoing institutional support from R&D ecosystem. The EU strategic orientation is expressed in the Green Deal and the Farm to Fork strategy as well in the digital single market strategy. The execution directions are included in common agricultural policy and its country level implementation schemes, environmental legislation and food safety and quality standards. The supporting mechanisms are EU and country specific funding and implementation programs stimulating the development and spread of novel solutions throughout agri-food chain and advisory and research institutions that fuel the knowledge discovery and sharing.

The European Green Deal and Farm to Fork Strategy

The European Green Deal is a comprehensive strategy aimed at promoting sustainability, combating climate change, and fostering economic growth through environmentally friendly practices. The European Union (EU) introduced the Green Deal in December 2019 as a key initiative to transition towards a sustainable economic model, focusing on achieving climate neutrality by 2050[11, 20, 27]. It comprise: (1) the overarching climate objectives; (2) strategies focused on specific sectors and systems including energy, construction, industry, biodiversity, food, mobility, and pollution; (3) key drivers in the transition towards sustainability such as international collaboration, financial aspects, regulatory frameworks, innovation, and research; and (4) initiatives aimed at facilitating an equitable transition and engaging stakeholders and the public[1].
Farm to Fork (F2F) Strategy being a part of the Green Deal is an approach that encompasses the entire journey of food production, from cultivation to consumption, emphasizing sustainability, health, and environmental considerations[7, 17]. Farm to Fork strategy aims to create a fair, healthy, and environmentally friendly food system by analysing and optimizing the agricultural value chain. F2F strategies include setting targets for reducing pesticide use, nutrient losses, and antimicrobial resistance while promoting organic farming[19, 24].

The Common Agricultural Policy (CAP)

The Common Agricultural Policy (CAP) is an EU policy regulating financial support for farmers to ensure fair living standards and stabilize agricultural incomes[6] **and in this way creating favourable conditions for certain types of activities**. The CAP has evolved to support sustainable rural development and greening of agricultural production through eco-schemes, aligning with the European Green Deal objectives and luring the agricultural sector towards sustainable development with 40% of the CAP budget intended to support climate-relevant initiatives[10]. The CAP's strategic plans are outlined in the European Commission's communication on 'The Future of Food and Farming'[29], which emphasizes the importance of sustainability and innovation in agriculture. The CAP enhances the innovation activity through measures like the agricultural European Innovation Partnership (EIP-AGRI) which promotes bottom-up, multi-actor approach in creating innovations for increased productivity and sustainability. The EIP-AGRI approach is detailed in 'The European Innovation Partnership (EIP) Operational Groups – Bringing Innovation to Practice'[30].

The Digital Single Market Strategy

Today's economy highly relies on information processing and digitalization, so it was an important step to establish guidelines and create favourable conditions for the digital economy. The Digital Single Market Strategy initiated in 2015 aims at creating a unified digital market across member countries to enhance access to online goods and services[9].

Agri-food clusters benefit from digital single market and facilitating digitalisation by using Blockchain, IoT technologies, artificial intelligence, and smart sensors that enhance productivity, reduce environmental footprints, increases resilience, and improve efficiency in agri-food supply chains[14].

These technologies enable better management of agri-food safety, traceability, sustainability, performance measurement, resilience in disruptions, integration, and transparency, ultimately leading to improved social welfare and increased competitiveness for companies[8]. The adoption of digital solutions in agri-food clusters is crucial in the face of challenges like climate change, population growth, and other turbulences like the COVID-19 pandemic, driving the need for Industry 4.0 technologies to reshape the industry and mitigate negative effects on food systems[15]. Additionally agri-food clusters benefit from initiatives run under this strategy, such as the development of digital skills and the deployment of high-speed broadband in rural areas, facilitating the adoption of digital technologies in agriculture and rural areas[26].

Horizon Europe and the Role of Research & Innovation

Horizon Europe, the EU's key funding program for research and innovation plays a critical role in supporting inclusion of agri-food clusters and particular agri-food companies in innovation activities. By funding research projects that are implemented by various actors and inter alia by agri-food clusters, Horizon Europe bolsters innovation in agricultural technologies, sustainable practices, and the bioeconomy[18]. Similar role plays the Circular Bio-based Europe (CBE-JU) that constitutes public-private partnership program funding initiatives that develop innovative and sustainable bio-based solutions, focusing on raw materials, processing and products. There is also the broad choice of programs that are mainly targeted to individual innovative companies, that can later diffuse the knowledge and solutions to its partners in the agri-food clusters. For example the development of highly innovative solutions coming from small to medium enterprises and start-ups is supported by the European Institute of Innovation and Technology in Food (EIT Food). These above described initiatives aim to address the low propensity towards innovation in the agri-food sector and improve the quality of products throughout the supply chain, ultimately

enhancing global competitiveness and regional development[23]. Another opportunity pose the EIC Accelerator (previously operating as the SME Instrument) and other programmes run by the European Innovation Council (EIC).

Environmental legislation

Environmental legislation impacting agri-food clusters includes regulations on chemicals, GMO cultivation, waste management, and pro-environmental measures under the Common Agricultural Policy (CAP)[23]. The EU has stringent laws on chemicals used in food production, waste management, and interactions with the environment[3]. Additionally, EU legislation focuses on the cultivation and import of genetically modified organisms (GMOs), with directives and regulations ensuring transparency, limited use, and traceability throughout the food chain[2]. Moreover, the European Green Deal emphasizes the role of agriculture in achieving environmental goals, with pro-environmental measures like organic farming, agri-environmental climate measures, and afforestation being crucial for sustainable practices in agri-food clusters. These regulations are intended to promote sustainable practices, reduce emissions, and enhance resource efficiency within the agri-food industry[21].

Food Safety and Quality Standards

Food safety and quality standards shape the activities of the EU agri-food companies and agri-food clusters[4]. Some standards are mandatory for EU processors like HACCP and other are optional. Both types of standards protect consumers' health, facilitate international trade, and ensure compliance with other regulations[13]. Private food safety standards, enforced through third-party certification, have become de facto mandatory for suppliers aiming to access profitable markets, contributing significantly to food safety and consumer health protection[12]. In the European Union (EU), key Food Safety and Quality Standards include private standards like BRC, IFC, and FSSC 22000, which are widely adopted in the food industry and supported by major retailers and manufacturers. The EU legal framework has integrated private standards into its regulations, benefiting from the experience of standard-owners, certification bodies, and the food industry[16].

Innovation activities regulated and supported by the EU are essential for the advancement and sustainability of agri-food clusters. Through a combination of policies, funding programs, and regulatory frameworks, the EU tries to establish an environment where innovation can thrive, addressing the challenges of sustainability, productivity, and competitiveness of companies and clusters[5].

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2.4 Approaches to the intellectual property management

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Intellectual property includes creations of the mind, such as inventions, literary and artistic works, designs, symbols, names, and images used in commerce. Intellectual Property and exploitation of results issues are key points regarding the impact and feasibility of the agri-food cluster project. In general terms to take to market the results of research and development activities require additional investments, which is appealing if the results are well-protected through intellectual property. Intellectual Property Law includes a range of intangible property rights, including patents, copyrights, trademarks, trade secrets, design rights and an indication (the original geographical indications laws). In this context, intellectual property refers to an intangible property right which is enjoyed by law after the engagement in intellectual creative conduct. In Europe, intellectual property ("IP") law combines copyright and other copyright-related rights laws and industrial property. Collaborative projects, including cluster projects, bring together partners with different company cultures, business mindsets, interests, and strategic objectives. Different partners also bring different background knowledge and IP for use during the project and, if needed for commercial exploitation, after the project ends under agreed terms and conditions. Results from collaborative projects are often built on the combined knowledge of several partners, so they are jointly created and jointly owned; therefore, the partners need to agree on appropriate and shared strategies for their management, protection, and exploitation. Effective management of all intellectual assets is crucial; particularly of those results which are developed collaboratively, and jointly owned[3]. This is why proper IP management is very important.

IP management matters for various reasons, all contributing to the strategic utilization and protection of intellectual property assets within an organization, including: optimizing asset value, protecting investments, driving innovations, enhancing market positioning, enabling strategic partnerships, mitigating risks, and finally supporting business growth.

IP management covers the strategic and systematic handling of intellectual property assets within an organization. Effective IP management aims to protect these assets, maximize their value, and ensure they contribute to an organization's competitiveness and innovation. Managing IP helps partners to avoid conflicts among the consortium in terms of ownership, rights and obligations and IP rights play an important role e.g. in promoting innovation and protecting investment. The European Commission works to harmonize and enhance laws relating to intellectual property rights in the EU, and to ensure that a level playing field is available at the global level. In 2020, the European Commission adopted the Communication "Making the Most of the EU's Innovative Potential – An Intellectual Property Action Plan to Support the EU's Recovery and Resilience".

The mentioned action plan presents proposals for specific measures in five key areas, including:

1. Improve the way IP rights are protected;
2. Boost the uptake and use of IP, especially by small and medium-sized enterprises;
3. Facilitate licensing and sharing of IP;

4. Ensure better enforcement and fight IP infringements;
5. Promote fair play at a global level.

The IP action plan conducted by the European Commission covers several documents available the website of the European Commission: https://single-market-economy.ec.europa.eu/industry/strategy/intellectual-property_en. In 2022 the EC and the European Union Intellectual Property Office (EUIPO) have launched a new EU SME Fund with a budget of €47 million, which offers vouchers for European SMEs to help them protect their IP rights[1]. The Fund aims to increase the resilience of its SMEs to help them to cope with last years' economic crises, as well as promote their green and digital transitions. A flexible intellectual property toolbox is key to protecting SMEs' innovations. EUIPO administers the EU Trade Mark and Design rights, applicable throughout the EU, the Observatory on Infringements of Intellectual Property Rights and the Orphan Works Database. These rights complement national intellectual property rights and are linked to international IP systems. Since 2012, EUIPO has been responsible for the EU Observatory on the Infringement of Intellectual Property Rights and the Orphan Works Database.

Concluding, the EC is responsible for making legislative proposals on the process and procedures for registering and enforcing EU intellectual property rights. It is also responsible for ensuring that these measures are properly implemented and providing guidance to the Member States. The EUIPO registers EU trademarks and designs. Member State authorities are responsible for approving registration requests for EU geographical indications and for enforcement controls on EU intellectual property rights[4].

As mentioned above Intellectual Property Law (rules and regulations) includes:

1. **Patents** (patents grant) are exclusive rights to inventors for their inventions, preventing others from making, using, selling, or importing the patented technology without permission;
2. **Copyrights** protect original artistic and literary works, giving creators exclusive rights to reproduce, distribute, perform, and display their results;
3. **Trademarks** are safeguards symbols, names, and phrases to identify and distinguish products or services in the marketplace;
4. **Trade Secrets** include confidential business information, such as formulas, processes, and customer lists, which provide a competitive advantage.

All of these areas are related in that they deal with protecting products of the mind but in other ways, they are very different.

IP Management usually includes the following four stages of activities: identification, protection, commercialization and enforcement:

1. **Identification** means recognizing all forms of intellectual property within a business, whether created in-house or acquired from external sources. This is the initial development of an innovative idea or invention that IP rights can protect(the phase of creation).

2. **Protection** covers implementing measures to safeguard IP rights, such as filing for patents, registering copyrights and trademarks, and using non-disclosure agreements. Protection is an application for legal protection (e.g., patent application, copyright registration) to secure exclusive rights.
3. **Commercialization** means determining how to extract value from IP, whether through licensing, joint ventures, partnerships, or direct exploitation. Commercialization includes exploration of various avenues to monetize IP, such as licensing, selling, or integrating it into products and services.
4. Finally, **enforcement** means actively monitoring and enforcing IP rights to prevent infringement and unauthorized use by others. Enforcement covers market monitoring for potential IP infringements and taking legal action if necessary.

Pain points in IP Management may result in some problems (pain points), e.g. in **complexity** (IP laws and regulations can be intricate and differ between jurisdictions, requiring expert knowledge to navigate effectively), **valuation** (determining the monetary value of IP assets can be challenging, impacting decisions related to licensing, sales, and investments), **globalization** (as businesses operate across borders, managing IP becomes complex due to differing legal systems and cultural norms), **cybersecurity** (protecting digital IPs from threats and unauthorized access is a growing concern), and **balancing act** (businesses must balance the need to protect their IP with the desire to share and collaborate with others in an open innovation environment).

Concluding, IP management is a dynamic and multifaceted process that demands careful consideration and planning, which may lead to increased competitiveness, revenue generation, and protection against infringement. Intellectual property rights play a vital part in the EU's economy, generating almost 45 % of the EU's gross domestic product, worth 6.6 trillion euros and 29 % of employment[4]. That's why EC and other EU bodies work with Member State authorities to ensure IPR protection, a key factor in the success of the Single Market.

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Chapter 3. Management of innovative activities

3.1 Entrepreneurship in innovative activities

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Among the economic theories of the last century, the works of J. Schumpeter are notable, who considered economic development on the basis of innovations and the 'human factor'. In his opinion, the driving force of development in his theory was the entrepreneur as an economic entity whose social status is characterised not by property rights and capital, but by specific character qualities: initiative, the gift of foresight, and risk-taking[1]. Thus, entrepreneurial activity is associated with a special motivation, namely: the desire to succeed, the will to win, the pleasure of creativity, the desire to establish a private business, openness to competition, etc.

In scientific works, entrepreneurship is associated with such terms as innovative, flexible, dynamic, risky, creative and growth-oriented, which requires a more detailed consideration of this concept. It is known that the discipline of entrepreneurship is taught in business schools in the United States, but the content is mostly focused on the development of small businesses into large ones. At the same time, in recent years, in leading countries of the world, the discipline of innovation management has been included in the educational programmes of training specialists, which includes the innovative enterprise.

Entrepreneurship can be described as a process of actions undertaken by an entrepreneur based on creativity, the search for new opportunities, the ability to accept foreseeable risks and reap benefits by creating a private business. It includes numerous actions related to substantiating the economic feasibility of an investment project, establishing an enterprise and running its operations. Entrepreneurship is based on the entrepreneur, who is considered the fourth factor of production along with land, labour and capital.

In P. Drucker's classic book 'Innovation and Entrepreneurship', published in 1985, the author presented innovation and entrepreneurship as a purposeful and systematic activity. According to Drucker, innovation is

a specific function of entrepreneurship, and entrepreneurship is a tool by which an entrepreneur creates new resources that create wealth or gives existing resources an increased potential for wealth creation[2]. It is worth noting that P. Drucker in his book considers entrepreneurship as a big business that is market-oriented. At the same time, the author emphasises that innovation is not inspired by a bright idea, but rather by organised, systematic, rational work

Other authors view entrepreneurship as 'the process of planning, organising, operating, and taking risks in business'[3]. Undoubtedly, risk and the willingness to risk time and money are key features of entrepreneurship. In this approach, the author emphasises the role of an individual entrepreneur in the implementation of innovative technologies, products and solutions, whose entrepreneurial abilities are driven by his/her own economic interest, which is an incentive for new innovative developments.

It is known that the first programme of teaching the discipline 'Entrepreneurship' at Harvard Business School was developed by G. Stevenson, who offers the following definition of entrepreneurship: 'entrepreneurship is the search for opportunities that go beyond the available resources'[4, 5, 6]. This definition takes into account both the individual and the society to which the individual flexibly adapts. In the author's opinion, entrepreneurial activity is different from the activity of an administrator, since entrepreneurship can be seen as a way of managing within a corporation.

Summarising the above, the essence of innovative entrepreneurship is manifested through the value and functions it implements in ensuring economic growth in the country, industry, region in compliance with the principles of sustainable development, and is characterised by a set of consistent elements, which are presented in Fig. 3.1.

In the innovative aspect of entrepreneurship, an important place is given to the development of technologies, which are drivers of economic growth in regions, industries and the country, but remain the most problematic areas in innovation. The book 'High-Tech Entrepreneurship' describes in detail the peculiarities of high technologies at the stages of creation and growth of a small firm, and also emphasises the availability of tools to encourage investors to invest in the development of innovative technologies[8]. Thus, the activation of a technological enterprise is possible provided that the country has a well-thought-out innovation policy with an effective arsenal of tools to encourage entrepreneurs to develop breakthroughs.

Study[9] reveals the characteristics and importance of national innovation systems, entrepreneurship and innovative entrepreneurship and their impact on the intensification of innovation activity. It is concluded that the world's leading countries prove that innovation and entrepreneurial activity are key to increasing competitiveness and economic growth. As a constraint to the development of technological entrepreneurship, the absence or imperfection of links between the following areas is identified: scientific and technical policy; small and medium-sized enterprises; innovations; entrepreneurship.

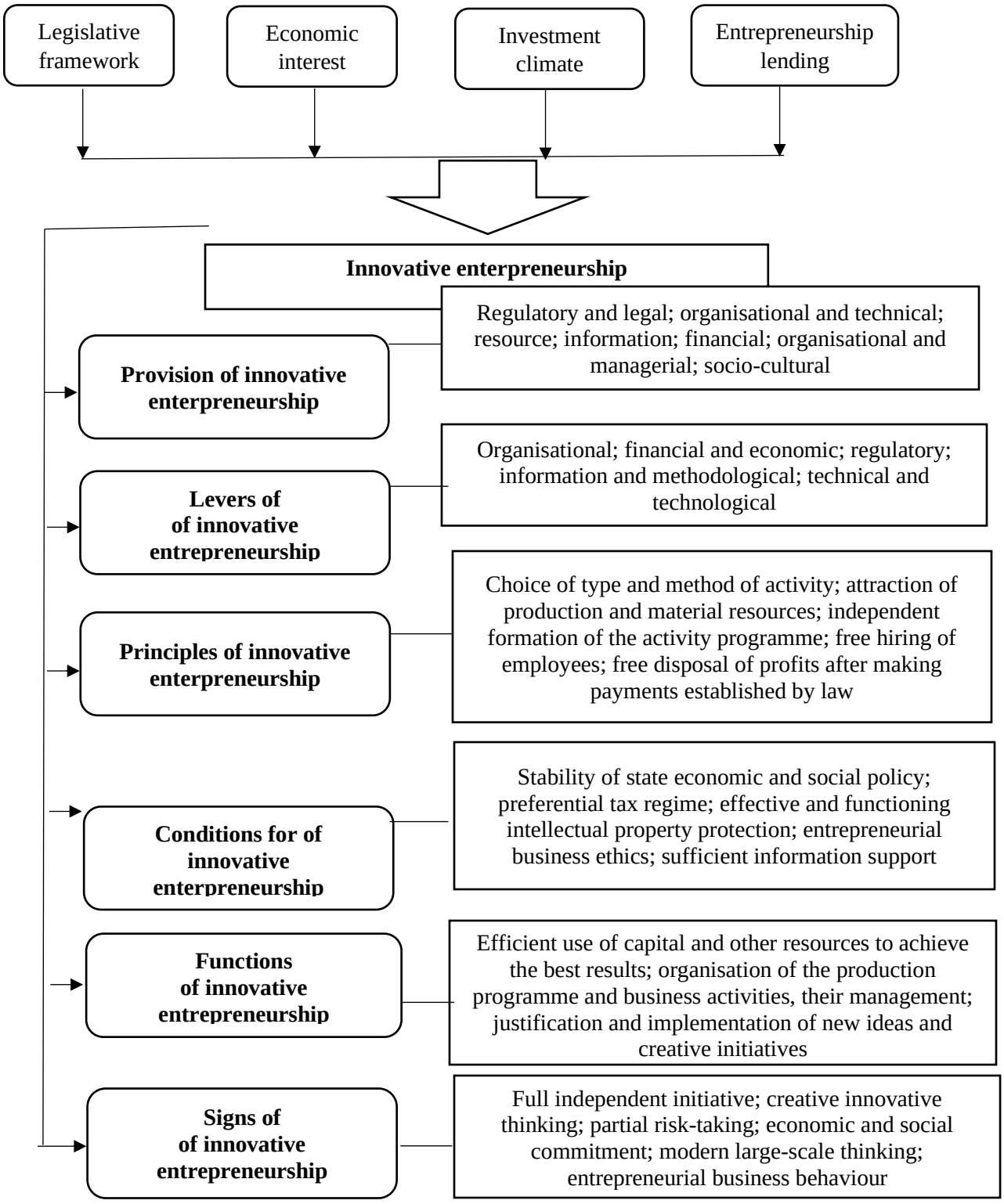

Fig. 3.1. **Elements of innovative entrepreneurship**

Science and technology policy is an area of state regulation that affects research and innovation activity, the main tools for implementing which are technology corridors, tax breaks, loan repayment holidays, cheaper bank loans and risk insurance, state guarantees, state orders, state funding for science, projects to develop technological innovations in the field of new products, healthcare, environmental monitoring, etc.
With regard to small and medium-sized enterprises, there is a widespread view in the academic literature that most small businesses are not ready to invest in their own development on their own. Their owners are often unwilling to search for sources of equity-based investment or potential investors to sell their business, which reduces the attractiveness of initiatives to encourage business angels or create venture capital[10]. It should be noted that *business angels* are private investors who invest in a start-up business at an early stage, usually in exchange for convertible debt or a stake in the company.

A *venture fund* is an investment fund that focuses on innovative enterprises and projects (so-called 'start-ups'). Venture funds invest in securities or shares in enterprises that are characterised by a high or relatively high level of risk and a correspondingly high expected return.

Business incubators play an important role in the development of innovation-oriented SMEs, as they can offer start-ups various forms of assistance based on the provision of business services, including expert assessment, advisory support, access to venture capital funding, etc.

A business incubator is an organisation that supports projects of start-ups and existing entrepreneurs at all stages of development: from idea development to commercialisation.

In the current environment, technology incubators are actively developing, usually located near research parks, universities or research laboratories, to provide entrepreneurs with access to research infrastructure on a lease basis. In addition, tenant firms have the opportunity to network with successful entrepreneurs, leading researchers and innovators within the incubator network, and can form strategic alliances to pursue business opportunities as subcontractors or suppliers.

Let's consider the types of innovative companies that commercialise innovative technologies. These include start-ups, spin-offs/spin-outs, and spin-in companies. These are new, usually small innovative (knowledge-intensive) high-tech enterprises created on the basis of the results of research and development. In global practice, the following criteria are used to classify them: supply or demand orientation, as well as the level of technological certainty.

Technology start-ups – companies focused on creating innovative technologies that develop software, cloud technologies, machine learning, artificial intelligence, etc.

R&D spin-offs/spin-outs can be either academic or corporate companies that provide a supply of innovative technologies, but differ from the former in terms of technological uncertainty. Technological spin-out companies are created based on market demand, and such projects are implemented in conditions of technological uncertainty.

To date, university spin-outs have received a positive assessment in the development of technological innovation, but studies comparing university spin-outs and non-university spin-outs show a slightly different picture: the share of income generated by technology transfer is insignificant (for example, at the Massachusetts Institute of Technology in 2012, this figure was 2.4%); most US universities lose money on technology transfer due to their high operating costs (exceptions are a few universities that hold patents for key inventions)[11, 12]. We believe that despite this, university spin-outs have a significant economic impact, as they play a major role in the supply of highly skilled personnel, which are the drivers of economic growth.

Particular attention should be paid to innovation policy, which has a direct impact on the development of an innovative enterprise. As the experience of the EU and other leading countries, including South Korea, shows, innovation policy is focused on achieving the following goals: generating new knowledge; increasing the efficiency of public investment in innovation; enhancing the dissemination of knowledge and technology (network effects); creating effective tools to stimulate private sector innovation to transform knowledge into commercial success. It is known that in the initial stages of innovation policy implementation, instruments of state support for high-tech small firms were used, and in recent years they have been aimed at intensifying their research and development (R&D) through cooperation through local networks and technology transfer.

Thus, innovative entrepreneurship is the most important tool for the development and transformation of any economic system in the context of modern development, which requires the use of effective tools to support innovation, appropriate organisational forms and networks for the development and commercialisation of innovative developments.

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3.2 Sources of innovations. Technological transfer

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In innovation management, a special place is given to the identification of sources of innovation, a clear knowledge of which allows to establish a way to find opportunities and reduce risks. Sources of innovation should be seen as the impetus that drives innovation and its intensification.

It is known that P. Drucker identified seven sources of innovation generation, the first four of which are the result of something that has happened or can be implemented with little effort, and the last three are not as clear as the previous ones, are characterised by increased risk, but may provide greater rewards in the future[1].

The following are the sources of innovation identified by P. Drucker:

1. unexpected events for a firm or industry;
2. discrepancy between reality and perceptions of it;
3. innovation caused by the need for a technological process;
4. changes in the structure of an industry or market that are not recognised by everyone;
5. demographic changes;
6. changes in perceptions and meanings;
7. new knowledge.

Based on the study of scientific sources, we have summarised the main sources of innovation (Table 3.1).

Table 3.1. **The main sources of innovation**

Sources	Characteristic
Scientific research and scientific and technical (experimental) developme	R&DResearch and development (R&D) is a key source of innovat ideas and technologies that come from research laboratories a innovation centres at universities and research institutes, indust research centres and R&D companies.
Technological and innovative companies	These companies specialise in the development and implementation of latest technologies and innovative products, which can be either la technology corporations or small start-up organisations.
Potential and real consumers	The needs and requirements of potential and actual customers can lea innovative ideas. Companies create new products and/or improve exist ones based on customer needs.
Global information exchange	Globalization of the world market and the rapid development digitalization technologies, which today are an important source innovation.
Cooperation in the framework of partnerships, networks	By establishing long-term cooperation through partnerships or netwo between companies, universities and industry organisations and ot stakeholders, an intensive exchange of knowledge and innovative id takes place.
Legislative and regulatory activities	Laws and regulations affect the development of new technolog including tax breaks, loan repayment holidays, cheaper bank loans a risk insurance, government guarantees, government contra government funding for science, projects to develop technologi innovations in the areas of new products, healthcare, environme monitoring, etc.
Personnel and management of companies	Innovation-oriented staff and management with clearly defined strate goals and objectives for the development of an innovative company, appropriate organisational and management structure, an effect motivational mechanism and a high level of logistical support are a sou of innovation.
Competitors	Increased competition in the foreign and domestic markets for businesses to conduct research on the competitive structure of the mar and competitors, which results in the identification of their strengths a weaknesses, which become a source of innovation.
Suppliers of material and technical resources and services	The company's suppliers of inputs and services become a source innovation if they supply innovative products that force the manufactu to improve production technology, change the product and environment, such as packaging, storage conditions, etc.
Elements of the country's innovative infrastructure (startups, hubs, business incubators, etc.)	The development of elements of the country's innovation infrastruct and ensuring their full functioning can become generators of new id and innovative developments.

Source: summarised by the authors.

Technology transfer is the process of transferring technologies, technical and organisational skills, or knowledge from one person or organisation to another for economic purposes[2, 3]. Technology transfer involves the transfer of technical knowledge, technical or organisational skills, know-how, patents, as well as the provision of technical or advisory support, scientific support for the implementation of innovative developments, and can take place between organisations, countries or industries.

The following types of technology transfer are distinguished by the following criteria:

by the scale of use: international technology transfer; domestic (within the country) technology transfer;

by the level of cooperation: transfer of technology to newly created firms; technology transfer from research organisations to existing enterprises; transfer of technology to research laboratories, universities or their associations for the purpose of further research;

by the direction of technology flow: direct transfer, i.e. commercial transfer of licences from the parent company to related firms, including newly created or existing subsidiaries; reverse technology transfer, which involves a firm joining another firm to master the technology or transferring the developed technological documentation to the parent company;

by the nature of the association of participants: horizontal transfer, which involves the pooling of resources and production capacities of competitors to strengthen competitive positions; vertical transfer, which is aimed at combining participants in the distribution channel in order to save on operations and increase market influence[4].

The scientific literature considers organisational or commercial forms of technology transfer, which include: licensing, leasing, franchising, engineering, know-how agreements[5]. Thus, organisational or commercial forms of international and domestic technology transfer include the following instruments:

purchase and sale of licences in circulation in the technology market (the economic and legal basis for this is a patent as a security document, a licence agreement (or licence));

transfer of scientific developments on the basis of franchising;

transfer of scientific developments on the basis of a know-how agreement;

transfer of scientific developments on the basis of leasing;

transfer of scientific developments on the basis of engineering;

transfer of property rights to technologies and their components in the exchange of scientific and technical results based on joint ventures.

Here we systematise the main organisational forms of international and domestic technology transfer. Among them, *the first form is based on contracts*, which are the basis for the following actions: purchase and sale of licences in circulation in the technology market (the economic and legal basis for this is a patent as a security document, a licence agreement (or licence); transfer of scientific developments on the basis of franchising; transfer of scientific developments on the basis of a know-how agreement.

Licensing is the main form of technology transfer, implemented on the basis of a licence agreement. A licence agreement is one of the agreements that indirectly mediate relations in the field of technology transfer (the exercise of property rights to technology), i.e. are related to the process of technology transfer – the exercise of property rights to technology.

Franchising is one of the ways of transferring rights to intellectual property objects, innovative objects for their use in the production economic activity of business entities. The scope of the franchise agreement is the distribution of goods and production[6].

The second group includes those forms based on contracts that, although containing an element of technology transfer, are not fully aimed at determining the use of the transferred object. The second group includes: transfer of scientific developments on the basis of leasing (leasing agreement); transfer of scientific developments on the basis of engineering (engineering agreement as a service agreement (consulting, etc.)); transfer of property rights to technologies and their components in the exchange of scientific and technical results based on joint ventures (joint venture agreement).

Leasing as a form of technology transfer involves the long-term lease of equipment in production to improve the production process and ensure its compliance with the results of scientific and technological progress.

Engineering is a commercial activity, which, like any other business activity, has certain peculiarities. Engineering is a type of work performance contract that includes the provision of services for the creation of an innovative project, which helps to create and promote modern innovations.

The provision of engineering and consulting services is usually accompanied by the provision of technical assistance, namely, the transfer of technology, assistance in the use, operation, and repair of the relevant facility[7].

The third form of innovation transfer involves the transfer of property rights to technologies and their components in the exchange of scientific and technical results through joint ventures.

Joint ventures in the field of technology transfer involve a partial transfer of property rights to technologies and their components, which may be accompanied by contracts for the supply of equipment, components, raw materials, engineering services, transfer of know-how, etc. The main purpose of this form of technology transfer for technology transfer entities is to obtain the result of combining knowledge and experience in the production of a new product or product for a particular market.

Based on the above, we will highlight the main components of technology transfer, which include:

Fig. 3.2. **Components of technology transfer**

Source: compiled by the authors.

1. Technology provider – a company, research institute or university that develops and owns specific technologies or knowledge.

2. Technology recipient – another company, university or organisation that accepts the technology for use in projects or production.

Transfer mechanisms – includes licensing of rights to use patents or other intellectual property, franchising, leasing, engineering, joint ventures, financial investments, or even training and consulting.

Commercialisation is the process of introducing a technology into the commercial sphere for the production of goods or services.

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3.3 Evolution of approaches to innovation management. Stages of innovative activity at enterprise

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Innovation management is one of the areas of strategic management, as management decisions on the development and implementation of innovations are considered to be strategic tasks. The active development of innovation management took place at the end of the last century and continues in the current one, with considerable attention paid to the development of innovation strategies, as well as to the measures and tools on the basis of which they are implemented. In the context of the transition to

the Industry 4.0 technology platform [20], which involves the transfer of design, production and operation to full automated digitalisation under the control of intelligent systems in real time and constant interaction with the external environment beyond the boundaries of a single enterprise, the relevance of an innovative combination of strategic and innovation management is increasing.
The evolution of innovation management development as a science and practice is shown in Fig. 3.3.

Fig. 3.3. **Evolution of the organisation's innovation management**
Source: constructed by the author

In the current conditions of the knowledge economy development, we can say that the concept of management 4.0 is being formed and developed, which combines advanced strategies, innovative

approaches and the widespread use of modern information and communication technologies. We support the researchers' opinion that innovative management today should make greater use of digital tools and technologies in business practice, big data analysis, an innovative approach to all areas of activity and management decision-making, flexibility and adaptability in a highly uncertain environment, increasing the role and involvement of employees in management decision-making, communication and networking, and cyber defence.

Innovation activity is seen as an activity focused on the use and commercialisation of research and development results to expand and update the product range, improve product quality, and improve the technology of its manufacture with subsequent implementation and effective sale in domestic and foreign markets[1, 2].

Innovative activity can take the following forms:

- preparation and organisation of production, including the purchase of production equipment and tools, changes in them, as well as in standards, procedures, production and quality control methods for manufacturing a new product or applying a new technological process;
- pre-production development, which involves modification of the product and technological process, retraining of personnel;
- marketing of new products, including activities related to the launch of new products;
- acquisition of patents, licences, disclosure of know-how, trade marks, models, designs and services of technological content;
- acquisition of specific technology, i.e. machinery and equipment, which by their technological content are related to the introduction of product or process innovations at the enterprise;
- production design, which includes the preparation of plans and drawings to determine production procedures and technical specifications.

Innovations are divided into four types according to the area of innovation implementation:

1. Product innovations involve the expansion of the product line and qualitative improvement of product characteristics.
2. Process innovations involve optimising and improving the processes of production, delivery of the product to end users and further interaction with them.
3. Managerial involves increasing the efficiency of the organisation's activities based on leading methodological approaches to labour organisation and interaction in the company.
4. Strategic measures involve changes to the business model of the enterprise and its strategy.

It should be noted that the description of technological innovations is based on international standards, on the basis of which recommendations were adopted in Oslo in 1992 (the so-called ‘Oslo Guidelines’). These standards cover new products and new processes, as well as their significant technological changes[3]. Based on the standards, two types of technological innovation are distinguished: product innovation and process innovation.

Thus, product innovation covers the introduction of new or improved products and is divided into two types: basic product innovation and improving product innovation.

Process product innovation is the development of new forms and methods of production organisation for new products. This implies that the production of new products can be organised with existing technology, equipment, energy resources and using traditional methods of production and management.

Innovation activity at the enterprise can be divided into several stages, which include various types of work on the creation, development and implementation of innovations, the specifics of which should be taken into account by the innovation management unit at the enterprise or individual responsible managers. Thus, innovation activity is considered as a set of works performed by certain organisational structures from the inception of an idea, its development and commercialisation in a competitive environment and covers the entire range of relations in research, production, exchange and consumption.

Thus, innovation activity involves several stages: it begins with the emergence, the idea of generating a new promising idea (I), which, after checking the possibility of its implementation and suitability for use (II), is implemented in a new product, technology, new organisational form (VI), by creating and comprehensively testing a prototype in the market (III and IV), taking into account the wishes of consumers and eliminating the identified problematic characteristics (V), and with the help of a marketing complex (VI) allows achieving a certain effect (VII – market conquest, business development, etc.

At the stage of idea generation, it is necessary to take into account that new ideas should be developed and used in accordance with the strategic goals of the enterprise, as well as to take into account the impact of innovations on other components of the business process and the enterprise as a whole. That is why it is recommended to plan changes in all areas of the enterprise's activities if innovations are developed for a particular business process.

At the stage of checking the possibilities of implementing an innovation, preparatory changes are made to the organisational structure of the enterprise, personnel policy, financial and economic indicators, structure and composition of potential consumers, etc. The analysis of the possibilities for implementing a new idea should include the availability of resources at the enterprise (knowledge, experience, material and financial resources) to be able to develop and implement innovations.

The stage of analysing the suitability of innovations for use involves identifying the nature of potential or actual demand for innovative developments. An enterprise's need for innovation is determined by its strategic goals, which is possible only if these innovations are directly or indirectly suitable for meeting existing or potential market needs.

At the stage of creating a prototype, it is necessary to optimise all costs associated with its creation in order to achieve maximum profit or effect.

At the stage of testing the prototype in the market, it is necessary to identify the disadvantages and advantages that will be determined by real and potential consumers of innovative developments, and take them into account at the stage of improving the disadvantages.

The production stage involves organising and monitoring compliance with all quality characteristics of the innovation. An important role at this stage is assigned to the personnel of the innovation department, quality department, chief technologist department, and technical control department, which can influence the innovation management process.

At the stage of implementing innovative products (services), the marketing department staff needs to choose the right marketing concept and justify the marketing mix for the innovative product (service).

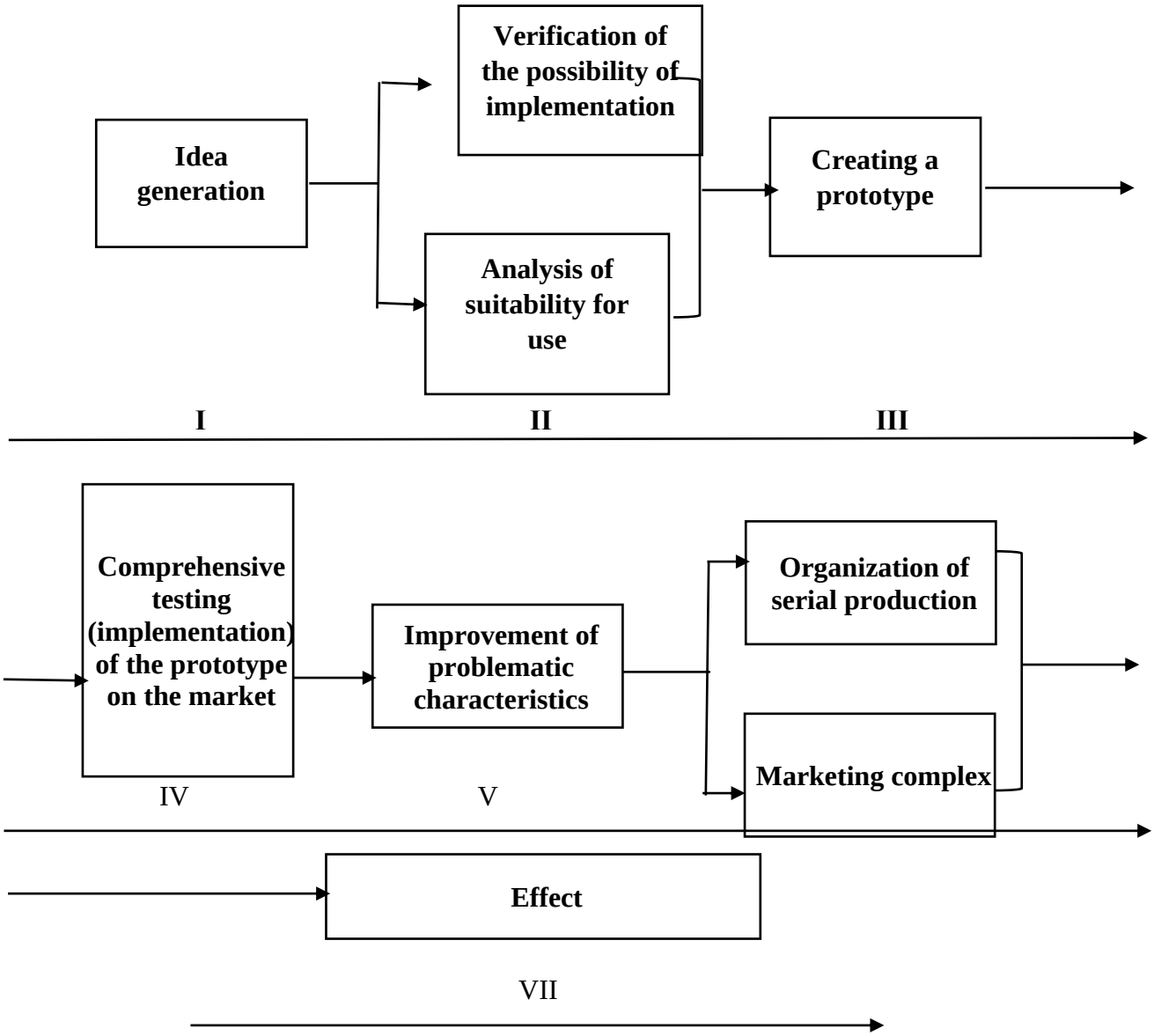

Fig. 3.4. **Stages of implementation of innovative activity**

Source: based on [24, p.15].

If the above-mentioned stages of innovation activity at the enterprise are implemented consistently and all requirements are met, the end result will be the achievement of the enterprise's strategic goals in terms of strengthening its competitive position in the target market segments.

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3.4. Process of innovative activity management

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A study of the scientific literature on the organisation of innovation management has revealed differences in the approaches used for this purpose. Thus, initially, innovations were considered as separate functional areas of the enterprise, i.e. the functional approach, and the processes of organising and managing innovation activities were concentrated on separate functional units responsible for research, design, engineering and technological preparation of production. The functional model involved high specialisation, which ensured a higher technological level of development, contributed to improving the quality and enhancement of products and technologies. However, conflicts arose between functional departments in the process of mastering the production of new products and technologies. For example, technologies required simplifying the design of a new product or replacing materials based on the existing technological base, which ultimately deteriorated the product's structural properties.

As a result, the paradigm of innovation management changed from a functional to a project-based approach. Innovation project management began to be allocated to separate 'cross-functional' projects, and enterprise management structures began to transform from linear-functional to matrix or project-based programme-targeted ones. The presence of horizontal links and a common vision of the end result among all project participants helped avoid conflicts. In addition, the project approach allowed for the concentration of resources, control over the timing of individual activities and stages, and increased the effectiveness of innovative projects. However, this approach did not take into account consumer needs, market dynamics, competitors' achievements, etc.

Today, the process approach is becoming more and more widespread, which considers innovation activity as a complex activity that covers all divisions of the enterprise and represents a set of business processes for creating, developing, promoting and supporting innovations. On the one hand, the in-depth specialisation of participants in the innovation process, which is inherent in the functional approach, is preserved, and a high technological level of development is ensured; on the other hand, business processes ensure the integration of participants and concentration of resources, and their regulation, as in the project approach, ensures compliance with deadlines and the possibility of coordinating actions in the process of innovation. In addition, the process approach implies that innovation becomes a permanent form of enterprise development and does not end with the implementation of projects. Nevertheless, for individual innovations or small innovative enterprises, the project-based approach to managing innovation has been successfully used.

The innovation management system involves identifying areas and directions of innovation activity, justifying and selecting innovative projects, and implementing them. Let us consider the definitions of the main concepts of innovation activity.

Innovation activity is a process aimed at implementing the results of completed research and development or other scientific and technical achievements and development or other scientific and technical achievements into a new or improved product sold on the market, into a new or improved technological process used in practical activities, as well as additional research and development related to this.

Innovation process is a process of changes in system elements and interrelationships between them, an intra-system process of result formation, a process of system response to changes in the external environment, primarily to changes in market requirements.

The innovation cycle is a periodically repeated process of consistent creation of innovative products from the identification of a new need to the birth of an idea (concept) to its practical implementation and marketing.

Innovation management as a special type of professional activity aimed at achieving the innovation goal of an enterprise, optimal results based on the rational use of resources, application of scientific principles, functions and methods of managing innovation processes and innovation activities. The system of management of innovation activity at an enterprise should be holistic, consist of interrelated parts and include the following components: object of management, goals, objectives, management bodies, methods and functions.

Innovation is the end result of innovative activity, which may be in the form of a new or improved product (service) sold on the market, a new or improved technological process used in practical activities.

It is known that innovations are divided into:

- technological;
- organisational and managerial;

economic
marketing
social;
information.

The most widespread in practice are technological innovations – the product of innovation in the form of new products and the process of mastering new technologies, equipment and materials. Organisational innovations include the development and implementation of a new organisational structure for enterprise management; economic innovations include the use of systems and forms of remuneration, methods of managing production costs that have not been used before; marketing innovations include entering a new market and modernising promotion methods; social innovations include methods of motivating labour that have not been used before; environmental innovations include the implementation of new technologies in the field of environmental protection; informational innovations include the use of new information and communication technologies.

In a more general sense, innovation management is a system of managing innovations, the innovation process and the relationships that arise in the course of innovation. The main goal of innovation management is the effectiveness of the innovation process, i.e. maximising the effect of commercialisation of an innovation. Innovation management is based on the following stages:

1. Purposeful search for an idea that will be the basis for a specific innovation.
2. Organisation of the innovation process for this innovation: carrying out a set of works to transform the idea into an object (a new product, a materialised form of operation), ready for market promotion and sale.
3. The process of promoting and implementing an innovation in the market, which requires a creative approach and active actions of sellers.

Reengineering as a tool of innovation management refers to the innovation process, which is aimed at both the production of new products and operations, as well as at sales, promotion, and diffusion. Since the ultimate goal of reengineering is to introduce new products (i.e. innovations), reengineering in a narrower sense is the reengineering of innovations. Thus, re-engineering refers to organisational innovations, which are understood as innovative changes in the structure of an enterprise's organisation. The objectives of organisational innovation are: 1. Implementation of a new development strategy; 2. Changing the structure in line with standards or the introduction of new legislationg4 3. Improving financial performance within the core business of the enterprise; 4. Overcoming internal organisational problems; 5. Bringing the company out of the crisis.

The process approach to innovation management involves structuring the enterprise's processes by type of activity, which are summarised in Table 3.2.

Table 3.2. **List of activities of an innovation-oriented enterprise within the process approach**

A business process	Type of activity
Basic business processes	
1. Marketing	1.1. Marketing management. 1.2. Market segmentation of innovative products (services). 1.3. Marketing analysis of the operating environment. Tools for forming demand and stimulating sales of innovative products (services)
2. Development of innovative products (services)	2.1. Coordination of the process of development of innovative products (services). 2.2. Design and development of new services, their creation processes and service procedures. 2.3. Creation and testing of prototypes
3. Implementation of innovative products (services)	3.1. Management of the implementation process of innovative products (services). 3.2. Operation, condition control, maintenance and repair of innovative products (services)
4. Supply management for the implementation of innovative products (services)	4.1. Procurement management. 4.2. Obtaining materials and organization of warehouse management. 4.3. Control of provision of material stocks
5. Development and maintenance of information systems and technologies	5.1. Information system resource management. 5.2. Development and maintenance of applicable programs. 5.3. Development and management of information protection systems. 5.4. Provision of informational reports
6. Resource support for the development and implementation of innovative products (services)	6.1. Resource support for the development of innovative products (services). 6.2. Resource support for the implementation of innovative products (services)
Additional business-processes	
1. Improvement of management	1.1. General ongoing management of the organization. 1.2. Development and management of the process of continuous improvement of the company's activities
2. Security management	2.1. Development and implementation of environmental protection manageme strategy. 2.2. Restoration of the environment
3. Management of external communications	3.1. Management of external relations
4. Public relations management	4.1. Public relations management
5. Financial management	5.1. Maintaining accounting records. 5.2. Assessment of financial performance. 5.3. Internal audit and control
6. Personnel management	6.1. Organisation of personnel document flow. 6.2. Planning and conducting employee training
7. Information support for the management of the company's activities	7.1. Information support for the management of the company's activities
Management business processes	
3.1. Settlement services	1.1. Management of the process of providing accountant services. 1.2. Payments to customers and contragents

A business process	Type of activity
3.2. Provision of information and reference services	3.2.1. Providing of informational services
3.3. Service fecilities	3.1. Management of service fecilities. 3.2. Processing requests and providing customer support. 3.3 Assessment of the quality of service frcilities

Source: based on [1].

The implementation of the process approach in the practice of the enterprise will allow to combine into a complete system of planning, accounting and analysis of costs by types, place of their formation and calculation volumes, regulatory accounting of costs, cost calculation methods and methods of assigning costs by processes to relevant telecommunications services, planning, accounting and analysis of production investments.

Management of innovation processes in companies includes the following stages:

1. Formation of the goals of innovative activity;
2. Planning of the main directions and proportions of innovative activity in accordance with the defined strategic goals of the enterprise's development, the possibilities of resource provision and the existing demand for innovative products in the relevant markets;
3. Organization of innovative activities for the purpose of the adopted enterprise development strategy;
4. Control of innovative activity ensures the fulfillment of specified planned indicators and tasks aimed at achieving the accepted goals of the enterprise's development.

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3.5 Peculiarities of innovation management at agricultural enterprises

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The innovation process is a set of organizational and management solutions aimed at changing the internal and internal conditions of the functioning of agricultural enterprises based on the implementation of parallel and sequential scientific, technical and economic stages and actions for the transformation of breakthrough developments into a knowledge-intensive product, the further distribution and practical use of which allows obtaining the expected effect that corresponds as closely as possible to these changes. Therefore, innovation is understood as the logical result of dynamic changes introduced into economic practice in the process of carrying out scientific, technical and innovative activities and is reflected in the form of an economically feasible science-intensive product that contains qualitatively improved characteristics and properties, which ensures an increase in the efficiency of the enterprise.

We believe that the concept of 'innovation' in the practice of agricultural enterprises should be considered from a systemic point of view, since agricultural production is multifunctional and multidimensional. Considering an agricultural enterprise as a system, innovation in this case can be identified from the standpoint of a specific targeted quantitative or qualitative change in the functioning of the elements of this system or the entire system as a whole.

An important feature of innovation is that, in addition to the development of new plant varieties, poultry crosses, breeds and species of farm animals, it is expected that the results of research and development of environmentally friendly and conservation technologies for the agricultural sector will be put to practical use, as well as the use of new approaches and forms of organisation and management for agribusiness enterprises that will improve the efficiency of agricultural production.

The innovation process in agriculture is characterised by specific features, including the following:

- significant differences between regions in terms of natural and climatic conditions and specialisation of production;
- diversity of types of agricultural products, products of their processing, differences in production technology, animal husbandry and feeding;
- long lags in the production periods of certain types of agricultural products and their processed products;
- the presence of a large number of producers that differ in terms of types of production, organisational and legal forms, ownership, size, specialisation, development of integration and cooperation, etc;
- high dependence of production technologies in agriculture on natural and climatic conditions, development of road transport networks, remoteness from supply centres and markets, and other factors;
- isolation of agricultural producers, remoteness from information and advisory services and organisations producing scientific and technical products.

In addition, the innovation process in agriculture has peculiarities due to the use of land as the main means of production, seasonality of agricultural production, high dependence on natural and climatic conditions, and the presence of human interaction with animals and plants. The impact of technological, scientific and technical, organisational and managerial, information and communication, political and legal factors on the innovation activities of agricultural enterprises cannot be ignored.

Thus, it can be concluded that the peculiarities of the development of innovation processes are determined by the specifics of agricultural production, which can be summarised as follows

high dependence of agricultural enterprises on natural and climatic conditions, which directly affect the relationship of technological processes with the processes occurring in the natural environment, and further affect the nature of the assessment of the results of innovation;

production of diversified crop and livestock products, which implies certain differences in technological processes of their production, which leads to numerous technological developments and complication of the innovation process;

insufficient development of regional innovation infrastructures due to the lack of a targeted innovation policy in agricultural enterprises, especially small ones, which are unable to carry out the necessary transfer and diffusion of high-tech technologies into the production process in a systemic way;

limited financial capacities and effective demand for the development of innovations in agricultural enterprises, which results in the differentiation of farms by the level of their innovation capacity;

rather lengthy adaptation of innovations to specific production, technological and agro-climatic conditions of functioning of agricultural enterprises due to the cyclical (seasonal) nature of agricultural production and a long period of implementation of innovative.

In agriculture, innovation activity is heterogeneous, due to the increased influence of certain factors, in particular, the unstable economic and financial situation of agricultural producers and their different innovation potential. This implies that the process of innovation development is not linear and depends on various circumstances.

The transition of agricultural development to a new technological mode in the future of agri-food production will depend more on innovative technologies and developments to increase yields, productivity and reduce losses, and less than ever on the impact of external climatic and biological factors.

In addition, in the future, changes in agri-food supply chains will lead to an increase in value creation in knowledge-intensive areas (genetics, breeding, IT technologies, industrial design, engineering). Let us consider the components of innovation management and value added in agricultural enterprises, as shown in Fig. 3.5.

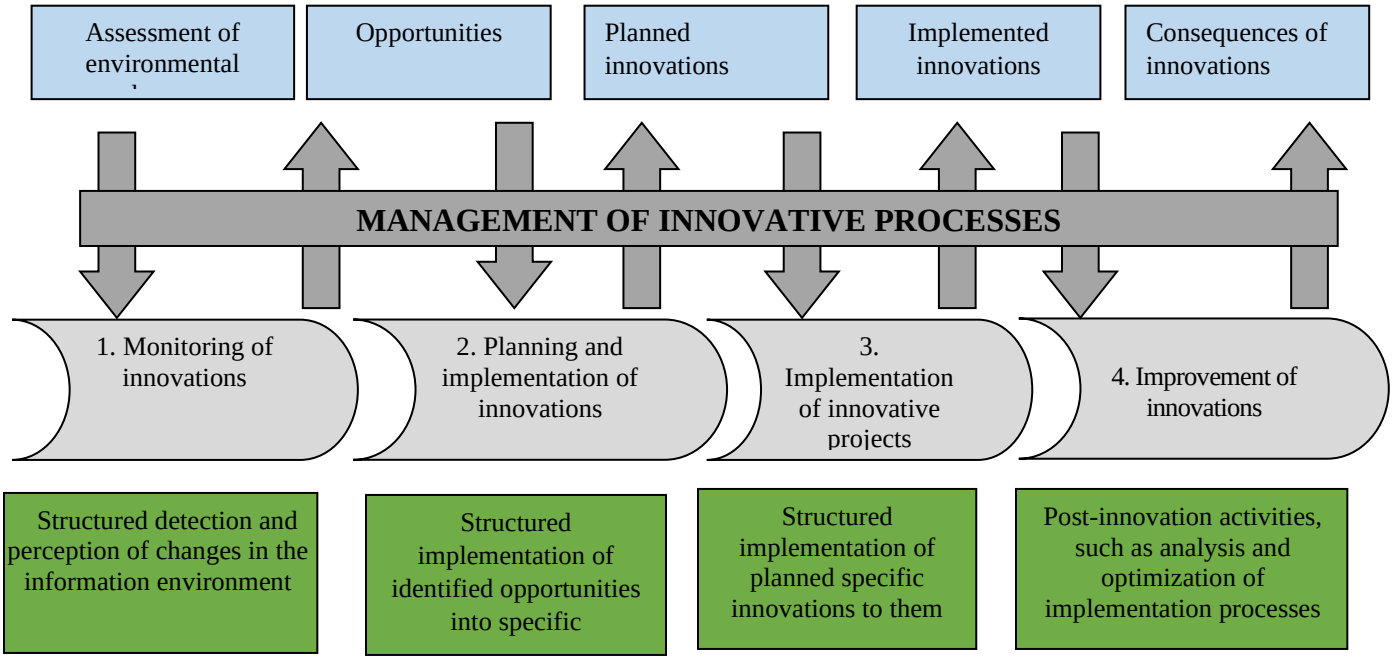

Fig. 3.5. **Management of innovation processes and creation of added value of the enterprise**
Source: constructed by the authors.

Thus, the innovative development of the agri-food sector in the future will combine nano-, bio-, information and cognitive technologies, which will lead to fundamental changes in the allocation of priority production factors and competitiveness, more active promotion of productivity and safety technologies and reduced dependence on natural, climatic and biological factors.

It is worth noting that in the current environment, vertically integrated holding companies demonstrate high innovation activity, being the drivers of innovative technologies and capable of achieving high efficiency in achieving economic, environmental, social and other key goals and forming global value chains. In the future, the competitiveness of agriholdings will also be ensured by the introduction of innovative technologies in the field of alternative energy sources, deep processing of agricultural raw materials, environmental projects, etc.

In such circumstances, it is important to create favourable conditions for the competition of large integrated agri-food producers and small and medium-sized agricultural enterprises based on access to innovative technologies and products through the creation of cluster agricultural formations in the regions, increased efficiency of state support, and intensification of the activities of research organisations and agricultural universities in the development of innovative products and their commercialisation.

Case study

The case: MHP Innovation Lab https://mhp.com.ua/uk/pro-kompaniiu/departament-innovatsii

The goal of the MHP agricultural holding is to act as a catalyst for transformational changes inside and outside the company. These changes involve the transformation of MHP from a food company to a culinary company, and therefore in the transition from a focus on the product to the development of an ecosystem to create customer value.

Principles:

1. Client – understanding of clients' tasks and desire to help in their implementation;
2. Technologies – an opportunity to implement the plan with internal and external resources;
3. Business – creation of sustainable and profitable business solutions.

The process of launching innovations at MHP:

1. Identify the opportunity;
2. Implement the prototype;
3. Scale and develop.

Innovation categories:

1. Products – development of new products that help consumers realize their needs (functional and emotional);
2. Services that create additional value through the highest level of customer experience (offline and online);

3. Business models – new business models and partnerships around ordering, cooking, shopping, delivery and other elements of the customer experience.

The MHP Innovation Lab company organized a competition of open innovative ideas. The competition of innovative ideas is held for those who openly look at the world, dream about how to make it better, wake up in the middle of the night from brilliant thoughts and ideas, charged for action and results. We are looking for insights, bold ideas and innovative solutions that will help MHP to be an even more client-oriented, dynamic and modern company.

The competition is held in the following directions: products; business models; services.

The motto of the innovative ideas competition is: 'Make your contribution to the environment'. Sustainability is of utmost importance to MHP, which has an ambitious goal of becoming a carbon-neutral business by 2020.

Directions of innovative ideas:

1. Restoring soil fertility and 'clean' organic fertilisers

Area 1: Soil fertility restoration technologies.

Area 2: Improving organic fertilisers after biogas production.

Area 3: Innovative methods of fertilisation and tillage with minimal mechanical impact on the soil and reduced greenhouse gas emissions.

2. Decarbonisation of production processes and Green CO2

Area 4: Cryogenic technologies for freezing and storing finished products.

Area 5. Use of green CO2 in the agricultural sector.

Area 6: Innovative resource-saving and environmentally friendly packaging.

COMPETITION WINNERS, 2023

'Pasternak Bio' is an innovative solution for the processing of food and organic waste by the California worm, which produces organic fertiliser, vermicompost;

'Moravis' – the use of probiotics for organic compounds of plant and animal origin, disinfection without thermal/chemical treatment and preservation of the viability of beneficial microorganisms.

'FuelWell' is an in-house developed fuel catalyst for internal combustion engines that reduces CO2 emissions;

'Umnaya Sreda' – production of small architectural forms from environmentally friendly building materials, which reduces plastic emissions into the environment.

Chapter 4. Organisational forms and structures of innovations development and implementation

4.1 Organizational forms and structures of innovations development and implementation

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The innovative dimension of the development of the economies of the countries of the world requires a change in approaches to economic conditions, which change not only the processes and functioning of the environment, but also the forms – by spreading more progressive and adaptive to modern realities. It is in such conditions that the creation of innovative integrated structures is a timely step for deepening innovative transformations in the economy. After all, innovative structures, regardless of their type, are an ideal environment for the implementation and transfer of innovations, which, in turn, provides the entities operating within such structures to generate innovative ideas with the aim of selling them as a product or service in the future.

For the economies of countries that are at the stage of economic integration, including Ukraine, Moldova, and Azerbaijan , the spread of innovative integrated structures is the primary basis for strengthening the competitiveness of the national economy as one of the most effective mechanisms for the transfer of research and development into new products or services.

The aspect of the positive impact of innovative integrated structures on the state of the economy was proven in case studies conducted in various countries of the world. In particular, a study of 12 Swedish clusters by Solwell and Williams showed that, as a result, companies belonging to such structures created new and improved products and services, and also led to increased sales[1].

According to Muro's study, which tested 10 pilot cluster programs conducted by Small Business Authority (the USA), it was found that cluster participants included in the experiment increased integration into their industry supply chains[2]. Ketels, in turn, found that the presence of innovative and integrated organizations has a positive effect on the level of average wages[3]. At the same time, Delgard, Porter and Stern noted that those industries in which enterprises are part of innovation-integrated structures have growing employment, increase the number of enterprises and institutions, patents, and also, undoubtedly, there is an increase in wages[4, 5, 6].

D. Fondo and K. Badel, having conducted an analysis on the example of Romania, determined that clusters have an economic and social impact on competitiveness and innovation[7]. However, as the European Commission notes in its research, innovation-integrated structures function differently in the countries of the world, in particular – in countries with a developed economy, more attention is paid to innovative services and knowledge creation, while in countries in transition, – supply chain development, export promotion or simple networking and training. The most priority tasks

of innovative and integrated structures in Europe are the creation of identity and branding; initiation of innovative projects and investments in scientific research and development; building a strategy and vision of such structures[8]. Thus, we note that considering the aspect of diversity, the study of foreign experience is quite relevant, first of all, now, in the conditions of the forming of economy, based on knowledge and competences, where attention to the emergence and spread of innovative integrated structures is growing every year.

First of all, we consider it necessary to determine the essence of the integrated structure, which is a set of interconnected business entities, which makes it possible for increasing the effectiveness of the activities of each of its participants due to the optimization of resource provision, aimed for achieving the common goals. Then, the innovation-integrated structure is a set of economic subjects connected to each other by a network system of financial and economic relations, aimed at increasing the efficiency of innovative activities of participants by optimizing resource provision. Based on this, we can say that it is innovative integrated structures that are characterized by advantages compared to the usual types of interaction of individual business entities, because they make it possible to ensure not only sustainable economic development and strengthening of the competitiveness of the national economy, but also the national security of the country in general.

However, despite on the spread of innovative integrated structures in the world, there is no single classification of existing types. Therefore, analyzing the experience of functioning of innovative integrated structures, we consider it necessary to consider presence different species innovative – integrated structures by countries of the world (Table 1).

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4.2 Territorial clusters as tools for ensuring competitiveness

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Innovative or territorial cluster is a geographically concentrated group of interconnected and complementary organizations (companies producing goods or services, educational institutions, technology parks and business incubators, research centers and laboratories, suppliers of equipment and components, banking and other financial institutions, state administration bodies, public organizations, etc.), which jointly participate in the production of the finished innovative product, starting with the development of a fundamental scientific idea and ending with the production of finished products, with the aim of achieving maximum efficiency and competitiveness and developing the innovative potential of the region.

An innovative or territorial cluster is a network primarily of scientific, technical and industrial enterprises and organizations of interconnected and supporting high-tech branches of the economy, which is concentrated in a certain territory (country, region) and aims to implement innovative developments and increase competitiveness through competitive and cooperative interaction

As research is shown, territorial clusters are the most common form of innovative integrated structures. As evidenced by the research of foreign scientists, such clusters have a number of strengths and opportunities for the enterprises that are part of them.

Table 4.1. **Types of innovative integrated structures in different countries of the world**

Species name	UKRAINE	Austria	Bulgaria	the Great Britain	Hungary	Germany	Denmark	Spain	Lithuania	The Netherlands	Norway	Poland	Serbia	Slovakia	Finland	France	Czech Republic	Australia	India	China	Italy	Turkey	Japan	USA
Scientific and technical alliance																								
Technopark	+	+		+	+	+*	+	+		+		+	+**		+	+**	+	+				+	+	+
Technopolis															+	+							+	+
Innovative business incubator	+					+	+																	
Innovation cluster		+			+			+		+	+	+	+					+	+	+	+			+
Innovation center		+		+		+					+					+	+							
Venture firms																								
Technology transfer center				+												+								
Regional entrepreneurship support fund	+																							
Scientific and technical union			+																					
Industrial park				+	+				+					+										+
Business zone					+																			
Free/special economic zone									+	+		+	+											
Scientific and technical association												+												
Center of excellence											+													
Association and union of business communities														+										
Technocent																						+		
Technological platform										+														

Note: *in the form of technological incubators, scientific/research parks, technological campuses ** in the form of scientific and technological parks

The SWOT analysis of the innovation cluster is given in Table 4.2.

Table 4.2. **SWOT analysis of the innovative (territorial) cluster**

Strengths	**Weakness**
Orientation to new markets and industry development; Wide range of opportunities for cooperation; Orientation to the international vector; Gathering and sharing ideas with other members; "smart" approach to specialization	Lack of physical dimension ; Lack of "mental attitude" to the advantages of the virtual community ; Lack of perception of creation of "social ties" ; Cultural problems; System problems
Opportunities	**Threats**
Joint projects ; International synergy ; Participation in European projects and grant applications; Benefits of the ICT revolution ; Improvement of the company's competences ; Open and innovative	Lack of trust in the "virtual" community ; Lack of time ; Absence of "aggregation phenomena" ; Political problems

compiled by the author based on [1]

As can be seen from Table 4.2, despite on the weaknesses and threats, the innovation cluster is a powerful tool for strengthening the efficiency of enterprises and industries in general.

Clusters are widely recognized as one of the ways to overcome the size limitations of small and medium-sized enterprises (SMEs) and as an important tool for increasing their productivity, knowledge, innovation and overall competitiveness[2, 3], which is quite important at the current stage of reforming this sector in Ukraine, Moldova and Azerbaijan.

Kovarnyk, for example, believes that clusters bring positive effects that can spread to planning, organization and project management, production and human resource management, finance, logistics, marketing and sales, research and development. In addition, UNIDO is noted that, given the growth strategy among the poor, the cluster approach can be a valuable tool to reduce poverty and create the basis for a large-scale growth process.

Thus, in the conditions of strengthening the innovative activity of enterprises and the transition to an innovative model of the development of the economy of the countries of the world, the aspect of the functioning of innovative integrated structures in different countries of the world is quite relevant, and their classification is necessary.

First of all, in the prism of studying the specifics of their activities and, as a result, adapting positive foreign experience to national realities. The analysis showed that there are different types of innovation-integrated structures, all of them are aimed on the strengthening innovative activity, but each has its own specifics.

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4.3 Technoparks and technopolises

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Technopark is a territorial interdisciplinary scientific and technical complex of legally and economically independent, functionally united around a large center of scientific, design and construction, technological, educational, financial, information and other institutions and industrial enterprises (mainly small and medium) with joint using of land and infrastructure, the activities of which are coordinated within a single innovation process[1] or a legal entity or a group of legal entities acting in accordance with the agreement on joint activities without creating a legal entity and without pooling contributions in order to create the organizational basis for the implementation of technology park projects with production implementation of science-intensive developments, high technologies and ensuring the industrial production of products competitive on the world market[2].

Technopolis ("city of science and technology") – a territorial scientific and industrial complex, which was created on the basis of separate city, which includes scientific institutions, research organizations, educational institutions, technology parks, business incubators, manufacturing enterprises, etc. with a developed and dynamic production supply system, communications, infrastructure network objects, which specialize in the introduction into production of science-intensive innovative developments or the production of new progressive products[3] or the unification of scientific, innovative, scientific and technical parks and business incubators in a certain territory with the aim of providing a powerful impetus to the economic development of the region. In technopolises, new ideas are developed and implemented in the form of science-intensive commercial products and high technologies, competitive on world markets[4].

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4.4 Innovation centres – incubators

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An innovation center is an organization (business entity, enterprise, division, etc.) whose activity is exclusively innovation activity. In other words, the activity of the innovation center consists in finding "ripened" fundamental knowledge and turning it into applied knowledge and (or) experimental production.

Innovation centers are an economic structure, located within a small area of the territory, intended for small, newly created venture firms.

An innovative business incubator is a complex multifunctional complex that provides favorable conditions for the effective operation of newly created innovative firms implementing interesting scientific ideas, with the aim of increasing the probability of growth and survival of these firms[1].

In general, it is worth noting that an incubator is a form of business organization, the main activity of which is based on the creation of new firms with an effective management system[2].

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4.5 Advisory firms and venture capital firms

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Venture firms are mainly small enterprises in the newest branches of production (electronics, biochemistry, bioengineering, nanotechnology, etc.), which are rapidly progressing and in which there is an intensive change of generations of products and technologies associated with basic innovations[1].

Venture firms are mainly small enterprises in technologically advanced sectors of the economy, specializing in the areas of scientific research, development, creation and implementation of innovations associated with increased risk[2].

The technology transfer center is the organization whose activities are aimed at the introduction of modern commercially promising scientific, scientific research, scientific and practical, research and development, design and construction developments into the real sector of the economy and are focused on obtaining profit from the using of the results of scientific research[3].

The regional business support fund is a separate legal entity created to support and develop SMEs in the designated area.

Spinout companies – companies that are "detached" from the parent company, but maintain close ties with it, unlike spinoff companies, which are given greater freedom of action, the opportunity to independently develop innovative products or organize production; retain subordination to the enterprise (scientific organization) that created them, regarding financial and operational relations (financial control, administrative service, management support, advisory activities)[4].

Spinoff companies are successor companies that are separated from the parent company for the purpose of independent development, development and introduction to the market of an innovative product or technology, which are most often formed by transforming a division of the parent company into an independent structure[5].

The technological platform is a union of representatives of government, business, science, and education around the common vision of scientific and technical development and general approaches to the development of relevant technologies; mechanism of private-state partnership, which is aimed at rapid development of research and development within certain sectors of the economy.

The zone of development of new and high technologies is zonal structures that have a larger territory than technopolises, which are created in areas characterized by the concentration of material, personnel and scientific and technical potential with the developed production

infrastructure and industrial base, and their activities are focused on the development of new and high technologies and the production of many varieties of science-intensive high-tech products[6].

Regions of science and technology are a special type of scientific and technical zones, which are large scientific and industrial complexes located on large territories and characterized by the developed service infrastructure[7].

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4.6 Strategic alliances

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A scientific and technical alliance or a strategic alliance is a stable association of several firms of various sizes among themselves and/or with universities, state laboratories based on an agreement on joint financing of research and development, development or modernization of products[1].

Analyzing the existing types of innovation-integrated structures, we believe that the common feature for all types is that the complexes unite, concentrating on a certain territory, enterprises, institutions or organizations with the aim of transferring new ideas or developments into the direct process of their transformation into new science-intensive types of goods or services and introduction of high technologies. At the same time, each of the types has a fundamental difference, for example, existing firms within a certain industry, in order to share the infrastructure and combine their scientific potential, form clusters in the technology park, while new firms are formed in business incubators, which voluntarily, in the future, can join the cluster. A cluster is an entity that ensures the equality of all participants of such an entity, on the other hand, in a technology park, the leading role is played exclusively by a scientific institution, around which such integrated structures are usually formed. Further, if the main purpose of the formation of technoparks is, first of all, the generation and implementation of new ideas and innovative projects, high technologies, and not the production of products themselves, while clusters are created, first of all, for the production of goods and services, without the goal of developing new technologies or products, and produces already existing technologies, including those developed by technoparks.

Participation in management is also a distinctive feature: clusters can be managed not only by entrepreneurs who voluntarily joined it, but also by representatives of governmental, scientific, and financial institutions.

The technological platform, for example, in contrast to the regional focus of cluster development, is more in line with national development. Moreover, if the cluster solves current problems, then the technological platform develops a strategy and perspective for future periods.

A decisively different feature of business incubators compared to other innovation-integrated structures is that they develop not a certain product or service, but an independent business entity.

If we analyze the difference between a technopolis and a cluster, we consider it necessary to note that a technopolis is characterized by the presence of a special status and a preferential regime, which allow business to develop at a faster pace, however, along with the above-mentioned advantage, territorial attachment to a certain city slows down the possibility of both territorial and and industry development.

Regions of science and technology, along with the fact that they have a significant advantage, concentrating in their structure a significant number of intellectual centers and institutions, to get the opportunity to quickly respond to changes in demand by producing the latest innovative goods or services, this in itself is a significant disadvantage, because, complicating the organizational structure, may cause an uneven distribution of functions and volumes of performed works.

Given the fact that the main coordination of efforts within scientific and industrial parks is focused on research and design development, the latter causes the possibility of problems with meeting demand in newly created products due to a lack of production capacity. At the same time, such an integrated structure is characterized by accelerated application of innovative solutions.

For zones of development of new and high technologies, a disadvantage, in comparison with a cluster, is the need for a zone of high concentration of personnel, material, etc. resources, which limits the development of such associations in any economically active regions, instead, regions with available resources provide an opportunity to choose professional personnel and business partners.

Thus, each of the types has its advantages and disadvantages, which distinguish them from each other and make it possible to choose the most optimal form of innovative integrated structure for each country, taking into account the state of the environment.

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4.7 Innovation and technology transfer networks and platforms in the EU

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"Innovation" is one of the most used notions in recent EU policies. It is mentioned on highest policy level with an especially dedicated Research and Innovation Strategy and a strategic plan and getting more concrete and detailed for implementation in subordinated programs and plans like the Green Deal, EU Missions, Farm to Fork Strategy or concrete interventions for example in the CAP Strategic Plan. To force innovation activities and impacts, technology transfer networks and platforms are installed on various levels and in different sectors. Sometimes they are named and defined very concretely, sometimes they are hidden behind other notions or they can be understood in a broader thematic sense. For example, the focus in the European Rural Development Network is only partly on innovation and technology but also on environmental and social innovations and projects.

4.7.1 EU Research and Innovation Strategy

The EU Directorate-General for Research and Innovation is responsible for the Research and Innovation Strategy (Strategy 2020-2024 – European Commission (europa.eu)) which sets out the general objectives in Europe (Green Deal, Fit for Digital Age, Economy that Works for People, Promoting European Way of Life, Stronger Europe, Push for European Democracy, Modern, High Performing, Sustainable European Commission). It is the basis for the Horizon Europe research program with five Missions (Adaptation to Climate change, Sol Health and Food, Climate Neutral and Smart Cities, Cancer, Healthy Oceans, Seas, Coastal and Inland Waters). In addition, it enables

Institutionalised European Partnerships which are designed to accelerate transitions and allow teaming up of the research with the private sector. European Technology Platforms (ETP, public-private partnerships) are installed to align research priorities in technological areas, to create a European Research Area (ERA) with cooperation of industrial stakeholders. 34 ETPs are active in the topics Bioeconomy, Energy, Industrial Technologies, Mobility and Space, Information and Communication Technologies (ETP topics).

4.7.2 EU Innovation Agenda

The New European Innovation Agenda Regulation (EC COM(2022) 332 final) formulates "flagship projects", e.g. funding of deep tech scale ups, enabling deep tech innovation through experimentation spaces, accelerating and strengthening innovation in European Innovation Ecosystems, and fostering, attracting and retaining deep tech talents and improving policy making tools. All of them include a kind of network, pools, hubs or platforms for possibilities of information and knowledge exchange (EU Flagships) and support European Innovation Ecosystems (EIE projects), like Regional Innovation Valleys (see 4.7.4).

4.7.3 EU Technology Transfer

The Commission Regulation (EU) no 316/2014 is very concrete about the functioning of the European Union to categories of technology transfer agreements. It covers various definitions, technology and know-how rights, their licensing, assignments and restrictions, depending also on market share thresholds.
The European Commission runs a Competence Centre on Technology Transfer (EU_CCTT) as reference point for expertise and services in technology transfer on topics like Innovation Ecosystems, Financing and Capacity Building. A network (TTO CIRCLE, Technology Transfer Offices – Connecting Innovation and Research Centres and Laboratories in Europe) has been launched with the aim of increasing the market and societal impact of publicly-funded research (European Technology Transfer Network). It is led by the Joint Research Centre and expected to promote a culture of innovation and entrepreneurship among the partners involved, allowing for the reinforcement of their scientists' skills and competences through specific training and good practice exchanges.

4.7.4 Regional Innovation Valleys

Based on a project Partnership for Regional Innovation of the Committee of the Regions and the European Commission's Joint Research Centre (Regional Innovation Playbook) the European Commission wants to strengthen and better connect innovation players through Europe, including regions lagging behind by creating "regional innovation valleys". The aim is to bring together less and more innovative regions with a view to addressing the most burning challenges facing the EU. For example, reducing the reliance on fossil fuels, increasing global food security, mastering the digital transformation, improving healthcare and achieving circularity (RIV-ECR-2023).

4.7.5 European Cluster Collaboration

Specifically dedicated to industrial cluster activities is the platform European Cluster Collaboration (European Cluster Collaboration Platform). It is seen as online hub for cluster stakeholders. It provides a lot of information on cluster activities and funding opportunities in Europe, gives possibilities to exchange and connect and set up partnerships, organises meetings and analyses recent trends. In various country reports it shows national cluster activities and platforms to connect.

4.7.6 Green Deal, Farm to Fork Strategy, Rural Vision, CAP Strategic Plan

The European Green Deal (COM(2019) 640 final) sets out how to make Europe the first climate-neutral continent by 2050. It maps a new, sustainable and inclusive growth strategy to boost the economy, improve people's health and quality of life, care for nature, and leave no one behind. The Farm to Fork Strategy (for a fair, healthy and environmental-friendly food system, EU-Farm to Fork) is seen as the heart of the Green Deal. It shall ensure sustainable food production, processing, retail and food services, ensure food security, promote sustainable food consumption, reduce food loss and waste. A chapter is dedicated to research, innovation, technology and investments where the Horizon research program and the EU-missions are mentioned. The EU Commission provides a lot of agricultural and rural data and analysis (markets, financing, employment, farm structures, economics, food security…), an overview gives the webpage EC Data. The Farm Sustainability Data Network as well can be seen as a specific network or platform (FSDN, collecting concrete single farm data, former FADN, Farm Accounting Data Network). In future a common European agriculture data space will comprise all these data and additional data for land use, environment and links to Geoportals to enable tailored applications of production processes and monitor the sector's performance (AgriDataSpace).
The Long-Term Vision for the EU's Rural Areas (EU Long-Term Vision) points in the same direction and wants to care for stronger, connected, more resilient and prosperous rural areas in implementing a Rural Pact as a common framework for cooperation. It includes an action plan which also sets up a rural observatory in the Commission to deepen data collection and analysis on rural areas to support policy making – aagain a kind of knowledge exchange platform.
The above-mentioned EU strategies and programs influenced the Common Agricultural Strategic Plan Regulation (CAP Strategic Plans) which breaks down the general objectives to more concrete specific objectives and interventions for the national implementation of the policy. Among them in our concern are to mention the Agricultural Knowledge and Innovation System (AKIS) and the European Innovation Partnership (EIP). AKIS means the combined organisation and knowledge flows between persons, organisations and institutions who use and produce knowledge for agriculture and interrelated fields. The EIP should care for agricultural productivity and sustainability and enables to support and stimulate innovation, connect innovation actors and cares for wider use of innovation measures via networks**.** In the framework of the CAP Strategic Plan also to mention are networking activities: The European CAP Network (European CAP Network) provides a lot of information and data for knowledge exchange on new projects, innovations – not only technological but also environmental and social, also on topics of the Community Led Local Development (CLLD). It includes hints to specific focus groups on innovation and various national networks.

4.7.7 European Enterprise Network

The European Enterprise Network (EEN), is operated by the Observatorio Technologico of the University of Alicante, wants to help researchers, entrepreneurs and companies taking advantage of scientific and technological information for decision-making and favouring value networks for digital transformation. It offers information and knowledge on news, events, provides tools, webinars and MOOCs, specifically to technology monitoring and transfer and possibilities for networking.

Chapter 5. Research project management

5.1 Concept of a research project and its content

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The concept of a scientific project is defined as a set of activities that includes a plan of research and experiments aimed at obtaining new knowledge, examining a certain problem or answering specific scientific questions. Scientific projects are often interdisciplinary, involving researches from different fields. Scientific projects are characterized by the following features: the goal – problem formulated at the beginning of the scientific project, which is tried to be analysed; research plan – includes planning experiments, observations, data collection and analysis, choosing which methods will be used to obtain reliable results; funding and resource planning – scientific projects may require funding, equipment, specialists and other resources; data collection and analysis – it is important to collect and systematically analyse data, this allows you to draw conclusions and answer the questions asked; interpretation of results – results should be interpreted and compared with the objectives; findings – implications for further research or application in practice.

The main parts of a scientific project are:

- Research topic or problem – defines the area of specific questions or problems that the researchers plan to study. It is important that the topic is clear and defined;
- Goals and tasks – the goals set for the project, which are aimed to be achieved, and the specific tasks related to them are formulated. This may include obtaining new knowledge, confirming or disproving theories, expanding the scope, etc.;
- Literature review – describes what is already known about the research topic, how and what has been done by previous researchers. A literature review helps to ensure that the study adds value and does not replicate already known results;
- Methodology – describes how the research will be conducted. This includes various research methods, experiments, data collection techniques, analysis techniques and all other information necessary to achieve the project objectives;

- Resources and financing – describes what resources will be needed for the implementation of the project. This may include financial resources, necessary equipment, laboratories, a team of specialists, etc.;
- Schedule of activities – a plan is drawn up, indicating the steps necessary for the project, their order, duration and end date. It helps to efficiently organize work and monitor project progress;
- Data collection and analysis – describes how the data will be collected and processed, how their analysis will take place and how conclusions will be drawn from the obtained results;
- Conclusions and recommendations – the main conclusions from the study are briefly presented and possible directions for further research are indicated;
- List of references – all used sources, books, articles, blogs and other sources used for the preparation of the project are presented.

The success of a scientific project depends on the quality of each of these parts and the connection between them. Project preparation is a sequential and systematic process, and each part is important to its overall successful completion.

5.2 Design of research project

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Scientific research is purposeful cognition, the results of which appear in the form of a system of concepts, laws and theories[1]. Each scientific research conducted by a scientist, economist or student includes a sequence of certain actions, the systematization of which forms the stages of work on scientific research.

The successful conduct of the author's scientific research is largely facilitated by the correct, well-thought-out organization of research work, planning, staging and consistency[2].
In general, by systematizing the scientific work of domestic scientists and research experts, it is possible to identify the following 8 key stages of work on scientific research[1, 3].

The first stage is the selection of the topic of scientific research and the formulation of its name.
The second stage is the definition of the purpose, objectives, subject, object and methods of scientific research.
The third stage is a review of the scientific literature, in which the topic of scientific research was previously investigated.
The fourth stage is the development and formulation of a hypothesis of scientific research that the scientist wants to protect as part of his work.
The fifth stage is the formation of a plan and program of scientific research, as well as the definition of methods for verifying the correctness or fallacy of a scientific hypothesis.

The sixth stage is the conduct of scientific research, within the framework of which information/data is collected, systematized and analysed.
The seventh stage is the processing of the results obtained from the analysis of scientific research and summarizing its results.
The eighth stage is the formulation of conclusions, results and conclusions/conclusions of scientific research as well as confirmation of the hypothesis.

In addition, the following sequence of stages of work on scientific research can be distinguished[4]:

- the theoretical stage, which is associated with the study of literature on the topic, the analysis of existing experience;
- the preparatory stage, where the conditions for the implementation of the theoretical model of the process are being prepared;
- the formative stage, where the experimental verification of the developed model is carried out;
- the generalizing stage, within which the generalization and examination of the obtained results of scientific research is carried out.

Thus, the stages of work on scientific research include preparatory, theoretical, analytical and final stages, within which a topic, subject, goal is selected, a hypothesis is developed and facts proving its reliability are established.

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5.3 Selection of priority areas for research and development activities

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Research projects can be carried out in various fields of science, including physics, biology, chemistry, medicine, sociology, psychology, etc. subject and interdisciplinary research. Projects may vary in scope and duration, depending on the complexity of the issue, funding and other research related opportunities.

In order to choose the priority directions of scientific research, it is important to pay attention to the solution of regional, national or global problems, the main directions of international scientific programs. The main criteria for forming priority research directions are:

- Identification of the problem – challenges arising at the national and / or international level are identified;
- Literature review – a detailed literature review is conducted, what is already known about the chosen field, what are the research gaps and in which fields there are opportunities to contribute are analysed;
- Market needs and the purpose of the research – it is determined what the purpose of the research is, considering the needs of the market. Research that is relevant to the market can contribute to a common goal and gain industrial or social impact;
- Global trends – analyses global trends and new scientific discoveries that can give you new ideas and perspectives.
- It is important to note that when choosing a priority direction of research, which is not only relevant, but also meets personal and professional goals.

5.4 Preparation of research projects within the framework of the Horizon Europe and Cost programmes

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In order to develop scientific research in the European Union, various international scientific programs are developed. Horizon Europe and the European Cooperation in Science and Technology (COST) programs are international initiatives funded by the European Union to promote and support research and innovation. These programs serve different purposes, but both aim to promote collaboration and innovation in science.

Horizon Europe – is the largest EU funded program for scientific research and innovation. Its purpose is to strengthen the European research and innovation sector and to solve important societal problems. The Horizon Europe program provides funding for a wide range projects, including research, technological development, innovation and training. The program is divided into three main parts:

- Excellent Science;
- Global Challenges and European Industrial Competitiveness;
- Innovative Europe.

The COST program is designed to promote international scientific cooperation, including across countries, research groups and sectors. The main goal is to facilitate scientific meetings and information exchange. COST project participants must be representatives from various countries and organizations. The program enables the creation of scientific networks and the organization of various events that promote research and knowledge exchange. COST provides funding for

various actions that promote scientific cooperation, such as meetings, scientific conferences, trainings, etc.

In order to carry out scientific research using these programs, using the COST program, researchers from different countries have the opportunity to submit project proposals that meet the goals set by the program. Proposals can be submitted in a variety of thematic areas, from basic science to innovation. In the COST program, researchers can join existing scientific networks or create new ones. The networks organize meetings, conferences and other events where researchers can share their knowledge and experience.

To summarise, Horizon Europe provides direct financial support to the projects themselves, while COST finances actions and events aimed at promoting cooperation and knowledge exchange. In order to participate in these programs, it is important to follow the official calls for proposals and engage in networking

5.5 Development of research project budget

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The budget of the scientific project foresees the costs and financial resources necessary for the implementation of the project. A budget helps to plan, track and control the financial side of a project. The drawing up the budget of the scientific project, the identification and classification of the costs of the project budget must be carried out all costs that may be incurred during the project are determined. Expenses can cover different areas, thus dividing them into categories:

- Salary for staff – it is estimated how many people and what work to do will be needed in the scientific project. Position salaries, taxes and other wage-related costs are determined;
- Infrastructure – the necessary equipment and technologies that will be needed for the implementation of the project are calculated. It can be hardware, software, computer equipment, research equipment, etc.;
- Research materials – estimated costs for materials that will be used for your research or experiments and research. These can be chemicals, reagents, biological materials, paper, etc.;
- Expenses for business trips – calculated expenses related to transportation, hotels, meals, insurance, etc.;
- External services – costs of consultations and other services provided by specialists are calculated;
- Administrative costs – administrative costs such as room rent, utilities, office supplies, etc. are calculated;
- Unplanned expenses – estimated funds for unplanned expenses or discrepancies in the budget. This will help protect the project from unforeseen situations.

The preparation of a budget document includes all expenses and their justification must be clearly presented. Data should be presented in a tabular or other format depending on the requirements. It is also important to mention that continuous and regular monitoring of the project is an integral part of the project to avoid budget surplus or shortage.

5.6 HR management at research organisations (motivation, creation of project teams, etc.)

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Human resource management for a scientific project is the process of organizing, managing and optimizing all the human resources involved in a scientific project to ensure that people work effectively together to achieve the project's objectives. These activities include various tasks, from the selection and involvement of people in the project to their motivation, training and further development. Human resource management covers the following main functions:

- Staff selection and involvement in the project – the human resources manager plays a key role in the selection and involvement process. This includes finding, evaluating, selecting and engaging the right researchers for the project;
- Creation and organization of the workplace – the human resources manager ensures that suitable working conditions are created for the project. This can include the organization of workplaces, the creation of team spaces and the availability of work tools;
- Motivation – the human resources manager is responsible for motivating people. This can be achieved through a suitable wage system, the provision of additional benefits, recognition and the opportunity to participate in interesting projects;
- Training and competence development – it is important to ensure that the people involved in the project have the necessary knowledge and skills. The human resources manager should organize trainings, seminars or other activities that promote the growth of competence;
- Team building and management – the project manager ensures effective team work. This ensures equality among team members, fostering interpersonal relationships, conflict solution, fostering communication;
- Communication – ensuring that information is clear and accessible to all project participants. The human resources manager must promote effective communication between team members and other project stakeholders.

The human resources manager monitors the performance of employees, evaluates their contribution to the project, and offers reward or recognition measures based on performance. Human resource management of a scientific project includes not only technical knowledge, but also tactical, emotional and social aspects that are necessary for the successful implementation of a scientific project.

Case study

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Project management has its own peculiarities and difficulties. The working group created for the implementation of the project solves new tasks that differ from the tasks that the existing functional units face.

There should be a stable connection between the working group and the entire organization, since the project should be implemented in cooperation with existing departments and the result should be integrated into the existing structure. For example, the introduction of a distance education system at a university should take place in cooperation with deans, departments and other departments.

Each member of the working group has, as a rule, two managers (the head of the group and the head of the functional unit). A special supervisor may be assigned to manage the project. The structure of the project team depends on the complexity of the project. If this is, for example, a product modification, then a limited working group is created, which includes the departments of new product development, production, marketing and service. Such a group reports to the head of the relevant department.

If we are talking about radical innovations, the group may include: a technical ("working") leader who decides what and when employees should do; a scientific ("professional") leader responsible for the quality of work; an organizing leader who ensures the personal interests of employees (wages, etc.).

Managers form a coordinate group, whose tasks include:

- Defining the purpose of the project;
- Appointment of the heads of the working groups;
- Creation of working groups;
- Setting the task;
- Control over the implementation of the project (quality, time, costs);
- Making a decision on the continuation of work on the project;
- Dissolution of the working groups.

The working groups carry out their part of the project; they are responsible for planning and monitoring, compiling reports for the coordinating group and the entire organization.

The following criteria are used in the selection of candidates for the working group:

- Competence and experience;
- Availability of special knowledge in the problem area;

- The ability to engage in work;
- Power and authority in the organization;
- Ability to resolve conflict situations;
- Attitude to the case;
- Personal interest and motivation.

It should be borne in mind that the project manager plays a crucial role in the organization of work. Therefore, according to his personal qualities, abilities and powers, he must have authority in the eyes of the heads of functional departments.

In management practice, various methods of managing a working group are used, for example, budget planning and cost control; information flow management, etc. However, these methods are not special for the working group, they are used to manage any processes. The procedure for organizing project meetings, decision-making, etc. is also universal.

Specific project management tools include:
1. Defining the problem and setting the task.
2. Establishment of intermediate stages (dividing the project into separate phases).
A clear formulation of the problem and setting the task is important for:

- Understanding the project and setting the stages of implementation;
- Highlighting the most important issues;
- Creating an information exchange model;
- Determination of expected results;
- Development of recommendations after completion of work.

There are mottos in modern management:
Measure it seven times, cut it off once!
Think before you do it!

At the stages of the project implementation, decisions are made on:

- Continuation or correction of the task;
- Clarifying the last stage;
- The form of completion of the last stage.

Dividing projects into stages allows you to control the progress of its implementation. The allocation of stages in the project should be carefully considered. One of the reasons for the failures in the implementation of the project is the unclear organization of cooperation and inconsistency within the working group, as well as between the group and the organization.

- ***Conclusions:***
- Research projects outline scientifically sound technical, economic or technological solutions.
- Projects can be funded through the state scientific and technical program, by receiving grants.

- Each project is designed taking into account certain requirements, has a clear name, is accompanied by a brief annotation, the project indicates the number of performers, deadlines, the need for financing per year, information about managers and key performers.
- Priority areas of research and development are implemented in the form of large cross-industry projects.
- Priority areas for the development of science and technology in Russia are: information technology and electronics, production technology, new materials and chemical products, technology of living systems, transport, fuel and energy, ecology and environmental management.
- A working group is being created to manage the project and implement it.

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Chapter 6. Innovations for sustainable development of the agri-food sector

6.1 Characteristics of sustainable innovations in the agri-food sector

Part 1

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In modern conditions, innovations are a necessary condition for the development of agriculture, increasing its competitiveness not only in the economy, but also in the implementation of the policy of import substitution of food products and, as a result, ensuring sustainable development and maintaining food security of the country. As a result, innovations contribute to the dynamic sustainable development of the industry, which in modern economic conditions is the most important task of the state agrarian policy for several reasons: firstly, agriculture is the basis of food security for the country's population, and secondly, agriculture, like none of the sectors of the country's economy, has undergone large-scale transformations, not always accompanied by positive changes, thirdly, and to this day, there is a residual principle of the state agrarian policy towards the village and the peasantry as a whole. Due to these circumstances, the problem of sustainable agricultural development remains very relevant both for the country as a whole and its individual regions.

One of the urgent problems of the agricultural sector of the modern world is the innovative way of development of the agro-industrial complex. The widespread introduction of innovations in all areas of activity of agricultural enterprises contributes to the growth of labour productivity, saving various types of resources, reducing costs and reducing the cost of agricultural and food products, increasing the volume and improving the efficiency of agricultural production in general. Sustainable innovation potential forms the ability of agricultural enterprises to compete in domestic and foreign markets and helps to avoid an economic crisis. Innovative activity in agriculture requires the introduction of measures regarding the use of the latest achievements of science and technology. These are the improvement of old or the creation of new tools, the cultivation of highly productive, suitable for a certain cultivation zone of zoned varieties of crops and animal breeds, the introduction of scientific developments, etc. An urgent problem of agriculture at the international and national levels, which hinders sustainable development, is that the irrational use of land has led to a violation of the stability of ecosystems, the inability to restore their natural properties. The main reasons for the deterioration of the environmental situation are:

- lack of advanced technologies in the agricultural industry, non-compliance with scientifically based crop rotations, the advantage of monoculture in agricultural enterprises;
- low rates of application of organic fertilizers;
- violations of the technology of application of mineral fertilizers and pesticides;
- widespread erosion processes;
- an increase in the areas of acidic, saline, technogenically polluted soils of the lands

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policy of import substitution of food products and, as a result, ensuring sustainable development and maintaining food security of the country. As a result, innovations contribute to the dynamic sustainable development of the industry, which in modern economic conditions is the most important task of the state agrarian policy for several reasons: firstly, agriculture is the basis of food security for the country's population, and secondly, agriculture, like none of the sectors of the country's economy, has undergone large-scale transformations, not always accompanied by positive changes, thirdly, and to this day, there is a residual principle of the state agrarian policy towards the village and the peasantry as a whole.

The introduction of innovative technologies in agriculture is the only effective scenario for the development of this industry due to the fact that it is one of the strategically important sectors of the national economy and the level of food security of the state depends on the pace of its development.
Innovative forms of activity are becoming the main factor that stimulates the development and economic dynamism of rural areas, giving them the opportunity to use their potential.

Changing markets create needs that can be met by the goods and services offered by the villagers. Innovations in agriculture increase the efficiency and competitiveness of farms. They help protect the environment, for example, by reducing the use of fertilizers or water consumption for agricultural production. Thanks to them, it is possible to withstand such challenges as climate change, growing consumer demands for food quality, and the need for plant protection. The condition for the effective implementation of new solutions in practice is the close cooperation of all subjects working in agriculture, including research units.

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Part 2

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Today, the topic of innovation, especially in the agri-food sector, plays an important role in ensuring its efficiency and competitiveness and covers all business processes at the levels of the agri-food chain, from crop and livestock production to food waste disposal. It is worth noting that until recently, due to a certain conservatism in agriculture, agricultural producers were slow to introduce innovative technologies, but this has changed. At the same time, in the food industry and distribution logistics, innovation processes have been developing more intensively, as changes in consumer demand for food and the identification of new needs, the formation of new competitive advantages and the strengthening of existing ones motivate producers to introduce innovative developments into business processes[1,,2]. In this regard, there is a need to establish close cooperation between research organisations and agribusiness, which will facilitate the implementation of more rational innovative developments and maximise their impact through the creation of networks or agri-food clusters.

The latest technologies that are currently being implemented in various sectors of the agri-food system can be divided into the following groups:

- automation and robotics systems, precision farming technologies (Agriculture 4.0);
- the use of the Internet of Things (IoT), a network of data transmission between physical objects, the functioning of which is ensured by built-in tools and technologies;
- new ways of farming, such as vertical farming and aquaponics;
- development of the 'new food' sector, which includes indoor and vertical farms, insect breeding as an alternative to protein production for feed, human nutrition, aquaculture and new types of ingredients. The active introduction of innovative products in agri-food systems is intended to reduce the negative impact on the environment and reduce greenhouse gas emissions.

In addition, it is important for agri-food chain actors to reduce production losses and food waste. To this end, it is advisable to modernise production, packaging and harvesting processes based on innovative developments, as well as to find ways to reuse food waste[3].

A review of the practices of implementing innovative developments in the agri-food sector allowed us to summarize the most important ones, namely: the use of manure and livestock waste for the production of biogas and fertiliser for crop production; development of new food products based on sustainable production technologies; production of artificial meat in the laboratory, from soy or tofu with insects products that are used as ingredients, are an alternative to common food products and are characterised by a high level of nutrition; production of products with a high level of health benefits and nutrition for human health, in particular, food additives, functional foods and nutraceuticals[4]. However, the latter types of food do not have a clear positive impact due to their high production costs, high energy consumption, and mixed perceptions of quality and positive environmental impact[5].

Sustainable innovations that have modernised the functioning of agri-food systems include the digitalisation of business processes at the level of all participants in the agri-food chain. Let's consider the specifics of implementing digitalisation tools in crop and livestock production.

The introduction of digitalisation tools in the livestock sector is considered within the framework of the so-called Smart Livestock Farming approach, which involves the use of the latest technological advances to improve the ability to expand the reproduction of livestock and poultry, stable operation, and increase socio-ecological and economic efficiency in livestock production[6-8]. Digitalisation tools allow livestock producers to minimise and neutralise climate risks, as the smart livestock model provides monitoring of individual animals and introduces rational methods and technologies for their maintenance, which are considered within the concept of the Internet of Things (IoT). The IoT is a network concept consisting of interconnected physical devices with built-in sensors and software that allows for the automatic transfer and exchange of data between consumers and computer systems using standard communication protocols. According to the study, IoT saves time and production resources, provides remote access for farmers and other stakeholders to data on the condition of animals, and identifies the producer and product in agricultural supply chains based on BlockChain (BC) technology[9-10].

Thus, the technology of smart livestock farming is based on the use of IoT-BC-SLF technologies by management, which will lead to a synergistic effect by improving the conditions of organisation and

management on the farm, improving the quality and safety of products, ensuring animal welfare, which in aggregate will ensure the socio-ecological and economic sustainability of livestock production. It is obvious that the creation of an IoT network in the production of livestock products in conditions of rising indoor temperatures allows you to quickly adjust the appropriate conditions for animals and poultry through the activation of a cooling or ventilation system[11-13].

According to the study, the IoT-enabled livestock farm management technology eliminates the unpredictability of keeping conditions, as it allows real-time information about the location, temperature, blood pressure and heart rate of the animal to be sent to farmers' gadgets via battery monitors on a collar or tag[14]. The Internet of Things can be used to track not only the physiological state, movement, and behaviour of animals, but also to monitor the sanitary and hygienic conditions in the premises and the feeding process[15, 16].
Today, blockchain technology and contactless sensing are an important element for the development of livestock production, which ensure the safety and quality of products in meat supply chains, generate arrays of information by livestock by age and sex of animals and poultry, allow for real-time location of animals, etc. and transfer the accumulated information to networks[17-19]. According to experts, the livestock sector is one of the least digitised, but it can benefit from the introduction of digital tools that will help improve the efficiency of livestock production and sustainability of the industry.

Today, dairy farming has gained the use of artificial intelligence and robots in the process of milking cows, which contributes to increasing the efficiency of milk production and rational decision-making by farm management. It is worth noting that artificial intelligence is the basis for the so-called Digital Twin (DT) technology[20], which is a digital copy of the cattle's intelligent environment that is constantly updated, which leads to lower production costs. Tools that can be used to automatically track the location of individual animals include the Global Positioning System (GPS), Radio Frequency IDentification (RFID), artificial intelligence and Machine Learning (ML).

In the context of increasing climate change in the crop production sector, there are risks of lower crop yields due to reduced precipitation and rising temperatures, which requires the development of adaptive crop production technologies[21, 22]. Obviously, the increase in the frequency of severe weather conditions (heat waves, heavy rains, severe drought, etc.) that can have a negative impact on crop yields and food production is confirmed by numerous research results.

In such circumstances, the stability of the development of agriculture and its sectors, as well as the reduction of the duration of crises, requires the development of innovative technologies and the breeding of resistant crop varieties, pesticides, herbicides, and, in the current environment, the widespread use of digitalisation tools. Agriculture 4.0 includes technological solutions that envisage the creation of climate-resilient agriculture that ensures long-term sustainable crop productivity based on the rational management of business processes and nutrients to promote organic carbon and plant growth in the soil and minimise waste in production processes[23]. One of the innovative approaches to crop production is the Smart Farming system, which involves information collection – data analysis – effective decision – control, based on the use of digital technology and specialised software at all stages of the technological process.
At the same time, precision agriculture is the beginning of smart farming. Precision farming involves the use of the latest technologies and equipment and contributes to the following benefits for the farmer:

improving the quality of air, water and soil, ensuring the rational use of material and technical resources; slowing down soil degradation, allowing for continuous monitoring of crops in real time, etc[24]. Today, the most common developments in the precision farming system are: parallel control systems for agricultural machines; controlled sowing and application of necessary substances (automatic shutdown of sections on overlapping floors); differentiated fertilisation according to field maps; control over irrigation, soil moisture based on the use of special sensors and portable weather stations; soil scanning; and software at all stages of the technological process.

Obviously, the strategic development of crop production will be focused on the introduction of smart technologies that reduce dependence on non-renewable or environmentally harmful resources and are based on eco-agriculture, permaculture, low-cost, resource and water-saving technologies.

An important way to mitigate the crisis in crop production is to reduce losses during harvesting and storage, especially of perishable products, as well as to promote best practices for sustainable nutrition[25]. On the other hand, the production of crop products in the face of rising temperatures requires the creation of irrigation capacities, as global warming will affect the shortening of the harvest season, changes in photosynthesis, and the active spread of diseases and pests. In addition, there are changes in nutrients from organic to inorganic, and it also affects the efficiency of fertiliser use, which increases soil evaporation, resulting in the depletion of natural resources. Therefore, the focus of agricultural producers on the principles of climate-smart agriculture will ensure efficient allocation of production resources, reduce production losses, and increase yields.
The digitalisation tools (information and communication technologies – ICT) currently used in agriculture are summarised in Fig. 6.1.

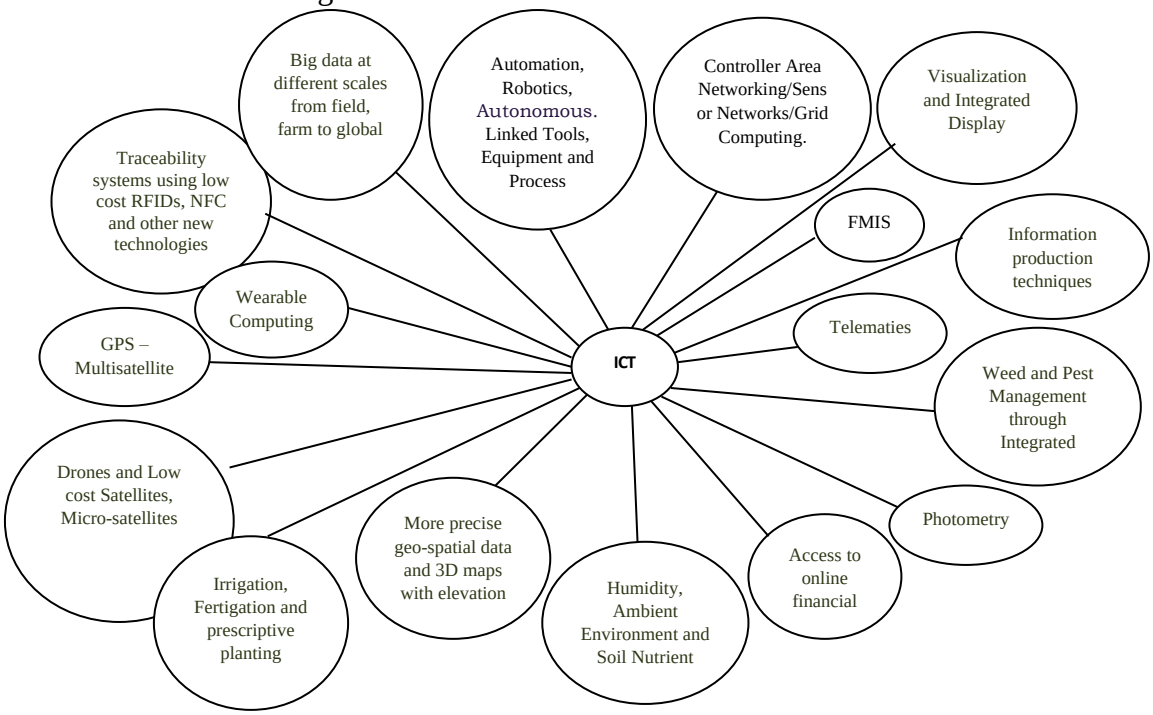

Fig. 6.1. **ICT Innovations and Smart Farming**

Source: 26

It should be noted that the implementation of innovative methods in agri-food companies is accompanied by difficulties due to disruption of supply chain links, inaccessibility of innovative developments, especially for small producers, insufficient dissemination of the culture of innovative enterprise, lack of a full-fledged innovation infrastructure, etc. In order to overcome these challenges, it is advisable to establish intersectoral cooperation between agri-food producers, research institutions, universities, state and regional governments, and innovation infrastructure organisations that are able to take into account the specifics of local development and successfully overcome existing barriers to the introduction of sustainable innovative products.

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6.2 Factors of innovation environment of agricultural producers

Part 1

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A key element of the system of effective agricultural development is the transition to an innovative model based on technical and technological re-equipment of the industry. The introduction of

innovations in all areas of activity of agricultural enterprises will contribute to: increasing labour productivity, saving various types of resources, reducing costs and reducing the cost of agricultural products, increasing the volume and efficiency of agricultural production. In the context of the need to increase production volumes and the level of competitiveness of agricultural products, one of the promising directions for the development of agricultural enterprises is the use of innovative approaches to the implementation of economic activities in agriculture. The basis of an effective innovation process in agriculture is the productive work of a system of research organizations and a high level of implementation of innovative developments by agricultural enterprises.

The innovation process in agriculture has a number of features in comparison with other areas of management, namely:

- a long process of innovation development (related to breeding work);
- innovations are, as a rule, of an improving nature (due to their focus on increasing yields, productivity of the object, and not on inventing a fundamentally new one);
- research of living organisms (plants, animals, microorganisms);
- the leading role of research institutions;
- dependence on the natural area and climatic conditions.

Therefore, there are three main directions for introducing innovations into the activities of agricultural enterprises:

1) innovations in the field of the human factor — training of specialists capable of operating new machinery, equipment and technologies, improving their skills, retraining;
2) innovations in the field of biological factor — the development and development of innovations that ensure an increase in the fertility of agricultural land, an increase in animal productivity and crop yields;
3) innovations in the field of techno genic factor — ensure the improvement of the technical and technological potential of an agricultural enterprise.

Innovation is an important component of sustainable agricultural development. In general, the structure of innovation activity in agriculture can be represented in the form of four main stages:

- creation of scientific developments;
- dissemination of innovations (approbation, verification and communication of information about innovations);
- mastering innovations in production;
- evaluation of the effectiveness of innovations.

It is in the agricultural sector, unlike in other areas, that the development of innovations is more slow, which requires special attention. The most common innovations are: new varieties and hybrids of plants, animal breeds, strains of microorganisms, brands and modifications of agricultural machinery, technologies, chemical and biological preparations (vaccines), economic developments (documented procedures, various recommendations, etc.).
The process of creating innovations is the longest. Conducting fundamental and applied research and development, despite the fact that this is associated with a certain risk of obtaining

unsatisfactory results, is a necessary stage in the process of creating scientific and technical products.

Today, the most effective means of growth and development of agricultural production is of a strategic nature, a real guarantee of confidence of agricultural producers in their own competitive positions in the world market, a means by which enterprises adapt to changes in the external environment, new jobs are created, and, accordingly, innovations are a necessary condition for the development of rural areas. Innovations in agriculture are, first of all, new plant varieties, animal breeds and poultry crosses, new fertilizers and means of protecting plants and animals, modern technology, new methods of prevention and treatment of animals, technologies, forms of organization and financing of production, approaches to personnel training, etc..

In addition, innovations in agriculture increase the competitiveness of agricultural products, solve the problem of limited opportunities for expanding agricultural land, contribute to reducing the threats of the global food crisis, and the like.

In order to ensure the innovative development of agricultural enterprises, it is necessary to form an innovative investment model for agricultural development in the context of balanced rural development, which would take into account the regional characteristics of agricultural production and the natural resource potential of rural areas.

Part 2

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It is obvious that the innovation activity of agricultural producers is influenced by a number of factors that have both a stimulating and a restraining effect on the introduction of innovations. In the scientific literature, experts propose to consider the factors of the innovation environment from two sides – the state regulation of innovation activity and the individual enterprise. However, in our opinion, consideration of the innovation environment also requires identification of global factors that require agribusiness producers to intensify the implementation of innovative developments. The proof of this is that the new technological stage of development in the world is called 'AgroTech 4.0' and is based on the introduction of 'smart' solutions (artificial intelligence, IoT (Internet of Things), bio- and nanotechnologies, robotics, changes in the purchasing behaviour of agri-food consumers, etc.

Let's highlight the specific features of global challenges and their combination, which determine the key innovation trends in agri-food systems.

1. **Factors of resource supply** caused by increased demand for food against the background of slower productivity growth in the agri-food sector and a reduction in its resource potential. According to experts, the demand for food, water and energy will increase by 35, 40 and 50 % by 2030, respectively, compared to 2012, due to the increase in global population and rising incomes.

Thus, according to the UN, the population growth will reach 8.5 billion by 2030 and approach 10 billion by 2050 (compared to 7.7 billion in 2019)[1]. Experts estimate that the increase in purchasing power by 2030 will result in the size of the middle class reaching 5.3 billion people, or 1.3 billion more than in 2020 – almost 4 billion people[2]. At the same time, most of this growth will occur in South and Southeast Asia, where the share of the middle class will be 65%.

In recent years, ecosystem degradation has been observed under the influence of agricultural activities, primarily large-scale intensification of the industry, which has led to a reduction in resource potential. According to the FAO, about 25% of the world's agricultural land was assessed as severely degraded as of 2011, and 46% as moderately and slightly degraded[3]. In addition, intensification has also led to the loss of natural biodiversity, depletion of underground water sources, and the spread of pathogens and pests that are not sensitive to protective measures.

The most significant factor affecting the intensification of innovation activity is global climate change, the impact of which leads to a decrease in agroclimatic potential. Thus, according to the report of the International Panel on Climate Change (IPCC), the most likely scenario is that the average temperature of the Earth's climate system will increase by 1. 5°C compared to pre-industrial levels between 2030 and 2052[4], which will lead to the following negative processes: reduction of areas suitable for agricultural production due to flooding, desertification and salinisation, as well as increased urbanisation; increased risks of lower yields and quality (in terms of protein, trace elements and vitamins) in crop production due to increased frequency of meteorological extremes: droughts, floods, sharp temperature fluctuations and increased CO_2 concentrations; the spread of plant and animal pests and diseases.

The growing threat of dangerous infectious diseases is a factor that can not only cause significant damage to certain agricultural sectors (e.g. African swine fever) but also spread from farm animals and poultry to humans (zoonotic infections). Examples of such outbreaks include bird flu, swine flu, and Covid-19. Some threats may be manifested by attempts to use pathogens of dangerous diseases for terrorist purposes aimed at both the population and undermining the sustainability of agricultural production. Of particular importance in this case is ensuring the availability of CRISP technologies, the consequences of which cannot be overestimated[5].

The problem of food losses and waste has been exacerbated in recent years, with FAO experts estimating that the share of losses and waste is about 30% for cereals, 40-50% for root crops, 30% for fish, and 20% for oilseeds and meat[6]. Between 33% and 50% of all food produced in the world is not used for food, and the total cost of losses is almost USD 1 trillion. At the same time, 28% of the world's agricultural land, or 1.4 billion hectares, was used for the production of unclaimed food.

An interesting fact is that almost 54% of losses occur at the stage of production, harvesting and storage of agricultural products, and 46% – at the stages of processing, distribution and consumption of food. It should be noted that the main losses in developed countries are associated with the problem of ‘wasted food’, while in developing countries, losses at the production stage are the most common[7].

The integration of the food and energy sectors has been driven by an active policy of switching from fossil fuels to biomass (Brazil, the US, the EU, and China), which creates benefits in terms of improved

environmental performance and reduced energy demand. However, this approach results in increased competition for land and water resources, rising food prices, and degradation of large areas due to deforestation and uncontrolled use of agrochemicals, etc. Thus, the development and implementation of more advanced second and higher generation technologies is one of the most important challenges at the current stage of development of the agri-food sector.

Summarising the above, it can be concluded that in the coming years, global agri-food production will be developing under the growing threat of resource shortages and increasing biosecurity concerns. Under such conditions, food production will depend on the introduction of innovative technologies that will increase crop yields, livestock and poultry productivity, and reduce losses caused by external climatic and biological factors.

2. Economic factors. *Increased price volatility* in agri-food markets under the influence of the following multidirectional factors: an increase in the world's population amid resource shortages, rising energy prices and natural and climatic risks; increased competition, the introduction of high-performance technologies and growth in agricultural production, the release of agricultural land as a result of the transition to second-generation 'biorefining' technologies (production of high-value-added products based on complex deep processing of plant raw materials).

Increased influence of vertically integrated holding companies, which have significant market power, and in some cases political power, and are able to push out (or integrate into) small and medium-sized agricultural producers, leading to monopolisation of the competitive environment and rural unemployment. In addition, the development goals of transnational holding companies may contradict the principles of food security of a particular country, sustainable development, etc. In this regard, countries are increasingly becoming more protectionist as a response to external challenges by reducing their dependence on international trade and adhering to the priority of self-sufficiency (the concept of food sovereignty).

The global trend towards the introduction of sustainable development principles based on the development of bioeconomy and circular economy strategies. One of the main tools for implementing such solutions is standards, quotas and other measures that limit the use of less sustainable alternatives. Despite the fact that discriminatory measures are currently used mainly to regulate domestic markets, a global shift to a more circular model is expected in the near future.

Transition to a knowledge economy: a model of a post-industrial economy in which knowledge and technology are one of the most important resources and the production of goods and services relies on highly developed cognitive and social skills of workers. The transition to the knowledge economy model and technological development require a dynamic labour market, which will experience rapid changes in the competencies and skills in demand, which will change professions[8].

We believe that the identified trends can, in the medium term, radically change the processes of agri-food production and increase the influence of developed countries, as well as change the perception of agriculture as a conservative and uncomplicated activity in rural areas, which will increase the dependence of producers on innovative technologies and developments.

3. Technological factors.

Information technology and IT infrastructure:

1. *Quantum computing,* which in the future will form a new technological ecosystem that will expand opportunities for solving various applied problems;

2. *Big Data* allows transforming large flows of information from a form inaccessible to human understanding into results that are accessible to the public. Such technologies have a great potential for practical use in the agri-food sector (Big Driven Farming): BigData technologies allow making more informed management decisions based on weather forecasts, disease probabilities, yield estimates, market trends, etc.

3. Self-learning systems (artificial intelligence, AI): the development of data mining technologies is expanding the list of tasks that can be solved by computer systems. Integrated AI systems (IoT platforms) are now being used in the agri-food industry, allowing for the creation of self-managed farms and production facilities, chatbots, and virtual assistants.

4. *Internet of Things (IoT):* the technology of combining physical objects equipped with communication means into a single information system for the purpose of collecting, exchanging and analysing information necessary for making management decisions. In the agricultural sector, IoT is combined with robotics, telematics, sensor technologies and other elements of the IT infrastructure to implement the Smart Agricultural model. Experts estimate that by 2050, an average farm will generate 4.1 million data points daily, compared to 190 thousand in 2014[9]. Thus, the increase in the number of IoT-connected devices provides great opportunities for commodity producers, but complicates the management of processes that will be largely delegated to artificial intelligence in the future.

5. Blockchain: the technology can be represented as a system for accumulating and storing data on all operations carried out during the product life cycle in the form of 'chains of blocks'. Today, blockchain technology in agri-food supply chains allows to ensure transparency of the chain of goods movement from farm to plate, providing an opportunity to identify low-quality products, optimise logistics, etc.

6. Robotics is associated with the use of robots and drones, which, in combination with artificial intelligence, allow for the introduction of 'smart' robotic systems in agri-food production. In 2009, there were about 10 million robots in operation; in 2011, there were more than 18 million units; by 2025, the number will exceed the population of developed countries – 1.5 billion units. In the period 2030-2035, there will be more robots than people[10]. Thus, the development of technological progress will lead to the following trends: human labour will be replaced by intelligent mechanisms, on the one hand, and on the other hand, the management of robotic systems will become more complex, which will require more technical and biological knowledge from the farmer in the future.

7. *Biotechnology* involves the use of living organisms, their systems and products to solve various problems (including the production of living organisms with specified properties).

6. Nanotechnology: technologies for manipulating matter at the atomic, molecular and supramolecular levels. Despite the agri-food sector's significant lag in the development of nanotechnology solutions compared to leading industries, their implementation can be a positive impetus for the development of

agriculture and the processing industry in ensuring efficient use of resources, increasing productivity, etc.

Let us now describe the factors that shape the innovation environment for agricultural producers. In the economic literature, there are different approaches to the classification of factors that influence the innovative development of an enterprise, the broadest list of features is proposed in[11]:

by belonging to the environment: external, internal;
by the nature of influence: stimulating, restraining, neutral;
by the degree of formation: individual business factors, macroeconomic level factors, factors meso-level factors (regional, sectoral), microeconomic factors of the microeconomic level;
by the dynamics of the course: static, dynamic;
by the duration of action: one-time, periodic, permanent;
by the possibility of measurement: parametric, non-parametric;
by content: economic, non-economic;
by the possibility of control: controlled, uncontrolled;
by cause and effect: ordinary, force majeure, force majeure.

External factors that influence the innovation activity of agricultural producers include:

state innovation policy;
the level of development of research and innovation potential of the industry;
level of novelty of innovation in the field of technology;
level of economic development of the state;
state support for agricultural producers;
level of integration of agricultural producers with research and innovation organisations, universities, etc;
development of innovation infrastructure.

Internal factors include:

goals and strategies for enterprise development;
innovation and intellectual potential;
human resources;
financial stability;
availability of material, technical, organisational and information resources;
culture of innovative entrepreneurship.

The factors that stimulate innovation activity at the global level include:
communication with the global community within the framework of innovative projects that facilitate effective knowledge transfer, exchange of experience and replication of innovations;
the ability of innovative products to integrate with products and technological processes of the relevant industry.

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6.3 Circular economy as an innovative model for sustainable development

Part 1

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The circular economy – the closed-loop economy – is an alternative to the classical linear one. The task of a circular economy is to use renewable and secondary resources as widely as possible.

Compared to a linear circular economy, it helps to reduce the negative impact of the extraction, use and disposal of production materials. Ideally, with such a business model, exhaustible natural resources are not used at all: a cyclical economy replaces traditional (primary) sources of raw materials with renewable ones.

The development of the global economy, the expansion of economic activity and population growth lead to an increase in demand and consumption of natural resources, the use of which has a significant impact on the environment.

On September 25, 2015, the UN General Assembly adopted the Declaration "Transforming our World: the 2030 Agenda for Sustainable Development" (Transforming our world: the 2030 Agenda for Sustainable Development), which defines the Sustainable Development Goals[1]. The Declaration includes 17 global goals and related objectives in the field of sustainable development, which should ensure a balance between the three components of sustainable development: economic, social and environmental, and be achieved and solved by the countries of the world by 2030. Sustainable Development goals such as poverty eradication, conservation of the planet's resources and well-being are universal. The goal "Ensuring rational consumption and production patterns" (12th in the list of Sustainable Development Goals) involves "doing more and better with less money" through the use of rational production and consumption patterns; rational development and efficient use of natural resources; rational use of chemicals; significant reduction of waste by taking measures to prevent their formation, reduction, recycling and reuse[2].

In the modern global space, a linear take—use—throw-away model of the use of natural resources has developed, based on the assumption that these resources are abundant, accessible, easy to use and cheap. In recent years, the demand for limited and scarce natural resources has increased markedly in the world, which has led to the development of competition between owners of these resources.

Addressing the issues of effective use of natural resources, which make it possible to extract economic and environmental benefits from their use, is an important component of the currently emerging vision of the prospects for sustainable development of the world economy. The transition to a circular economy is of great importance for the implementation of tasks in the field of resource conservation in order to use resources efficiently.

The principle of a closed—loop economy — the introduction of the ideology of minimal consumption of any external resources and maximum use and regeneration of internal ones – is the basis of the economic model called the "circular economy". A circular economy is an economy based on the principle of resource renewal, in contrast to the linear model, namely the processing of secondary raw materials and the transition from fossil fuels to the use of renewable energy sources, aimed at increasing the life cycle of a product and a high degree of its further reuse, including through recovery and recycling[2]. All phases of the circular economy are interconnected, as materials can be used in a cascading manner. At the same time, the main goal is to minimize the resources coming out of the circle so that the system functions optimally. As part of a circular economy system, the product, when it reaches the end of its service life, can be productively used over and over again, as a result, additional product value is created.

To date, the most significant results in the field of transition to a circular economy are demonstrated by the countries of the European Union (EU).

The European Resource Efficiency Platform, which unites EU countries, is designed to ensure the transition to a circular economy based on the reuse and high-quality processing of primary raw materials.

In 2008, the EU adopted Framework Directive 2008/98/EC[3] as the main legislative document on waste management, according to which the EU member States implemented domestic legislation on waste management. At the same time, an analysis of the implementation of these acts showed that during this period there was no full implementation of the circular economy in the EU, since the main task of the economies of the EU countries at that time was waste recycling in order to reduce the volume of landfills in the final burial sites.

Consistently pursuing a policy in the field of resource conservation, the European Commission in 2015 presented a new action plan for the development of a circular economy in the EU, as well as legislative proposals amending EU Directives 2008/98/EC on waste[3], 1999/31/EC on landfills[4], 94/62/EC on packaging and waste from packaging[5], 2000/53/EC on vehicles with an expired service life[6], 2006/66/EC on batteries and accumulators and on waste of batteries and accumulators[7], WEEE 2012/19/EU on waste of electrical and electronic equipment[8].

In order to increase the economic, social and environmental benefits resulting from more efficient waste management, the EU Commission proposes[9]:

- to increase the reuse and recycling of municipal waste to 70% by 2030;
- increase the recycling of packaging waste to 80% by 2030, with interim targets of 60% by 2020 and 70% by 2025;
- ban the dumping of recyclable plastics, metals, glass, paper and cardboard, and biodegradable waste by 2025, and EU member states should strive to virtually eliminate landfills by 2030;
- to promote the further development of markets for high-quality secondary raw materials.

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Part 2

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The circular economy is a model of economic activity that focuses on minimising waste and maximising the impact of the use of production resources. According to the World Economic Forum, 'a circular economy is an industrial system that is restorative or regenerative in intent and design. It replaces the concept of 'end of life' with recovery, moves towards renewable energy, eliminates the use of toxic chemicals that prevent reuse, and aims to eliminate waste through improved design of materials, products, systems and business models'[1]. This model is based on the principles of sustainable development and is often contrasted with the traditional linear model of economic activity, which is based on the 'take, make, and dispose' model of resource use.

The term 'circular economy' was first introduced in 1990 in a book called 'The Economics of Natural Resources and the Environment', in which the authors emphasise that in the traditional economy and previous production systems there were no incentives for recycling. and at the time, producers viewed the environment mainly as a place to dump waste and pollutants from production[2]. The basic principles of the circular economy are as follows: waste is a resource; diversity is an advantage; energy used should come from renewable sources; management should be based on systems thinking; prices and feedback mechanisms should reflect real costs.

The circular economy has a high potential to make a significant contribution to the achievement of the Sustainable Development Goals (SDGs) set by the United Nations (UN), which aim to end poverty, protect the planet, and ensure peace and prosperity for all. According to experts, the 'circular economy' ensures the future development of humanity, in which economic growth will be decoupled from resource constraints and negative environmental impact[3].

Thus, important practical actions through which the circular economy can contribute to the SDGs are the reduction of waste and pollution. According to the European Environment Agency, 'the circular economy aims to minimise the environmental impact of economic activities by closing the loop of resource use. It seeks to maintain products, components and materials at their highest utility and value

at all times, thus eliminating waste and minimising the use of natural resources'[4]. Through the reuse and recycling of resources, the circular economy helps to reduce the amount of waste generated and pollution released into the environment. This can have a positive impact on the goal of sustainable cities and communities, as well as the pursuit of responsible consumption and production (SDGs 11 and 12).

In addition to reducing waste and pollution, the circular economy can contribute to economic growth and development. According to the World Business Council for Sustainable Development, 'the circular economy can stimulate innovation, create new business opportunities and jobs, and contribute to the competitiveness of companies and regions. It can also increase resource productivity, reduce costs and increase sustainability'[5]. By creating new business opportunities and jobs, the circular economy can contribute to the goal of decent work and economic growth (SDG 8). The circular economy can also promote innovation and technological development by supporting industrial design, innovation and infrastructure (SDG 9). For example, the circular economy can support the development of small and medium-sized enterprises, which can help build more inclusive and diverse economic systems[6].

The circular economy can also promote resource efficiency and the use of renewable resources. According to the United Nations Environment Programme, 'the circular economy can increase resource productivity and reduce demand for primary resources, as well as reduce greenhouse gas emissions and improve energy security. It can also help to reduce the economy's vulnerability to fluctuations in resource prices and supply. risks'[7] By creating new business opportunities and jobs, the circular economy can contribute to the goal of decent work and economic growth (SDG 8). The circular economy can also promote innovation and technological development by supporting industrial design, innovation and infrastructure (SDG 9).

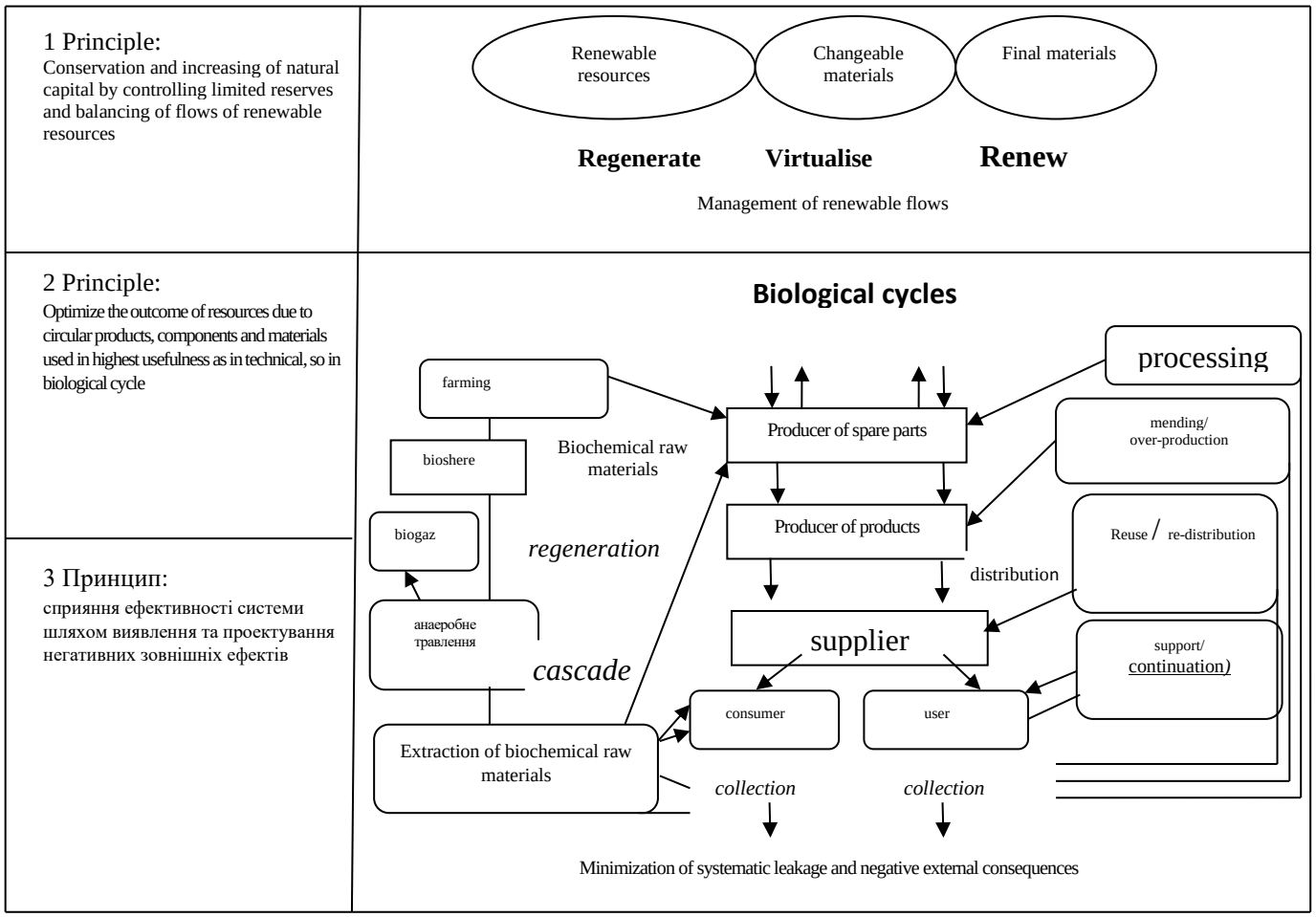
Clearly, by using resources more efficiently, the circular economy will contribute to reducing the demand for non-renewable resources and using renewable resources. This can contribute to the goal of ensuring access to affordable, reliable and modern energy for all (SDG 7) and the climate change goal (SDG 13).

From the perspective of efficient use of resources, one example of the benefits of the circular economy is the cradle-to-cradle design approach developed by the German company MBDC. This approach is based on the principles of the circular economy and aims to develop products that can be continuously reused and recycled rather than disposed of at the end of their service life. In line with the Cradle to Cradle approach, MBDC has successfully reduced the use of non-renewable resources and increased renewable resources, while reducing waste and pollution[8].

The implementation of the circular economy concept is based on the so-called 3Rs (recycle, reuse, reduce) (Fig. 1). For example, reduction means that it is possible to reduce resource consumption and at the same time increase production efficiency. The restriction concerns three aspects, i.e: 1) reducing the consumption of raw materials and energy; 2) reducing the number of products that most people do not need; 3) reducing demand while maintaining the current quality of life[9]. Recycling means that waste can be transformed for further use, and reuse means that processed materials can become an input in further production processes[10]. Reuse has three aspects: 1) it takes into account multifunctional goods; 2) it takes into account waste as a raw material in the production process; 3) it provides for the possibility of replacing renewable and non-renewable resources.

We believe that the implementation of circular economy principles and approaches in the practical activities of agricultural enterprises requires: 1) implementation of sustainable business models; 2) adoption of ecodesign practices; 3) creation and implementation of environmental innovations.

Concept of circular economy



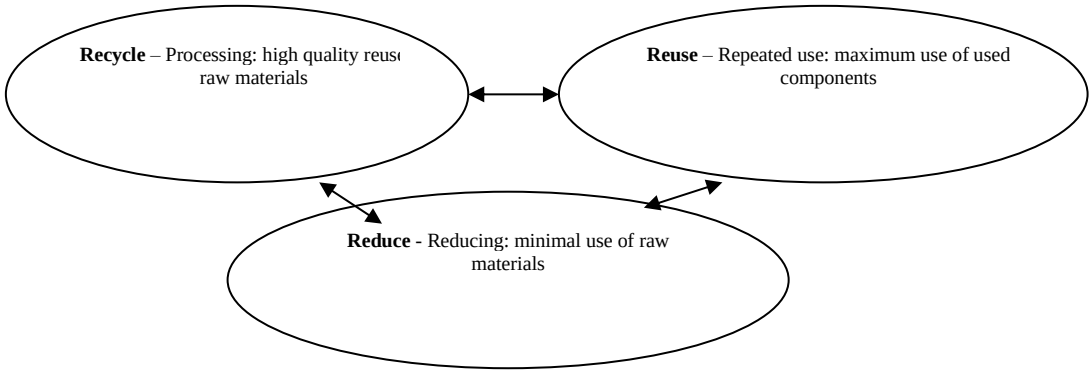


Fig. 6.2. **3R-scheme of the realization of the circular economy concept**
Source: [11]

The circular economy is based on the implementation of green business models that promote the rational use of resources and reduce dependence on critical resources. It is clear that reducing the dependence of agricultural enterprises on critical resources can provide them with not only a strategic advantage, but also ensure their sustainability. The development of green business models involves promoting new forms of consumption that involve the use of renewable energy sources, reducing the overall energy intensity of products and services, minimising product waste by selecting appropriate materials and services.

The development of sustainable business models is linked to eco-design as well as to reverse supply chains. Ecodesign means designing products with minimal waste generation at the production stage and the lowest environmental impact. However, when assessing the potential negative environmental impact of these products, it is advisable to take into account their lifecycle impact. For example, the use of raw materials that emit fewer harmful substances during the production process, but at the stage of processing or reuse, the opposite trend may be observed – an increased negative impact on the environment.

New and greener solutions (i.e. eco-innovation) encompasses all types of innovation aimed at achieving sustainable development goals through reducing environmental impact or using natural resources more efficiently. The theory of eco-innovation suggests that environmental problems can be solved through technological and organisational innovations. Technological innovations include, for example, limiting emissions of harmful substances from technological production or innovative processing technologies that avoid the generation of excessive amounts of waste, while organisational innovations include the creation of an effective internal environmental management system at agricultural enterprises.

Thus, the circular economy has the potential to make a significant contribution to achieving sustainable development goals through the efficient use of production resources, reduction of waste and pollution, and economic growth. Today, the scientific literature defines the circular economy as ‘an economic system in which the concept of the product life cycle is replaced by the concept of 4Rs (reduce, reuse, recycle and recover) of materials in all production, distribution and consumption processes’. Obviously, to ensure the implementation of the principles of sustainable development, this system should be implemented at all levels of the economy, i.e. at the micro level (producer, product, consumer), meso level (e.g. city, region, industry) and macro level (state and above).

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6.4. Environmental innovations in green growth strategies

Part 1

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The global financial crisis has vividly demonstrated the instability of the modern financial and economic system and has set the world community with particular urgency the task of finding an alternative model for achieving economic growth, taking into account environmental safety factors.

The concept of "Green Growth", first presented in 2005 in Seoul at the 5th Conference of Ministers of Environmental Protection of the Asia-Pacific region, is one of the approaches that ensure a balance of ecological and economic development.

The concept of "Green Growth" is based on the use of four principles:

- the principle of eco-efficiency, which involves maximizing the beneficial properties of goods and services while minimizing the environmental impact throughout the life cycle of products;
- the principle of resource conservation involves making management decisions taking into account the need to conserve natural resources;
- the principle of unity presupposes the coordination of actions of all subjects of the national economy involved in the development process;
- the principle of intersectorality means the involvement of representatives of various sectors of society in the decision-making process.

The use of these principles allows us to conclude that the concept of "Green Growth" acts as the first stage of transition to sustainable development at both the country and global levels.

According to the Concept of "Green Growth", these principles are integrated into the process of strategic planning for the development of national economies through the following mechanisms:

- reforming the system of budgetary relations through the introduction of environmental taxes;
- implementation of sustainable production and consumption models;
- development of "green business";
- the formation of a sustainable infrastructure.

The implementation of the first mechanism – reforming the system of budgetary relations through the introduction of environmental taxes – allows shifting the tax burden from traditional activities to industries that pollute the environment. This measure, which affects the interests of all participants in economic relations from consumers to public institutions, will minimize the burden on the environment and at the same time ensure economic growth in the parameters provided for in the strategic plan.

The main purpose of the introduction of eco-taxes is the redistribution of the tax burden from socially significant activities (for example, employment of the population) to activities harmful to the environment. In addition, the redistribution of budget funds to increase investments in the development of environmentally friendly activities, for example, in improving transport infrastructure and developing public transport to reduce pollution in the air basin of large cities, is also one of the measures to reform the tax system. The goal is not to increase the tax burden, but to take effective and efficient measures to protect the environment and preserve natural capital for future generations.

Eco-taxes are the most effective tool for creating an effective, socially and environmentally oriented fiscal system, the main principles of which are the internalization of production costs and an even distribution of income. Thus, the introduction of eco-taxes does not increase the overall tax burden, but contributes to its redistribution within society and at the same time reduces environmental damage to nature.

The next mechanism for implementing the principles of "green growth" is the formation of models of sustainable production and consumption. As you know, production and consumption methods are the main engines of any type of economy and, accordingly, actually determine the quality of economic growth. The development of regulatory frameworks and standards, and the increase in prices for raw materials, may lead to producers' interest in a cleaner, environmentally sustainable production process.

This area of "green growth" includes tools such as environmentally friendly public procurement; assessment of the life cycle of goods and demand-based management that takes into account trends in sustainable consumption; stimulating sustainable use of resources and increasing interest in clean production through reuse and waste disposal.
This mechanism of "green growth" is closely linked to the development of "green business", which is focused on the sustainable use of renewable natural resources, the production of environmentally friendly products, the use of low-waste and resource-saving technologies. As a rule, companies implementing the policy of "green business" have a positive image on world markets, their products are highly innovative and, accordingly, competitive.

The development of green business is also facilitated by various forms of public-private partnerships, including environmental partnerships, which are currently developing rapidly and are supported by private and public institutions such as banks, insurance companies, etc. This initiative of the governments is supported by the population, as it contributes not only to poverty reduction, but also to environmental protection.

In the Asia-Pacific countries, business sustainable strategies are developing mainly due to pressure from governments, the need to meet corporate interests and the increasing need of the population, including consumers, non-governmental organizations, etc., for information about the activities of companies.

Reference

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Today, the definition of a green economy has become widely discussed in both scientific and practical terms, primarily due to the serious environmental problems caused by human economic activity. The term ‘green’ economy was first used in 1989 in a report by a group of scientists prepared for the United Kingdom of Great Britain and Northern Ireland. After the global financial and economic crisis of 2008-2009. UNEP published the Green Development Report, which became a driver for the development of the green development concept. and in 2009, 34 OECD countries adopted a strategy for environmentally oriented (green) development as a tool for overcoming the consequences of the financial and economic crisis in the medium term (until 2030) and long term (until 2050). Today, both developed and developing countries are gradually shifting or setting themselves the task of shifting to a green economy strategy.

It should be noted that the definition of a ‘green’ economy is interpreted as an economic activity that contributes to improving human well-being and ensuring social justice, while significantly reducing environmental risks to the environment and the impoverishment of nature on the planet[1]. Summarising the existing approaches to the interpretation of the concept of ‘green’ economy, we can conclude that it is an economy that ensures the rational use and reproduction of natural resources, the increase of natural capital, the use of alternative energy and renewable energy sources in order to improve the quality of life of people.

In the context of the actualisation of the concepts of sustainable development, circular and green economy, there are growing demands on business structures to ensure not only economic, but also

social and environmental responsibility, which can be realised through the introduction of eco-innovations. These issues are also relevant to agribusiness companies, as they are engaged in the production of agricultural products, their processing and delivery of finished agri-food products to end consumers, i.e. they carry out activities that are highly dependent on the natural environment. Business processes in agri-food systems result in direct and indirect environmental impacts, which necessitate the introduction of eco-innovations. Agribusinesses that introduce environmentally responsible innovations, such as those that help reduce water pollution, soil degradation or biodiversity loss, make a direct positive contribution to minimising climate change risks. Clearly, due to the close link between food production and natural resources, the transition to innovative ecosystems should be based on the introduction of environmentally friendly agricultural systems and practices. Likewise, processors and wholesale and retail organisations in the agri-food supply chain should strive to achieve high levels of energy and water efficiency to reduce the negative environmental impact of their operations.

The 'green' economy is based on 'green' technologies, which are based on eco-innovations, which are considered in the scientific literature as innovations that reduce the negative impact on the environment and are often presented as interchangeable concepts: 'green', "eco" and "ecological" innovations[2]. In the scientific literature, the concept of 'eco-innovation' first appeared in 1996 in the book 'Driving EcoInnovation: A Breakthrough Discipline for Innovation and Sustainability', where the concept of eco-innovati on is defined as products and processes that contribute to sustainable development[3]. We have summarised the approaches to the definition of the concept of 'eco-innovation', which allowed us to highlight the following: '...these are new or changed processes, equipment, products, methods and management systems that allow avoiding or reducing harmful environmental impact'[4]; 'the creation of new competitively priced goods, services, processes, systems and procedures designed to meet human needs and ensure a better quality of life for everyone, achieved with minimal use of natural resources (raw materials, energy and land area) per unit of output and minimal emissions of toxic substances'[5]; '...it is the production, application or operation of a product, service, production process, organisational structure, management system or business method that is a new for the firm or user and that lead to a reduction in environmental risk, pollution and negative impacts of resource use (including energy use) throughout their life cycle compared to relevant alternatives'[6] [p.8].

It should be noted that a distinction is made between technological and non-technological eco-innovations. The first group includes ecological products and business processes of ecological production, and the second group includes management, marketing and business methods that reduce the negative impact of any company's activities on the environment[7].

Fig. 6.3 systematises the factors driving the development of environmental innovations in modern conditions.

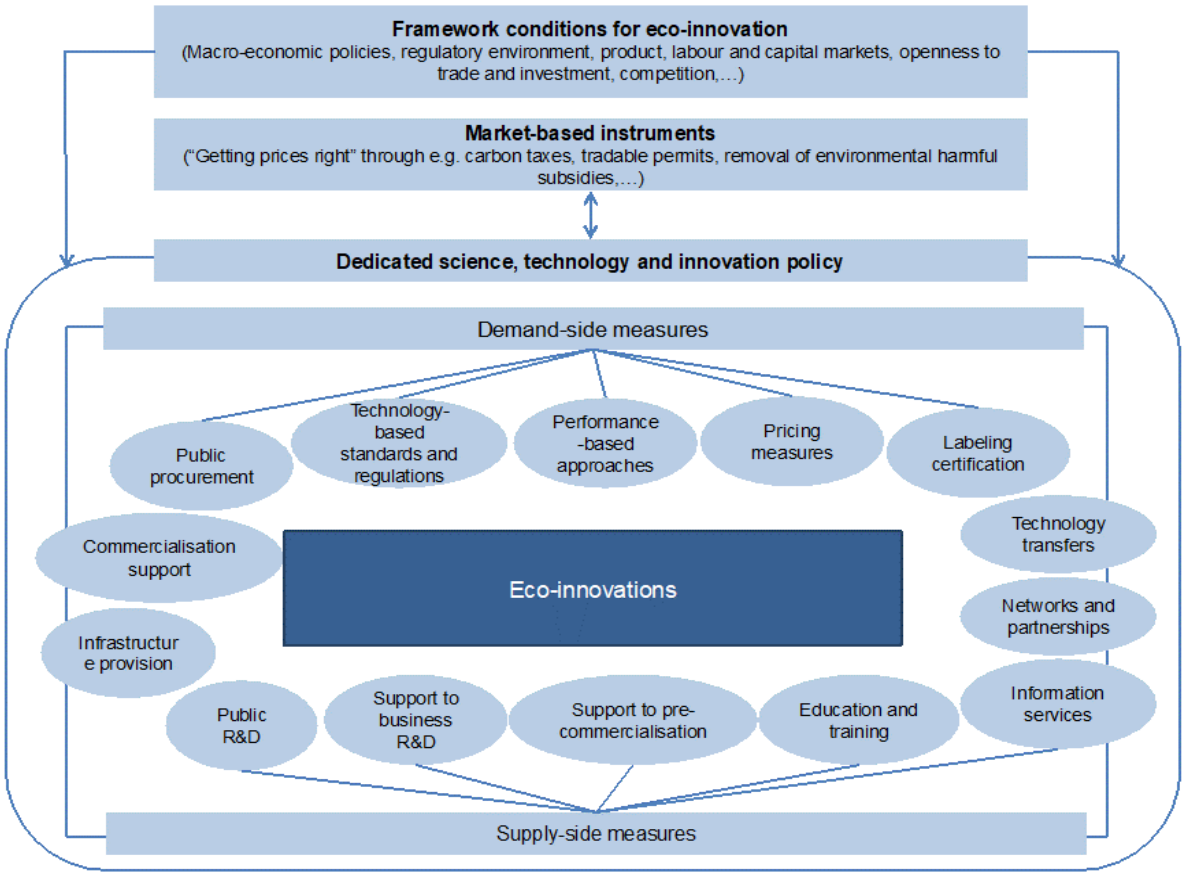

Fig. 6.3. **Driver impacting the development of eco-innovations**
Source: [8].

It is obvious that intensification of the processes of development and dissemination of systemic eco-innovations at the country level requires creation of favourable conditions through the use of market instruments of regulation and development of specialised fields of science, development and commercialisation of technologies, as well as environmentally oriented innovation policy. The following market instruments can be used to boost the development of eco-innovation: 'green' taxes, green bonds, special permits, state support, etc. Obviously, the impact of instruments that promote the development of environmental innovations should be considered from the demand side – regulatory instruments and standards, public procurement and demand support, technology transfer, and supply-side measures – research and development, education and training, networks and partnerships, innovation infrastructure.

In the scientific literature, the following types of eco-innovations are distinguished: ecological technologies, eco-efficient innovations, and systemic innovations. The common feature of these groups of eco-innovations is that they help to reduce the burden on the environment on the part of business entities. Eco-innovations lead to the development and adoption of complex solutions

aimed at reducing the consumption of resources and energy, while simultaneously improving the quality of products and services.

A more detailed description of ecological technologies can be found in the source[9], where product, process and organizational eco-innovations are presented, but marketing ones are not highlighted. In addition, the authors describe technological eco-innovations in more detail, namely:

- technologies that eliminate environmental pollution;
- technologies that ensure the avoidance of contamination in the environment;
- devices for cleaning technological processes: new production processes that pollute the environment less or use resources more efficiently than alternatives;
- equipment waste management;
- environmental monitoring and measuring devices;
- green energy technologies;
- water supply;
- noise vibration.

A noteworthy approach to the classification of eco-innovations was proposed by K. Rennings[10], it considers the following types:

- technological – include products and processes, in particular, reactive (additive) technologies, "end of the pipe" technologies, complex technologies of preventive measures and "clean technologies", the purpose of which is preventing the formation of pollution;
- social is considered as a consequence of compliance with sustainable consumption patterns by society (includes consumption habits, ecologically oriented purchasing behavior);
- organizational – the result of the introduction of new processes or management methods, "green" research works or in the field of eco-auditing are distinguished;
- institutional – include organizations operating at different geographical levels and areas, which in the decision-making process are oriented towards taking into account environmental aspects in the context of achieving the goals of sustainable development, informal groups, cooperation platforms, unions, created for the solution of ecological problems.

Numerous leading companies in the world present successful examples of the implementation of eco-innovations. For example, the Michelin company, whose environmental innovation concerns the management of used tires, namely it maintains control over the tires throughout their period of use, collects them at the end of the rental period and extends their technical life (for example, by retreading) and ensures proper reintegration into cascade of materials at the end of life[11]. Consequently, the reuse and resale of a product at the end of its life is one of the highest levels in the circular economy waste hierarchy.

Caterpillar's recycling model is another example of environmental innovation. This company established a restoration division in 1972. In the first decade of the 21st century, its growth rate was 8-10% higher than the level of the world economy as a whole. In 2010, the company's "recycled parts portfolio" was 70,000 tons, compared to 45,000 tons in 2005[12].

A silicon-based solar panel is another example of eco-innovation that supports the concept of a circular economy. A solar panel with a charger and the Internet is an environmentally friendly product designed for use in both domestic and industrial environments. Built-in photovoltaic panels allow you to harvest energy from the sun to power Wi-Fi access points, seat heating, power LCD displays, LED lighting, or monitoring[13].

Therefore, the transition to sustainable development involves the use of "green" development strategies and the transition to a bioeconomy, which will reduce environmental risks, develop the economy in harmony with nature, improve the quality of life of the population, and preserve our planet for future generations.

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Case study

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Innovative program of the vertically integrated holding company Myronivsky Hliboproduct: Biogas 5.0 for carbon-neutral production

MHP's goal is to achieve carbon neutrality by 2030, which means that quality goods can and should be produced without harming the environment.

MHP is a Ukrainian vertically integrated holding company, the largest producer and exporter of chicken in Ukraine. The company specializes in the production of chicken and grain, as well as other agricultural activities (production of meat and sausage products and ready-to-eat meat products). MHP's website: https://mhp.com.ua/uk/pro-kompaniiu
This activity envisages the transformation of agriculture: a strategy for the sustainable use of chemicals and reduction of CO2 emissions. The following activities are envisaged within the framework:

- Rural transformation;
- Modernization and changes in approaches to work in agricultural enterprises;
- Package of climate laws;
- Development of bioenergy, renewable energy and eco-products.

It is known that the European Green Deal includes the implementation of biogas and biomethane projects in agriculture as an important area.

For reference: **biogas** is a technology that converts organic waste into clean energy and organic fertilizers.

Biogas technologies are dynamically developing globally, and their development makes a significant contribution to the country's environmental and energy security. The biogas sector has the potential to reduce greenhouse gas emissions.

Ukraine, with its strong agricultural sector and raw material base, has significant prerequisites for the development of biogas technologies, and MHP, a vertically integrated holding company, is an innovative leader in this area.

MHP's biogas projects are a tool for decarbonizing production and achieving carbon neutrality.

The Ukrainian company MHP started implementing biogas projects long before the presentation of the EU's European Green Deal. Since 2013, MHP has been operating the biogas complex of Oril-Leader PJSC in Dnipropetrovs'k region. The installed energy capacity is 5.5 MW.

In December 2019, the vertically integrated MHP holding put into operation the first stage of the biogas complex "Biogaz Ladyzhyn" with an installed power capacity of 12 MW.

The facility is located near the town of Ladyzhyn, in the village of Vasylivka, Tulchyn district, Vinnytsia region. Only the first stage can provide electricity at the household level to all residents of the Tulchyn and Haysyn districts of the Vinnytsia region. And on an industrial scale, the energy produced should be enough to provide electricity for about 40% of the capacities of the agro-industrial sector of the MHP.

Fig. 1. **Biogas complex of MHP "Biogaz Ladyzhyn"**

A number of powerful German and Ukrainian companies and manufacturers participated in the implementation of the Biogas Ladyzhyn MHP project.

In particular, among German companies are: Wolfsystem, Ellman Engineering, ABB Germany, Siemens, Caterpillar Germany and others. The effective innovative cooperation of MHP, a number of Ukrainian and 10 German companies made it possible to design, build and bring to the planned energy capacity the unique European and global Biogas Ladyzhyn project.

Fig. 2. **Biogas complex of MHP "Oril-Leader"**

In recent years, the MHP company has implemented the concept of "Biogas 3.0" and is starting to implement "Biogas 5.0" technologies.

Biogas 5.0 is waste utilization + clean energy + organic fertilizers + reduction of greenhouse gas emissions + production of CO2 and biomethane + integration of "green" hydrogen technologies. The MHP company has a significant potential for biomethane production. At the existing capacities of biogas complexes, it is possible to produce about 40 million cubic meters per year of biomethane based on the company's organic waste, the volume can be about 100 million cubic meters per year, and based on organic waste with the integration of "green" hydrogen – 150 million cubic meters per year.

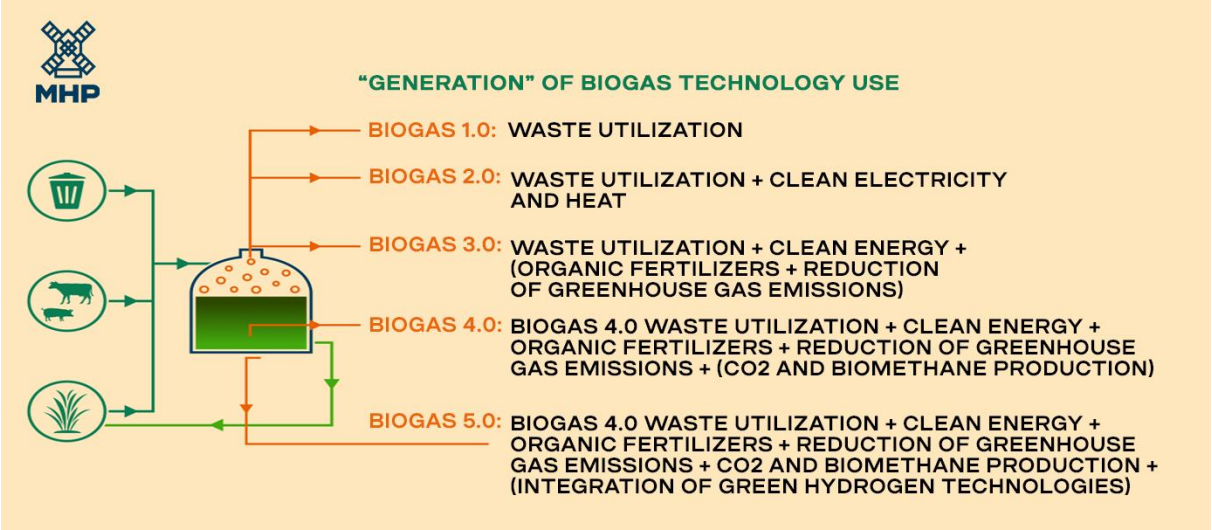

Fig. 3. **Evolution of generations of biogas technologies**

"Innovative program of the MHP: Biogas 5.0 for carbon-neutral production" includes the following elements – waste disposal, clean energy, organic fertilizers, reduction of greenhouse gas emissions, production of CO_2 and biomethane, as well as the integration of "green" hydrogen technologies.

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Chapter 7. Climate smart and sustainable agri-food systems

7.1 Systems from "farm to fork" to "industry to fork"

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Speaking about the systems “farm to fork” to “industry to fork” we mean food system. This term is generally employed in discussions about nutrition, meal production and consumption, health, economic development, and agriculture. Food system can be described as adaptive system exhibiting complex dynamics and oriented to feed the world growing population), including both the inputs needed (e.g., natural resources) and outputs generated (e.g., innovations and sustainable solutions) within the food supply chain[1].

Our current food system, which is often focused on mass production, is a result of the industrial revolution that resulted a shift from self-relying people for food sources to counting on bigger food organizations and productions. But these processes intensified the need for resources and energy and the emission output of global food industries. So, in its attempt to provide a greater food access for the world’s population, the food industry slowly transitioned from a system of “farm to fork” to ‘industry to fork”.

The system “farm to fork” means the passage of food from its origin through various stages of production, processing, distribution and reaching consumer. This system often involves smaller-scale, local production, prioritizing traditional, often more natural and sustainable methods, using shorter and more direct supply chains, focusing on freshness, sustainability and local sourcing.

The system “farm to fork” is considered as more sustainable and environmentally friendly. It is in the heart of the European “Green deal” – the set of political initiative launched by the European Commission with the purpose to make the European continent climatically neutral by 2050.

The Strategy “farm to fork” is a new comprehensive approach to the Europeans value food sustainability. It is an opportunity to improve lifestyles, health, and the environment. The creation of a favourable food environment that makes it easier to choose healthy and sustainable diets will benefit consumers’ health and quality of life, and reduce health-related costs for society[2].

This Strategy foresees four mains tasks for producers: 1) Agree on ambitious Common Agricultural Policy objectives to protect ecosystems, enhance biodiversity and create economic opportunities for farmers; 2) Define clear, ambitious and fair EU-wide standards for sustainable food systems to boost resilient and inclusive business models; 3) Incentivize all actors to pursue fairness for all approach and provide end-to-end transparency to show progress; 4) Guide consumers towards more sustainable and healthier diets[3].

The Common agricultural policy of the European Union 2023 – 2027 will be a key tool in reaching the ambitious of the strategy "farm to fork". This strategy includes different non-binding EU-level targets which are particularly relevant to the CAP and relate to the areas covered by its specific objectives, such as: reducing the risk and use of chemical pesticides by 50% (compared to 2015-2017); reducing nutrient losses from agriculture by 50%, while ensuring that there is no deterioration in soil fertility (compared to 2012-2014/2015); achieving a coverage of organic farming of at least 25% of total agricultural area (compared to 2018)[4].

According to the estimation of OECD and FAO the world population is expected to grow from 7.9 billion in 2022 to 8.6 billion people in 2032. This corresponds to an average annual growth rate of 0.8%, a slowdown compared to the 1.1% p.a. rate experienced over the last decade[5].

Naturally, the need to ensure access to food for the growing number of people in the world may mean fundamental shifts in agricultural production that exacerbated existing environmental and social problems. Thus, even now, according to some estimations, current food production methods lead to extensive use of fertile lands and freshwater, ocean acidification, high level of greenhouse gas (GHG) emissions, disruption of phosphorus and potassium cycles, and contribution to biodiversity loss[1].

There is a need to find a system that would be sustainable on the one hand, and on the other hand, ensure that sufficient food is available for the growing population. Therefore, the progressive transition from the system "farm to fork" to "industry to fork" could be considered as an alternative, especially in the urbanization conditions.

The system "industry to fork" represents a more modern and industrialized approach to food production. It involves larger-scale operations, advanced technologies, and sometimes more complex supply chains. This model might involve extensive processing, preservation methods, packaging, and distribution networks that may extend beyond local regions or even countries. It can prioritize efficiency, mass production, and longer shelf life, potentially sacrificing some aspects of freshness or direct sourcing.

Nevertheless, during last period this strategy tries to focuse on understanding, optimizing, and ensuring the quality, safety, and environmental impact of food production, processing, distribution, and consumption. Thus, it involves maintaining visibility and clarity across the entire food supply chain; emphasizes environmentally friendly and socially responsible practices throughout the food production chain, including reducing carbon emissions, minimizing waste, using renewable resources, supporting local farmers. It tries to ensure quality, safety and a high nutritive value of foodstuffs by implementing rigorous quality control measures, adhering to food safety standards, and conducting regular inspections at various stages of production and distribution. The sustainability and ethical practices in the industrial food production are supported by the policy and regulation. This can include labeling laws, certifications, incentives for sustainable practices, and penalties for non-compliance.

The use of technological advancements such as blockchain, IoT (Internet of Things), AI (Artificial Intelligence), and data analytics to track and monitor the food supply chain efficiently, ensuring transparency and accountability helps fortering trust, promoting consumption, and driving positive changes in the food system to create a more sustainable and secure future.

Governments, businesses, consumers, and various stakeholders play essential roles in implementing and supporting the "industry to fork" strategy to create a more transparent, sustainable, and resilient future.

Both models have their advantages and drawbacks, they can exist at the same time, and the choice between them can depend on various factors including consumer preferences, market demands, environmental considerations, and economic factors. There is also a growing movement to integrate aspects of both models, seeking a balance between efficiency and sustainability, which involves adopting some industrial practices while still emphasizing local, sustainable, and fresh food sources.

The transition from the strategy "from farm to fork" to the strategy "from industry to fork" represents a shift in focus and perspective within the food supply chain. It may occur by the following ways:

- increased industrialization involving a more comprehensive view that acknowledges the role of various industries and technologies in food production;
- integration of technologies ensuring technological advancements in agriculture, food processing, and distribution to improve efficiency and sustainability;
- supply chain optimization that encompasses not just the farming aspect but also processing, packaging, transportation, and retailing, aimed to reducing wastes, enhancing product quality, and ensuring food safety;
- consumer awareness and transparency ensured by labeling, providing information about the industrial processes used in bringing food from the source to plates;
- sustainability and environmental impact with the use of sustainable practices throughout the food production process reducing carbon footprints, minimizing water usage, and adopting eco-friendly packaging and transportation methods.

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7.2 Sustainability of agri-food systems: principles and peculiarities of its ensuring

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The aggravation of the geopolitical situation has become a serious challenge to the sustainable development of the agro–food system (hereinafter referred to as APS). New risks related to: disruptions in food supply chains; the vulnerability of small forms of agribusiness, including the self-employed; trade restrictions and problems in transport and logistics infrastructure; an increasing burden on budgets at all levels; the transformation of food demand due to a reduction in real incomes and exacerbation of social problems. This requires the search for new opportunities to increase the adaptability and transformability of the APS, i.e. the ability to change the combination of available resources without negative consequences in changing the current system architecture. Sustainable development of agri-food systems is possible only if rural development is more inclusive. Inclusivity will minimize the consequences of uneven APS development and provide hidden reserves of economic growth to achieve sustainable development goals.

The development of agri-food systems plays an important role in improving food security and nutrition of the population due to several factors. Firstly, by increasing the production of a variety of food products. And this is the main driving force of economic transformations in the agricultural sector. Secondly, agriculture is the main source of income for a significant number of people. There are 1.3 billion people working in this sector of the economy in the world.

To improve food security, both the development of agriculture and the growth of the economy as a whole are necessary. But not only that. The principle of inclusivity is required, i.e. the development of the rural economy by creating equal conditions for investment and expanding productive employment in rural areas. Moreover, all these factors are complementary.

The problem of food security is again very acute. It has a global character. Pandemic factors and the Russian–Ukrainian and Israeli-Palestinian conflict have been added to the well-known causes of the disruption of the sustainability of agri-food systems, the so-called "triple burden" of malnutrition – the continuing significant food shortages in the world, malnutrition and overeating, environmental problems. Food chains have been disrupted, which further distances humanity from the most important goal of development – the elimination of hunger.

The sustainability of the agri–food system is, first of all, the reproduction of the system itself, in its development and adaptation to changing external and internal conditions. It is sustainability that is the most important characteristic of any system as a viable education. Theoretically, the management of an economic system is not possible without knowing the patterns of its development, namely stable, intra-system forces and connections that follow from the inertia properties of the system itself.

The problem of sustainability of agricultural production is more complex and important for humanity than other sectors of the economy.
Firstly, because agriculture is the main source of life support for people. Any violations in its development lead to destabilization and imbalances in production and consumption.

Structural changes in the economy are aimed primarily at the production of products that ensure maximum profit, and in the agricultural sector this is not always justified precisely from the standpoint of ensuring food security.

Secondly, the market forces producers to change production volumes and specialization of farms in conditions of fierce competition. However, the global market environment often changes much faster than agricultural producers can respond to it without financial and other negative consequences, which leads, as a result, to a decrease in production sustainability and social problems.

Thirdly, despite the scientific-technical progress (STP), the biological nature of the main production processes continues to be the main factor in maintaining the instability of agricultural production, especially since the main scientifically based methods of control such as mechanization, land reclamation, chemicalization, etc., are impossible without serious financial investments, which are not always available not only to farmers, but also and the state.
Fourth, not the least factor in ensuring sustainability is the standard of living in rural areas, which also requires serious financial investments.

Fifth, the state is the guarantor of the sustainability of the reproduction process in the agro-industrial complex in "stressful" situations and structural target restructuring. The zero or inadequate regulatory function of the state exacerbates the effect of the above reasons, which is why economic losses from instability in the agro-industrial complex significantly exceed losses in other sectors of the economy.

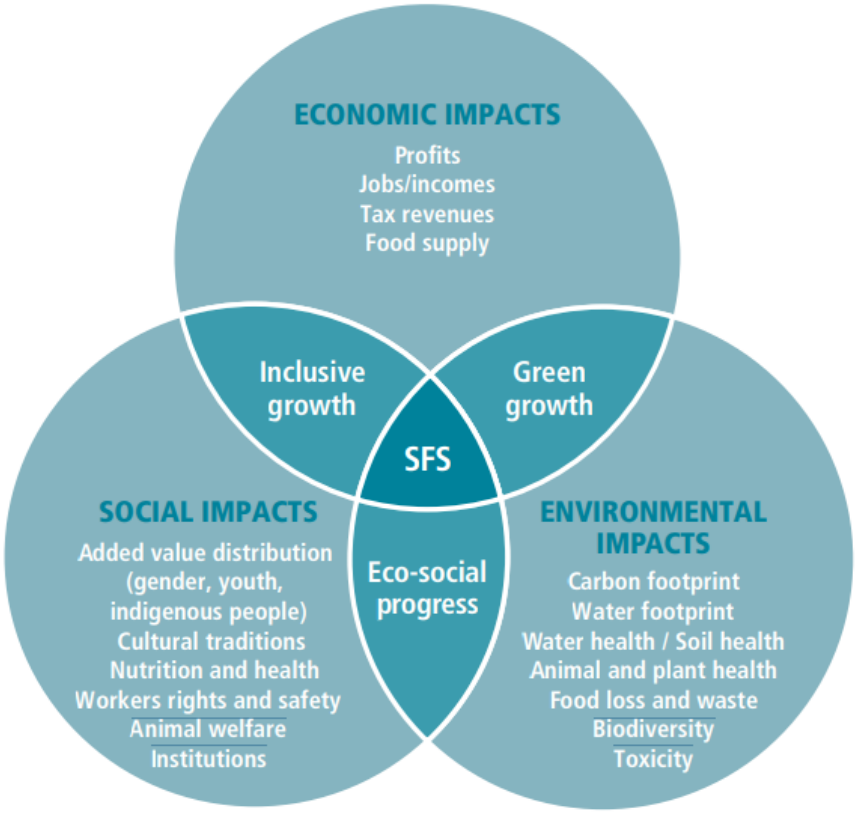
Sustainable socio-economic development of the agro-food complex means the ability to meet the needs of the country's population in their own food in the present, provided that future generations retain the ability to meet food needs at the expense of their own resources. This definition means that meeting the food needs of all social strata of the population, including the poorest, is one of the top priorities of the state's agri-food policy. At the same time, restrictions are taken into account due to the state of the non-renewable resource potential of the agro-food complex, technology and organization of production, which limit the capabilities of the agro-food complex as an essential element of the environment to meet the current and future needs of the population, ensure economic efficiency of production and increase in added value.

Achieving the goal of sustainable development of the agro-food complex requires solving technical, economic, financial, social, demographic, environmental, and foreign economic tasks that are interrelated and determine the content and structure of the long-term development strategy of the complex.

The sustainability of agro-food systems and their adaptation to the changed geopolitical conditions are possible only under the condition of inclusive development of rural areas, including equal conditions in terms of the development of each rural resident. The issues of balancing the development of social infrastructure, which has a significant impact on the processes taking place in the rural community, require close attention. The problems of matching the incomes of a significant part of rural residents to social services, differentiation of local budget expenditures on

the social sphere of activity, and finally the quality of social services. Their effective solution is possible only on the basis of an interdisciplinary approach to state regulation of rural development, spatial development of countries and regions.

In sustainable food system development, sustainability is examined holistically. In order to be sustainable, the development of the food system needs to generate positive value along three dimensions simultaneously: economic, social and environmental (Figure 1). On the economic dimension, a food system is considered sustainable if the activities conducted by each food system actor or support service provider are commercially or fiscally viable. The activities should generate benefits, or economic value-added, for all categories of stakeholders: wages for workers, taxes for governments, profits for enterprises, and food supply improvements for consumers. On the social dimension, a food system is considered sustainable when there is equity in the distribution of the economic valueadded, taking into account vulnerable groups categorized by gender, age, race and so on. Of fundamental importance, food system activities need to contribute to the advancement of important socio-cultural outcomes, such as nutrition and health, traditions, labour conditions, and animal welfare. On the environmental dimension, sustainability is determined by ensuring that the impacts of food system activities on the surrounding natural environment are neutral or positive, taking into consideration biodiversity, water, soil, animal and plant health, the carbon footprint, the water footprint, food loss and waste, and toxicity.



Source: Adapted from FAO, 2014.

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7.3 Innovations as a driver of sustainable agri-food systems

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Sustainability is a major challenge for the planet and its population. For food companies whose performance depends on their ability to innovate, the equation between the economy, society and the environment is often complex. To be economically viable, they have to sell products corresponding to their clients' demands. However, it is not always easy to understand and to satisfy consumers in order to provide them good, safe, nutritionally interesting, practical, quality products. The list of expectations can be long. Environmental concerns are also becoming increasingly important, they are, for example, pesticide-free, less plastic, organic products etc. This situation may require efforts on all fronts. The triple performance of developed products can be the result of three corporate objectives: maintaining the company's activities in line with its strategies, meeting consumers' expectations and considering environmental impact.

The European societies in the 18th and 19th centuries still suffered from food shortages (at least until the 1850s) that challenged the effectiveness of the institutions that governed agriculture, revealed the limitations of existing techniques, and called for progress in food production and distribution. Across Europe, the period was marked by the emergence of industry, profound political changes, an increase in scientific knowledge, population and urban growth, etc. Technical changes brought about a slow agricultural revolution, differentiated according to regions and sectors, closely linked to the growth of industry and trade (Vanderpotten, 2001).

The changes mainly concerned tools (ploughs, scythes, etc.), application of lime and fertilizer, drainage and irrigation, selective breeding of livestock, new crops and rotations, mechanization and motorization (threshing machines, traction engines, followed by tractors). Although mechanization of labour began in the 1850s, tractors started to be used for ploughing only much later because of the fragmentation of farms.

This process spanned several centuries, with specific geographical variations. It was concurrent with the beginning of industry, which gradually absorbed the workforce no longer required by agriculture and which, in return, provided new technical objects for transport, mechanization and,

progressively, fertilization and crop protection. The desire to increase the productivity of agricultural labour through scientific and technical progress kept growing[3].

Actually, the agri-food system all over the world is also under strong pressure due to climate change, unsustainable agricultural practices, changes in dietary habits and growing urbanization. To deal with such crisis, technological innovation is crucial. A major policy approach that the EU implemented to boost sustainable development through Multi-stakeholder Partnership is the Smart Specialization Strategy. The core idea of such strategy is that a limited number of promising priorities has to be selected to stimulate regional growth, job creation and collaboration among research and knowledge institutions, business and investors[2].

The companies working in agri-food sector need to learn from a large number of subjects, co-creating and sharing knowledge with them if they want to innovate efficiently[1]. Innovations in the food ecosystem can range from food technologies, food biochemistry, to agricultural process, and production strategies. So, they can be considered as an essential element to facilitate the transition of the food ecosystem to the sustainability.

The agri-food sector is considered as a slow-growing industry where innovations mainly come from existing knowledge and usually lead to small improvement of existing products, processes and services. But now we can constat that innovations aimed at the sustainability in the food industry “tend to depend on individual member contribution, the interaction between them, and their existing collective knowledge that is distributed through exchanges in formal and informal networks[1]. That is called a food ecosystem.

Companies must innovate to remain competitive in a highly competitive market. New product development are often presented in two ways. The first is "market pull", meaning that innovation is driven by market demand. The second approach is the "technology-push" approach, which means that innovation is driven by technological discoveries, such as new components computers. Another 'need seeker' approach, which consists of seeking to respond to the unexpressed or future expectations of consumers, has existed since the 80s[5].

In 2011 OECD identified a number of science and technology policy instruments for a green growth strategy in agriculture, including public research to promote eco-efficient agriculture (including organic farming), research and development of agricultural biotechnologies, alternative farming systems and related training. New agricultural technologies can help to increase production and can be used to improve practices that benefit sustainability and food security for current and future generations.

Nevertheless, questions related to the safety of these new technologies and their ability to solve the problems of poverty, malnutrition and biodiversity loss, remain. For example, modern biotechnology can bring about rapid changes in plants and animals. In this respect, we still do not fully understand the possible effects of genetic engineering on the target organism, environment and future generations.

Innovation is the result of a high level of investment, with greater corporate concentration and patent protection, exacerbating inequalities while monocultures dominate the agricultural landscape. The role of the public sector is limited to updating regulatory frameworks, the applicability of which is constantly being put under doubt by new genetic improvement techniques. Nanotechnologies aimed at reducing demand for raw materials and manufacturing costs, synthetic biology aimed at reducing inputs based on fossil fuels, and geo-engineering aimed at capturing greenhouse gases affect every aspect of the food system, from production, processing, packaging, transport and shelf life to bioavailability. The health impact of nanoparticles in food and feed is a major public concern; plants genetically modified to resist herbicides promise a reduction in input requirements, but this promise is constantly being called into question by new products (genetic modification) that perpetuate quick fixes that don't last.

The ideal scenarios are proposed by some others. One of them is the implementation of an international information and technology assessment mechanism, based on the precautionary principle, to strengthen the capacity of stakeholders to assess the health, environmental, economic and social impacts of new and emerging technologies, such as biotechnology, nanotechnology, synthetic biology and geo-engineering. Appropriate technological development to serve producers in the food supply chain is taking place as populations become more urbanised. In particular, long-awaited enhanced agro-ecological strategies, combined with improved labour-saving equipment running on renewable energy (50% by 2050 and increasing to 100%), are being developed. Recycling is becoming the main form of raw material supply, leading to a reduction in the use of natural resources and greenhouse gas emissions[4].

Also, this scenario proposes the additional solutions. International policy makers are bridging the current gap between food security, agriculture, environment and climate policy by establishing innovative and authoritative mechanisms. The integrated implementation of the Sustainable

Development Goals, through the review of national efforts and thematic reviews of selected topics, establishes a global mechanism that leaves no one behind and steers development paths towards sustainability. New institutions and innovative financing models complement the roles of the market and the state to jointly manage the agri-food system, with land and food both framed in ecological rather than economic terms. Public funds are dedicated to supporting the commons (stewardship of nature), with producers and consumers cooperating within the food chain. Research funds are allocated to regenerative and zero-waste agriculture. Finally, nations and peoples democratically determine their own food and agricultural policies[4].

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Case study

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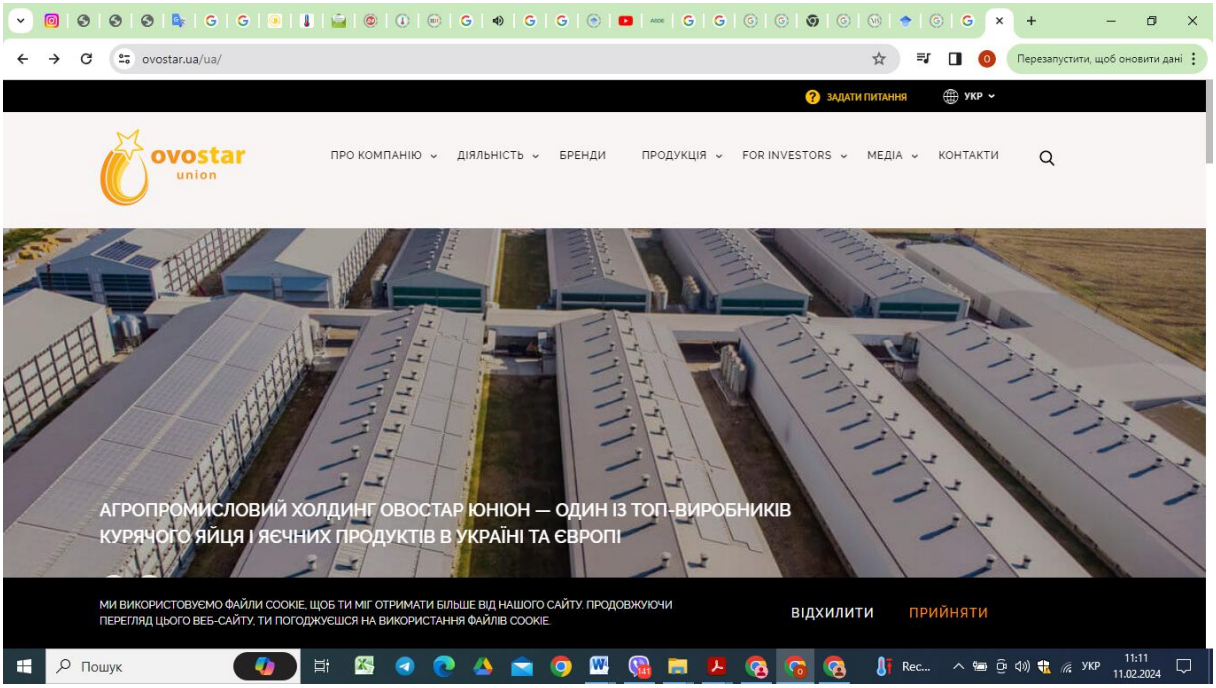
Let's consider the activities of Ovostar Union, an Ukrainian vertically integrated holding company, which focuses on the implementation of the principles of sustainable development, active implementation of innovative developments in business processes and covers the supply chain of eggs and egg products on the principle of 'from farm to fork'.
The society link: https://ovostar.ua/ua/



This is evidenced by the company's mission and values and development strategy. For example, the company's mission is to work and improve in order to produce high-quality, environmentally friendly and healthy food for the growing world population.

The main goal is to strengthen the company's position as a leading producer of high-quality branded products by further developing the Yasensvit and Ovostar brands and strengthening vertical integration.

The priorities of the company's strategic development are to achieve the following goals:

01 Sustainable development;
02 Transparency of food production;
03 Strengthening export positions, including opening production facilities abroad;
04 Increasing production efficiency;
05 Increasing the value of the group's shares;
06 Creation of new technologies and value-added products.

Ovostar Union's values:

01 Primacy and sustainable development;
02 Quality and safety of products;
03 Innovation and leadership;
04 Impeccable service and customer support;
05 Partnership and customer focus;
06 Employee development and training.

Ovostar Union's vertically integrated production covers all processes from feed production to a wide distribution structure.

Feed mill, link https://ovostar.ua/ua/diyalnist/operatsiyna-struktura-hrupy. The feed needs of the company's own livestock are covered by two feed mills. The first, located in the village of Skibyn, was acquired in 2000. Additional capacity was created at the site in Krushynka village, Vasylkiv district, Kyiv region, in 2009. Both plants produce feed exclusively of plant origin. At the end of 2018, the combined capacity of the sites was 56 tonnes of feed per hour.

Ovostar Union owns an oil mill for the production of vegetable feed additives. The diet of their chicken contains no substances of animal origin and no synthetic additives.

Parent herd. As of the end of 2018, the number of Ovostar Union's parent flocks was 80 thousand. This provides more than 10 million eggs for further incubation annually. The site for keeping the parent flock is located in Romashky village, Kaharlyk district, Kyiv region.

Hatchery. Ovostar Union acquired its own hatchery in Kaharlyk in 2000. The hatchery has a capacity of 5 million birds and produces 10 million eggs per year.

A farm for growing young stock. The production capacity of the two farms for rearing young poultry is 1.8 million. Ovostar Union produces only one poultry cross, Hy-Line W-36.

Poultry farms. The Ovostar Union group of companies includes two poultry farms. The Yasensvit poultry farm is located in the village of Krusynka, Vasylkiv district, and the Stavyshchenska poultry farm is located in the village of Stavyshche (both in Kyiv region). In 2018, Ovostar Union's poultry farms produced 1.6 billion eggs and had 6.4 million laying hens. In 2017, the poultry farms received permission to sell their products in the EU and annually confirm their systematic quality management through audits by the European Commission's certification body and Bureau Veritas.

The plant for the production of egg products. The Ovostar egg processing plant ranks first in Ukraine in the production of liquid and second in the production of dry egg products. It is a modern facility that meets international hygiene and food safety standards. Regulatory authorities regularly inspect the production sites, which is confirmed by the relevant certificates and protocols. The plant has been authorised to sell its products in the EU and has been audited by the European Commission's certifying body and Bureau Veritas. The production facility is located near the poultry farms of the Ovostar Union group of companies, which allows fresh eggs to be delivered to the plant immediately after a thorough quality check.

Trading and distribution company. In Ukraine, the company's products are sold under "YASENSVIT"(table eggs) and "OVOSTAR" (liquid and dry egg products) brands. In addition, a large part of the national Private Label market is made up of eggs produced at Ovostar Union poultry farms. The company supplies its products to all national grocery chains, as well as to a wide range of local retailers and wholesalers, which allows Ukrainian consumers to buy products in their nearest store.

More than a third of the Group's products are exported to 55 countries, including the EU, the Middle East, Southeast Asia and Africa. The company has two sales offices in Latvia and the UAE to ensure efficient operations in export markets.

Ovostar Union is one of the top 5 egg producers in Europe. In 2018, the company's poultry farms produced 1.6 billion eggs, and the number of laying hens totalled 6.4 million. The freshness and naturalness of eggs have always been the company's advantages. It takes less than 24 hours from the moment an egg is collected to its further distribution through sales channels. They put a three-digit internal quality code on each egg to guarantee the freshness and safety of the product. The eggs comply with Ukrainian and international quality certificates ISO 9001:2015 and ISO 22000:2005 (HACCP), so they are safe even for children's diets. The hens that lay them consume exclusively vegetable feed produced by "YASENSVIT".

Egg products are a safe and high-quality product that retains all the nutritional and functional properties of eggs. Packaging of various volumes from 1 litre to 1 tonne makes the product convenient for a wide range of consumers. Ovostar Union produces dry and liquid products, separated products and mixtures, chilled and frozen. Continuous investment in the development of production facilities allows the company to customise its finished products to meet unique customer specifications. Additionally, the company offers caterers eggs after special processing: washing and disinfection, followed by the application of white edible oil wax to the shell to preserve the natural coating.

Benefits of eggs and egg products:

01 Cost-effective solution with all the functional and taste properties of eggs;

02 Convenience of transportation, storage and use;

03 No waste, if only white or yolk is required in production;

04 Shelf life – up to 15 months for frozen and up to 24 months for dry egg products;

05 Affordable price due to vertical integration and close proximity of all production facilities.

Quality and safety certificates can be found at https://ovostar.ua/ua/produktsiya/yaytse/, https://ovostar.ua/ua/produktsiya/yayechni-produkty/

Chapter 8. Management of innovations in the field of knowledge-intensive technologies

8.1 Foresight as a tool of technological forecasting

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Foresight is a look into the future. The term was first used by the famous English science fiction writer H.G. Wells in 1930. Speaking at the Air Force, he introduced a special speciality – 'Professor of Foresight' – to analyse and find applications for future technological discoveries[1].

In process of foresight ideas spreading, its tasks and goals became more diverse. We can distinguish three stages at which the goals of foresight have changed (Figure 8.1):

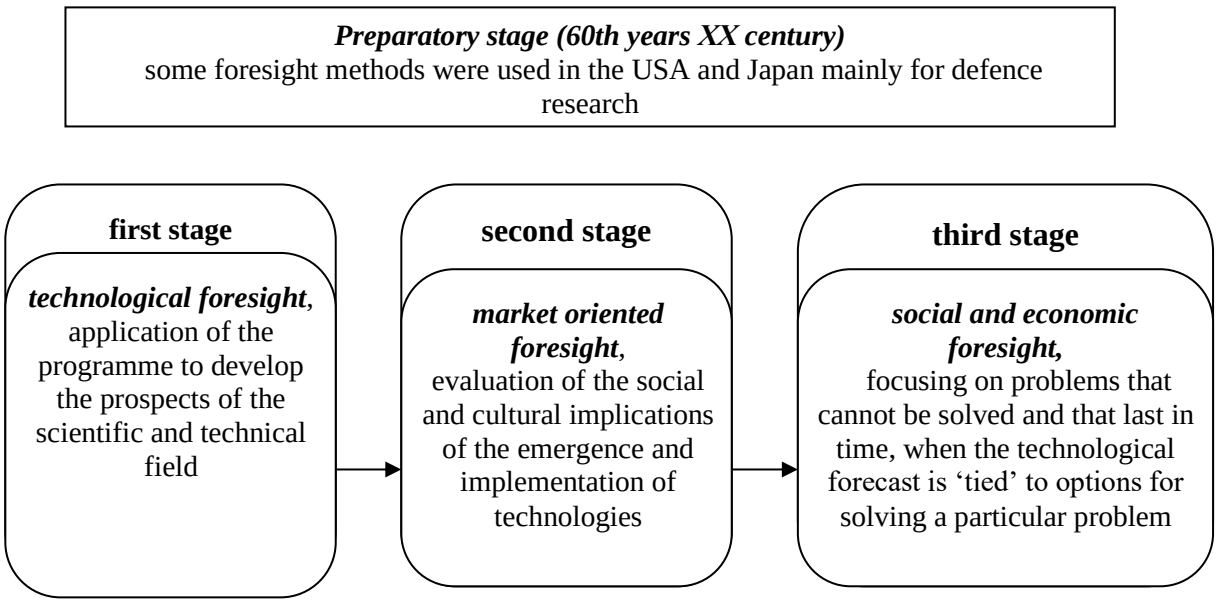

Fig. 8.1. **Evolution of foresight goals**
Source: Developed by the author

The stages of the foresight concept have evolved along with the development of states and changes in social structures. Today, it is transforming into the field of social, public and cultural relations. Foresight is a system of methods for expert assessment of strategic axes of socio-economic and innovative development, identification of technological breakthroughs that can affect the economy and society in the medium and long term.

Foresight is based on the following basic principles:

- Involvement of various social forces – business, scientific community, public authorities and civil society – in discussing and drawing up long-term forecasts and development strategies.
- Communication of participants.
- Concentration on the long term.
- Coordination: assessment of the development of science and technology is presented in connection with economic and social changes.
- Consensus: the need for coordinated work of business, scientific community, public authorities and civil society, which are trying to reach a consensus based on scenarios of society development developed by experts.
- Systematic process based on the structured thinking of experts.

Thus, foresight has four key elements (Figure 8.2.)

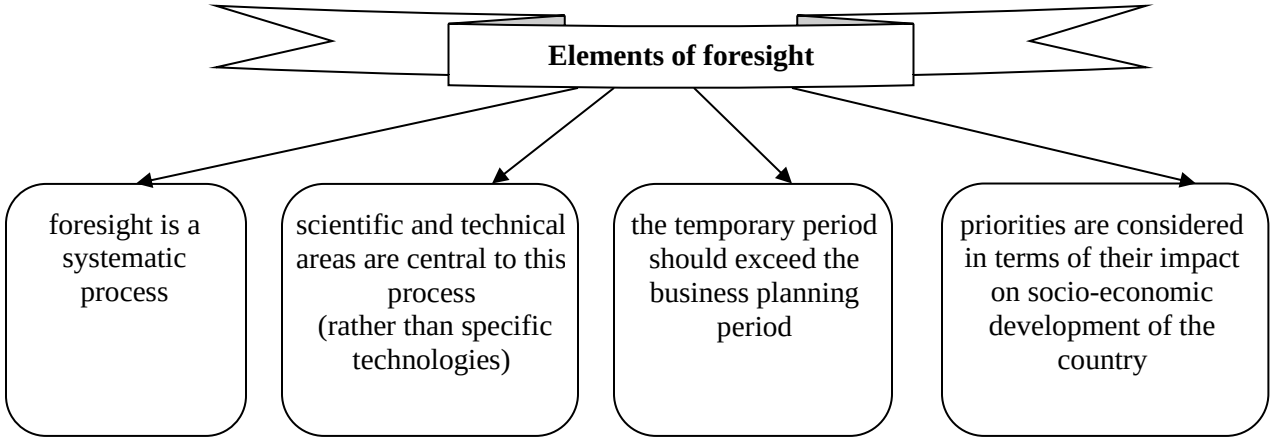

Figure 8.2. **Elements of foresight**

Source: Developed by the author

The foresight methodology has incorporated dozens of traditional and fairly new expert methods. At the same time, they are constantly being improved, techniques and procedures are being developed, which ensures that the forecasting of the prospects for scientific, technical and socio-economic development is more reliable.

The methodology presented here assumes that the occurrence of the "desired" future version largely depends on the actions taken today, so the choice of options is accompanied by the development of measures that ensure the optimal trajectory of innovation development. Most foresight projects include prospects for the development of science and technology as a central component. Usually, these issues are discussed not only by scientists, but also by politicians, businessmen and practitioners from various sectors of the economy. The result of such discussions is the emergence of new ideas related to improving the mechanisms of science management, integrating science, education and industry, and ultimately increasing the competitiveness of a country, industry or region. On the other hand, the organization of systematic attempts to "look

into the future" leads to the formation of a higher management culture and, as a result, to the development of a more sound science, technology and innovation policy.

Foresight projects are aimed not only at obtaining new knowledge in the form of a report, a set of scenarios, recommendations, but their more important result is the development of informal relationships between participants, creating a unified picture of the situation. Usually, foresight projects are conducted regularly, if necessary, according to a repeated scheme (similar to long-term forecasting in Japan, which has been conducted every 5 years since 1971), in other cases, research is carried out sequentially.

The interconnected projects aim to address a number of challenges in order to develop coherent ideas for long-term perspectives on technology, innovation and social development. In some projects, one of the main effects is the formation of horizontal networks, i.e. platforms where scientists and businessmen, university professors and officials, and experts in related fields can systematically discuss common issues.

The foresight methods include more complex techniques than traditional forecasting:

- firstly, forecasts are usually made by a narrow circle of experts and are mostly associated with predictions of uncontrollable events (forecasts of stock prices, weather, sports results, etc.). Foresight is about assessing possible prospects for innovative development related to the progress of science and technology, outlining possible technological horizons that can be achieved with the investment of certain funds and the organisation of systematic work, as well as the likely effects on the economy and society;
- secondly, foresight always involves the participation of many experts from all areas of activity that are to some extent related to the subject matter of a particular foresight project, and sometimes even surveys of certain groups of the population (residents of the region, youth, etc.) who are directly interested in solving the problems discussed within the project;
- the third main difference between foresight and traditional forecasts is the focus on developing practical measures to bring the selected strategic benchmarks closer. Foresight technology is being improved, and international networks for coordinating innovation development are being created.

Thus, foresight is linked to the future, and the future is created today. It is very important that foresight should be based on real needs, not opportunities. When applying this tool in practice, it is necessary to focus on future needs rather than current opportunities.

Foresight priorities are not strict criteria for budget funding of research and innovation activities, and the structure of state funding of research and development (R&D) only partially coincides with foresight priorities.

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8.2 Peculiarities of entrepreneurial activity in the field of knowledge-intensive technologies

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The importance of developing domestic competitive innovations and technologies cannot be overstated. Innovations and technologies are a powerful driver of social and economic development. The level of gross domestic product (GDP) growth depends, among other things, on how efficiently the achievements of scientific and technological progress are produced and applied in the country[1]. Thus, the progressive development of the economy is directly related to the opportunities created by the processes of transforming the results of scientific activity into goods.

Economists associate the processes of innovation development with changes in scientific and technological modes and cycles, which are caused by profound changes in technology based on the emergence of radical innovations that significantly transform the basic conditions of economic activity. These changes may occur if two conditions are met:

1) availability of relevant innovations;
2) the existence of the necessary economic opportunities for their introduction into civilian circulation[2].

It should be noted that the "innovative" nature of entrepreneurial activity is one of its "doctrinal" features.

Schumpeter first drew attention to this feature of entrepreneurial activity. The scientist noted that entrepreneurial activity is one of the factors that give impetus to market development through the promotion of innovation to the market[1]. Indeed, in order to compete with others, an entrepreneur is constantly forced to "invent" new ways to increase the competitiveness of his or her goods, works and services. It is in an attempt to outperform competitors and make a profit that an entrepreneur becomes an "innovator".

The following qualifying features of entrepreneurial activity in the field of innovation and technology can be distinguished:

1) it is carried out in the field of innovations and technologies;
2) aimed at creating, implementing and commercialising innovations and technologies;
3) its main purpose is to make a profit from commercialisation of innovations and technologies – involvement of scientific and (or) scientific and technical results in economic circulation;
4) the subjects of the mentioned activity are business entities (legal entities and individual entrepreneurs);
5) this activity may cover both the entire innovation cycle (technological cycle) and individual stages (research and development, technological development of large-scale production, commercialization);
6) special ways to stimulate the development of entrepreneurial activity in the field of innovation and technology (special, including experimental, regulation, creation of support infrastructure);

7) covers the entire life cycle of innovations and technologies: from the development of a new product and its launch on the market and increased demand for it to the decline and fall in demand for such a product.

Managing the creation and implementation of innovations is an important component of the management of modern industrial enterprises and organizations in the non-manufacturing sector.

Depending on the size and type of activity of the organization, its resource and innovation potential, management can choose different forms of participation in the innovation process – from co-operating in the creation of an innovation at the first stages of the innovation process to purchasing a ready-made innovative product on the innovation market and promptly introducing it into production. Each such decision should be carefully justified and ensure the best results from its implementation for a particular market player, which may act as a producer of innovations, investor or innovator.

State and municipal governments, through the formation of innovation infrastructure, also contribute to the intensification of innovation activities in a country or region, contributing to overall economic growth. Business incubators play a special role in the innovation infrastructure. In today's world, a business incubator is an innovative structure that aims to support the creation and development of new organizations by providing them with rental space, initial capital, advice, etc. There have been cases of several successful business incubators merging into a new structure – a technopark, although business incubators that promote high-tech ideas through the development of small and medium-sized businesses are often called technoparks.

There is no complete terminological definition here yet. In most modern countries, as a rule, a technology park (technical center) is a form of cooperation between universities, large research centers, local governments, industrial organizations, banking and commercial structures interested in the socio-economic and technological development of a particular region. Today, there are about 500 technology parks in the world, including 150 in the United States.

The creation of technology parks specialised in the development of new products and technologies is possible and effective in many ways, depending on the functions, scope and level of cooperation. The most popular parks (centres) may be

- Technological (specialised in the implementation of high technologies and including risk capital enterprises);
- industrial (based on the rational use of production potential and infrastructure);
- Grants (quickly created to provide ‘start-up’ assistance with a wide range of services to manage the formation of small and medium-sized firms);
- research and development (aimed at using applied research and development work and designing new products, service production of which is then established outside such parks);
- consulting (created for the purpose of providing services to firms engaged in innovative activities).

Technology parks are characterised by a specific location, most often in a research institution or higher education institution widely known for its scientific and technical achievements, which is

the strategic founder of the technology park and engages design institutes, design bureaus, experimental and industrial enterprises focused on innovation. The full cycle of the innovation process is carried out within the technology park. If necessary, various institutions and enterprises may be involved in achieving the goals of the technology parks through the establishment of a subsidiary or joint venture. The social, production and commercial relations of such enterprises in the technology park are regulated by its charter and agreements on joint (cooperative) activities.

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8.3 Business plan for an innovative project

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Without a well-thought-out and prepared business plan, it is impossible to make informed decisions on the choice of alternative business ideas aimed at implementing and commercialising an innovation. Business is a purely commercial activity, and a businessman is a person (individual entrepreneur or owner of a legal entity) who proposes ideas, makes decisions and manages business activities on the basis of his own mind, systematically, at his own risk and actively chooses to do business.

The process of developing a business plan is one of the areas of planning. A business plan is a document that describes a specific business idea and ways to implement it[1]. Thus, a business plan for an innovation project describes an innovative business idea, i.e. a plan for investing in the implementation and commercialisation of an innovation. A business plan is a working tool that provides a comprehensive vision of the goals and means of achieving them, together with all the risks associated with the implementation of an innovation project. A business plan provides the most effective assessment of a business idea, its practicality, potential profitability and possible risks. Successful implementation of innovative projects in the course of doing business can give you a competitive advantage, increase your company's profitability and achieve long-term growth.

The business plan should be presented in writing, which makes the process of its preparation more efficient, and the business plan itself systematic and concise[3].

The goals and objectives of an innovation project business plan are as follows[2]:

1) A business plan is a documented business plan that allows you to assess the current economic situation and your own innovative capabilities, determine the prospects for starting and developing your business, identify all the necessary actions to achieve your goals (not just the formal end

result), and the process itself is valuable because participants gain experience in joint activities and business communication, as well as a reasonable and positive vision of business development prospects);

2) In the process of fully preparing a business plan, analyse market trends, develop forecast reports and compare actual values of indicators with planned values so that problems can be identified and eliminated before risks arise during the implementation of innovative projects, i.e. the business plan can take measures to minimise risks in the event of unfavourable developments;

3) Study further prospects for the development of the sales market in order to produce only those products that are in demand;

4) Estimating the costs required for the production and sale of a product made using an innovation, as well as comparing it with the selling price, can determine the potential profitability of a business idea;

5) The business plan allows attracting investments or obtaining a loan for the implementation of an innovative project (if own funds are not enough). Investors or creditors must have written evidence that the funds they provide will bring profit with minimal risk;

6) The business plan allows to define standards and indicators of control over the process of implementation of innovative projects, i.e. the business plan can be used as an effective tool for controlling and managing the internal activities of the enterprise.

Serious investors require that the business plan be presented by the head of the company, so its preparation requires the personal involvement of the management or a person who intends to start his or her own business. The time that a manager spends on developing a business plan is time invested in the future of the business, as well as time spent on gaining and deepening business experience. Of course, if necessary, you can resort to the services of experts: companies specialising in marketing activities, authors' groups, individual authors, consulting firms, and narrow specialists. It usually takes a month to create a business plan. During this period, experts review the necessary documents and make calculations.

Everyone who wants to invest in the implementation of an innovative business idea needs a business plan. All users (consumers) of a business plan can be divided into two target groups: external and internal:

- External consumers are stakeholders who only invest and do not participate in the implementation of innovative projects. Investors are interested in projects that maximise their return on investment and are aware of the direct link between return on investment and risk (the higher the return, the higher the risk of not achieving it);
- Internal users – stakeholders who invest their own funds in the implementation of innovative projects and/or participate in their implementation.

Thus, a business plan has two main areas:

- Internal – it is an information-rich plan for the implementation of an innovative project with an assessment of the results of each stage of its implementation;

- External – informs external investors and other stakeholders about the technical, marketing, organisational, economic, financial, legal and other advantages of the innovation project.

Since the economic essence of a business plan is the potential investor's awareness of the essence of the business idea in the form of an innovative project to be implemented and his/her interest in participating in it, the business plan must meet certain criteria[1]:

Completeness – the business plan must contain all the necessary parts to reflect the business idea in its most complete form, i.e. contain all the information necessary for a potential investor to make a positive investment decision;

Usefulness – the information contained in the business plan should be not only complete, but also useful, i.e. there should be no unnecessary information that would interfere with and burden the understanding of the business idea;

Neutrality – the business plan should reflect all the characteristics, strengths and weaknesses of the business idea as objectively as possible;

Reliability and credibility – business plans should be based on reliable information, deliberate distortion of parameters to increase the attractiveness of the business idea is not allowed. Analogies between the data provided in the business plan and the current state of affairs (or major market trends) should be drawn. All figures must be supported by appropriate calculations;

Transparency – the business plan should be written in a logical and consistent manner so that users (potential investors or business partners) can follow the rationale for the inputs and conclusions;

Flexibility – as the market environment continues to change, business plans need to be adapted, which should be done with minimal effort. If deviations occur during project implementation, adjustments should be made and parameters changed to achieve the maximum possible effect in the new environment;

Control – with the help of a certain system of indicators, business planning allows you to monitor compliance with deadlines, production, deliveries and sales, as well as the compliance of actual indicators with planned ones (control tools);

Clarity – one of the main requirements of a business plan – should be written in a clear language using accepted terminology;

Compactness and structure – the optimal size of a business plan is no more than 35-50 A4 pages. More than this amount will be difficult for potential investors to find. All information should be grouped into sections without clutter and duplication;

Clarity – It is recommended to use graphic images to make the results clear, but it is necessary to remember about moderation in everything, including in the presented diagrams, graphs, drawings. Only those that best reflect the essence of the proposed business idea should be used.

There are no clear criteria that would limit the development of a business plan. Its composition, structure and detail depend on the specific circumstances of the business, the size of the enterprise, the objectives of the business plan and the prospects for business development. If necessary, in addition to the standard part, the business plan of an innovation project may also include a section on legal protection.

Let us consider the comprehensive structure and content of an innovation project business plan[2]:

Summary – provides the main results and conclusions of the entire business plan and each section. The main purpose of the executive summary is to attract attention and make a good impression on potential investors;

Market situation analysis – describes the current state and trends of macroeconomic processes, provides the results of SWOT analysis, describes the business area (industry) and its development prospects, introduces the results of the analysis of the sales market and competitors. Identify the key success factors and competitive advantages of the company;

Marketing plan – provides a marketing strategy – an action plan aimed at bringing an innovative product to consumers, which includes the following main components: product, price, distribution, promotion. The purpose, technical parameters, novelty of consumer quality, advantages or uniqueness of the innovative product in relation to similar products should be indicated separately;

Sales plan – to offer the results of the sales forecast for innovative products (goods);

Production planning – the company's choice of production processes and necessary equipment, the use of which will ensure the proper quality of innovative products;

Organisational plan – demonstrates how the organisational structure of the enterprise will be used to achieve the goals described in the business plan;

Legal protection – stipulates the degree of disclosure of information about the innovative product(s) (demonstrations at exhibitions, presentations in the media); confirms the availability of protection documents (patents, copyright certificates); if necessary, works out the transfer of ownership (re-transfer) of the contract; in the case of patented research, provide information on the purpose of the research, the depth of the search and the identity of the researcher; confirm the availability or need to acquire certificates (compliance, quality, hygiene);

Financial plan – Provides a financial justification for the feasibility of the business plan: forecast financial statements, indicators for assessing the effectiveness of innovation projects;

Risks and guarantees – Describes the risks associated with the implementation of the innovation project and specific measures to minimise them.

When developing a business plan, you should pay attention to the following:

- No grammatical or spelling errors in the text;

- The binding for small business plans can be soft, for documents over 80 pages – hard;
- The layout should be neat and tidy.

A responsible attitude and preparation of a thorough business plan for an innovative project allows you to achieve your goals in the shortest possible time with minimal risk, thereby ensuring the efficiency of project implementation and the realisation of the company's competitive advantages and opportunities. Further sustainable development in the face of environmental change.

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8.4 Financing of an innovative project

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Innovative projects and programmes are a practical basis for economic reforms in the country, as their implementation allows attracting significant amounts of financial resources, as well as using tools for planning, controlling and coordinating the work of all project participants. The experience of implementing such projects and programmes in Ukraine shows that in today's environment of limited financial resources, finding and rationalising sources of funding for innovative projects and programmes, as well as increasing the efficiency of using financial levers, is one of the crucial points in their preparation and successful implementation[1].

The distinctive features of the organisation of financing of innovation activities are a variety of sources of financing that ensure comprehensive coverage of financing of various areas of the innovation process and its various actors and the ability to flexibly adapt to dynamically changing environmental conditions in order to ensure maximum efficiency of the use of financial resources. The growth of financial returns from the implementation of innovation projects is the most important generalised indicator on the basis of which the final results of innovation activities and the effectiveness of financial policy implemented by business entities and the complex economic entity – the state – are determined[2].

Financing of an innovative project is an activity of raising, distributing and using capital, as well as managing it in the risk capital market.

The main elements of the innovation project financing system are:

- sources of financial resources for the implementation of innovation projects;

- mechanism of accumulation of funds, participants from different sources;
- mechanism of investment control;
- mechanism of repayment of advanced funds.

The main sources of funds used to finance innovation activities are[3]:

- budget allocations;
- funds of special extra-budgetary funds for R&D financing, which are formed by ministries and regional authorities;
- own funds of enterprises (industrial investments from profits);
- funds of various types of commercial financial structures (investment companies, commercial banks, insurance companies, etc.);
- credit resources of investment banks specially authorised by the government;
- foreign investments of industrial and commercial firms and companies;
- funds of national and foreign research funds;
- private savings of individuals.

Self-financing is the main source of financing innovation activities.

The principles of organising financing should be focused on multiple sources of funding and should allow for the rapid and efficient use of innovations with their profitability, ensuring the growth of financial returns from innovation.

Methods of financing innovation projects are understood as those ways of financing innovations that reflect the use of specific sources of financing in relation to the economic situation of the firm, its current operations and development plans.

All financing methods are divided into direct and indirect.

The most common sources of direct financing of innovative projects are[4]:

- Bank credit..
- Funds from the issue of securities.
- Third-party investments for the creation of a separate enterprise for project implementation.
- Proceeds from the sale or lease of free assets.
- Innovative credit.
- Income from short-term projects (in relation to financing long-term projects).
- The company's own funds (profit, depreciation fund).
- Funds received on the security of property. Revenues from the sale of patents and licences.
- Factoring.
- Forfaiting.

In turn, indirect methods include those that are based on providing innovative projects with the necessary material, technical, labour and information resources. Such methods include:

- purchase by instalments or leasing (renting) of equipment required for the project;
- acquisition (for the technology used in the project) of a licence with payment of the latter in the form of a royalty (a percentage of sales of the final product specific to the licence);

- placement of securities with payment in the form of supply or leasing of necessary resources;
- attracting the necessary labour resources and making contributions to the project in the form of knowledge, skills and know-how.

There are the following forms of state support for projects[5]:

- Provision of credit resources on the basis of repayment, urgency and payment.
- The same on the basis of state ownership of a part of the shares, creating joint-stock companies 'for the project'.
- Provision of guarantees of reimbursement of part of the investor's funds in case of failure of the project through no fault of the investor.

An important role in creating an innovative climate in our country is played by innovation funds, which are essentially based on a mixed form of financing.

Innovation funds are formed at the expense of organisations and enterprises engaged in innovative activities, as well as banks, insurance companies and other financial institutions. The government may participate in the creation and operation of innovation funds.

The main purpose of innovation funds is usually to concentrate funds on priority areas of innovation activity for financial support of promising innovations. As a rule, innovation funds provide independent expertise and competitive selection of innovative projects with financial resources on a repayable or non-repayable basis. In addition, innovation funds often act as guarantors and sureties for the obligations of innovative enterprises.

When financing innovative projects, the implementation of which involves a high level of non-financial risk and uncertainty of commercial results, innovative enterprises may use various forms of cooperation, including the creation of venture capital funds.

The development of the venture capital industry is designed to help attract extra-budgetary funds to the innovation sector. In the most general terms, venture capital financing can be defined as a type of equity investment. Venture capital funds prefer to invest in innovative companies whose shares are not freely traded on the stock market, i.e. by purchasing shares on the over-the-counter market (direct investment) rather than by buying shares on organised stock markets (portfolio investment). Venture capital often serves as a bridge to an innovative company's entry into the stock market.

A distinction is made between venture capital and all other over-the-counter (direct) equity investments based on the presence or absence of controlling participation in the implementation of an innovative project. In order to reduce risks as an element of the financing condition, a venture capital investor in most cases requires its representative to be a member of the Board of Directors of an innovative enterprise

Venture financing is provided, as a rule, to small and medium-sized innovative enterprises without providing them with any collateral or institution, unlike, for example, bank lending. At the same

time, the venture investor, as a rule, does not seek to acquire a controlling stake in the invested company, which fundamentally distinguishes him from a strategic investor or "partner".

Innovation grant – budgetary means provided to subjects of industrial and innovative activity on a free basis for the implementation of their industrial and innovative projects within the priority areas of providing innovative grants.

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8.5 Risk management in venture capital projects

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When analysing risk management issues in venture capital projects, one should simultaneously take into account the risks of venture capital investors and venture capital entrepreneurs. After all, for an investor, the main thing is systemic (market) risk, and systemic risk cannot be influenced. Systemic (market) risk affects a large number of assets and is typical for all market participants. It can be caused by processes occurring in the entire market environment. This type of risk is also called market situation risk, which is the probability of losses or additional opportunities due to changes in the economic situation in a market or business sector. However, venture capital business is a specific financial and economic activity, and its risks are multifaceted. To this end, it is necessary to identify the main risk factors and their possible impact on the final result of the structural efforts of the enterprise and apply certain methods to minimise risks for investors and investment recipients. A general flowchart of risk management in venture capital projects from the perspective of investors and business recipients is shown in Figure 8.3[1].

In particular, as can be seen from the diagram, measures taken by venture capital firms are mainly based on the use of management technologies at the level of the enterprise. As for investors, they can apply both managerial influence and methods of insurance, diversification and distribution of risk under contracts, which are external to the venture capital enterprise.
Let us describe each of the methods from both the enterprise and the investor's perspective.

Methods of risk minimisation for venture capital enterprises are to improve and increase the efficiency of the internal systems of the enterprise, which can significantly affect its position in the external environment. Thus, a venture entrepreneur can 1) improve his or her own marketing strategy, update it or develop it in case of its absence.

Management mechanisms for reducing the venture capital firm's risks also include 2) shortening the period of market entry, which, in turn, can be achieved by a) accelerating the timeframe for R&D or development of the innovative part of the project, b) accelerating the technical procedures for bringing a new product to market and its commercialisation, c) removing entry barriers through additional injections of funds, government subsidies, etc.

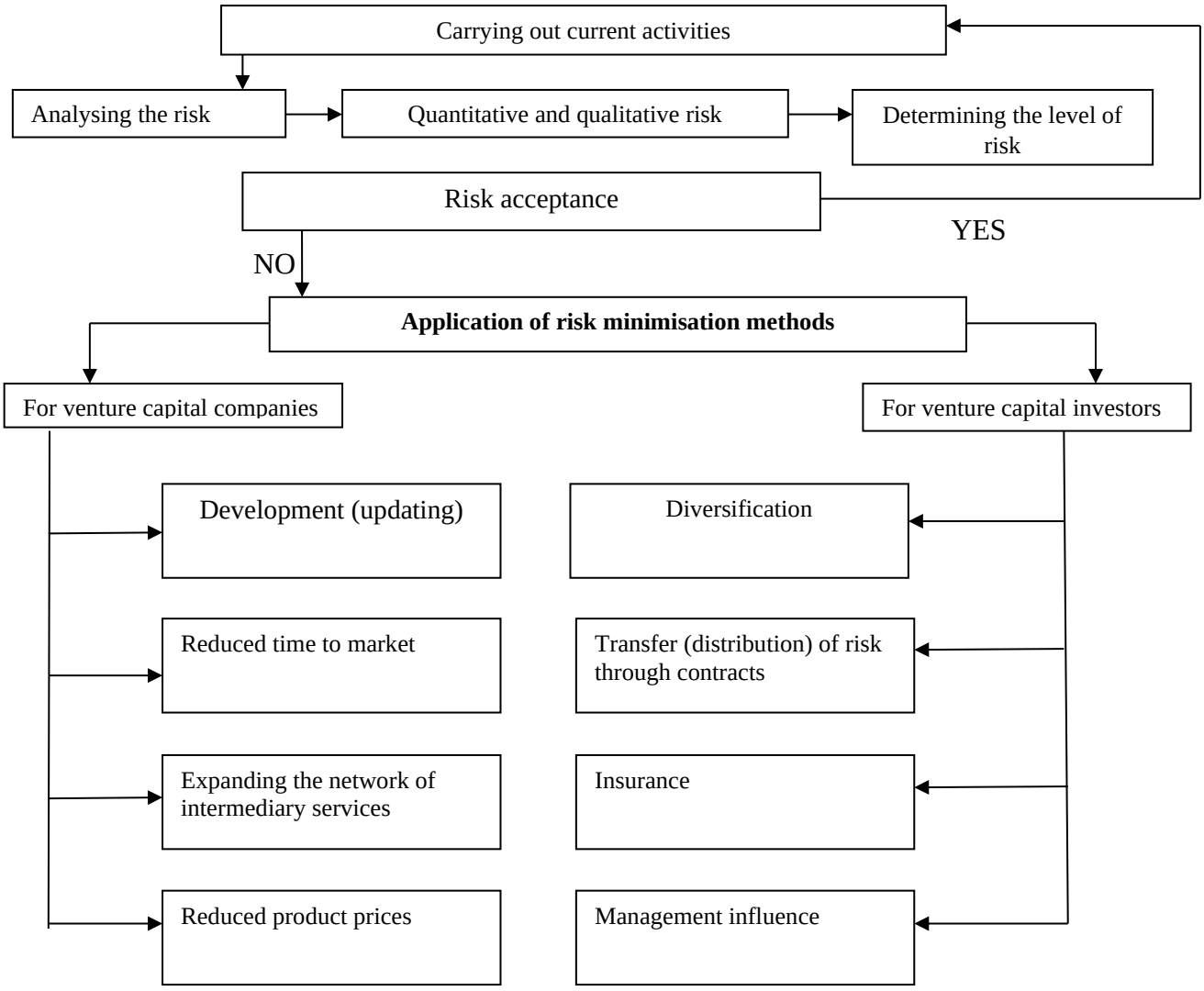

Fig.8.3. **Model of risk management in venture capital projects** [1].

Another method available in the arsenal of a venture capital enterprise to minimise risks is 3) expansion of the network of intermediary services, which is a kind of risk diversification between intermediary organisations.

As one of the methods, a venture capital company may use 4) a mechanism for reducing product prices, but it is obvious that such a method, despite its significant effectiveness, must be well justified and justified in order to prevent the company from crossing the threshold of profitability beyond which the project will be unprofitable.

As for the methods of minimising risk for venture capital investors, the following are the main ones.

One of the ways to reduce innovation risk is 1) diversification of innovative entrepreneurial activity, which means distribution of efforts of developers (researchers) and investments for implementation of various innovative projects that are not directly related to each other. If, as a result of unforeseen events, one of the projects is unprofitable, other projects may be successful and generate profit.

The next method of minimising risk, primarily in innovation activities, is the transfer of risk by 2) concluding a contract. As practice shows, the transfer is carried out by entering into the following contracts: construction contracts, lease of machinery and equipment, contracts for the carriage and storage of goods, contracts for the sale, maintenance, supply, contractor agreements, etc.

Perhaps the most important method of risk mitigation is 3) insurance. Insurance is a system of economic relations that includes the creation of a special cash fund and its use to overcome and compensate for various kinds of losses and damages caused by adverse events by paying insurance indemnities and sums insured. Of all the forms of risk transfer, insurance most fully meets the ideal conditions proposed for risk transfer, because the resources to cover the losses of an innovative firm come from insurance organisations faster than from any other source.

In the current conditions, the most effective way for enterprises to prevent negative consequences is also such a method of reducing investment risk as 4) the use of direct managerial influence. For example, such actions as checking potential partners, recruiting qualified personnel, thorough analysis and evaluation of innovative measures, etc. At the same time, planning and forecasting of the company's innovation activities is an important factor in reducing risk.

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