CHAPTER 1
CONCEPTUAL PRINCIPLES OF A HIGH-TECH PRODUCT COMMERCIALIZATION IN INTERNATIONAL BUSINESS

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1.1. The Essentials of the Scientific Object Categorical Apparatus

Dynamic, complex and contradictory social processes are currently taking over upon the world economy. Significant changes have taken place in recent years: international division of labor, internationalization of production and migration of capital have all reached a qualitatively new level of development. The latter is due to the strengthening of international cooperation, which allows the global economy to be defined as a national-world economy, which makes the functioning of autarky completely impossible.

The acceleration of global economic processes takes place due to the emergence of new, modern day technologies, which have been called "high tech". A component of the relevant global industry market has actually been formed and developed within the framework of the integrated worldwide economy. The main problematic aspects that require research and scientific substantiation are methodological principles of market formation, scientific analysis and trends defining proccess in the development of various market segments. The main issue that needs to be resolved first is the creation of prerequisites for the implementation the of commercialization of high-tech products strategy.

The first stage of the research is the thorough study of the essence of the concept of "commercialization" through reference to its etymology. Among the scientists whose works are devoted to the commercialization of innovative technologies products, are the works of the following researchers: F. Kotler, V. Ling, V. Chesa, F. Frattini, S. Chen, S. Daneshjovash, D. Markman, S. Slater, V. Wong, L. Kung, etc.

When forming the spectrum of research related to the specific terminology of innovative activity, special attention should be paid to the concept of "commercialization of a high-tech product". It is appropriate to note that, on the one hand, both high technologies and products, created

on the basis of these technologies can be commercialized. This approach requires a clear definition of the commercialization economic category and the specifics of its application in relation to high technologies and product. In the interpretation of the above, there is currently no unity among the academic community. The opinions of researchers should be therefore divided into two groups. The idea of the first group is the perception of commercialization as a process that includes all stages from the formation of an idea to the successful implementation of an innovative product. The second defines commercialization only as a stage of the innovation process, which is determined by the competencies and ability to transform the product into a commercially successful enterprise project. The interpretation of the concept of "commercialization" is ambiguous, as is evidenced by the presented generalization of the analyzed scientific approaches (Figure 1.1).

The methodological toolkit can be used to identify the theoretical and methodological principles of the interpretation of the "commercialization" category through the use of an operational approach (Table 1.1).

Table 1.1

Conceptual basics of the structure of commerzialisation economic category apparatus

Substance	Result	Objects	Subjects
The process of transforming a scientific idea, research into a product	Which leads to the appearance of a new product that satisfies the needs of the consumer and causes a commercial effect	Technologies, innovation, objects of intellectual property	Enterprises, institutions and organizations, subjects of international enterpreneurship

Source: formed based on [186]

Based on the research of structural elements of the category under consideration, we suggest defining the basic content of the commercialization category as a process.

The main arguments in that favor can be the following. Firstly, commercialization has systemic characteristics and relies on many factors, both external and internal. In addition, the commercialization of the results of scientific research in the field of high technologies needs joint consideration

in a complex with fundamental and applied research. In addition, the process of commercialization, which, in our opinion, is mistakenly highlighted by researchers, is aimed not only at making a profit, but also at satisfying the needs of consumers of services and goods as a result of research in the field of high technologies.

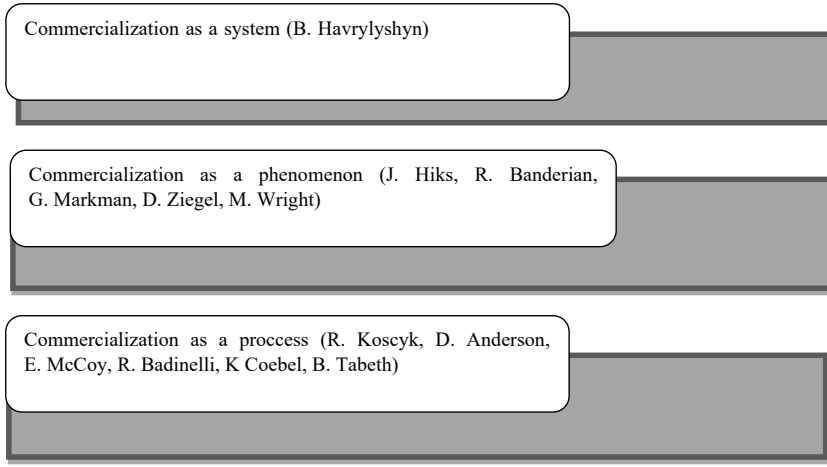


Figure 1.1. Generalization of the commercialization economic category

Source: formed based on [3; 6; 39; 71; 99; 117; 121; 174; 213]

Summarizing the abovestated and as well based on the conducted research, we have formulated own definition of the commercialization of a high-tech product as a synergistic process of interaction between the market and scientists who generate ideas embodied in high technologies, which, thankfully to financing, production, logistics, marketing, organizational and management factors, take the form of a high-tech product that enters the market and finds its consumer, thereby providing a commercial effect.

The commercialization of a high-tech product in the system of international entrepreneurship will acquire the specifics inherent in the globalization of economic processes, the transition of the national economies of the most developed countries to the fifth and sixth technological sectors, the unification of the principles of conducting business on world and

industry markets. The emergence and rapid spread of network and cloud technologies affect the development of new models of commercialization of a high-tech product.

The definition of the high-tech product category must be considered in the context of the classical definition of the high-tech category. According to the UN methodology, the definition of technology has a two-fold interpretation: as technology in its pure form, covering the technological method of production of goods and services; as an embodied technology, covering means of production and products with high technical and economical parameters.

Technology transfer in the context of research is a process by which new inventions and other innovations created in the laboratories of these institutions are transformed into products and commercialized. This is typically done in two ways: by licensing proprietary intellectual property to corporations and by creating start-up companies that also often license intellectual property created by researchers.

A key role of technology transfer professionals is to protect the intellectual property associated with valuable innovations so that they can be licensed, commercialized and brought to market for the benefit of society.

But over the years, technology transfer has become much more than intellectual property protection. Technology transfer specialists are involved in a wide range of activities to support the commercialization process, including: working with attorneys to secure patents and other intellectual property rights, evaluating the commercial potential of new inventions, marketing existing technologies to potential licensees and partners, training researchers in tactical and methodological principles of commercialization, assistance in the professional education, provision of funding for research at the initial stage and startups, negotiations on partnership and license agreements, organization of business plans and start-up competitions, promotion of the construction of innovative ecosystems and support of structures that promote innovation and economic development [151].

Technology transfer can be classified into vertical and horizontal.

Vertical technology transfer is a transfer chain that includes basic research, applied research to development, and from development to

production. It is also known as internal technology transfer. This type of transfer is mostly utulized between scientific associations, universities and governments.

Horizontal Transfer of Technology – When a technology already implemented or used in one organization is transferred and used elsewhere, the transfer is known as horizontal transfer of technology. It is also known as external transfer of technology. This type of transfer occurs between private companies, small and large business organizations [173].

The Law of Ukraine "On State Regulation of Activities in the Field of Technology Transfer" defines high technologies as those developed on basis of the latest scientific knowledge, which by their technological level exceed the best domestic and foreign analogues and are competitive on the world market of science-intensive products [161].

In the Order of the Ministry of Industrial Policy of Ukraine dated February 8, 2008 No. 80, the term "high technologies" receives the following interpretation: High technologies are systematized advanced knowledge at a certain point in time, aimed at the production of products or the creation of a process that are fundamentally new (those that have no analogues) or new in a certain field of knowledge, the application of which will allow to gain a monopoly position in the international market or improve the competitive position of the person who develops or applies them and obtain a high added value [164].

In our opinion, the disadvantages of this definition are that, without delineating the fact of the direct application of systematized advanced knowledge, the vector of the introduction of high technologies is associated only with obtaining a monopoly position in the market and high added value, that is, with the commercialization of the process. In fact, this is a false statement in most cases.

High technologies are technologies based on radically new knowledge of the modern stage of scientific and technological progress, which are produced for the purpose of producing and supplying products with a high level of scientific intensity, which corresponds to the priorities of scientific, technical and innovation policy of developed countries [111]. Unfortunately, practice shows that the list of the product portfolio of the world market changes dynamically precisely due to the emergence of new achievements in the field of high technologies.

Thus, the scientific identification for the category "high technology" can be summarized as a set of systematized knowledge necessary for the creation of qualitatively new products or services throughout the creation of a new technological process, the application of which will create clear prerequisites for improving the competitive position and increasing the share of the market segment [175]. The given definition allows to focus on the immediate novelty of high technologies and the existing commercial side as a prerequisite for the creation of high-tech products.

In methodological recommendations "Indicators of high technologies. General methodology" National Institute of Statistics of Spain provides a definition of the term "high technologies" as a stock knowledge necessary for the production of new products and processes. High technologies are characterized by a rapid update of knowledge that surpasses other technologies, and their complexity requires continued research efforts and a reliable technological foundation [85].

There is no doubt about the relationship between high technologies and the stock of knowledge, but reducing their essence to only a collection of knowledge is considered insufficiently legitimate. The "Economic Encyclopedia" provides the following interpretation: "High technology is a conventional designation of a knowledge-intensive universal, multifunctional, multi-purpose technology that has a wide scope of application, is capable of causing a chain reaction of innovations, which provides a more optimal ratio of costs and results compared to previous technologies, provides a positive impact on the social sphere" [76, p. 332].

A number of definitions of high technologies are given in the literature. In many cases they are defined in an industry context, in others in the context of individual companies, products or life cycles. Most definitions are related to the creation of the product, i.e. the amount of knowledge or research required, or the pace of product development, i.e. the moral depreciation of the product. High attention is paid to the production proccess. Therefore, research on high technology uses a number of definitions that do not provide consistent results in what should be identified as high technology [186].

When reviewing sources, the dimension of knowledge intensity is not obvious in the definition of technologies. In strategic management, technology is seen as a tool, investment management should contribute to

enterprise value. In production management, technology is classified as unit of mass production. In marketing, technology is considered in relation to the life cycle of the product, which reveals the content of market manipulation. None of the definitions take into account the knowledge component. In the context of economic development, technology is embodied in three components: software, hardware and human. Others include a management component. Some authors provide a detailed structure of the relationships between micro- and macro-level technologies, which include four components: technological, labour, informational, and organizational. Ultimately, a nation's technological capability depends on the technology content at the firm level, which is related to the pecularities of each of the components.

The generalization of the results of conducted research made it possible to propose conceptual bases for the interpretation of the "high technologies" category (Table 1.2).

Table 1.2

Conceptual basis of the high-tech products economic category apparatus

Substance	Content	Implementation result
Technologies that appeared due to the intensive development of scientific and technological revolution	Advanced systematized scientific knowledge, which is embodied in relevant products (tangible and intangible) that have no analogues or provide more effective indicators compared to previous analogues	Ensure high levels of profit and competitiveness of enterprises and are able to cause an unpredictable chain reaction during the commercialization of innovations and initiate dynamic processes of self-organization of socio-cultural systems

Source: formed by author

Based on the study of the categorical apparatus of the definition of "high technology", the definition of "high-tech product" is proposed as a set of advanced systematized scientific knowledge, which is embodied in the corresponding products (tangible and non-tangible), which have no analogues or provide more effective indicators in comparison with previous analogues, and enable to ensure a high level of competitiveness, income

and cause an unpredictable chain reaction of innovations, as well as initiate dynamic processes of self-organization of socio-cultural systems.

High-tech industry is characterized by a high degree of technological and competitive uncertainty. Given the turbulence, some argue that conventional marketing tools are not suitable for the high-tech arena and a different set is needed. Given the growing influence of high technologies, it is important to analyze the planning procedures in the context of high-tech marketing [78].

The works of O. Kosenko, M. Butko, O. Popelo, T. Bogolib, V. Denysiuk, Y. Melnyk, L. Sager and others are devoted to the study of the peculiarities of the implementation of the commercialization strategy. If we consider technology as a multi-layered concept consisting of acquisition or formation of a license, obtaining technical assistance and training, providing the commercialization process with technical documentation and equipment, therefore the process of strategic development for each layer specific priorities (Figure 1.2).

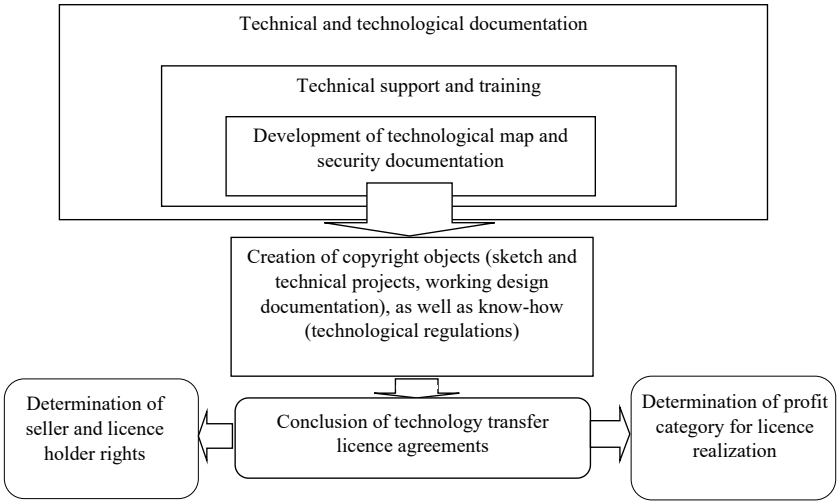


Figure 1.2. Strategic landmarks of the technology R&D process life cycle stages

Source: formed by author

The strategy of commercialization of a high-tech product, taking into account the complexity of the object, includes traditional conceptual elements: purposes, goals, tasks, targeting the audience and tools, as well as specific ones: stages of the state's innovative development strategy, international market needs, global perspectives, etc. (Table 1.3).

Table 1.3

Fundamental basics of the high-tech commercialization strategy

Goal	Creation of a competitive high-tech product on domestic and international markets
Objectives	Acquisition of financial results and social effects from high-tech product commerzialization on microeconomical level
Tasks	Formation and development of high-tech market needs; creation of an institutional and financial plane for technology transfer; innovative activity outburst of domestic enterprises; stimulation of potential demand for high-tech products; diversification of funding sources for innovative projects; formation of public-private partnership platforms in the field of high-tech product R7D proccess
Instruments	Marketing, infrastructural, logistic, economic, financial, institutional

Source: based on [54]

The choice of the direction of development and the tools of the high-tech product commercialization strategy depends on the capabilities of the resource base and the development prospects of the enterprise.

Large entities of entrepreneurial activity are characterized by the use of such commercialization strategies as offensive and defensive, which are associated with the availability of material and resource support [54].

Today, the state of socio-economic and technological development of the social method is largely determined by the level of innovative entrepreneurship and the technological method (Table 1.4).

Participation in the international division of labor implies that the spread of markets and production processes around the world causes an increasing diversification of economic activity. However, in orthodox economics the division is seen as a providence of mutual benefit to specialized industries, an alternative analysis of the international division of labor that emphasizes the inequality and structured hierarchies it creates.

Much of economic activity involves complex concepts and interactions that cannot be modified or simplified. These interactions require comprehention, familiarity and trust between the agents. In our opinion, in order to solve the problems of transformation, crises and economic growth, economic science should integrate the most general patterns of development of complex non-linear systems, known as synergy.

Table 1.4

Stages of international markets evolution

Pretechnological stage	**1 stage**		**2 stage**	**3 stage**		
Before 1790	1790-1830	1840-1880	1890-1940	1950-1980	1990-2010	2011 up till now
Goods market						
	Capital market					
	Labor market					
		Services market				
			Technology market			
				Market of information		
					High-tech market	

Source: formed based on [95; 108]

The phenomenon of synergy is not new both in the general sense and in relation to individual scientific disciplines. The topic of synergy occupies a special place in economic sciences. Synergy plays an important role in business management, including strategic management. This seems to be important in spheres of concentration and centralization of capital, as well as in cooperation and development of new organizational forms of enterprises. The synergistic effect is a subject of interest in the field of business administration in terms of growth strategies (including diversification of the business structure) and methods of their implementation (external growth).

The works of N. Grazhevska, L. Tkachenko, M. Dutchak, T. Kychkyruk, O. Sklovska, H. Pylypenko and others are devoted to the study of high-tech products and technology in the context of application of the synergistic paradigm.

Summarizing the set of propositions of the synergistic market hypothesis, we will identify the characteristic features that fully correspond to the essence of the modern world market of high technologies and products:

1) the search for an equilibrium point in the market of high-tech products is a permanent phenomenon, since the market itself is constantly under the influence of a large number of dynamic and static factors and increasingly acquires a network character. The emergence of a scientific idea, its adaptation to the needs of production and consumption cannot be predicted, accordingly, the market has many attractors of development;

2) the trends of the high-tech product market are characterized by a high level of uncertainty, the presence of synergistic effects, are reflected by a set of non-linear trends, have significant fluctuations from the average market trends, which complicates extrapolation and forecasting. The defining trend today is the digitization of the economy, which caused a synergistic effect in the high-tech segment and covered the entire spectrum of issues of socio-economic aspects of society's life;

3) the activity of enterprises in conditions of uncertainty of the market system leads to an increase in transaction costs.

Taking into account the above, we define the definition of the world market of high technologies and products as an extremely complex open dynamic nonlinear system that arose and develops on the basis of the continuous deepening of the international division of labor and specialization, unites national economies that are in a state of constant transformation.

The definition of the categories of high technology, high technology product and commercialization of a high technology product formulated in the works lay the theoretical foundations for further analysis of models of commercialization of high technology products on international markets.

1.2. Retrospective and functional analysis of innovative models

The global nature of the modern economy presupposes the globality of competition and the study of its new forms and methods. The main factors influencing the strengthening of transformational and competitive processes of the national and world economies are shown in Figure 1.3.

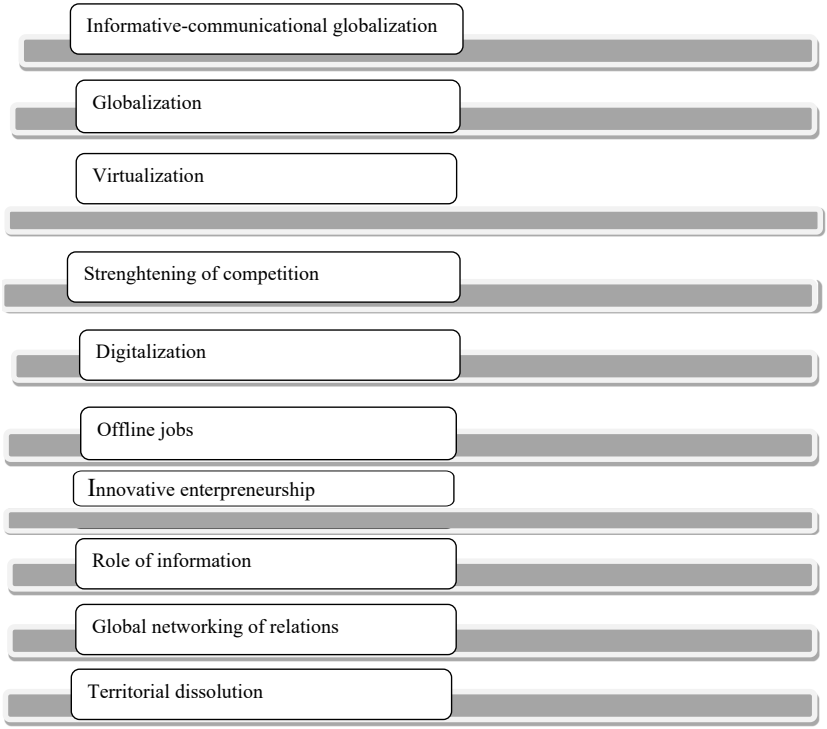


Figure 1.3. Factors that influence transformation processes of national and world economy

Source: based on [88]

Factors influencing the strengthening of transformation processes include factors inherent to the the macro- and micro-environment. Factors of the macro environment include: political, legal, economic, socio-cultural, technological. Factors of the microenvironment consist of: interaction with agents, government, etc.

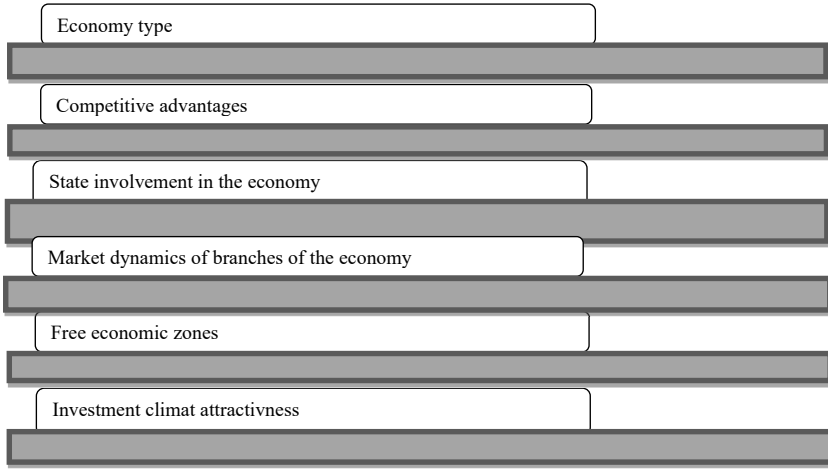


Figure 1.4. Key parameters of high-tech market initiation

Source: based on [88]

The study of the abovementioned factors allows to determine the key parameters of the formation of the market of high-tech products, which are as follows: economic, political-legal, technological (Figure 1.4).

The main system-essential factor influencing the development of the market of high-tech products is technological, which includes differences in: potentials for the development and implementation of technologies; volumes of the country's trade balance; socio-economic processes [88].

Today, it is possible to state that the formation of a new informational and innovative (post-industrial) economy, which has established mainly thanks to the development of the high-tech sphere.

The main features of the post-industrial economy are:

– humanization of technology, minimizing heavy monotonous physical work;

– increase in the knowledge intensity of production, specific weight of technologies;

– miniaturization of equipment, individualization and diversification of work, revision of the workplace parameters, etc.;

– ecologization of production, which involves the use of low-waste and zero-waste technologies, strict environmental standards;

– a combination of localization and globalization of production, an example of which can be the information networks that provide consumers with results of creativity of all mankind.

The analysis of current state of the world market of high-tech products allows us to highlight contradictions: on the one hand, an extremely high level of competition, and on the other hand, a completely new type of this competition, which has fundamental differences from the previous stage – the industrial economy.

This type can be defined as innovative competition. In our opinion, the peculiarity of innovative competition and its differences from free market competition are determined by the following: a high level of risk, associated with the development and introduction of a product to the market; high dynamism of market processes; aggressive nature of competition; shortening terms of the monopolistic position on the market; high non-price flexibility of the demand; increased importance of the manufacturer's image; weakness of buyer's market force; low price flexibility of the demand.

A synergistic approach to the consideration of trends in development of the world market of high-tech products requires a comprehensive analysis of commercialization models of a high-tech product from different standpoints. In this study, we shall consider models of commercialization of a high-tech product according to the following existing directions and supplement the list with author's features: according to the vector of commercialization, according to the nature of the interaction of elements, according to the location of idea generators, according to the form of product implementation, according to the number of influencing factors, according to the motives for the emergence of ideas (Figure 1.5).

The direction of vector of commercialization "from science to the market" was called "Technological push". The neoclassical model of the "technological push" was developed in the early 50s of the last century (Figure 1.6). The model showcased in the figure is based on the sequential relationship between stages of the introduction of innovation processes: from idea to final product.

Organization is one of the main functions of management. Organization can be defined as the creation of organized structures in a company. The main priority of these structures is the achievement of the company's

goals. The enterprise together with the management determine goals, and therefore, the role of management is to organize and provide the necessary resources (personnel, financial, etc.) for their implementation. Among the factors of organization – distribution and sources of authority.

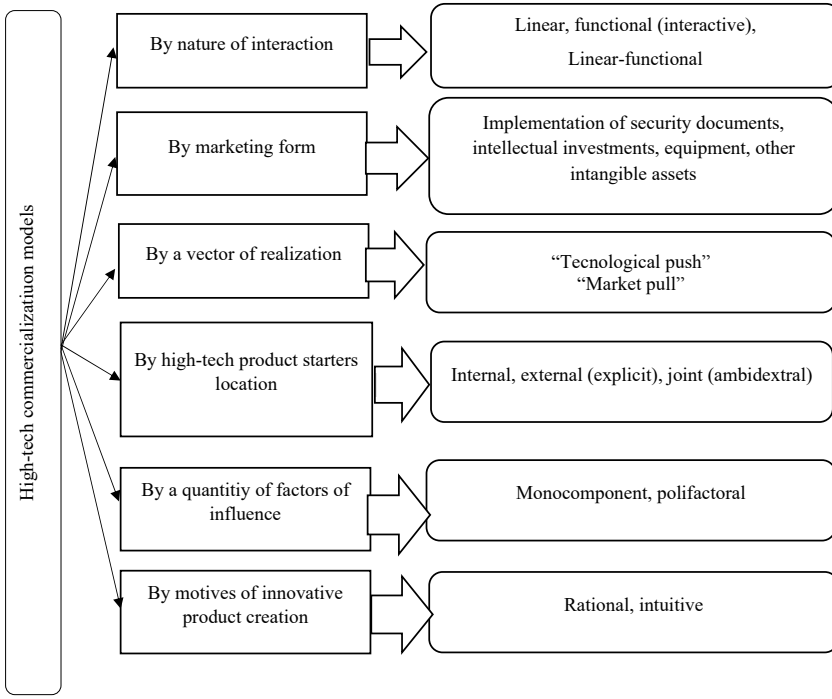


Figure 1.5. High-tech product commercialization model

Source: based on [54]

A dynamic organizational structure is suitable for companies engaged in project-based and innovative activities, and allows to respond faster to market changes thanks to the flexibility of management, fewer elements and decentralization. Such a structure supports new ideas and encourages a creative approach, it has a substancial potential of high added value for the enterprise. Innovative, financial, marketing, and production departments can be responsible for innovative processes.

A dynamic organizational structure includes the following organizational features:

– innovation commission: to consider the activity of the innovative enterprise;

– innovation team: implement ideas and turn them into innovations;

– innovation center: solve cases in the innovation process.

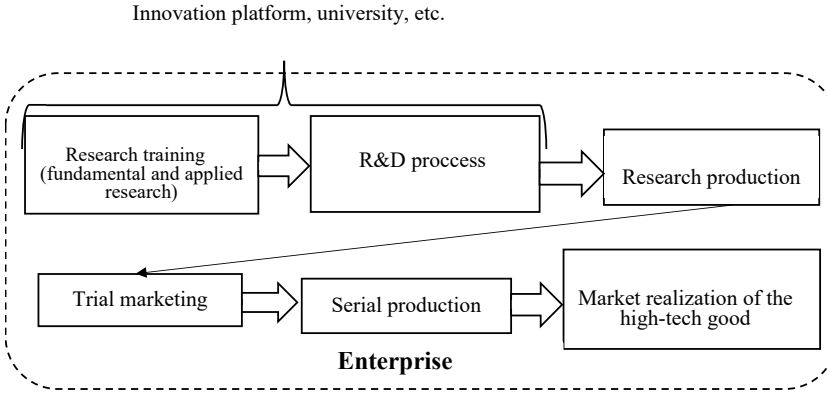


Figure 1.6. Technological push innovation model

Source: based on [157]

Despite the fact that current approaches to the organization of innovative activities in companies have changed significantly in favor of market-oriented methods, this model remains relevant and is used in scientific organizations, education institutions, in certain technological startups and spinoffs, in the organization of large projects, focused on creating breakthrough products.

The "market pull" model refers to the demand for a new product or solution to a problem coming from the market. A product is developed to satisfy the initial need. Market pull sometimes starts with potential customers bidding for improvements to existing products. Focus groups are often central to product concept testing (Figure 1.7).

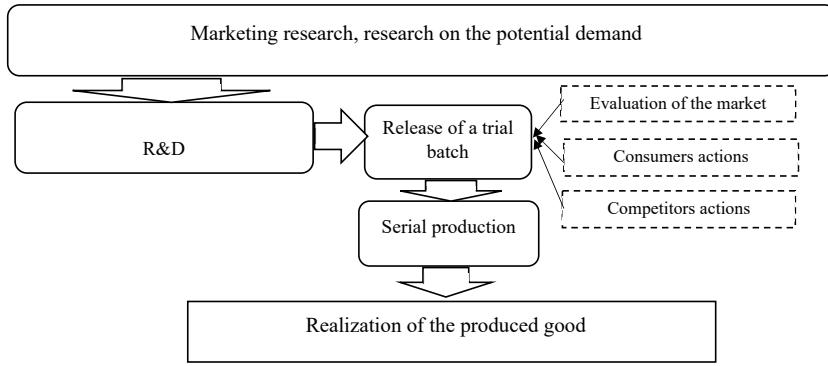


Figure 1.7. Market pull innovation model

Source: based on [90]

At the same time, the intensification of competition for market share became crucial, which made it necessary to shift the focus from scientific research to identification of market needs. Marketing and demand forecasting began to gain more and more importance. The orientation of the model is characterized by the scheme "from market relations to scientific research". It should be noted that the "market pull" model still describes the approach that is predominant in the organization of the process of commercialization of product and technological innovations in commercial companies.

A simple linear model of commercialization involves describing the process of creating and promoting any innovation to the market as a set of separate stages, the implementation of which is characterized by a clearly established sequence and unidirectionality. The main advantage of a simple linear model is the unambiguity of its process structure, which allows to establish a list of main tasks to be solved at each stage, to distribute responsibility for their implementation among the company's divisions, and to design a system of necessary relationships between divisions. Despite the fact that today this model is relevant even in the high-tech sphere, most experts consider it the least relevant to the dynamics of modern transformations. The following are the main disadvantages of the linear model:

1) the model is based on the false assumption that all innovative ideas are the result of specialized research services of the enterprise and arise as a result of R&D proccess. In fact, most ideas are produced by marketing departments or are the result of creative suggestions by staff;

2) the model ignores the role of the marketing function as the main coordinator of innovative developments. At the same time, the participation of marketing departments is necessary in the implementation of all stages of the innovation process without exception, because it ensures the consistency of qualitative parameters of new products with the specifics of demand, which ensures the effectiveness of the process of commercialization;

3) a simple linear model connects the activities of R&D services only with the implementation of initial stages of innovative development. This approach seems suboptimal, as it reduces the efficiency of further commercialization of development, because in the process of market promotion, operational improvement may be neccesary in accordance with consumer requests;

4) linear models ignore the complex of direct and reverse relationships that are established between the company's divisions during the implementation of innovative developments and their commercialization.

The defining characteristic of the second half of the 20th century is intensive technological development, which allowed the leading countries of the high-tech sphere to determine global geoeconomical transformations.

The central component of such a model is a new industrialization designed to ensure an intensive type of extended reproduction, a new quality of human capital, as well as the formation of a high-tech base of the economy as a key factor for increasing competitiveness and ensuring national security. Solving these problems requires an alternative reorientation of various engineering and technological systems to self-reproducing environmentally friendly technologies.

The growing level of prevalence of innovations contributed to the formation of the idea of the model of commercialization of a high-tech product as a model that is implemented within the framework of systemic and synergistic approaches. Such approaches involve analysis not in the form of a linear chain, but as a system of interaction of the entire complex of political, social, economic and organizational factors that determine the nature of innovative processes and commercialization prospects.

The "Connected model" is characterized by active feedback and asserts the subordination of each stage from the generation of the idea to its implementation in the demand, that is, complete integration into the commercialization process (Figure 1.8).

It should be emphasized that the transition from linear to functional through the intermediate "Combined Model" of commercialization of a high-tech product should be considered a revolutionary step in the development of the high-tech sphere. The interactive model predicts the unorthodoxity and heterogeneity of the innovation process, shows that the equal sources of high-tech innovative ideas are not as much logic of technological development as a market demand. This conclusion will significantly affect the dynamics of the development of the high-tech products market and outline its market specifics.

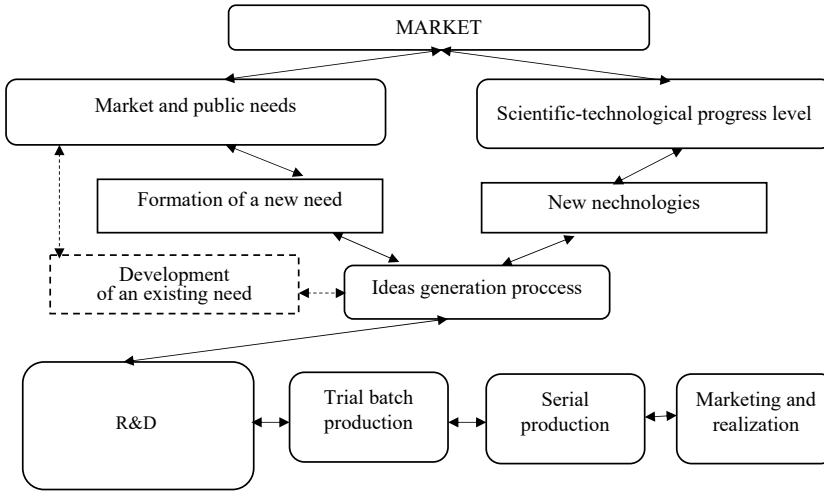


Figure 1.8. Combined high-tech product commercialization model

Source: based on [125; 138]

Before proceeding to the consideration of interactive models of the fourth and fifth generations of commercialization of a high-tech product, we shall consider it appropriate to pay attention to the Klein-Rosenberg chain model (Figure 1.9).

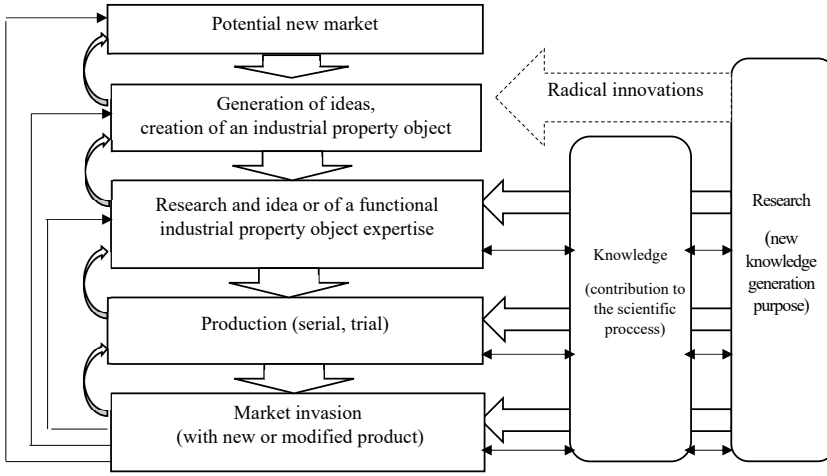


Figure 1.9. Klein-Rosenberg chain innovation model

Source: based on [171]

The linear perspective of innovative models has been challenged by modern innovations and empirical research. According to Rosenberg, a realistic conceptualization of the innovation process should be perceived as a series of changes resulting from the interaction of two forces, which leads to a constant and ultimately uncertain process of transformation of the interweaving of commercial and technological opportunities and constraints. Thus, "in the full picture, we must recognize not only that innovation is based on science, but also that the requirements for innovation often force us to create science" [182, p. 155].

The chain-linked model shows the paths of the vector of technical development that takes off not with research, but with a broad idea of potential use in the market, which is translated into a prototype, which over time initiates a feedback loop (Figure 1.10). At any stage of this process, scientific knowledge necessary for innovation is accumulated, new knowledge can be created in response [171].

The main features of the fourth generation model are: a complex interrelationship between scientific and research works and production of

goods; provision of services; strengthening cooperation with counterparts; improvement of organizational aspects of enterprise activity.

An example of the application of high-tech results are Japanese companies. This experience indicates the relationship between demand analysis and the introduction of innovative processes, as well as their impact on market demand [122] (Figure 1.11).

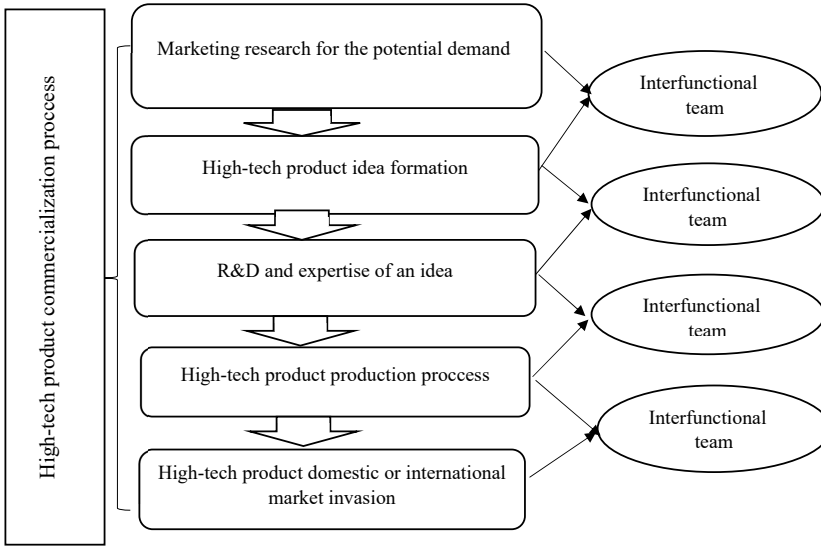


Figure 1.10. 4th generation interactive model

Source: based on [122]

The main distinguishable feature of the new generation of models of the fourth generation, in which the parallel development and commercialization of a high-tech product prevailed, is the emergence of the following functions: digitalization of the high-tech commercialization process; strengthening the interactive exchange of information between researchers; conducting continuous marketing: from basic research to after-sales service of finished products.

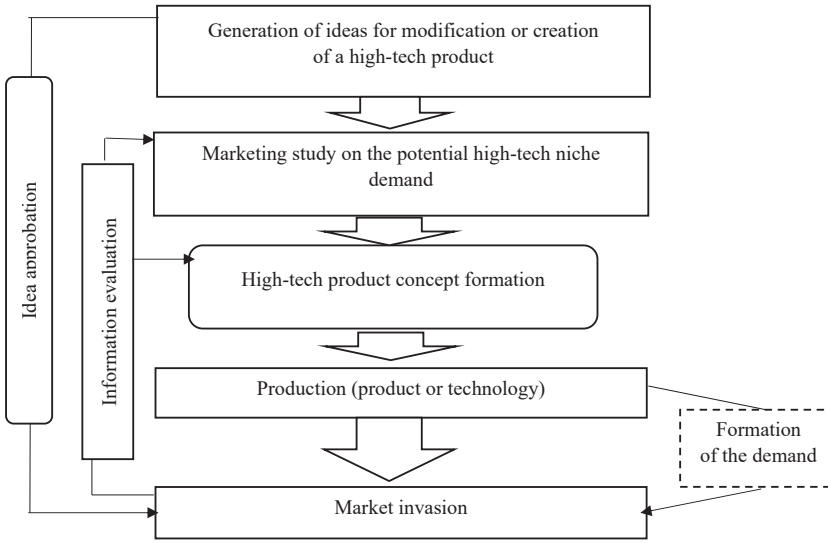


Figure 1.11. Japanese high-tech commercialization model

Source: based on [93; 97]

Some researchers also note the thesis about the role of relations between participants in the introduction and spread of innovative processes [68].

Thus, we can determine that the network model of commercialization of a high-tech product is a set of interconnected participants in the creation and commercialization of high technologies (or products), who gain free access to information and innovations. The networking model is characterized by high adaptability, responsiveness and openness, its form depend on the size of the enterprise and the scale of production (Figure 1.12).

Commercialization is becoming an increasingly important source of competitive advantage, and business investment in R&D and innovation is growing. Increased competition, shorter product life cycles, and expanded technological capabilities force manufacturers to innovate faster and focus R&D spending while seeking quick access to additional knowledge. The result of these shifts was the emergence of a new way of organizing industrial research, which is less focused on individual indicators, but in some cases relly more on small technological directions.

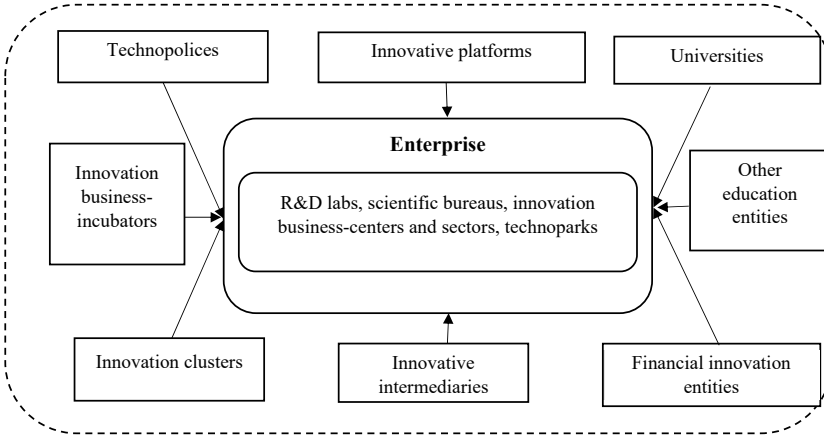


Figure 1.12. Networking model of the high-tech commercialization process

Source: based on [63; 131; 172]

Such collaborations can provide a solid basis for commercializing innovations and provide other potential benefits, such as facilitating access to new technologies and entering new markets through licensing. Rather than relying on internal resources, small high-tech companies are increasingly engaging in open innovation collaborations that can help partners effectively commercialize. Companies increasingly try to use external knowledge in the process of commercialization, although they may experience difficulties in creating an appropriate business model. Each specific business model creates different options in terms of speed, cost, potential of using access to the partner's intellectual property. Let us consider the main elements and characteristics of the studied model (Table 1.5).

Research within the network model has become a strong alternative that provides access to external sources of information. In the networking model, participants in commercialization of a high-tech product share and develop their knowledge together with others. Networks are the main way of coordinating market. The combination of information resources

in networks leads to the strengthening of innovative dynamics, which significantly accelerates commercialization.

Table 1.5

Basic strategic elements of the 5th hoigh tech commercialization model

Strategic elements	Pecularities
Time-based strategy Focusing on quality and other non-price factors is total quality marketing Corporate adaptability The client is the primary component of the strategy. Integration with partners Strategy of horizontal technological cooperation. Strategy of electronic data processing	Higher organizational and system integration Flexible organizational structure that allows for flexible adaptation to the current situation Fully developed databases Effective external communication channels

Source: based on [70; 153; 183]

The formation of the sixth generation model is a manifestation of the growing trend of the role of information and adaptability of enterprises to current situations. A feature is the risk of information asymmetry and possession of "hidden" knowledge [36].

Amongst the main elements of the sixth generation of high-tech product commercialization models, the following can be distinguished: a single information base of the organization; intangible assets as the main resource; flexibility of the organizational structure; resource mobility; principals as one of the most important links of the strategy, their direct involvement in the commercialization process; refusal of direct competition due to the strategy of integration with competitors (Table 1.6).

It is obvious that, in addition to the matrix organizational structure of the enterprise and partners, which directly influences the commercialization process, an important component of the external circuit should be agents that provide support for commercialization at the levels that determine the enterprise's environment. This will make it possible to build a system of integrated interaction between the enterprise and the given environment (economic, social, political, legal, etc.) for the purpose of effective management of commercialization.

Table 1.6

Basic strategic elements of the 6th hoigh tech commercialization model

Strategic elements	Pecularities
Time and space are compressed Focusing on intangible assets as the main resources of the organization Attention is paid to the ability to establish connections Co-owners are an important part of the strategy Strategic integration with competitors Focusing on hidden knowledge	Flexible structures and resource mobility Effective mechanisms for sharing internal and external knowledge Involvement of senior management Culture and a unified information base Relations with external institutions Mechanisms of identification, measurement, management of intangible assets

Source: based on [39; 152; 154]

At the end of the consideration of models of commercialization of a high-tech product by the nature of the interaction of elements, we shall note that some scientists, in our opinion, do not give a correct definition of the sixth generation of models as informational [194; 196. Closer to delineating the essence of the model is its definition by O. Petukhova as intellectual and informational [154]. At the same time, we believe that it is more accurate to define this model as an intellectual-communicative.

Depending on the location of the producers of high technologies and products, commercialization models can be differentiated into implicit (internal), explicit (external) and mixed. From the table 1.6 it is clear that both intra-corporate R&D, serial production and marketing (implicit model) and the acquisition of technologies (products) from external agents with further production and promotion (explicit model) are possible. A combination of these two models (mixed model) is also possible. Such a combination can significantly reduce the time for project implementation.

The implicit model seems to be the most expensive. Its implementation is used by transnational corporations, which create scientific research units and powerful marketing units within their organizational structure. The auditing company PricewaterhouseCoopers annually identifies twenty leading companies in terms of R&D spending (Appendix A) [52] (Table 1.7).

Today, TNCs operate in a dynamic, aggressive and multidimensional competitive environment, and their actions are described with the following features:

Table 1.7

Corporations – world R&D expenditure leaders in 2018-2019

Rating position as of 2022	Rating position as of 2021	Brand	State of origin	Branch	R&D expenditure (US$ bln.)
1	1	Volkswagen	Germany	Automobile	13.2
2	2	Samsung	South Korea	Computing and electronics	12.7
3	7	Amazon	USA	Software and Internet	12.5
4	6	Alphabet	USA	Software and Internet	12.3
5	3	Intel Co	USA	Computing and electronics	12.1
6	4	Microsoft	USA	Software and Internet	12.0
7	5	Roche	Switzerland	Healthcare	10.0
8	9	Novartis	Switzerland	Healthcare	9.5
9	10	Johnson & Johnson	USA	Healthcare	9.0
10	8	Toyota	Japan	Automobile	8.8
11	18	Apple	USA	Computing and electronics	8.1
12	11	Pfizer	USA	Healthcare	7.7
13	13	General Motors	USA	Automobile	7.5
14	14	Merck	USA	Healthcare	6.7
15	15	Ford	USA	Automobile	6.7
16	12	Daimler	Germany	Automobile	6.6
17	17	Cisco	USA	Computing and electronics	6.2
18	20	AstraZeneca	Britain	Healthcare	6.0
19	32	Bristol-Myers Squibb	USA	Healthcare	5.9
20	22	Oracle	USA	Software and Internet	5.8

Source: based on [159; 160]

Firstly, TNCs and their strategic management simultaneously focus on all competitive parameters: production costs, product quality, delivery time, development of know-how, market barriers and stabilization of the financial situation;

– secondly, TNCs implement global innovation strategies from different vectors at different levels: in the field of resources, in the markets of goods and services, in merged companies, etc.;

– thirdly, the positions of TNC competitors face dynamic changes, the situation on a global scale, markets are becoming less predictable, and forecasting periods are shorter. Today, biotechnology, nanoproduction, education, sociology, medicine and computer technology are the main areas for innovation;

– fourthly, the aggressive expansion of market competitors is growing in the global innovation market, legal conditions are being violated, and therefore, competition priorities are also changing.

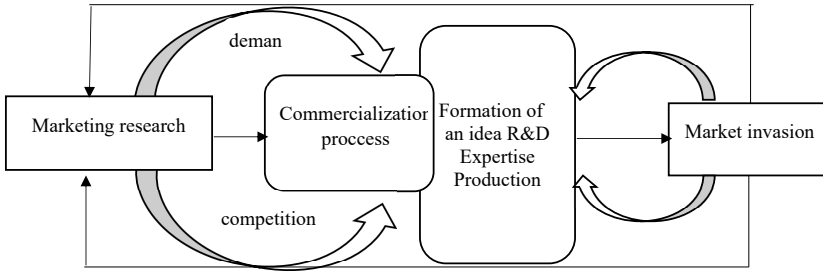
In addition to the considered models of commercialization, other forms of commercialization resemble own characteristics, namely: licenses, patents, franchising, engineering, consulting, leasing, etc. The use of certain direction of implementation of a high-tech product specifies the commercialization process and modifies the specific applied model.

In addition, the process of commercialization of a high-tech product can be influenced by non-market technologies: scientific and technical publications, exhibitions, conferences, forums, training, internships, retraining of personnel, migration of scientists and specialists, joint research and development by scientists of different countries, implementation of programs of international technical assistance, international cooperation of centers of scientific and technical information, etc.

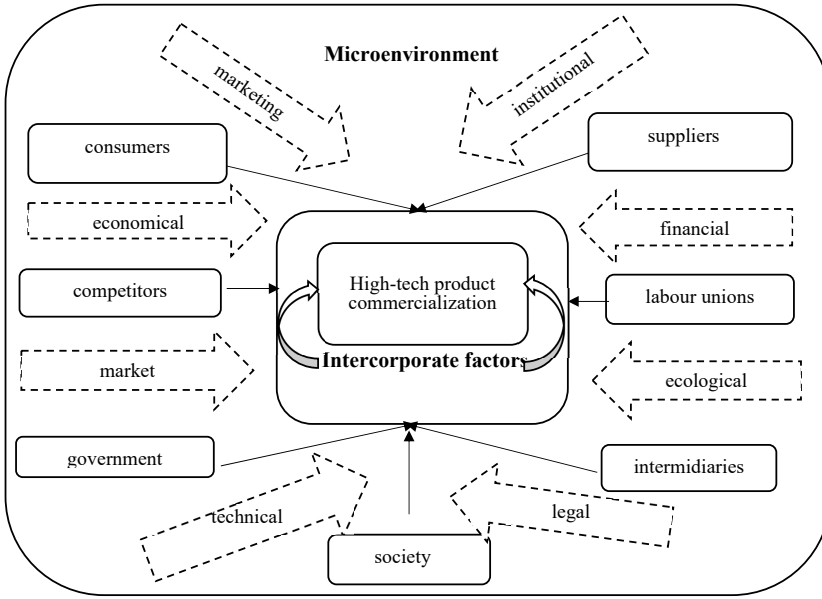
Thus, it is necessary to state that the commercialization of a high-tech product at current stage of social development is not determined by a single sustainable model. Depending on the tasks that a specific enterprise sets, an effective combination or transformation of various existing models is possible. It must be taken into account that modern society is based on the knowledge economy, that is, the institutions formed in society should meet the requirements that the modern knowledge economy puts forward.

On the basis of the conducted research, additional models are proposed for consideration according to the classification features

"by the number of influencing factors" and "by the motives of the emergence of commercialization ideas". According to the first sign, we suggest considering monocomponent and multifactor models (Figure 1.13).



а) monocomponential



б) policomponential

Figure 1.13. High-tech commercialization models

Source: author's investigation

The offer of such models is due to the need to take into account a significant number of factors influencing the process of commercialization of high-tech products. For example, in monocomponent models, the process of commercialization is carried out under the influence of a small set of factors, namely: only demand, or government order, competition or internal needs. Multifactor models, in turn, take into account influence of the main factors and subfactors on commercialization process of a high-tech product as a predominating category of the efficiency of the innovation process.

In addition to analyzed variety of models, it is suggested to use rational and intuitive models. Their formation mostly depends on the motives of generated ideas and market trends. Most often, rational modeling of the commercialization of high-tech products is a radical innovation that arises as a detailed and planned innovation project. As for intuitive modeling, this is, in our opinion, mostly a reaction to market needs.

Therefore, the analysis of models of commercialization of high-tech products covered almost all elements of the interaction of subjects of the innovation process at enterprises and outside, but we believe that rapid changes make it necessary to deepen the research in the direction of taking into account a large number of factors and risks.

1.3. Organizational Forms of Commercialization

Despite the growing importance of innovative activities of enterprises, the implementation of advanced research, business structures in every country face a number of barriers to access to financing, primarily asymmetric information and significant financial lags between investors and entrepreneurs. These imperfections of the innovative market justify the state. In addition to creating framework agreements that facilitate R&D investment and commercialization, governments use various instruments such as credit subsidies, tax breaks, and government support for venture capital. Grants and subsidies are considered particularly effective in easing financial constraints for high-tech small and medium-sized enterprises, especially in the early stages of development. Seed funding can help entrepreneurs not only gain access to finance, but also overcome the "valley of death" that occurs between the point of innovation creation and its commercialization to the end consumer. In the annual review of the OECD, the main instruments for financing small and medium-sized enterprises with the aim of promoting innovation are given (Table 1.9).

Table 1.8

The main instruments for financing SMEs with the aim of promoting innovation

Financial instrument	Key features of investment	Notes
Banking credit	Used as one of the most common tools for accessing finance, it requires collateral or guarantees in exchange for loans.	Debt payment obligation
Grants	It is used as initial financing of innovative "Startups" and SMEs at the embryonic and early stages: small business innovation studies in the United States of America, Great Britain and the Netherlands; preferential tariffs in Denmark and Germany: OSEO financing in France; Innovation and investment fund in Great Britain.	Supplements market failures, seed and seed funding
Business Angels	A source of funding at early risk stages and provides financing, consulting and business management coaching.	Funding for "Start-up" and early stage
Venture capital	As a rule, they invest in the form of groups and networks, for example Tech Coast Angels and Common-Angels in the USA, Seraphim Fund in Great Britain. As a rule, more and more investments are made in the later, less risky stages of growth. Called "patient" capital due to a long period of time (10-12 years) for investing, maturing and finally getting a result, for example Pre-seed Fund and Innovation Investment Fund in Australia, Yozma Fund in Israel, Seed Fund Vera in Finland, Scottish Co-investment Fund in Great Britain.	Late-stage expansion financing
Corporate venture investment	Used by large companies. Investments in innovative "Startups" with the aim of increasing corporate competitiveness to solve strategic or financial goals.	Strategic motive
Croudfunding	An online crowdfunding tool that makes it easier for small business entities to raise seed and early stage capital.	Potential for fraud
Tax incentives	A wide range of tax incentives for both R&D and business investment in most countries, such as the Enterprise Investment Scheme in the UK, the Wealth Tax Credit (ISF) in France, the Business Expansion Scheme in Ireland.	Indirect, non-discriminatory

Source: formed based on [148]

The formation of national innovation systems becomes possible thanks to the creation of the appropriate infrastructure. Venture funding is considered the most suitable for investing in such infrastructure. Here, trends in the development of venture capital investments in the world are investigated. It was determined that the sphere of global investment priorities is now focused on social technologies that ensure sustainable development.

Venture funds accumulate venture capital and invest the accumulated funds in projects characterized by the highest level of risk. The structure of venture capital varies depending on the sector of the economy.

According to research, Ukraine has focused on financial support for innovative enterprises in retail trade and construction, financial services and communication, which means that venture funds in Ukraine are created for short-term projects of medium and low risk. The development of venture financing in Ukraine is restrained by the following factors: lack of funding sources; a small number of projects with a marketing strategy and market potential; lack of experienced specialists who have the technology to select promising innovative projects. In Ukraine, the development of venture capital investment is hampered by the growth of financial, economic and political-legal risks, which can inevitably lead to loss of income (Figure 1.16).

The current situation can be improved by creating favorable conditions for the generation and implementation of business ideas through the integration of science and production. The most effective organizational and economic form is technological parks, which are able to combine the potential of universities, research structures, industrial enterprises and subjects of innovative infrastructure into clusters. Clustering will contribute to the innovative development of the state and its regions [Butko B. O.].

The OECD report emphasizes the important role played by "Business Angels" in financing firms with high growth potential. "Business Angels" are private individuals with business experience who directly invest part of their personal assets in new growing companies that are not listed on the stock market (Figure 1.14).

Although angel investing has been around for centuries, the concept of angel investors as a powerful source of financing for emerging companies has emerged over the past few decades in the US and Europe and is growing rapidly in other regions of the world.

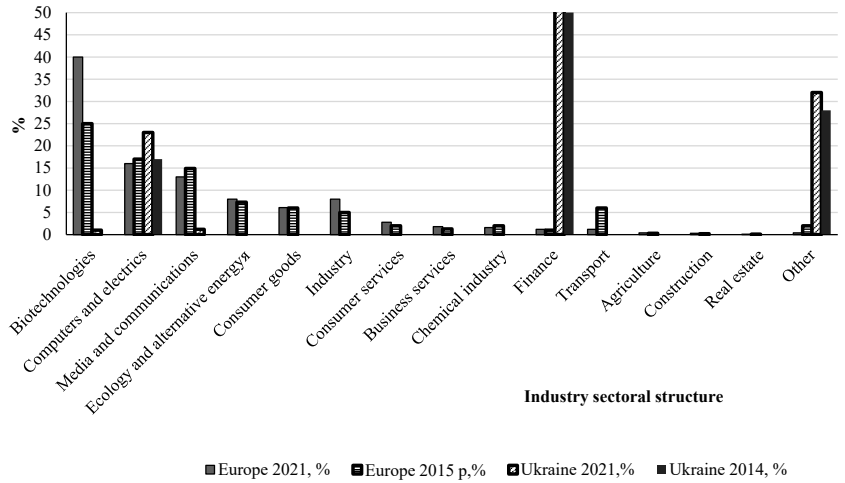


Figure 1.14. Comparative characteristics of the sectoral structure of venture investments in Ukraine and in European countries in 2014-2019 in %

Source: formed based on [89]

The "Angels" investment sector is not only growing, but is becoming more formalized thanks to the creation of "Angels" networks. In addition to the money provided, angel investors play a key role in providing operational expertise to new ventures, as well as social capital (i.e. their personal networks).

We will also consider additional features of the activity and attraction of financing from "Business Angels". First, campaigns with high risk and high return potential are preferred. Second, preference is given to start-ups and the absence of industry advantages. It should be noted that investing in risky projects related to high-tech production is gaining volume and requires more and more information about the transparency of activities and the profitability of projects. Crowdfunding is another tool for financing risky investment projects, which has recently gained significant popularity.

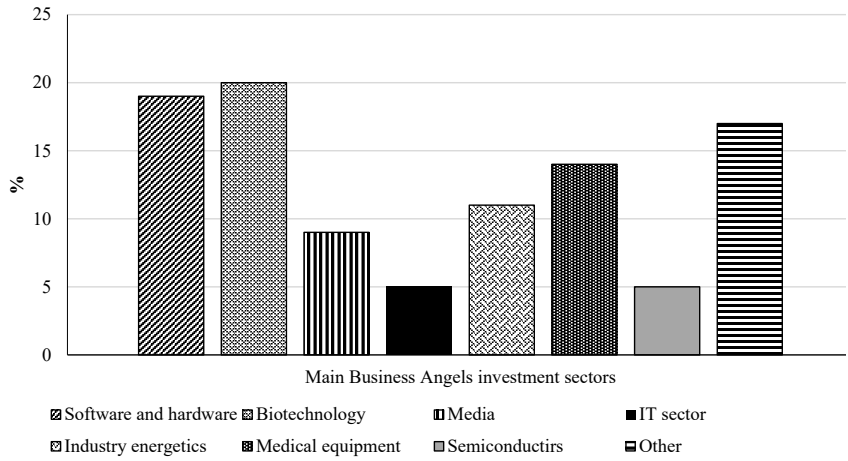


Figure 1.15. Market segments in which Business Angels invest

Source: formed based on [63]

Crowdfunding is the practice of financing a project or enterprise by attracting investments from a large number of private investors. As a rule, most successful projects receive about 25-40% of their income from the first, second and third degrees of pooling of funds. This is a circle of connected persons. If the project is successful, unrelated consumers start investing to support these campaigns.

According to data published by Massolution (a research firm specializing in the analysis of mass business processes), the global crowdfunding figure reached $34 billion in 2018, which is equivalent to an increase of almost 7 times compared to 2016 [45]. In 2018, the total amount of funds raised in the EU amounted to 4.2 billion euros [61].

Thus, the structural elements of the innovative component of the institutional environment of the commercialization of a high-tech product, namely: institutions of venture investment funds and support networks of high-tech ideas, which we have considered, provide a complete vision of the institutional foundations of the commercialization of a high-tech product from the point of view of the innovation process.

In our opinion, the central institution of the informational component of the institutional environment for the commercialization of a high-tech product is the support of small and medium-sized enterprises.

Small and medium-sized enterprises (SMEs) play an important role in most economies, especially in developing countries. They represent about 90% of enterprises and more than 50% of the employed worldwide. SMEs contribute up to 40% of national income in developing economies. These figures are much higher if informal SMEs are included. It is estimated that 600 million jobs will be needed to support the growing global workforce by 2030, making SME development a high priority for many governments around the world. However, access to finance is a key constraint to SME development and is the second most cited barrier for SMEs to develop their business [206].

SMEs are less likely to get bank loans than large firms; instead, they rely on internal funds or cash from friends and family to launch and begin operating their businesses. The International Finance Corporation estimates that 65 million firms, or 40% of formal micro, small and medium-sized enterprises (MSMEs) in developing countries, have an unmet need for financing of $5.2 trillion each year, equivalent to 1.4 times the current global lending to MSMEs. The size of the gaps varies significantly by region. In particular, in Latin America and the Caribbean, as well as in the regions of the Middle East and North Africa, the largest share of the financing gap compared to potential demand is 87% and 88%, respectively [206].

Stimulating the development of small and medium-sized businesses has always been an important task in most countries. Innovative socio-economic development is impossible without the dynamic development of small and medium-sized businesses. Over 20 years ago, there was an explosion of small business activity, especially in Western economies. Costs associated with a high degree of risk in lending to small and medium-sized businesses are transferred by banks to borrowers due to high loan interest rates or the requirement of large amounts of collateral. In the event that due to the high degree of banking risk, the availability of loans on acceptable terms for enterprises is reduced, foreign SMEs have the opportunity to use various types of support, namely the services of specialized institutions: guarantee institutions thanks to the intervention that reduced the level of bank credit risk, and credit cooperatives that provide financing for small

and medium-sized enterprises on more favorable terms compared to banks (Figure 1.16).

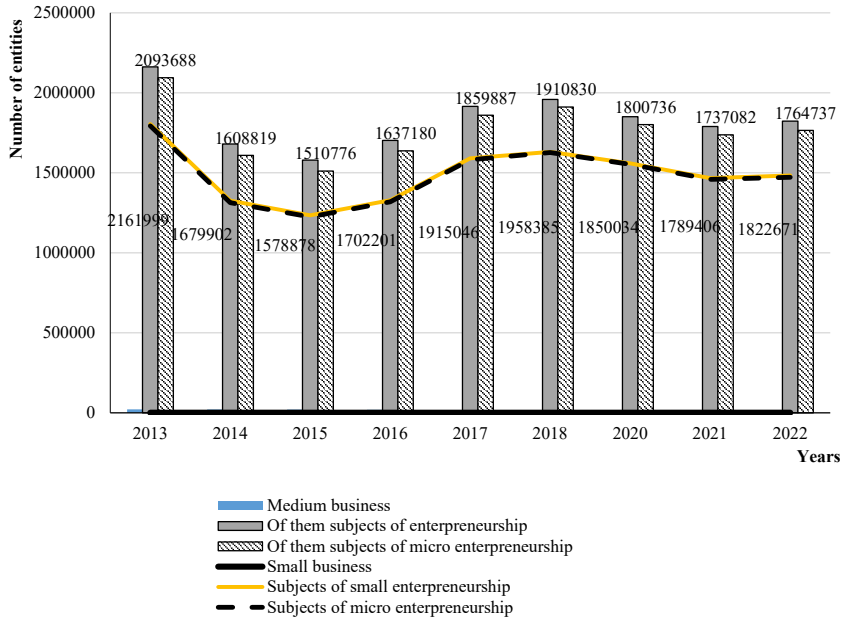


Figure 1.16. The number of subjects of medium, small and micro enterprises by types of economic activity in 2010-2018

Source: formed based on [101]

The main problems faced by small and medium-sized enterprises during the economic crisis: most Ukrainian banks did not provide loans to SMEs, and those that did, did so under rather unfavorable conditions. For example, loans in dollars or euros.

No one could predict what the exchange rate might be when the loan came due; extremely disorderly regulation in all spheres of the economy; inactive legislation on entrepreneurship, despite reforms in some areas regarding non-compliance with laws and orders of the Cabinet of Ministers by the majority of representatives of all levels of government; imbalances

due to political differences and inefficient public administration and judiciary; unprecedented corruption.

The study of the public-private partnership program deserves special attention (Figure 1.17).

Public-private partnership in Ukraine is declared as a system of mutual relations between the public sector and Cooperation is implemented on a long-term basis for the creation and reconstruction of existing facilities that require investment and use of these facilities. Public-private partnership projects were implemented by both economically developed countries and developing countries facing the problem of rebuilding the national economy in adverse conditions. Their experience proves that such projects allow attracting private capital to infrastructure in the short term, ensuring rapid economic growth, even if the amount of public investment is not significant.

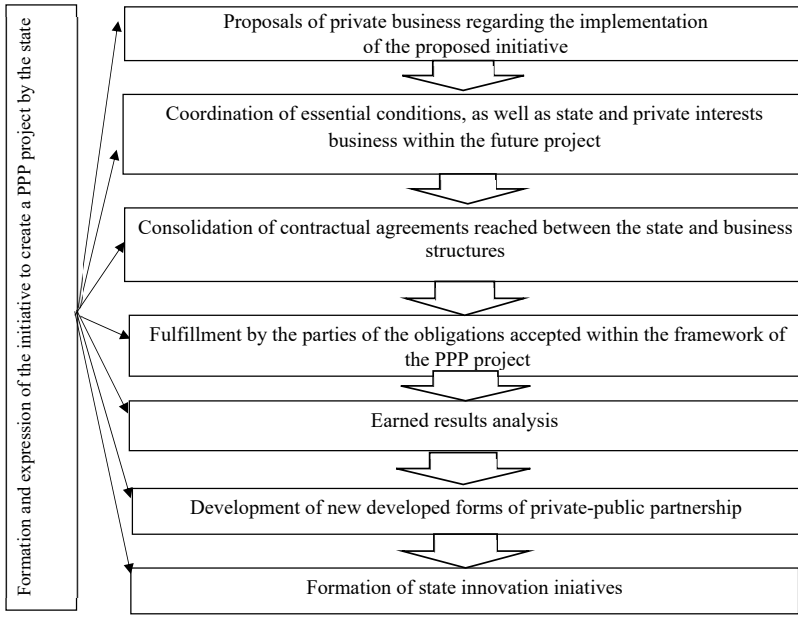


Figure 1.17. Scheme of interaction of public-private partnership participants

Source: formed based on [112]

There are certain conditions that can contribute to the effective implementation of the PPP mechanism in Ukraine.

Thus, the implementation of large-scale modernization projects in various sectors requires significant investments. At the same time, during the current phase of post-crisis development, we can observe the growing interest of business in state support, which will reduce the risks of private investments and increase the reliability of investment projects for credit institutions.