CHAPTER 2
STUDY OF CONDITIONS FOR THE DEVELOPMENT OF OF HIGH-TECH PRODUCT COMMERCIALIZATION IN THE SYSTEM OF INTERNATIONAL BUSINESS

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2.1. Overlook of the High-Tech Products Market Modern Development

The formation and development of the modern strategy of high-tech products commercialization in the system of international entrepreneurship is directly influenced by the main characteristic of the modern world economy – the expansion and deepening of globalization processes. The increase in the pace of scientific and technical progress and the formation of the information society was clearly manifested in the formation and rapid development of the market of high-tech products, which is determined as the main driving force of economic globalization. It is considered appropriate to define the existence of a dialectical paradigm – on the one hand, the globalization of the world economy deepens the dynamics of the development of the high-tech products market, on the other hand, the development of the high-tech products market accelerates the actual globalization processes.

In the first chapter of this study, considering the theoretical foundations of the analysis of the commercialization of high-tech products, we determined that the economies of modern developed countries have the ability to quickly develop and implement technological innovations. Thanks to the inherent self-organization property of innovations, they concentrate and group at the moment of reaching a critical mass of interaction within the innovation cluster, which causes a powerful cumulative growth of the economy.

The appearance of a cluster of basic technologies leads to the emergence of new industries, the launch of long economic cycles, forming the increasing stage of the M. Kondratiev cycle. The set of clusters of basic innovations forms a technological structure [95].

The theory of technological systems, that is, the formation of a set of technologies that correspond to a specific historical stage of the development

of the economic system, with subsequent replacement by the next, more progressive system, in the known sense is the development of the ideas of M. Kondratiev [108]. Today, the world economy is on the threshold of the sixth technological order. Some researchers claim that the sprouts of this system arose at the end of the 20th century. The contours of the sixth order are actively formed mainly in developed countries, primarily in the USA, Japan, the European Union and China, and are characterized mainly by targeting the development and application of knowledge-intensive or, in other words, high technologies. In the process of studying the specifics and development trends of the world market of high-tech products, it is necessary to provide a description of the sixth technological order, its main and fundamental differences from previous orders.

A synergistic approach to considering the specifics of the development of the world market of high-tech products requires an analysis of this process at the regional and industry levels. In order to determine the place in the field of innovative competition of a certain country, industry or enterprise, researchers orient on the Frascati Guidelines "Proposed Standard Practice for the Survey of Research and Experimental Development" [144] and the Oslo Guidelines the"Recommendations for the Collection and Analysis of Innovation Data" [147]. These recommendations are the main methodological documents of the Organization for Economic Cooperation and Development in the field of innovation for both member countries of the organization and a number of countries in the rest of the world.

The key indicators of the innovation potential of an individual country are the following:

1. The specific weight of R&D to GDP (is a relative indicator and is an indicator of the innovative component in the total product of the country. Today, the normal value for this indicator is 3% – Figure 2.1).

2. R&D expenditures per capita (is an absolute indicator and shows the state of innovative development of society in general). During the last time, the number of scientific employees has significantly decreased (20% compared to 2013), while in Poland their growth is observed by 45%, in the USA by 6%, in Germany by up to 16% (Figure 2.2). Based on the obtained data only existing reforms are not enough to change the situation with innovative progress in our state in the high-tech sector.

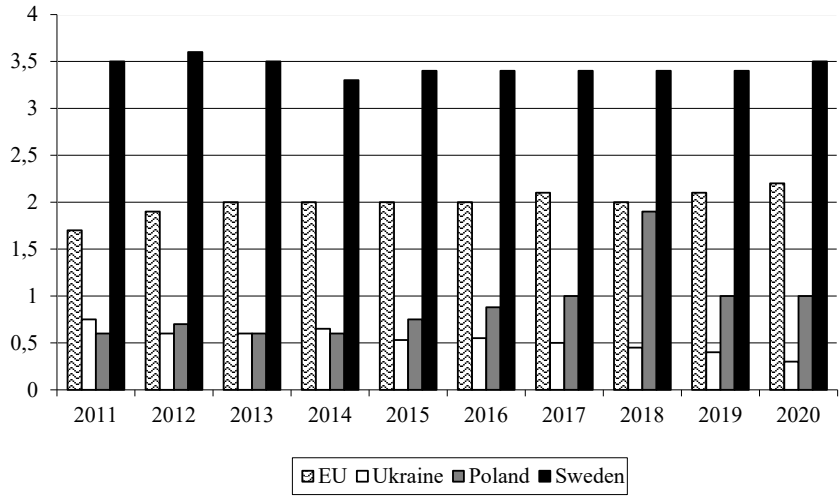

Figure 2.1. Dynamics of financing of research and development costs in the EU and Ukraine 2010-2019, % of GDP

Source: formed after [92; 165]

In the process of research, it is necessary to determine the priorities of the further development of the scientific sphere on the part of the government. In accordance with the adopted Innovation Development Strategy, a number of promising key indicators for state allocation from 2021 to 2025 have been approved (0.4%, 0.8%, 1.2%, 1.6%, 1.7% to GDP per year respectively).

3. The specific weight of state allocations for R&D is a relative indicator and reflects the influence of the public sector on innovative progress. In accordance with the Law of Ukraine "On Scientific and Scientific and Technical Activity", a constant amount of R&D spending is defined, which is a minimum of 1.7% of GDP per year. The reflection of the structure of funding sources according to some of the most progressive indicators of the development of science and technology indicates a disappointing situation for Ukraine in comparison with France, which is close in terms of parameters, where funding amounts to 59.4 billion dollars. USA, while in Ukraine – 0.25 billion dollars. USA (Figure 2.3).

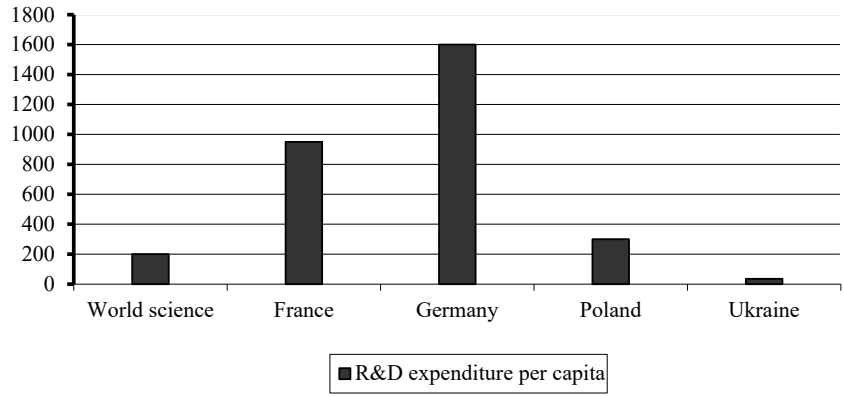

Figure 2.2. Share of R&D funding of individual countries in 2019

Source: formed after [213]

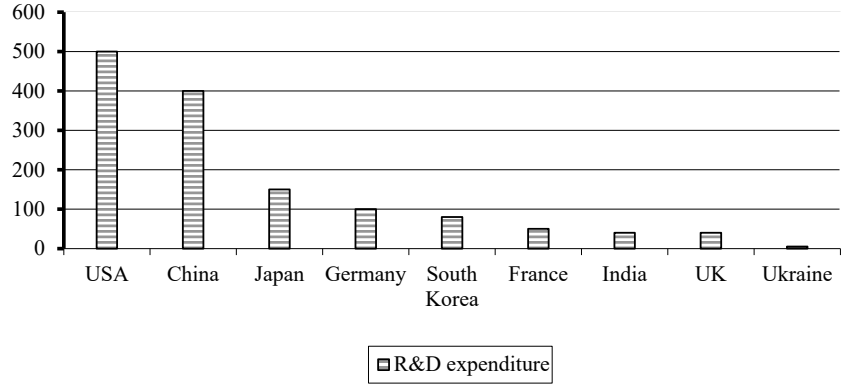

Figure 2.3. The structure of R&D funding sources in developed countries in 2019

Source: formed after [200; 201]

4. The number of specialists employed in science and scientific service, including the number of the country's population (Figure 2.4).

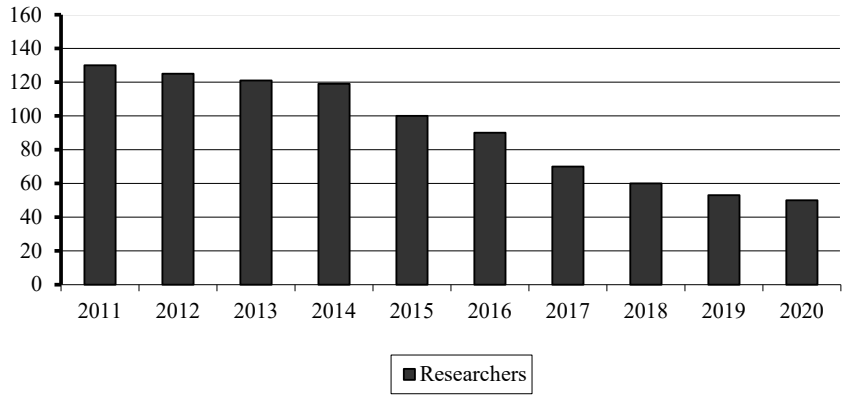

Figure 2.4. Dynamics of the number of researchers and scientific output in Ukraine in 2010-2019

Source: formed after [2]

Analyzing the data presented in the figure, we can draw a conclusion about the drop in the number of researchers and, as a result, the scientific content of products. Such a tendency is fully justified, taking into account the indicators of the remuneration of employees of scientific institutions and, as a result, the lack of motivation to implement innovative projects.

5. The number of international awards for outstanding scientific achievements (this indicator indicates the international recognition of the country's scientific achievements).

6. Citation index of scientific works, frequency of references in scientific works to the works of researchers of the country (Table 2.1).

7. The share of industrial and science-intensive products in GDP. According to the statements of the US Science Foundation, industries in which the share of R&D expenditures is more than 3.5% and the share of scientific personnel is at least 2.5% are considered science-intensive.

8. The country's share in the world market of high-tech products or technologies (the indicator is determined as a percentage when analyzing industries that are generally recognized as high-tech and characterizes the competitive position of the country in the relevant market). The ratio of

innovation technologies and human capital of the country makes it possible to reflect the general trend of development and improvement of production in particular and the national economy as a whole (Figure 2.5).

Table 2.1

Publishing activity in Ukraine in 2016-2019

Years	Number of pulications in scientific journals, indexed in Scopus			The share of publications in scientific journals indexed in Scopus, in the total number of publications, %	
	Alltogether in Ukraine	ZVO	National Academy	ZVO	National Academy
2018	11 151	6 166	4 820	55,3	43,2
2019	12 379	7 291	4 779	58,9	38,6
2020	13 833	8 770	4 570	63,4	33,0
2021	14213	9231	4665	64,5	33,5

Source: *formed after [2]*

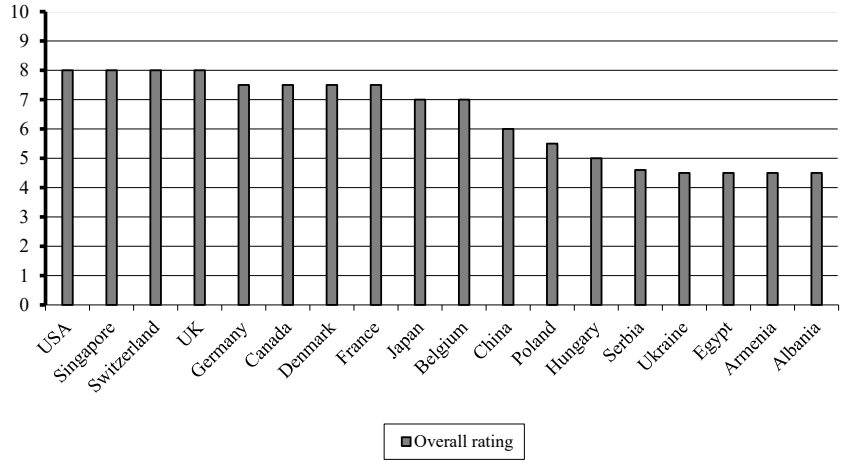

Figure 2.5. Ratings of countries according to the "engine of production" criterion in 2018

Source: formed after [210]

According to the studied criteria, the United States of America has the highest value of the comprehensive rating in most positions, the highest value of the "Technology and Innovation" criterion certainly leads to the growth of trends in global trade and the inflow of investments in science-intensive industries. In the overall rating, Ukraine takes 67th place, which indicates a large number of shortcomings in the innovative sphere.

According to the data of the Industrial Research Institute, published in the "Forecast of Global R&D Funding in 2021", in recent years there has been a noticeable trend towards a decrease in the share of North America and Europe in global R&D spending, where the share of North America decreased by 0.2%, Europe – by 0.8%. At the same time, Asian countries increased funding by 1.6% during this time.

In general, according to the researchers' forecasts, worldwide R&D expenditures will amount to more than 2.0 trillion US dollars. The United States of America remains the largest investor in research and development in the world. In 2017, R&D spending in this country amounted to $527.46 billion (Appendix A).

Although China lags behind the US in gross R&D spending, its growth rate over the past three years is almost 2.5 times higher than that of the United States (15.21% to 6.16%, respectively). It should be noted that the leaders are four Asian countries – China, Japan, South Korea and India – and only three countries represent Europe, namely: Germany, France and Great Britain. Ukraine is not included in the list of 40 leading countries in terms of domestic R&D spending and is inferior to such countries as Mexico, Iran, Poland, Egypt, Pakistan, South Africa and Bangladesh. Thus, ten countries account for more than three-quarters of all global R&D spending (77.75%), which certainly provides them with competitive advantages in their respective markets.

It should be noted that the R&D financing system abroad (primarily in the USA, Japan, China, and Western European countries) is characterized by the presence of various sources of funds:

1. State (state budget or special funds).
2. Industrial corporations (R&D financing from own sources).
3. Higher educational institutions (private and state universities, colleges, higher technical schools).

4. Non-commercial organizations, such as university research units, business research corporations, professional scientific and technical societies, private charitable foundations, independent research institutes.

5. Foreign investment capital.

The special role of the state in financing the creation of a high-tech product is explained by a number of reasons:

1. Large-scale and tending to increase expenditure of financial resources necessary for the organization of research, remoteness in time of their return on capital, limit the possibilities of private capital investment in some areas of research and development, especially in fundamental research.

2. The degree of development of R&D and the depth of penetration of scientific ideas and developments into production becomes a decisive factor in the security and competitiveness of countries in the world market, which requires the active participation of the state, including through the investment of these processes.

State financing of the innovation sphere, especially in the high-tech sphere, allows to carry out scientific research, which is impossible even for a large private business, the practical significance of which can be manifested only in a rather distant perspective and contributes to the development of fundamentally new directions of science and technology.

The principle functions of state regulation in the high-tech sphere are as follows:

– creation of funds for financing R&D activities;

– coordination of activities of market entities (innovation policy);

– motivation of innovative development and competitive structure of the market, hedging of risks, development of fiscal measures to avoid or strengthen active depreciation policy by enterprises;

– formation of an adequate and transparent legal framework for relations in the innovation sphere, including the protection of intellectual property rights for inventions;

– promotion of the strategic formation of personnel in the innovation sphere;

– development of high-tech infrastructure;

– promotion of long-term institutional provision of the high-tech sector within the limits of the state's competences;

– promotion, encouragement and compensation of environmentally friendly programs;

– promoting the growth of the prestige of scientific and research activities in society;

– consulting local authorities on interaction with the high-tech sector;

– utilitarian and pragmatic regulation of international aspects of the relevant activity.

It should be noted that the public sector in developed countries, although it is an important source, occupies a secondary place in the financing and implementation of innovative developments.

In general, researchers evaluate innovation strategies in the global world based on an ever-widening list of indicators, emphasizing the complexity of the modern innovation process.

Today, the global trend of analyzing the state of innovative activity of different countries, which is guided by composite indexes of economic indicators, has become obvious. Among the most authoritative are the following: Technological Development Index, Global Innovation Index, Innovation Development Index, Knowledge Economy Readiness Index. In order to calculate such indices, various sources are used, in particular, statistical data and the results of expert assessments.

The most popular of those listed today is the Global Innovation Index, created with the participation of leading experts from international organizations and institutions in the USA, Germany and Switzerland. This index consists of 80 indicators that clearly reflect the state of innovation progress of countries at different levels of development. The majority of researchers believe that the success of the economy is related to the presence of innovative potential and the appropriate conditions for its implementation. Accordingly, the index is calculated as a set of assessments in two areas of indicators: the resource base and the available opportunities for carrying out innovative activities; realized achievements in the process of innovative activity. The general index is the ratio of costs and benefits, which is an objective assessment of economic innovation processes (Appendix B) [42; 206; 208].

Similar ratings use commonly used methods of data collection and questionnaire data of the management of high-tech enterprises. The survey has an annual frequency, organized by the World Economic Forum.

This year's survey covered 15,000 managers from 140 countries. Recently, the list of sections of the survey includes an analysis of the advantages and disadvantages of the competitiveness of the countries under study.

In addition to the above, the review of the World Economic Forum indicated two additional indices, namely: the Business Competitiveness Index and the Global Competitiveness Index, which specialize in summarizing the international competitiveness of the countries under study (Table 2.2).

Table 2.2

Ranking of countries according to the Global Competitiveness Index in 2015-2019

Rating no.	Years				
	2017	2018	2019	2020	2021
1	Switzerland	Switzerland	Switzerland	USA	Singapoure
2	Singapoure	Singapoure	USA	Singapoure	USA
3	USA	USA	Singapoure	Germany	Honkong
4	Germany	Netherlands	Netherlands	Switzerland	Netherlands
5	Netherlands	Germany	Germany	Japan	Switzerland
6	Japan	Sweden	Honkong	Netherlands	Japan
7	Honkong	UK	Sweden	Honkong	Germany
8	Finland	Japan	UK	UK	Sweden
9	Sweden	Honkong	Japan	Sweden	UK
10	UK	Finland	Finland	Denmark	Denmark
79	Ukraine	Armenia	Tadjikistan	Jamaica	Trinidad and Tobago
81	Greece	Brazil	Ukraine	Argentina	Albania
83	Armenia	Cyprus	Trinidad and Tobago	Ukraine	Argentina
84	Laos	Namibia	Gvatemala	Northern Macedonia	Shri-Lanka
85	Moldova	Ukraine	Shri-Lanka	Shri-Lanka	Ukraine
86	Namibia	Greece	Aljeria	Ecvador	Moldova
87	Jamaica	Aljeria	Greece	Tunisia	Tunisia

Source: formed after [208]

Based on the above, we can note that over the past 10 years, the leaders of the rating have remained unchanged: Switzerland, Singapore and the USA, which indicates the constant financing of innovative growth factors of

the national economies of these countries. Ukraine has the same unchanged position during this period, namely: the 80th position in the world rating, which indicates that there are practically no positive changes. A noticeable correlation between the two indices indicates that the basis of a certain country's high competitiveness is the prompt implementation of high technologies, primarily the sixth technological order.

Currently, developed countries are still the leading producers of high-tech products, but the contribution of other economies to the innovation sphere is growing. For example, the Indian government has steadily increased R&D expenses relative to gross domestic product. The governments of many other developing countries and countries with transition economies face this task. Thus, in the near future, the emergence of new serious players on the world market of high-tech products is not excluded, which, in our opinion, is fully consistent with the theory of cyclical development of economic systems.

2.2. Analysis of Intercorporate Factors of Domestic Enterprises Entry to International Markets

The import priority of the private sector in the formation and development of the high-tech products market, formation of its socially responsible role requires special attention to the essential characteristics of the internal environment of high-tech enterprises and requires a thorough analysis of the main intra-corporate factors of their development.

The model of the sixth generation of commercialization of innovations and its specification in the institutional environment clearly outlines the central place of the enterprise in the process of commercialization of high-tech products with the use of appropriate institutions and institutes. It is the intra-corporate factors for each individual enterprise that are the basis on which the commercialization of a high-tech product and its successful implementation in the system of international entrepreneurship is possible.

Since any enterprise can be considered as an object capable of self-organization and self-control, the internal environment primarily determines the nature and success of its activities. Private enterprises are open systems consisting of numerous interconnected parts, which are closely connected to the outside world. Interaction with the external institutional and commercial environment under unbalanced dynamic conditions practically uses the processes of self-organization of private business and forms adaptive

mechanisms. It is the internal environment of high-tech companies that determines the effectiveness of their self-organization processes, whether they will allow effective commercialization of the product and whether they will contribute to the company's entry into the international market of high-tech products.

The most important components of the internal environment of the enterprise are defined as internal variables. They distinguish a specific enterprise from the external environment. Such internal variables with a strong circular connection include the following: goals; task; structure; technology; staff.

In accordance with the task of forming a modern strategy for the commercialization of a high-tech product based on multifactor models, it will be appropriate to offer the model of the enterprises internal factors (Figure 2.6).

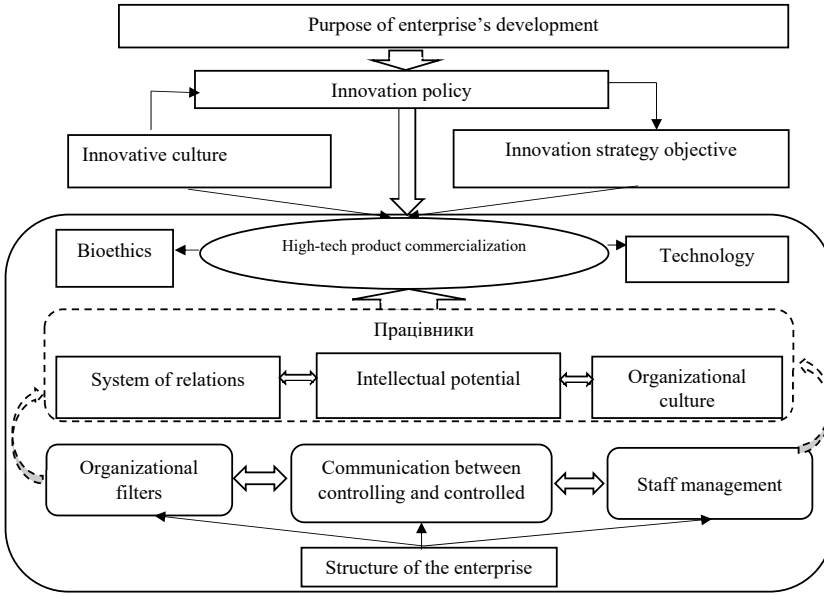

Figure 2.6. The system of internal factors of the enterprise in the aspect of commercialization of a high-tech product

Source: author's investigation

Within the framework of the study, the main goals of high-tech enterprises are the creation of an innovative high-tech product, its commercialization and introduction to the world market, obtaining competitive advantages and correspondence with commercial benefits, taking into account social and environmental priorities.

In accordance with the specified goals, high-tech enterprises also form a system of tasks. In general, this system unites three main areas of activity of companies: work with people, objects and means (means of production) and information.

The structure of the company is a logical relationship between management levels and functional areas, built in such a way that provides an opportunity to effectively achieve the company's goals. Today, the vast majority of high-tech companies utilize a network-matrix structure.

Technology in this context as an internal variable of the company has certain differences from the definition of the term "high technologies. In our opinion, the most successful definition of technology in this context is its outline by L. Davies: "Technology is a combination of qualification skills, equipment, infrastructure, tools and relevant technical knowledge necessary to implement the desired transformations in materials, information or people" [53, with. 408].

The leading form in which the internal variable technology is implemented in high-tech companies is R&D. It is effective R&D that creates appropriate opportunities for high-tech enterprises to ensure commercialization and a sufficient level of competitiveness on the international market. At the initial stage, a high-tech company develops an R&D strategy and carries out a detailed analysis of available and necessary resources. Then the direct process of R&D is carried out, which ends with obtaining a certain result – a suitable product or technology. The next step is the formation of an economically justified strategy, which is based on the correlation of the product or technology obtained as a result of R&D with the needs of the consumer [137]. At this stage, a high-tech company has two possible directions in making a decision regarding commercialization and organization of mass production based on an experimental product sample:

1) compliance of the experimental sample of products (technology) with the existing needs of the consumer;

2) the strategic capabilities of a high-tech company in forming the appropriate need of the consumer for the product (technology), if it is not immediately detected by the consumer (Figure 2.7).

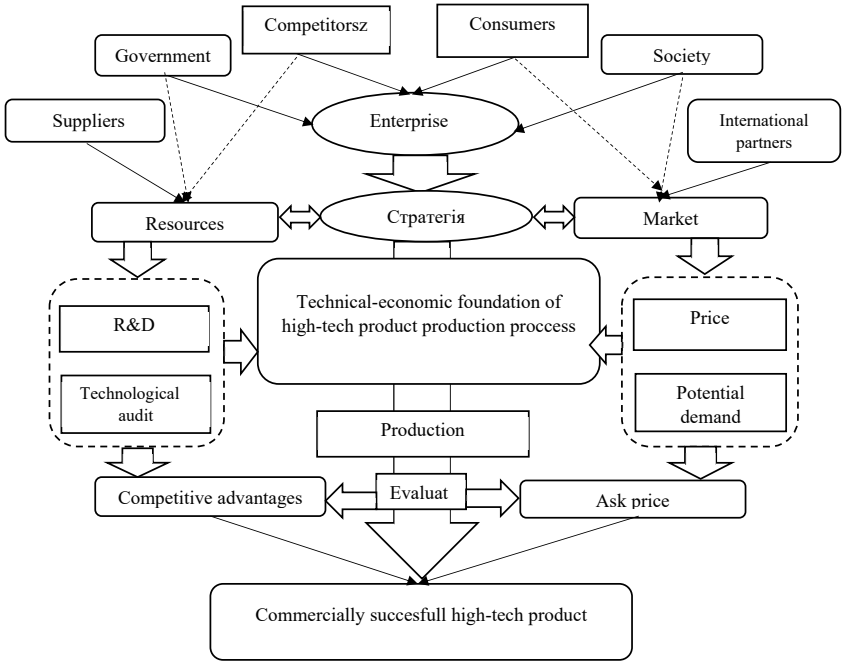

Figure 2.7. Components of strategies for the formation of competitive success of high-tech companies

Source: author's investigation

The next stage can be considered as the organization of production of a new high-tech product, where its real cost price is determined in relation to the planned cost price and the demand price lays the foundations for the formation of an economically useful strategy of a high-tech company and the determination of the future price offer for a high-tech product.

In this way, the position of effective commercialization and competitive success of the high-tech company in the corresponding segment of the

high-tech products market is ensured. As noted by M. Hammer, companies seeking to achieve success in the long term should prioritize the creation of technologies as the first stage of a commercially successful product [70, p. 143].

The leading role of R&D in shaping the competitive success of high-tech enterprises is determined by the fifth internal variable of a high-tech company, namely: personnel, their qualifications, abilities, professionalism, creativity and productivity. The importance of this variable in the formation of effective high-tech production is difficult to overestimate.

However, the review of the theoretical foundations for determining the place of the human factor in the production process took place only recently. Only in the 60s of the last century, thanks to the works of T. Schultz and H. Becker, the theory of human capital was formed, which is universally recognized today. The growing interest in the complex topic of human capital is related to the significant role of the human factor in the light of the intellectualization of human labor in the innovative economy. The transition from raw sources of economic growth to innovative ones inevitably brings the human factor to the fore as the main resource in obtaining added value, effective commercialization and building competitive advantages.

In his works "Educational Capital Formation" and "Investment in Human Capital" T. Schulz noted the natural basis of human abilities, and the skills acquired in the process of development, training and experience can be considered human or intellectual capital. H. Becker, a follower of T. Schultz, emphasized in his writings that the analysis of human capital is carried out by comparing the costs of its formation and the benefits of its use. Benefits, in addition to cultural and other non-monetized benefits, include increased wages and professional growth, while costs are determined mainly by the opportunity of time spent investing in the formation of intellectual capital. The amount of benefits and costs for the formation of human capital depends on a person's age, goals and aspirations, place of work, etc. [9; 10; 11].

In the context of the task considered in this section, special attention should be paid to on-the-job training – a direct influence on the internal variable of a high-tech company – staff – within and at the expense of this company.

Increasing the indicators of human capital is the most decisive and super-powerful factor of the internal development of the enterprise and strategic

strengthening of competitiveness in the process of commercialization of today's product. In addition to the above, this factor in the future determines the qualitative state of the accumulated national wealth, stability and quality of life of the society. Special, general, physical and mental indicators of the development of the collective worker are the primary basis for their effective installation in a complex system of high-tech production and innovative economy of the state. According to the definition of S. Nikolayenko, the specific weight of human capital in relative indicators to the accumulated wealth of developed countries reaches 70%. In the USA, this indicator is 76%, in the European Union – 74%, in the Russian Federation – 50%, in Ukraine it is less than 20% [134]. The concept of human capital became the basis for the formation of the theory of the knowledge economy. The definition of "knowledge economy" was proposed by F. Mahlup in 1962 specifically for a certain sector of the economy [116].

P. Drucker identified the formation of fundamentally new knowledge as the leading factor of production. This led him to a series of hypotheses about the formation of a new classical economy as a knowledge economy, the information processing and production sector as knowledge production, and society as a knowledge society, respectively [20]. According to this consistent series of theses, knowledge as an economic resource is the most productive compared to conventional factors of production and is the basis of modern economic development models. The defining feature of the post-industrial economy is not only the increase in the share of services sector of the national economy, but also the correct use and decoding of information with further transformation into knowledge using networks and clouds, which is the highway of modern innovative progress of society and a source of commercial effect [37].

It is important to emphasize that one of the key indicators of the evaluation of the knowledge economy at the input is the expenditure on R&D. The volume of these costs and their share in relation to GDP, together with the features of national innovation systems, determine the usefulishness of the development of science and the knowledge-based economy in the developed countries of the world. If we consider the trend of costs and results of research and innovation activities in Ukraine, we can come to rather disappointing conclusions regarding the formation of a platform for the creation of a new high-tech potential of the national economy.

The innovative activity of domestic enterprises in recent years rates at about 16%, this rate is insignificant taking into account the outlined guidelines of the Strategy of Innovative Development of Ukraine (Figure 2.8).

The key indicator of the state of knowledge economy at the "exit" is the export of products, which is a signal about the current state of the potential of innovative industries. First of all, the export of products as a factor in the accumulation of a depository of fundamentally new technological knowledge and their subsequent reflection in the form of finished products. Insignificant indicators of specialized exports are an indicator of the state's degradation and disappointing conclusions regarding the future prospects of increasing competitiveness. The identified regularities are the primary basis for identification, study and specification of the problem of intra-corporate factors that lead to this state of affairs, with the aim of correcting them and developing practical proposals for improving the methodology of their effective comparison and use (Figure 2.9).

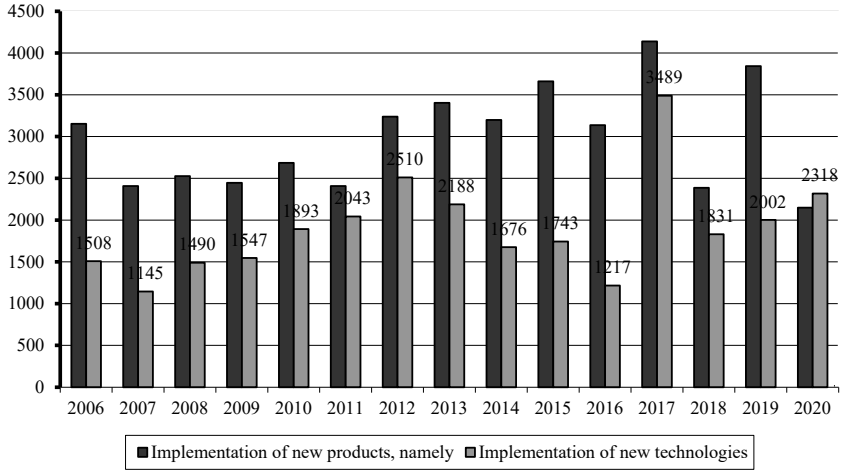

Figure 2.8. Implementation of innovations and the level of innovative activity of industrial enterprises of Ukraine in 2005-2019

Source: formed after [167]

Intra-corporate factors are determined by the variables available at the enterprise, which are tentatively divided into 2 volumetric blocks, namely: strategic and resource. The strategic block includes the factors constituting intra-corporate relations, the mission and strategic orientations of the establishment and development of the enterprise and its interaction with the institutions of the market environment. The factors of the internal strategic factors of the company's production should be attributed to the second block.

The specificity of the first block of factors depends on the direction and profile of the activity of a specific enterprise. The activity profile highlights the purpose, goals and means of the enterprise, the efficiency of economic processes and the competitiveness of the enterprise as a unit.

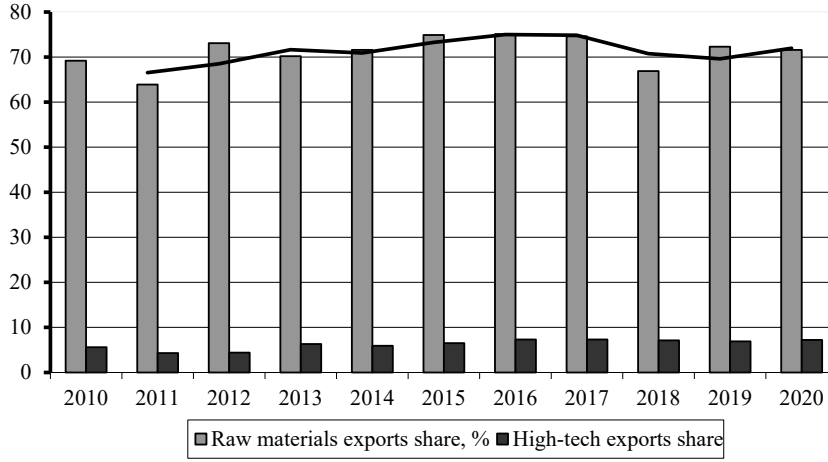

Figure 2.9. The share of exports of high-tech products and raw materials in the structure of exports of Ukraine in 2009-2019

Source: formed after [119]

The system of intra-corporate factors primarily depends on the ownership structure of the company's capital. This, accordingly, determines the nature of the motivation of economic units and affects the establishment of the specific nature of relations regarding the implementation of the management function. The constituted strategic center of responsibility is a sufficient condition for the enterprise to realize its international ambitions.

The organizational and economic model of the management structure of the commercialization process is another strategic internal factor in the enterprise management process, which depends on the flexibility and unorthodoxness of decisions and the approximation of the level of announced decisions to the censure of international competition in the international high-tech market.

An equally influential factor in an enterprise's entry into international markets is the amount of authorized capital and the scale of other economic indicators of activity, according to which enterprises are classified as small, medium, and large, respectively. These characteristics also determine the company's capabilities regarding the quality and efficiency of human capital in the process of innovation and further commercialization. The size and volume of the enterprise's production determine the potential opportunities for accumulating a share of its resources for the implementation of investment and innovation projects, R&D and the realization of the corresponding economic results. Given this, the capabilities of large businesses to expand and achieve competitive positions necessary for stable operation in international markets exceed such capabilities of smaller companies.

Another defined group of the block, namely: resource group – is a set of mutually determined capabilities of the enterprise. Summarizing previous work, we propose to single out seven system-forming potentials, which are the foundation of effective commercialization of high-tech products of enterprises on international markets. Resource potential is an indicator of the enterprise's resource base, its readiness to produce a certain range of products according to key market parameters.

The basis of the initiated research is 4 separate groups divided by fields of activity, which is the result of their approximation in accordance with the above studied international classification of NBIC-convergence, namely: "Chemical products", "Electronics and telecommunications", "Pharmaceutical products", “Other” and their corresponding companies. All the companies selected for the study are high-tech and carry out innovative activities within their own production facilities, implement international cooperation projects and are active participants in the system of international entrepreneurship. Thus, the proposed sample is representative and realizes the opportunity to investigate the current trends of the high-tech sector in relation to commercialization (Table 2.3).

Table 2.3

Characteristics of the researched enterprises producing high-tech products in Ukraine

Name of the enterprise	Profile of activity	Areas of R&D
1	2	3
Iskra PJSC	The largest domestic manufacturer of lighting products and light sources in Ukraine and with a complete technological production cycle	Development and production of both exclusive and "budget" versions of lamps and lamps of any complexity, taking into account the characteristics for individual orders.
Vatra LLC	A manufacturing enterprise engaged in the design, construction and manufacture of lighting devices	Improvement of lighting production technology and testing and certification of lighting and electrical engineering within the framework of the Ukrainian Institute of Lighting Technology created on the basis of the enterprise
Electron Concern	The leading scientific institution of the state in matters of scientific and technical support in the direction of "Materials of electronic equipment". The enterprise is a developer and coordinator of the implementation of state, inter-branch and branch programs in the field of radio-electronic materials science based on the projects of the State Fund for Fundamental Research.	Development of technologies for obtaining the latest materials for the needs of micro- and radio electronics and their introduction into industrial production
Rema PJSC	The plant produces more than 10 types of products. Cardiographs are one of the main ones. These are, in particular, single-channel portable cardiograph EK1T-04, three-channel cardiograph 3T-08, 3/6/12-channel cardiograph EKZT-08.	Development and improvement of a defibrillator in the maximum configuration, which has the functionality of a resuscitation monitor for resuscitation, an automatic external defibrillator and a patient transport monitor
Expomobile and Co. LLC	Production of goods for offices and trade enterprises	Development of ergonomic furniture designs for shopping halls

(End of Table 2.3)

1	2	3
Polimer Electron plant	The main areas of activity of the plant are plastic, expanded polystyrene, tool and non-standard production Table extension 2.8	Development of technologies that will allow the production of plastic products from a wide range of polymers, both common (polyethylene, polypropylene, ABS, PS, etc.) and specific (polycarbonate, polyamide, filled and reinforced plastics, etc.)
Borshgivskiy plant PJSC	Domestic manufacturer of medicines of the European level. Thanks to quality and innovation, the company has been the leader of the Ukrainian pharmaceutical market and the largest exporter of medicinal products since 2010.	Development, transfer and introduction into production of: innovative medicines, including modified generics; generic drugs; phytochemical preparations; veterinary drugs; dietary/food supplements; active pharmaceutical substances; phytochemical extracts
Farmak PJSC	The largest domestic manufacturer of lighting products and light sources in Ukraine and with a complete technological production cycle	Development and introduction to the market of complex modern drugs. Production of substances. Carrying out pharmaceutical, organic synthesis of medicines

Source: formed after [45-51]

In order to analyze the innovative activity of the studied enterprises, we will analyze the change in the share of income from innovative activity in the total income of enterprises and the main indicators of innovative development. The scientific and technical potential characterizes the capabilities of the enterprise in R&D and their implementation and commercialization efficiency (Table 2.4).

The financial potential of the enterprise gives an idea of its financial stability, solvency, the possibility of obtaining external financing for the implementation of innovative projects and the level of dependence on these sources of innovation financing. The main indicators that will allow us to draw a conclusion about the financial potential of the studied enterprises will be the coefficient of autonomy, which characterizes the financial independence of the enterprise, and the coefficient of maneuverability of equity capital, which determines the level of mobility of equity capital (Table 2.5).

Table 2.4

The share of income from the sale of a high-tech product in the total income of the enterprise, %

Enterprises	The share of income from the sale of a high-tech product in the total income, %							Absolute increment (+;-)	
	2013	2014	2015	2016	2017	2018	2019	2019/ 2013	2019/ 2018
Electronic and communications group									
Iskra PJSC	10	9,8	6,5	6,3	6,3	7,5	7,9	-2.1	0,4
Vatra LLC	6	7	7	5	4	5	5	-1	-
Electron Concern	17,1	15,9	23,5	19,8	21,9	20,2	20,3	3,2	0,1
Rema PJSC	1,5	2,5	2,5	3,7	5,2	10,4	9,8	8,3	-0,6
Chemical production group									
Polimer Electron Plant	1,5	3	4,5	2,8	4,2	4,3	4,1	2,6	-0,2
Farmaceuticals group									
Borschagivskiy chemical plant PJSC	13,8	15	12,9	15,9	15,8	16	18	4,2	2
Farmac PJSC	15,9	17	16,9	16,8	18,2	15,3	16,7	0,8	1,4
Other									
Expomobile and Co. LLC	0,1	0,1	0,2	0,1	0,1	0,09	0,1	-	0,01

Source: author's investigation

The marketing potential is understood as the set of means and capabilities of the enterprise for the implementation of marketing activities. Marketing potential is formed from a number of main components:

– merchandise (assortment, brand, productivity, management of relationships with consumers, etc.);

– communicative (forms of interaction, advertising, sales promotion, public relations, etc.);

– distribution (sales channels, logistics chains, sales methods, etc.);

– contractual (prices, discounts, loans, terms of delivery and payment).

Table 2.5

Coefficients of financial stability of the studied enterprises by groups of high-tech products in 2013-2019

Enterprises	Authonomy ratio							Equity maneuverability ratio						
	2013	2014	2015	2016	2017	2018	2019	2013	2014	2015	2016	2017	2018	2019
Electronics and communications group														
Iskra PJSC	0,7	0,8	0,82	0,83	0,75	0,8	0,78	0,3	0,35	0,35	0,35	0,35	0,36	0,35
Vatra LLC	0,7	0,6	0,7	0,8	0,8	0,85	0,8	0,25	0,2	0,2	0,25	0,2	0,2	0,2
Electron Concern	0,8	0,8	0,8	0,85	0,8	0,9	0,9	0,19	0,2	0,18	0,19	0,3	0,3	0,3
Rema PJSC	0,7	0,8	0,8	0,89	0,9	0,9	0,9	0,2	0,2	0,2	0,3	0,3	0,3	0,3
Chemical production group														
Polimer Electron Plant	0,6	0,7	0,8	0,8	0,8	0,8	0,9	0,2	0,2	0,1	0,1	0,2	0,2	0,2
Farmaceuticals group														
Borschagivskiy chemical plant PJSC	0,8	0,78	0,69	0,71	0,75	0,75	0,75	0,3	0,25	0,31	0,32	0,31	0,32	0,32
Farmac PJSC	0,8	0,82	0,83	0,81	0,79	0,79	0,8	0,32	0,25	0,3	0,35	0,32	0,32	0,35
Other														
Expomobile and Co. LLCV	0,8	0,88	0,85	0,85	0,8	0,8	0,8	0,3	0,32	0,32	0,3	0,25	0,25	0,3

Source: author's investigation

Personnel potential determines the level of professional qualification of the company's personnel, necessary for innovation, creation of a high-tech product, its commercialization and effective activity on the foreign market.

The information potential is understood as a set of information resources and opportunities for their implementation, which provide conditions for long-term development in the market based on the generation, accumulation and use of knowledge [63].

Brand potential of enterprises consists of the public image of the enterprise for consumers, state structures, social and business image of the enterprise.

The brand of the company gives the effect of its acquisition of a certain market power, in the sense that it leads to a decrease in the flexibility of demand. On the other hand, a strong image reduces the risk of changing product preferences and, thus, protects the company from the actions of competitors and strengthens the position of its products. In addition, the image facilitates the company's access to various resources.

In order to determine the scale of the potential of the studied enterprises in each of the presented groups, we can offer to carry out a taxonomic analysis based on the indicated data (Table 2.6-2.9).

Table 2.6

Information support for the calculation of the taxonomy coefficient for the enterprises of the "Electronics and Telecommunications" group

Period	The share of income from the sale of a high-tech product in the total income, %			Authonomy ratio			Equity maneuverability ratio		
	Electron Concern	Iskra PJSC	Vatra PJSC	Electron Concern	Iskra PJSC	Vatra PJSC	Electron Concern	Iskra PJSC	Vatra PJSC
2013	17,1	10	6	0,8	0,7	0,7	0,19	0,3	0,25
2014	15,9	9,8	7	0,8	0,8	0,6	0,2	0,35	0,2
2015	23,5	6,5	7	0,8	0,82	0,7	0,18	0,35	0,2
2016	19,8	6,3	5	0,85	0,83	0,8	0,19	0,35	0,25

2017	21,9	6,3	4	0,8	0,75	0,8	0,3	0,35	0,2
2018	20,2	7,5	5	0,9	0,8	0,85	0,3	0,35	0,2
2019	20,3	7,9	5	0,9	0,78	0,8	0,3	0,36	0,2
с/д	с	с	с	с	с	с	с	с	с
Average value	19,8	7,75	5,57	0,83	0,78	0,75	0,23	0,34	0,2

Source: author's investigation

Calculate vector-etalon by appliying the formula:

$$Z_{ij} = \frac{Xi}{Xc}, \quad (2.1)$$

де Xi – indicator of the enterprise; Xc – average value of the indicator.

Table 2.7

Calculation of the coefficient of taxonomy of Karat Concern and Iskra Public company of the «Electronics and telecommunications» group

Period	**Indicator of the reference vector Zij=** $\frac{Xi}{Xc}$					
	R&D Enterprise "Electron-Karat"			**Reference Vector "Iskra"**		
1	2	3	4	5	6	7
2013	0,86	0,96	0,83	**1,29**	0,89	0,88
2014	0,8	0,96	0,87	1,26	1,02	1,02
2015	**1,19**	0,96	0,78	0,83	1,05	1,02
2016	1	1,02	0,83	0,81	**1,06**	1,02
2017	1,1	0,96	1,3	0,81	0,96	1,02
2018	1,02	1,08	1,3	0,97	1,02	1.02
2019	1,03	**1,08**	**1,3**	1,02	1	**1,03**
Reference Vector "Karat" (1,19; 1,08; 1,3)				Reference Vector "Iskra" (1,29; 1,06; 1,03)		

Source: author's investigation

We determine the distance between separate periods of observation (Sio) and the reference vector: $Cio = \sqrt{\sum_{i=1}^{m}(Zij - Zoj)}$, (2.2)

where Zij – Standartized matrix value; Zoj – vector-etalon value.

Table 2.8

Calculation of the coefficient of taxonomy of Vatra LLC of the «Electronics and telecommunications» group *(author's investigation)*

Period	**Vector etalon value Zij=** $\frac{Xi}{Xc}$		
2013	1,2	0,9	1,25
2014	**1,4**	0,8	1
2015	1,4	0,9	1
2016	0,9	1,06	1
2017	0,7	1,06	**1,25**
2018	0,9	**1,13**	1
2019	0,9	1,06	1
Vector-etalon Vatra (1,4; 1,13; 1,25)			

Table 2.9

Calculation of the coefficient of taxonomy of the potential of enterprises of the «Electronics and telecommunications» group

Period	**Enterprises**								
	Electron Concern			**Iskra PJSC**			**Vatra PJSC**		
	Cio	**d= Cio / Co**	**Ki= 1-d**	**Cio**	**d= Cio / Co**	**Ki=1-d**	**Cio**	**d= Cio / Co**	**Ki=1-d**
2013	0,6	0,75	0,25	0,23	0,45	0,55	0,09	0,23	0,77
2014	0,6	0,75	0,25	0,06	0,12	0,88	0,18	0,46	0,54
2015	0,53	0,66	0,34	0,037	0,07	0,93	0,11	0,28	0,72
2016	0,54	0,68	0,32	0,23	0,45	0,55	0,3	0,77	0,23
2017	0,09	0,11	0,89	0,48	0,94	0,06	0,1	0,29	0,71
2018	0,17	0,21	0,79	0,32	0,63	0,37	0,31	0,79	0,21
2019	0,16	0,2	0,8	0,27	0,53	0,47	0,31	0,79	0,21
Co av. = $\frac{1}{m}\sum_{i=1}^{m} Cio$ = 0,38				Co av. = $\frac{1}{m}\sum_{i=1}^{m} Cio$ = 0,23			Co av. = $\frac{1}{m}\sum_{i=1}^{m} Cio$ = 0,2		
So =0,21				So =0,14			So =0,096		
Co=Co av. + 2×So = 0,38+2*0,21= 0,8				Co=Co av. + 2×So = 0,23+2*0,14= 0,51			Co=Co av. + 2×So = 0,2+2*0,096=0,39		

Source: author's investigation

Relative comparisons based on the taxonomy coefficient will make it possible to overlook differences in scale, sales volumes, and other features of the represented enterprises of the group (Figure 2.10). The different values of the coefficient reflect the level of high-tech potential of enterprises and their financial stability as a basis for large-scale research on entering foreign markets.

Based on the results of the research, we can draw a conclusion about the growing scientific and technical potential of the «Electron-Karat» SOE of the SE «Concern-Electron» PJSC, which is due to the scale of scientific and technical projects, their significance for domestic and international markets. As for PJSC «Lviv Electric Lamp Factory «Iskra», its scientific and technical potential is directed at securing a market niche, ensuring primacy in the market and modification innovation policy.

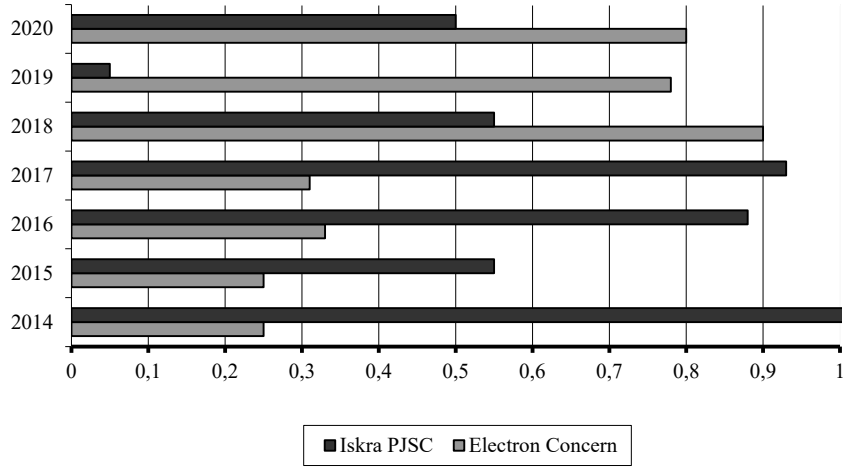

Figure 2.10. The dynamics of the taxonomy coefficient characterizing the potential of the investigated enterprises of the «Electronics and Telecommunications» group in the commercialization of a high-tech product

Source: author's investigation

In our opinion, it is not worth making extrapolations about the following years, since the pandemic and warfare made significant adjustments in the directions of high-tech development. According to the analysis algorithm of the first group of enterprises, we shall analyze all other groups presented in the monograph research (Appendix D).

Next, it is advisable to compare the enterprises of two different groups of high-tech enterprises, but components of Concern-Electron PJSC, which are defined by a common coordination policy, common conditions of operation, etc. (Table 2.10).

Table 2.10

Calculation of the coefficient of the taxonomy of the potential of enterprises of the «Electronics and telecommunications» and «Chemical products» groups

Period	Enterprises					
	Rema PJSC			Electron Concern		
	Cio	d= Cio / Co	Ki=1-d	Cio	d= Cio / Co	Ki=1-d
2013	1,78	0,68	0,32	0,89	0,9	0,1
2014	1,6	0,6	0,4	0,46	0,47	0,53
2015	1,59	0,61	0,39	0,61	0,62	0,38
2016	1,3	0,5	0,5	0,74	0,75	0,25
2017	1,01	0,39	0,61	0,14	0,14	0,86
2018	0	0	1	0,14	0,14	0,86
2019	0,11	0,04	0,96	0,06	0,06	0,94
Co av. $= \frac{1}{m}\sum_{i=1}^{m} Cio = 1{,}06$				Co av. $= \frac{1}{m}\sum_{i=1}^{m} Cio = 0{,}43$		
So $= \sqrt{\frac{1}{m}\sum_{i=1}^{m}(Cio - Cocep.)} = 0{,}77$				So $= \sqrt{\frac{1}{m}\sum_{i=1}^{m}(Cio - Cav.)} = 0{,}28$		
Co=Co av. + 2×So = 1,06+2*0,77= 2,6				Co=Co av. + 2×So = 0,43+2*0,28= 0,99		

Source: author's investigation

If we average the obtained values of the potential coefficient according to the taxonomy method, we can draw conclusions about similar trends in recent years. Such a trend are provoked by the growth of investments in Western Ukraine, the needs of the market and the possibilities

of PrJSC «Concern-Electron», although it is necessary to take into account the different markets on which enterprises are oriented. The products of Lviv REMA Plant LLP constantly compete with foreign analogues and are currently competitive. In turn, the «Polymer-Electron» Plant has great achievements in the domestic and foreign markets (Figure 2.11).

In our study, the most powerful pharmaceutical enterprises have access to international markets with high-tech products. Considering the trends of human development, such enterprises have significant potential and increase capacity through the creation of fundamentally new products. The value of the coefficient of taxonomy of studied enterprises of the pharmaceutical industry will reflect the trends in the development of biotechnology in Ukraine (Table 2.11).

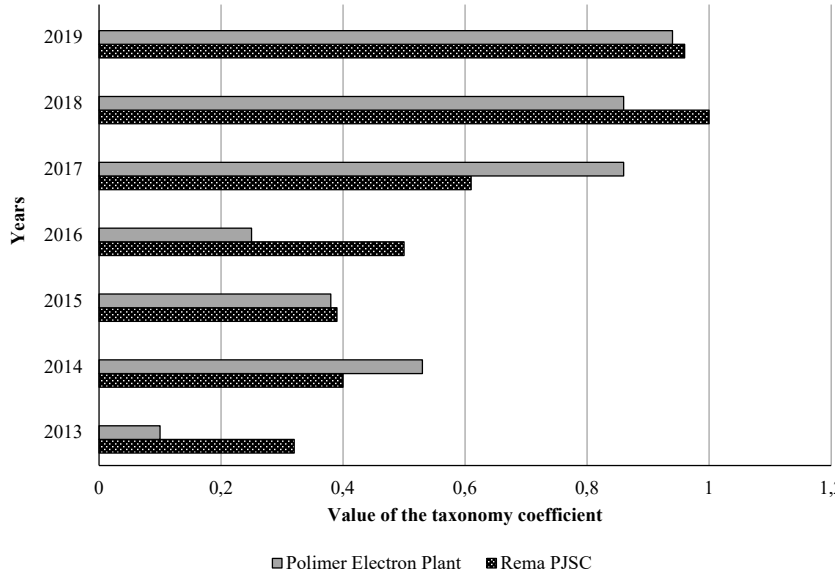

Figure 2.11. The dynamics of the taxonomy coefficient characterizing the potential of the researched enterprises of the «Chemical products» and «Electric machines and equipment and their parts» groups for the commercialization of high-tech products

Source: author's investigation

The conducted studies of the selected enterprises of the «Pharmaceutical products» group testify the growing potential in the direction of commercialization of created high-tech product, which is clearly higher than that of the enterprises of other groups, which is due to the high demand for the presented products on the domestic and foreign markets.

According to the results of the conducted research, domestic enterprises of the reference group are recommended to take into account and analyze the obtained results in order to critically analyze their own approaches to entering international markets (Figure 2.12).

Table 2.11

Calculation of the coefficient of the taxonomy of the potential of enterprises of the «Pharmaceutical products» group

Period	Enterprises					
	Borschagivskiy chemical plant PJSC			Farmac PJSC		
	Cio	d= Cio / Co	Ki=1-d	Cio	d= Cio / Co	Ki=1-d
2013	0,28	0,67	0,33	0,55	1	0
2014	0,32	0,76	0,24	0,34	0,62	0,38
2015	0,28	0,67	0,33	0,18	0,33	0,67
2016	0,13	0,31	0,69	0,1	0,18	0,82
2017	0,17	0,4	0,6	0,12	0,22	0,88
2018	0,16	0,38	0,62	0,18	0,33	0,77
2019	0,07	0,17	0,83	0,14	0,25	0,75
Co av. = 0,22				Co av. = $\frac{1}{m}\bullet_{i=1}^{m} Cio = 0,23$		
So = $\sqrt{\frac{1}{m}\sum_{i=1}^{m}(Cio - Coav.)} = 0,1$				So = $\sqrt{\frac{1}{m}\sum_{i=1}^{m}(Cio - Coav.)} = 0,15$		
Co=Co av. + 2×So = 0,22+2*0,1=0,42				Co=Co av. + 2×So =0,23+2*0,16=0,55		

Source: author's investigation

At the stage of decision-making regarding the possibility of the enterprise entering international markets, its results and prospects, primarily in the domestic market, are usually carefully evaluated in terms of the past, immediate and medium-term periods. The system of international

entrepreneurship on the scale of the world market, target sales markets and components of international competitiveness are studied. Prospective portfolios of marketing risks are also formed separately. The marketing and various tactical action programs are being formed, the canvas of conjunctural dramatizations is being considered.

Creating an effective strategy for entering international markets is a responsible and defining stage of the enterprise's life cycle. The result of the successful implementation of the strategy is the formation of a foundation and the formation of a practical methodology based on developed recommendations for the effective functioning of the company in the system of international entrepreneurship on a number of issues directly related to the commercialization process.

In order to analyze intra-corporate and external factors that affect the entering of domestic high-tech enterprises to the international market, we developed a questionnaire and conducted a survey of a number of enterprises operating in the domestic spheres of biotechnology, pharmaceuticals and nanotechnology.

Therefore, the conducted research revealed that the majority of Ukrainian high-tech enterprises pay attention mainly only to the improvement of existing technologies. At the same time, a significant number of enterprises (60-70% of surveyed companies) independently develop qualitatively new technologies, but significant problems in their commercialization have been identified, due to the fact that the foreign economic activity of Ukrainian enterprises is mostly focused on the purchase of ready-made equipment and licenses. In addition, it should be stated that only half of the investigated companies generally carry out foreign economic activity. A significant number of enterprises currently operate only within the domestic market.

The main foreign economic partners of domestic high-tech companies are partners from the CIS member states, and only a third of the companies have established cooperation with the business of the European Union, the countries of Southeast Asia, and Australia.

Most enterprises spend an average of two to three years on the introduction of a new high-tech product (from the idea to the launch of the product on the market). Almost all enterprises have planned to master the production of new high-tech products. However, only every tenth enterprise plans to completely replace the existing technologies with advanced analogues.

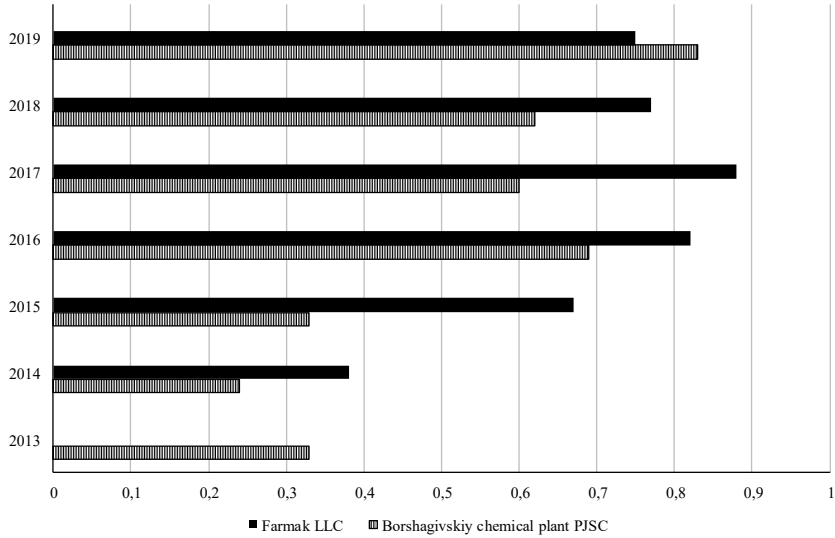

Figure 2.12. Dynamics of the taxonomy coefficient characterizing the potential of the researched enterprises of the «Pharmaceutical products» group in the commercialization of high-tech products

Source: author's investigation

It should be noted that the priority form of cooperation of Ukrainian high-tech companies is the direct export of jointly produced products. Only a quarter of the surveyed companies are involved in joint ventures and the use of FDI.

The decision to enter the world market at almost all domestic companies is made by higher management bodies. At the same time, such measures as marketing research, strategic planning, analysis of potential markets, comparative analysis of competitors and advertising are widely used. Negative phenomena, in our opinion, are a weak assessment of the risks of activities in foreign markets, the lack of a clear understanding of the commercialization process, and the complete lack of measures to stimulate the promotion of products to the world market.

The main internal problems and limitations of the company's international marketing activities include the lack of experience in international activities,

search and interaction with partners, lack of funds, internal problems and partially low qualifications of middle managers.

At the same time, the majority of enterprises note that the obstacles to effective commercialization are mainly external factors. Almost all enterprises noted the lack of effective cooperation with the state. Practically all forms of state support for private enterprises in activities related to the export of high-tech products are recognized as either absent or implemented inefficiently and without initiative. This indicates the low development of public-private partnership in the high-tech sphere of the domestic economy. The low efficiency of customs and currency regulation by the state was also pointed out. Even the presence of active competitors in foreign markets and the lack of experience in international activities prevail over the problems of interaction between high-tech companies and the state.

Summing up, it should be noted that the marketing activity of Ukrainian companies in the high-tech sector as a whole does not meet the modern competitive requirements of the world market.

The state has not implemented effective tools for stimulating the development of the high-tech industry, and the conditions for dynamic development in this segment have not been ensured. Practical overcoming of these negative phenomena can be based on an in-depth analysis of international experience and a proper evaluation of existing models of international cooperation in the creation and commercialization of high-tech products.