

Електронний журнал «Ефективна економіка» включено до переліку наукових фахових видань України з питань економіки (Категорія «Б», Наказ Міністерства освіти і науки України № 975 від 11.07.2019). Спеціальності – 051, 071, 072, 073, 075, 076, 292. Ефективна економіка. 2024. № 9.

DOI: <http://doi.org/10.32702/2307-2105.2024.9.35>

УДК 330.3

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RETROSPECTIVE AND FUNCTIONAL ANALYSIS OF INNOVATION GROWTH MODELS

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РЕТРОСПЕКТИВНИЙ ТА ФУНКЦІОНАЛЬНИЙ АНАЛІЗ ІННОВАЦІЙНИХ МОДЕЛЕЙ ЕКОНОМІЧНОГО ЗРОСТАННЯ

Paper highlights high-tech market economic growth models; growth modeling considering innovation growth priorities and perspective directions investigated; R&D trends and perspective functional directions taken to consideration.

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. The linear perspective of innovative models has been challenged by modern innovations and empirical research. 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.

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.

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 unorthodoxy 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.

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.

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.

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.

У статті висвітлено моделі економічного зростання ринку високотехнологічної продукції; моделювання зростання з урахуванням дослідження пріоритетів інноваційного розвитку та перспективних напрямків економічного зростання. Враховано сучасні напрями наукових досліджень та функціональної спеціалізації.

Фактори, що впливають на посилення трансформаційних процесів, включають чинники, властиві макро- та мікросередовищу.

Визначено, що до факторів макросередовища належать політичні, правові, економічні, соціокультурні, технологічні, тощо.

Фактори мікросередовища складаються із взаємодії з економічними агентами, урядом тощо. Лінійна природа інноваційних моделей детермінована емпіричними дослідженнями у сфері інновацій. Реалістична концептуалізація інноваційного процесу повинна сприйматися як серія змін, що є результатом взаємодії ринкових сил, що призводить до постійного та остаточно невизначеного процесу переплетення комерційних і технологічних можливостей і обмежень.

Незважаючи на те, що сучасні підходи до організації інноваційної діяльності в компаніях істотно змінилися на користь ринкових методів, ця

модель залишається актуальною і використовується в наукових організаціях, навчальних закладах, в окремих технологічних стартапах і спінофах, в організації великих проєктів, спрямованих на створення проривних продуктів та процесів.

Слід підкреслити, що перехід від лінійної до функціональної через проміжну комбіновану модель комерціалізації високотехнологічного продукту слід вважати революційним кроком у розвитку високотехнологічної сфери. Інтерактивна модель передбачає неортодоксальність і неоднорідність інноваційного процесу, показує, що рівноважними джерелами високотехнологічних інноваційних ідей є не стільки логіка технологічного розвитку, скільки ринковий попит. Цей висновок суттєво впливає на динаміку розвитку ринку високотехнологічної продукції та окреслює його ринкову специфіку.

Аналіз сучасного стану світового ринку високотехнологічної продукції дозволяє виділити наступне протиріччя: з одного боку, надзвичайно високий рівень конкуренції, а з іншого – абсолютно новий вид цієї конкуренції, який має принципові відмінності. з попереднім етапом – індустріальної економіки.

Серед основних елементів шостого покоління моделей комерціалізації високотехнологічних продуктів можна виділити: єдину інформаційну базу організації; нематеріальні активи як основний ресурс; гнучкість організаційної структури; мобільність ресурсів; принципалів як одну з найважливіших ланок стратегії, їх безпосередню участь у процесі комерціалізації; відмову від прямої конкуренції за рахунок стратегії інтеграції з конкурентами.

Синергетичний підхід до розгляду тенденцій розвитку світового ринку високотехнологічної продукції вимагає комплексного аналізу моделей комерціалізації високотехнологічного продукту з різних позицій. У даному дослідженні розглянуто моделі комерціалізації високотехнологічного продукту за існуючими напрямками та доповнено перелік авторськими

ознаками: за вектором комерціалізації, за характером взаємодії елементів, за розташування генераторів ідей, за формою реалізації продукту, за кількістю факторів впливу, за мотивами виникнення ідей.

***Keywords:** economic growth; innovations; high-tech; R&D; strategic marketing; modeling; enterprises; start-ups.*

***Ключові слова:** економічне зростання; інновації; високі технології; НДДКР; стратегічний маркетинг; моделювання; підприємства; стартапи.*

Statement of the problem in a general form and its connection with important scientific or practical tasks. 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 fig. 1.

Analysis of the latest studies and publications. Investment activity of TNC in the global high-tech market was studied by G. Ehrlich, M. Klein, M. Rocco, F. Rosenberg and etc.

Formulation of the goals of the article (statement of the task). Is to examine the species of the entrepreneurial investment activity in the process of R&D activities in high tech sphere, highlighting the mechanisms of their interaction and variable interconnections.

Outline of the main material of the study. 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

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 (Fig. 1).

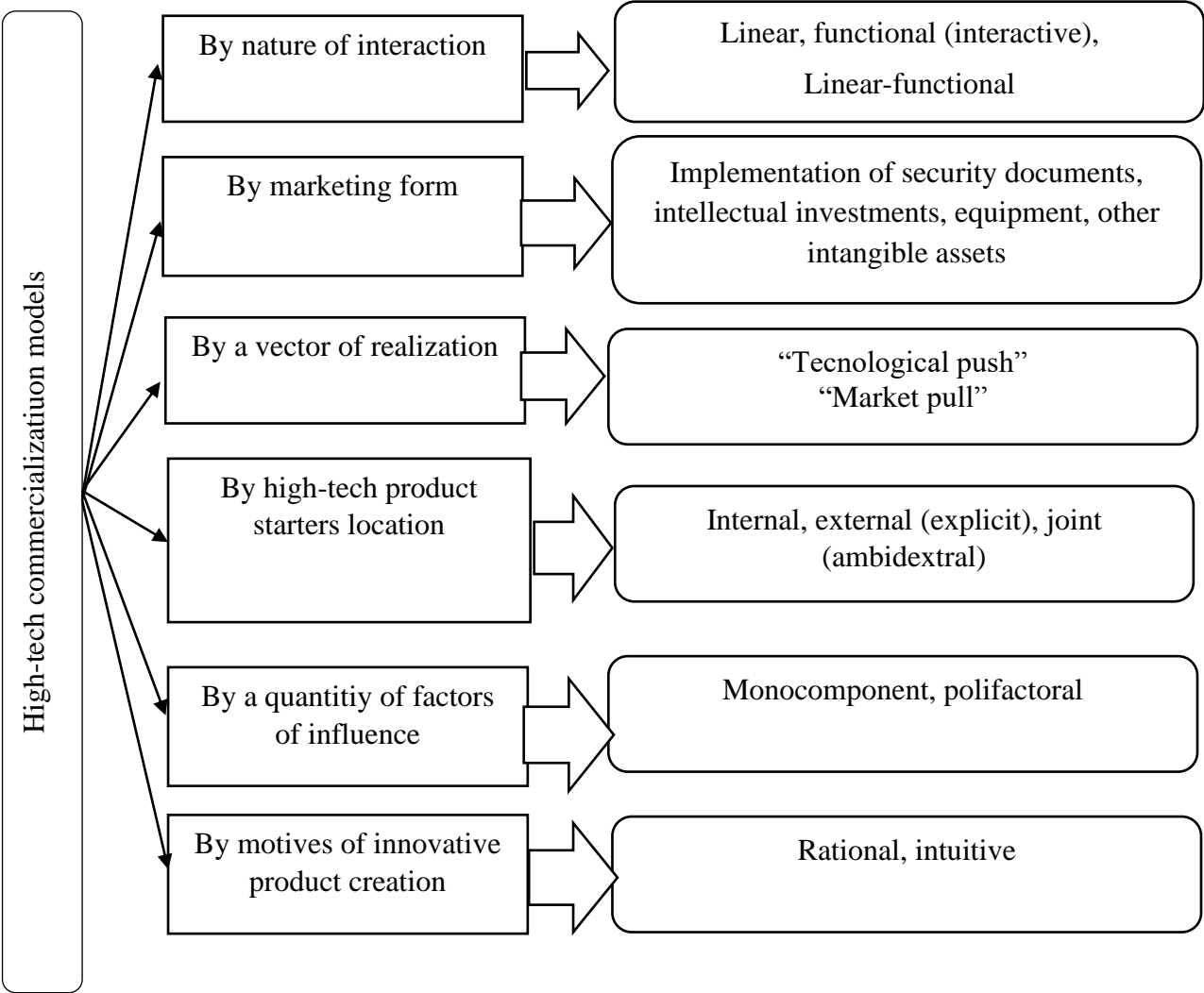


Fig. 1. High-tech product commercialization model (based on [1; 2; 3])

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 (Fig. 2). 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.

Innovation platform, university, etc.

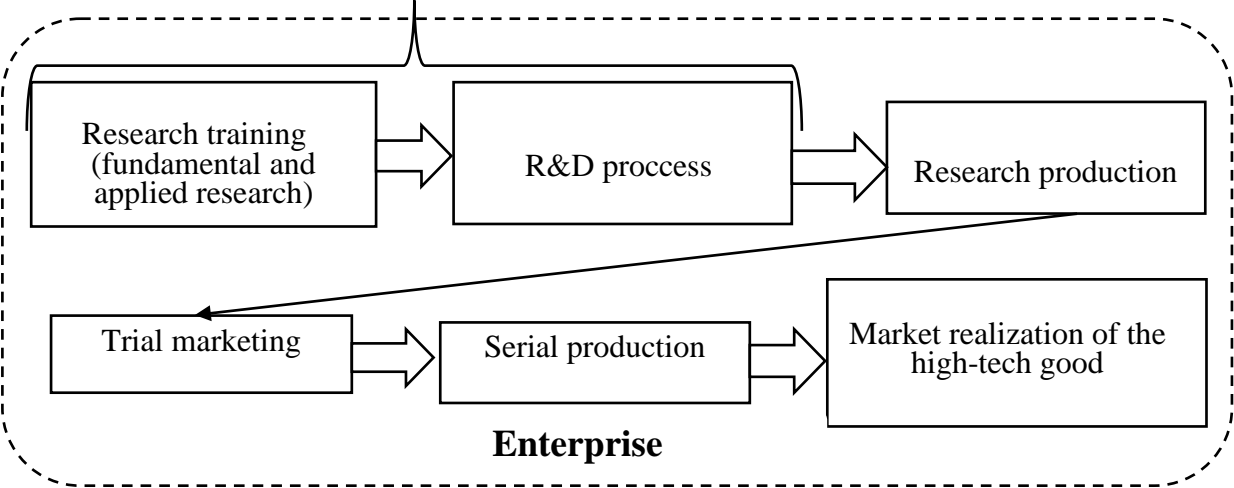


Fig. 2 Technological push innovation model (based on [4])

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 substantial 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.

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 (Fig. 3).

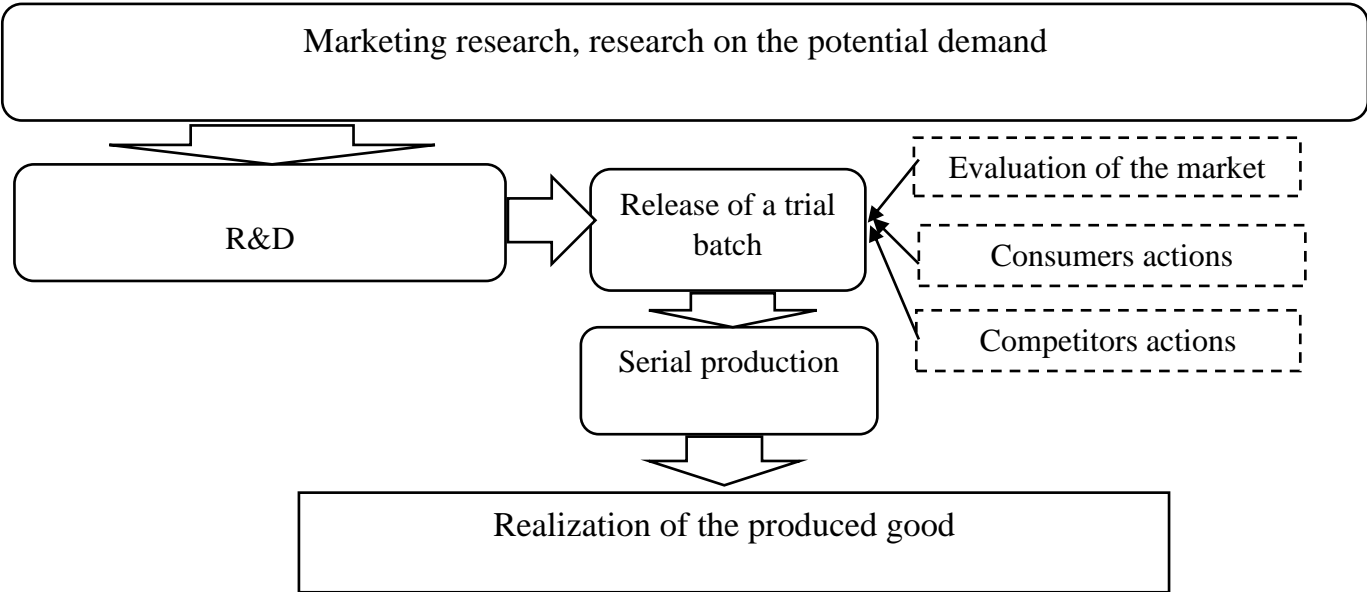


Fig. 3. Market pull innovation model (based on [5])

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 process. 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 necessary 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 (Fig. 4).

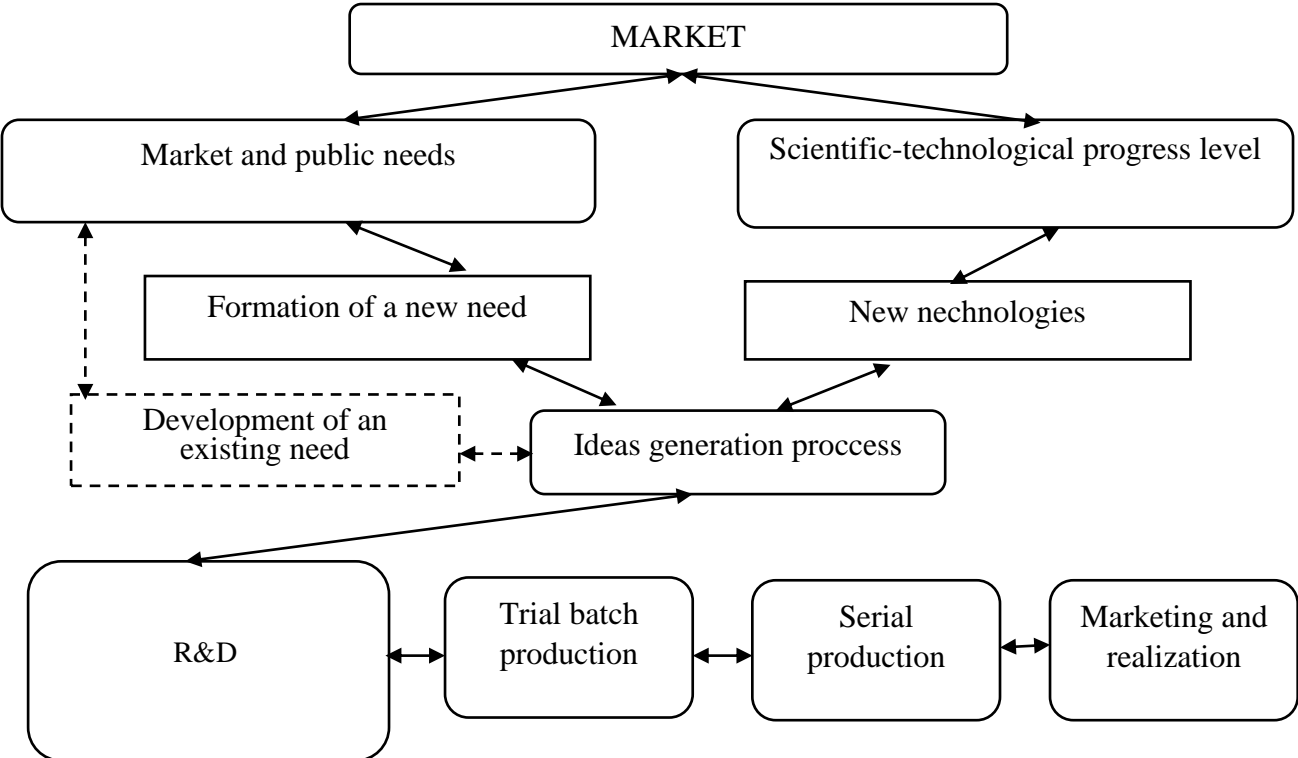


Fig. 4. Combined high-tech product commercialization model (based on [7; 8])

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 unorthodoxy 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.

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 (Fig. 5).

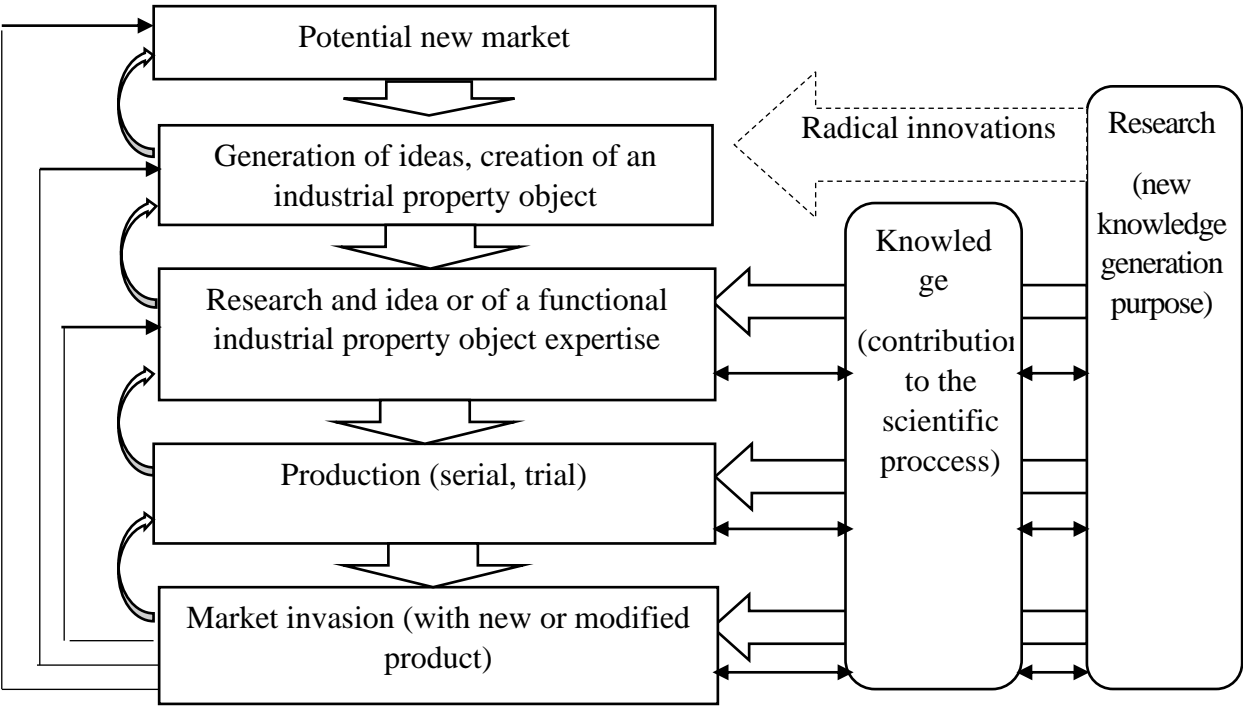


Fig. 5 Klein-Rosenberg chain innovation model (based on [10])

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" [9, 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 [10]

Conclusions and prospects of further investigations in this direction. 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.

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Стаття надійшла до редакції 10.09.2024 р.