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Turning Innovation into a Product Concept

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***Abstract*—The formation of the concept aims to further develop the innovative idea and transform it into a real innovative product intended for the market, as well as to bring consumer desires into a production-feasible product. Usually, a company has at least several innovative ideas for one product. The life cycle of innovations is presented, as well as the degree of novelty of products and processes as part of the industry. A model is presented for determining the degree of innovation through: Innovations outside industry – expanding the scope, technical regularities in innovative development, innovative development, intensification and productivity, innovative obsolescence, trends in the relative change in the parameters of products and processes under the influence of innovative obsolescence. The known technical, consumer and market indicators are used, which are redefined in view of the topic.**

Keywords— degree of novelty, innovation, life cycle.

I. Introduction

The present work on the topic "Transforming innovations into a product concept" contains a current work dedicated to improving the constructive and technological approaches in the design and manufacture of mechanical engineering products; innovations, their management, their implementation in enterprises, the innovation strategy and policies for achieving it, as well as methods for alternative solutions against the rapid obsolescence of innovations in the field of technologies in the conditions of the Fourth Industrial Revolution (FIR) and globalization [1, 2, 3, 4].

In the modern conditions of globalization and accelerated scientific and technological progress, innovations are established as a key factor for economic development and social transformation. They are not limited only to industrial production, but penetrate all spheres of economic and social life. The degree of novelty of the innovation process is an essential indicator that determines its significance, impact and effectiveness [5].

According to modern research, innovation is the implementation of a new or significantly improved product, process or organizational method, with its practical application being a mandatory condition. In this context, the degree of novelty determines whether an innovation is radical, improving or adaptive [6, 7, 8].

Innovation is the introduction into use of a new or significantly improved product (good or service) or production process, a new method of production or a new organizational and technological method. A minimum sign of an innovation is the requirement that the product, production process, technological method or organization is new (or significantly improved) for the practice of a given company [9]. This is included in the category of innovations in products, production processes and methods that companies have created first and/or products, production processes and methods borrowed from other companies or organizations. Innovation activity represents all scientific, technological, organizational, financial and commercial actions from which the implementation of innovations actually results, or which are conceived for this purpose. Some types of innovation activities are innovative in themselves, others do not have this property, but are also necessary for the implementation of the innovation. Innovation activity also includes research and experimental developments that are not directly related to the development of a specific innovation. A common feature of innovation is the fact that it must necessarily be implemented [10, 11]. A new or improved product is considered implemented when it has entered the market. New production processes, marketing methods or organizational methods are considered implemented when they are actually used in the company's activities [12]. The nature of innovation activities in different companies is different. Some companies are engaged in very clearly expressed innovation projects - including the development and implementation of a specific new product, while others are primarily concerned with introducing new and new improvements to their products, production processes and operations. Both types of companies can be considered innovative, since innovation can consist of the implementation of a single significant change or a whole series of less significant improving changes, which in their aggregate form a significant change. An innovative company is one that has implemented some innovation during a certain period of time during the study [13, 14].

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Successful innovation is strongly linked to financial results and is a major driver of economic growth in the economy.

The essence of the degree of novelty of an innovation

The degree of novelty of an innovation reflects the level of difference between the innovation and existing solutions [15]. It is considered as a criterion for classifying innovations into:

- Radical innovations – create new markets and technological directions;
- Incremental (improving) – improve existing products and processes;
- Imitative – adapt already existing solutions in a new context.

II. Materials and Methods

Innovations outside industry – expanding the scope

Current trends show that innovation processes are actively developing in various areas outside traditional production:

1. Social sphere

In the social sphere, innovations are manifested through:

- new models of social services;
- digitalization of education and healthcare;
- social entrepreneurial initiatives.

Here, the degree of novelty is often measured by social impact, and not only by technological progress.

2. Education and science

Innovations in education include:

- distance learning;
- interactive teaching methods;
- use of artificial intelligence.

These processes are related to globalization and the need to adapt to new requirements on the labor market, and an accelerated implementation of innovative solutions is observed [16].

3. Management and public sector

In the public sector, innovations are expressed in:

- e-government;
- new administrative models;
- transparency and digitalization of services.

Here, the degree of novelty is related to the efficiency and accessibility of services for citizens.

4. Services and trade

Innovations in services include:

- digital platforms;
- e-commerce;
- personalized services.

They are directly influenced by the development of information technology and global competition.

Relationship between the degree of novelty and innovation obsolescence

One of the key aspects considered in the materials provided is the relationship between innovation development and innovation obsolescence. It has been proven that there is a direct interdependence between them.

As the degree of novelty increases:

- the life cycle of innovations is shortened;
- the process of their obsolescence is accelerated;
- the need for continuous renewal increases.

Innovation obsolescence is considered a natural process in which new technologies quickly replace old ones, even having a greater importance than physical wear and tear.

Methods for assessing the degree of novelty

In scientific works, various methods have been proposed for assessing the degree of innovation, including:

- a method for determining the degree of innovation;
- a method for innovative activity;
- a method for assessing innovation obsolescence.

These methods allow:

- quantitative measurement of novelty;
- forecasting the innovation life cycle;
- choosing optimal management solutions.

Practical significance

Understanding the degree of novelty has important practical significance:

- supports the strategic management of organizations;
- facilitates the choice of an innovation strategy;
- increases competitiveness.

III. Results and Discussion

The modern stage of development of economic life is characterized by globalization of requirements for product quality, the need for sustainable growth, the desire for highly effective implementation of innovative achievements and high technologies in the field of information and communications [17, 18, 19, 20]. The sustainable trends of globalization of the economy determine the accelerated introduction of innovative solutions, expressed in new technologies and automation of production processes, which solve a wide range of tasks related to increasing productivity, the quality of manufactured products, the sustainability and flexibility of the production process, and shortening the period from the birth of the idea to the realization of the product on the market [21, 22, 23]. The innovative saturation of processes (technological and information) is aimed, in addition to the elimination of heavy, monotonous, harmful to health and unattractive work, at the implementation of specific innovative solutions (artificial intelligence) that increase productivity and efficiency. These solutions have the task of overcoming the persistent trend of labor resource deficit (human capital), determined by demographic factors. On the other hand, at the beginning of the 21st century, the ever-increasing demands of consumers and the increasing competitive pressure on world markets predetermine the need for a fundamentally different approach to the entire innovation process [24, 25]. A global trend is that manufactured products are beginning to become extremely complicated, both in terms of their internal structure and in terms of consumer and functional requirements that must satisfy the need. These new production concepts impose a fundamentally new way of industrial construction. In them, through the use of global information networks, an opportunity is provided for intensification of production and significant improvement of the quality of manufactured products [26, 27, 28]. The creation of environmentally friendly technological schemes, methods and processes is a priority of the new production concepts. In this regard, social problems and environmental restrictions will impose their predominant importance in the innovative development of production in the future. Moreover, productivity and efficiency will have an integral importance, determined by the groups of factors caused by the impact of the new concepts [29]. This highly efficient production is a direct consequence of the use of the latest advances in computer technology and equipment, i.e. innovation. The concepts and solutions for a new type of production are generated by the complex market conditions and the desire of leading companies to produce their new products more efficiently, with better quality and in a more environmentally friendly manner in order to satisfy the requirements of the consumer on a global scale and the communication between them [30].

Some concepts generated by globalization are a direct consequence of the use of innovations, including the latest achievements in computer technology and informatics.

All this proves that the current state of production is determined by the criteria of globalization, including global competition, the impact of high (High) technologies and the prevailing assumptions for sustainable growth. These three criteria actually determine the possibility of effective construction and development of industrial production (Fig. 1).

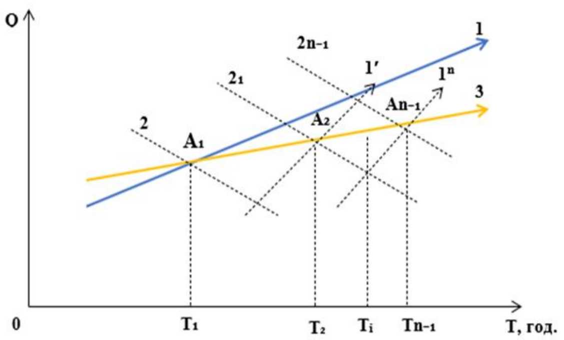

Fig. 1. Dependence between global competition under the influence of high (High) technologies and the prevailing assumptions for sustainable growth [1, 2]
(1 - global competition; 2, 2_1… 2_{n-1} - the resource of efficiency of old technologies; A_1, A_2, A_n- points of equilibrium between global competition (1, 1', ... 1^n); sustainable growth (3) and high technologies (2, 2_1,… 2_{n-1}); 3 - sustainable growth; T - time (years); Q – growth)

At $_t$.A we have a relative balance between growth and competition, and the period between T_1 and T_{n-1} is characterized by the need for investment saturation of the industry with new innovative solutions. In this case, productivity and efficiency will have an interdependent meaning, determined by factors characterizing the essence of high-performance technologies.

The relationship between technical levels (W), social productivity (Q_0), and efficiency (E) is shown in Fig. 2.

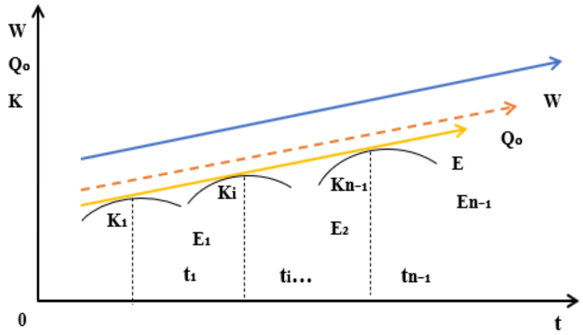

Fig.2. Relationship between technical levels (W), social productivity (Q_0) and efficiency (E)
(E- efficiency; Q_0 - social productivity; K - equilibrium point; t - time (years); W- technical levels)

After $_t$.K_1… K_i… K_{n-1} productivity begins to approach the limiting line of the achieved technological level in time t_i and remains constant, and efficiency begins to decrease.

Sustainable growth and global competition impose the need to use economic impacts to awaken production growth, effectively balanced between the needs of society and productivity. This means investing funds in high-performance technologies (production and information), which provide solutions for global innovation saturation of processes and activities.

Technical regularities in innovative development. Innovative development, intensification and productivity.

There is a certain dependence between productivity (Q) as the achieved world level and technical development. It is expressed in the achieved technical degrees of development (W), taking into account the differences in the respective levels (W_n) and the increase in productivity (Q_n). The indicators determining productivity and technical levels are closely related and interdependent, as they are defined by technological development at a given time, and it, in turn, is the result of the achieved productivity of technologies as a degree of development of scientific and technological progress. The physical essence of these dependencies is expressed in shortening the periods of creation of new technical solutions, technologies, modern designs, know-how, etc. and increasing their productivity in absolute and relative dimensions for each new period (T_1, T_2, T_3..., T_i,..., T_{n-1}). It follows that the periods of innovative obsolescence of technologies become shorter and shorter in time (t_1, t_2, t_3... ti, tn), and technical levels - higher and higher for each subsequent period. These are objective technical laws that, with technological development, mark accelerated steps for each subsequent period (Fig. 3).

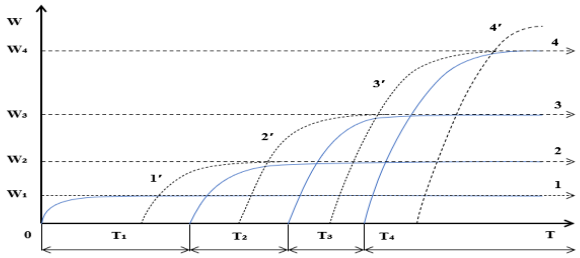

Fig.3. Technical regularities [2].

The figures 1, 2 and 3 used are part of a published monographic work by the author Desislava Petrova "Innovation management", Gabrovo, 2020, ISBN 978-954-683-615-1 [1].

Therefore, the future development of industrial activities will be characterized by increasingly higher technical levels, increasingly higher productivity, rapid innovative obsolescence and global intensification of processes and activities. At the same time, these dependencies form new spheres, generating a new development environment, flexibly balanced by the impact of internal and external factors [31, 32, 33].

Now we cannot speak only about individual innovations and innovation processes, but about innovative production, considered comprehensively. The impact of the external environment determines the basic requirements for the technological behavior of companies and creates the prerequisites and conditions for a new attitude to innovations as an integral and necessary part of the global development of industry and society.

From the above Fig. 3 it is seen that:

- in the vertical $W_1 < W_2 < W_3 <\dots W_i \dots < W_{n-1}$, where W_1, W_2, W_3, W_4 is the social productivity defined by the technical levels;
- in the horizontal $T_1 > T_2 > T_3 > \dots T_i > \dots T_{n-1}$, where T_1 is the period of steam engine and mechanization; T_2- the period of electricity and automation; T_3- the period of computerization and a high degree of automation; T_4- the period of artificial intelligence and cyber systems.

Innovative obsolescence

Innovative obsolescence is a regularity caused by innovative development in all directions of world scientific progress. At the current stage of technical development, innovative obsolescence has a predominant importance over physical. Therefore, a particularly important point in this direction is the correct determination of the degree of innovative obsolescence. The goal is to establish the influence of innovations on the technical, economic and social results of industrial activity. The correct assessment of their influence on the scale and terms of innovative obsolescence is of utmost importance for the timely elimination of the negative consequences of their impact.

Taking into account the factors that characterize the qualitative side of innovative development allows us to reveal not only the mechanism of its impact on production efficiency indicators, but also its influence on various aspects of the production process. To facilitate further clarification of the problem, we will group the influence of these factors into several directions.

The influence of innovative development on technology is expressed in the improvement of existing and the construction of fundamentally new machines, devices and equipment. By purpose and rates of growth of their productivity, they can be divided into two main groups: special machines and equipment, intended for the production of uniform products on a mass scale; and universal machines and equipment, intended for the performance of various activities. In recent years, a trend of strong unification and standardization of elements in machine units based on the modular principle has been observed. The goal is to create conditions for the rapid assembly of machines with different technological purposes, but with universal purpose (the principle of mechatronic machines). The study of the regularities of the development and improvement of technology with special and universal purpose makes it possible to determine the period in which the greatest effect can be obtained from a given generation of machines intended for a specific production process, and at the same time the term for switching to the production of new types of machines.

In the modern conditions of accelerated scientific and technological progress, the importance of this direction and its manifestation on the pace and scale of innovative obsolescence of technology has significantly increased. The real consequence of this impact is expressed in an increase in the scope and terms of innovative obsolescence of machines and equipment in operation and a rapid change in their structural composition.

Innovative development is also expressed in the creation of new materials, which have an active impact on accelerating the innovative obsolescence of operating technology. This impact is determined by the widespread use of new materials adapted for processing on a certain type of machine. The share of unnecessary equipment adapted for processing old materials depends on the scale of their use in production.

Innovative development affects technological processes. The changes occurring from the application of these new technologies in any case play an active role in the production process, as a result of which the relative share of old technological processes is constantly decreasing, and with them the machines and equipment used for this purpose. It is related to professional training and improvement of methods, to the improvement of qualifications and training of personnel. Significant changes occur in the qualification composition of personnel, as a result of which a large number of new professions arise, old ones disappear, and the ratio between individual groups of professions changes. This is the subject of Industry 5.0.

The development of technology leads to significant changes in the methods of its exploitation on the one hand, and on the other hand to the improvement of methods for changing the nature of labor and improving the qualifications of personnel.

From the above, it can be concluded that: the influence of innovative development is globalized, as a result of which innovative obsolescence of technology occurs and the level of technologies put into operation lags behind modern ones. Further use of innovatively obsolete technology and technological processes leads to certain losses, the amount of which will depend on the degree of this lag.

Trends in the relative change in the parameters of products and processes under the influence of innovative obsolescence.

Technological development and, more precisely, its consequences, manifested in the form of innovative obsolescence of products and processes, lead to a peculiar attitude of manufacturers to search for ways and means for improving and changing their parameters. The tendency to change the parameters of innovative products and processes as a result of their rapid innovative obsolescence forms a new alternative concept for innovative development. It also places new requirements on both the consumer nature of innovative products and the methods, approaches and ways of their production.

The main directions that provide an effective way out of the limitations imposed by the rapid innovative obsolescence in the creation of competitive innovative products are actively applied by many companies in mechanical engineering and electronics. This new approach, quickly adopted by industrial companies, already shows its advantages in the following directions:

- Application of the modular principle of design and production of innovative products;
- Design and production of modules with different technological purposes;
- Design and production of innovative products with the highest possible reliability and short service life;
- Consideration of the design and production cycle as a continuous process of flow and use of the methods of competitive engineering, simulation, virtual representation, etc. in order to shorten the cycle as much as possible;
- The shortest possible cycle from idea to manufactured innovative product.

IV. Conclusions

The degree of novelty of the innovation process is a key factor in the development of the modern economy and society. It determines not only the nature and impact of innovations, but also their sustainability over time. The expansion of innovation activity in various spheres of economic and social life requires new approaches to management, assessment and adaptation.

In the conditions of accelerated technological development and global competition, the successful implementation of innovations depends on the ability to correctly assess their novelty and timely respond to the processes of innovation obsolescence.

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