Innovative Obsolescence in Mechanical Engineering and Singleness of Indicators

Desislava Petrova
Department Management
Technical university of Gabrovo
Gabrovo, Bulgaria
des_petrova@abv.bg

Abstract. **The purpose of the present work is to present the manifestation of innovative obsolescence in mechanical engineering and the unequivocalness of the indicators - service life, reliability, physical wear, innovative and programmed obsolescence. The innovation life cycle and when innovation obsolescence occurs are presented. It has been proven that innovation obsolescence is a regularity that manifests as a consequence of the occurring change in the technical levels of innovations with the same technical purpose. The development is based on the thesis that between innovation development and innovation obsolescence there are certain interrelationships and interdependencies that essentially characterize the process of innovation obsolescence itself. In subsequent publications, an analysis of the dependencies and factors influencing the innovation process in the industry will be presented, regarding: constructive solutions, materials, processing processes, costs, demand and supply, price and obsolescence of solutions.**

Keywords: alternative solutions, innovative obsolescence, questionnaire.

I. INTRODUCTION

The achieved technical level of world progress is determined by the global measures of technical progress currently expressed through certain categories of measures, one of which is social productivity [1, 4, 16, 17]. There is a certain interrelationship and dependence between it and the technical level. This dependence is expressed in degrees of technical level, accounting for differences with a share of productivity increase. The technical level can also be taken as the reached innovation level at the moment of development of technical progress. These indicators are closely related and dependent on each other, because they are defined by the globalization of innovation development at a given time, the latter being the result of the achieved technical productivity, such as the level of scientific developments, or new designs and technologies. The physical essence of this process is expressed in a shortening of the periods of creation of new technical solutions, modern designs and technologies and an increase in productivity in absolute and relative terms of each new period. It follows from this that the innovative obsolescence of the technique occurs in shorter and shorter periods of time. These are economic and technical regularities which, with globalization and innovative development, mark accelerated steps for each subsequent period, creating increasingly high social productivity. Therefore, future industrial activities will be of higher technical levels, higher productivity, faster innovation obsolescence and global intensification of processes and activities.

II. MATERIALS AND METHODS

Unambiguity of indicators – Service live, reliabity, physical wear, innovative and programmed obsolescence

The efficiency of industrial production, and in particular that of industrial companies, largely depends on the service life of the equipment. But replacing old, innovation-obsolete equipment with new is not always effective, because it is related to a number of indicators such as the volume of production, fund allocation, growth of deductions, etc. [5, 6]. Factors related not so much to the period of operation of the equipment play a role here, but above all the profit that will be obtained from its overall use. High rates of technical progress require rapid innovation obsolescence of equipment, but this does not mean that it must be completely replaced with new ones. The successful solution of such tasks requires taking into account the influence or impact of a number of factors forming the requirements for the efficiency of both production and the capacity capabilities of enterprises [7, 8, 9]. Many of the authors dealing with these problems are of the opinion that a balance should be sought between the physical wear and tear and the innovative and planned obsolescence of the technique. So far, physical wear and tear often exceeds two to three times the innovative obsolescence of the technique. This is especially characteristic of universal machines or machines with flexible capabilities. The change in the

Print ISSN 1691-5402
Online ISSN 2256-070X
https://doi.org/10.17770/etr2024vol3.8123

unit cost of production depending on the operating period.

The main feature that characterizes innovations in general is their life cycle [10]. A distinction should be made between the life cycle of a product and the life cycle of an innovation. We can have several innovative solutions in one product. The product life cycle is a concept that expresses the change in sales and profit from the moment of idea generation to its market realization [11, 12]. However, they have a lot in common and overlap. For example, when some of the innovative solutions embedded in the product become obsolete, there is a drop in sales, as a result of losing part of the competitiveness. The graph of the innovation life cycle is given in Figures 1. and 2.

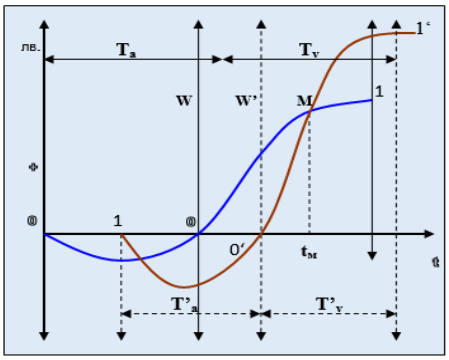

Fig. 1. Innovation life cycle

(t – time; Ta, Ta - investments made in an innovation cycle, including idea, research, design and production for 1 and 1' innovation; Tv, Tv' - innovation cycle, including development and moral obsolescence for 1 and 2 innovation; M , tm - impending moral obsolescence for the 1st innovation)Magnetization as a function of applied field.

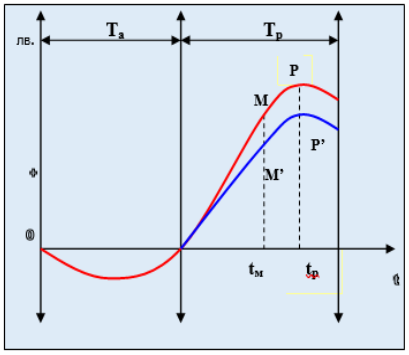

Fig. 2. Life cycle of the innovative product

(t - time; Ta - life cycle of products, including: research, design and production; Tr - market cycle; 1- change of funds, where investments are made during periods Ta, and in the period Tr are returned with profit (project and real); 2 - change in profit; M, M' - occurring moral obsolescence in time tm; P, P' - points of decrease in profit.Magnetization as a function of applied field.

III. Results and Discussion

In this case, development, implementation and growth times are short, with sales growth peaking soon and maximum revenue being realized more quickly. The maturity period should last longer and the decline of the curve should be very smooth.

TABLE 1

Criteria	Stages of the innovation product life cycle	
	1 Development, design, production	2 Introduction
Competition	*Absent*	*Insignificant*
Users		*Innovators*
Product assortment	*One model*	*One model*
Sales		*It depends on the conditions*
Profit		*Small*
Strategy		*New product attraction*

Criteria	Stages of the innovation product life cycle		
	3 Growth	4 Maturity	5 Decline
Competition	*Small*	*Strong*	*Insignificant*
Users	*Mass market*	*Mass market*	*Conservatives*
Product assortment	*The number is growing*	*Full assortment*	*Decreases*
Sales	*It's growing*	*It's growing*	*Decreases*
Profit	*Growing*	*It's growing*	*Decreases*
Strategy	*Sales development*	*It maintains distinctive advantages*	*Abbreviation, revitalization, termination*

Figure 3 shows the shape of the ideal life cycle of a new product.

The determination of the optimal operational period of the equipment appears as a necessary, but insufficient condition for the formation of the possibilities of the industrial company. This is explained by the fact that for different types of machines, their operating time almost always exceeds the optimal one, because material wear is slower than innovative wear [2, 13].

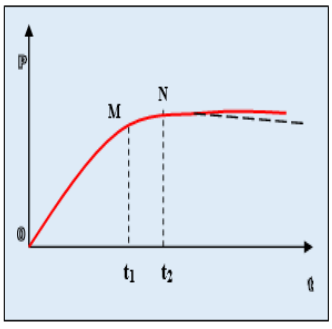

Fig. 3. Form of an ideal life cycle of a new product

(1, 1' - product life cycle; t - time; t1 - time for development, introduction and growth (M); t2 - complete exhaustion of resources (N); P - sales in BGN)

The search for the best solutions for determining the production possibilities creates conditions that also lead to the search for different forms of optimization of this process. The parameters and indicators that characterize the state of production facilities and determine their capacity can be divided into two types [14, 15]:

1. Economic parameters expressed in economic indicators (operating costs, the share of equipment costs per unit of production, cost per unit of production, total costs, depreciation costs, etc.) [3];
2. Technical parameters expressed in technical indicators (service life, reliability, repairability, coefficient of useful action, technological capabilities, etc.).

IV. Conclusions

- The lack of proper technical and economic justification of the developed technologies can lead to the implementation in production of inefficient and competitive variants of manufactured products.
- Innovation obsolescence is a regularity that manifests itself as a consequence of the occurring change in the technical levels of innovations with the same technical purpose. Between innovation development and innovation obsolescence there are certain interrelationships and interdependencies that essentially characterize the process of innovation obsolescence itself.
- The manifestation of innovation obsolescence is expressed with an impact on engineering structures, processes and industrial products.
- Innovation obsolescence negatively affects the rapid innovation development and efficiency of industrial products.
- Effective forms of solutions to eliminate negative consequences of rapid innovation obsolescence of products and processes are used by many industrial companies in our country and around the world.
- An effective alternative form of innovation obsolescence is the so-called "programmed obsolescence". It is increasingly being imposed as an approach for quick and effective removal of the consequences of innovation obsolescence and creates conditions for higher competitiveness.
- In world practice and in our country, many of the forms of programmed obsolescence have taken hold, as one of the means of increasing the competitiveness and efficiency of the production of industrial products.
- Innovative obsolescence is essentially a regularity, and programmed obsolescence is a human-regulated alternative activity aimed at eliminating the harmful effects of innovative obsolescence.

REFERENCES

[1] S.Berger, Making in America: From Innovation to Market, USA, 2013.

[2] I.Balabanova, G.Georgiev, "Image Recognition by FFT, Artificial Intelligence and k-Nearest Neighbors Approach". IOP Publishing, Journal of Physics: Conference Series - EEPES'22, vol. 2339, pp. 1-8, 2022.

[3] G. Chipriyanova, R.Krasteva-Hristova, A. Kussainova, A. Contemporary higher accounting education for social responsibility. // ECONOMICS ECOLOGY SOCIUM, Volume: 6, Issue: 4, Pages: 27-36 DOI: 10.31520/2616-7107/2022.6.4-3 Published: 2022 Accession Number: WOS:000904078500003 ISSN: 2616-7107.

[4] G.Chipriyanova, M.Marinova, Technological Aspects of Accounting Automation System as a Decision Support System, Vide. Tehnologija. Resursi - Environment, Technology, Resources, Open Access, Volume 2, Pages 28 – 33, 2023, 14th International Scientific and Practical Conference on Environment. Technology. Resources, ETR 2023, Rezekne, 15 June 2023 through 16 June 2023, Code 191610, DOI: https://doi.org/10.17770/etr2023vol2.7309 .

[5] D.Damianov, Modern alternatives to rapid innovative aging, Scientific Bulletins of NTS in Mechanical Engineering, Year XXVI, Vol. 3/224, ISSN 1310–3946, 27 ISTC "ADP 2018", June 2018, pp. 278-283.

[6] I.Mitev, Optimizing the quantity of liquid phase at the sintering of powder construction materials from system Fe-Cu-Sn, 11th International Scientific Conference "TechSys 2022" – Engineering, Technologies and Systems, AIP Conf. Proc. 2980, https://doi.org/10.1063/5.0184238 , Published by AIP Publishing. 978-0-7354-4814-8/$30.00, pp. 060017-1 to 060017-7.

[7] I.Mitev, Determining the diffusion coefficient in simultaneous saturation with boron and carbon of austenite alloyed with cooper in powder metallurgy structural materials, 11th International Scientific Conference "TechSys 2022" – Engineering, Technologies and Systems, AIP Conf. Proc. 2980, 060016-1–060016-8; https://doi.org/10.1063/5.0184239 , Published by AIP Publishing. 978-0-7354-4814-8/$30.00, pp. 060016-1 to 060016-8.

[8] N.Nikolova, Intellectual Capital Management used for Optimizing the Activities of Modern Small and Medium Enterprises/Companies. 4th International Conference Economics and Management-Based on New Technologies, EMoNT 2014, 12-15 June 2014, Vrnjačka Banja, Serbia., pp.258-262, ISBN 978-86-6075-045-9.

[9] N.Nikolova, Human Capital in the Changing Work Environment of Industry 4.0, Vide. Tehnologija. Resursi - Environment, Technology, Resources, Open Access, Volume 3, Pages 187 – 193, 2023, 14th International Scientific and Practical Conference on Environment. Technology. Resources, ETR 2023, Rezekne, 15 June 2023 through 16 June 2023, Code 191610, DOI: https://doi.org/10.17770/etr2023vol3.7177

[10] N.Nikolova, Entrepreneurial "Blue" Practices for Sustainable Development and Resources Efficiency, 12th Inter-national Scientific and Practical Conference "Environment. Technology. Resources", June 20-22, 2019, Rezekne Academy of Technologies, Rezekne, Latvia, Volume I, 198-203, ISSN 1691-5402, ISSN 2256-070X.

[11] D.Petrova, Analysis of SMEs in Bulgaria – Assessment of Their Innovation Activities, Rezekne 2013, Latvia, Rezekne Higher Education Institution, Faculty of Engineering, Scientific Institute for Regional Studies, Environment. Technology. Resources, Proceedings of the 9th International Scientific and Practical Conference June 20-22, 2013, Volume 3, ISSN 1691-5402: 46-49.

[12] D.Petrova, Analysis of Trends and Opportunities for Technological Development of Bulgarian Enterprises, Proceedings of the International Conference Danube Black Sea, 3E – Energy, Environment & Efficiency, September 18-21, 2013 Galati, Romania, ISBN, pp. 413-417.

[13] D.Petrova, Intelligent, Innovative and Sustainable Industry in Bulgaria – prospects and challenges, Vide I. Tehnologija. Resursi - Environment, Technology, Resources, Proceeding of the 12th International Scientific and Practical Conference „Environment. Technology. Resources", June 20-22, 2019, Rezekne, Latvia, Volume I, pp. 210-215, ISSN 1691-5402 – print, ISSN 2256-070X – online. https://doi.org/10.17770/etr2019vol1.4188

[14] D.Petrova, An Alternative Approach to Reducing Aging of Innovative Industrial Products in Terms of Industry 4.0, Environment. Technology. Recourses – Proceeding of the 13-th International Scientific and Practical Conference, Rezekne

Academy of Technologies, Rezekne, Latvia, 2021, ISSN 1691-5402, *Online ISSN 2256-070X*, *https://doi.org/10.17770/etr2021vol3.6507* p. 274-280, scopus

[15] D.Petrova, An Approach to Modeling Innovation Obsolescence, Vide. Tehnologija. Resursi - Environment, Technology, Resources, Proceeding of the 14th International Scientific and Practical Conference, 2023, Volume I, pp. 175–179, Print ISSN 1691-5402, Online ISSN 2256-070X, DOI: https://doi.org/10.17770/etr2023vol1.7237 , https://www.scopus.com/authid/detail.uri?authorId=56323816400

[16] D.Petrova, B.Vlahova, A. Lengerov, T. Zlateva-Petkova, Study of the State of Innovation Development and Obsolescence in the Republic of Bulgaria of Companies from the Mechanical Engineering Sector, Vide. Tehnologija. Resursi - Environment, Technology, Resources, 2023, 1, pp. 187–194, DOI: https://doi.org/10.17770/etr2023vol1.7239 , https://www.scopus.com/authid/detail.uri?authorId=56323816400

[17] M.Schillings, Strategic Management of Technological Innovation, Ravi Shankar, Edition: 6, 2019.

[18] J.Sunbi, A.Gallina, Contemporary Management of Innovation: Are We Looking at the Right Things?, USA, 2019.