Environment. Technology. Resources. Rezekne, Latvia
Proceedings of the 14th International Scientific and Practical Conference. Volume 1, 187-194

Study of the State of Innovation Development and Obsolescence in the Republic of Bulgaria of Companies from the Mechanical Engineering Sector

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Abstract. **The goal is to make an analytical study of the state of innovation development and innovation obsolescence in 15 machine-building companies in the Republic of Bulgaria. On this basis, the regularity of innovation obsolescence should be established and whether it has priority over physical wear and tear. An alternative approach for choosing solutions to reduce the harmful impact of rapid innovation obsolescence is proposed.**

Keywords: Innovation development, Obsolescence, Solutions.

I. INTRODUCTION

The modern stage of development of economic life is characterized by the globalization of product quality requirements, the need for sustainable growth, the pursuit of highly effective implementation of innovative achievements and high technologies in the field of information and communications [2]. Sustainable trends of globalization of the economy determine the accelerated introduction of innovative solutions, expressed in new technologies and automation of production processes. They solve a wide range of tasks related to:

- increasing productivity;
- with the quality of the manufactured product;
- with the sustainability and flexibility of the production process;
- with the shortening of the period from the birth of the idea to the realization of the product on the market.

Innovative saturation of processes (technological and informational) is aimed not only at eliminating heavy, monotonous, harmful to health and unattractive work, but also at applying specific innovative solutions (artificial intelligence) increasing productivity and efficiency [4]. These solutions have the task of overcoming the permanent tendency of a deficit of labour resources (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 radically different approach to the entire innovation process. It is a global trend that manufactured products are beginning to become extremely complex, both in terms of their internal structure and in terms of user and functional

Print ISSN 1691-5402
Online ISSN 2256-070X
https://doi.org/10.17770/etr2023vol1.7239

requirements that must satisfy the need [3]. These new production concepts impose a fundamentally new way of industrial construction. With them, the use of global information networks provides an opportunity to intensify production and significantly improve the quality of manufactured products. The creation of environmentally friendly technological schemes, methods and processes is a priority of the new production concepts. In this direction, social problems and environmental restrictions will impose their predominant importance in the innovative development of production in the future [1]. In doing so, productivity and efficiency will have an integral meaning, determined by the groups of factors generated by the impact of the new concepts. This highly efficient production is a direct consequence of the use of the latest advances in computer engineering and technology, i.e. of innovations [5]. The concepts and solutions for a new type of production are generated by the complex market conditions and the aspiration of the leading companies to produce their new products more and more efficiently, with better quality and more environmentally friendly in order to satisfy the demands of the user on a global scale and communication between them.

II. MATERIALS AND METHODS

Some concepts born of globalization are a direct consequence of the use of innovations, including recent achievements in computer technology and informatics [6].

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

In point 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 the investment saturation of the industry with new innovative solutions. In doing so, productivity and efficiency will have an interdependent meaning, determined by factors characterizing the nature of high-performance technologies [6].

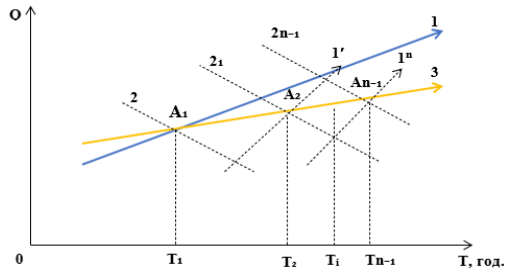

Fig. 1. Dependence between global competition under the influence of high (High) technologies and the imposing assumptions for sustainable growth.
(1 - global competition; 2, 2_1… 2_{n-1} - the efficiency resource of old technologies; A_1, A_2, An- equilibrium points between global competition (1, 1',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

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

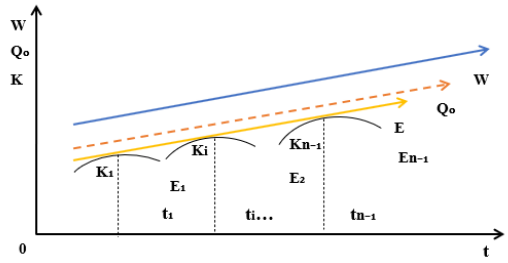

Fig.2. Dependence between technical levels (W), societal productivity (Q_0) and efficiency (E)
(E- efficiency; Q_o - public productivity; K - equilibrium point; t - time (years); W- technical levels).

After point K_1... K_i... K_{n-1}, the productivity starts to approach the limiting line of the reached technological level at time t_i and remains constant, and the efficiency starts 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 [7]. This means investing in high-performance technologies (pro-duction and information) that provide solutions for global innovation saturation of processes and activities.

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

There is a certain relationship between productivity (Q) as a world level reached and technical development. It is expressed in the reached technical degrees of development (W), considering the differences in the corresponding levels (W_n) and the increase in productivity (Q_n). Indicators determining productivity and technical levels are closely related and interdependent, as they are defined by techno-logical development at a given time, which in turn is the result of the reached productivity of technologies as a degree of development of scientific and technical progress [10]. The physical essence of these dependencies is expressed in shortening the periods of creation of new technical solutions, technologies, modern constructions, know-how, etc. and increasing their productivity in absolute and relative terms for each new period (T_1, T_2, T_3..., T_1,..., 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... t_i, t_n), and the technical levels - higher and higher for each subsequent period. These are objective technical regularities, which with technological development mark accelerated steps for each subsequent period (Fig. 3).

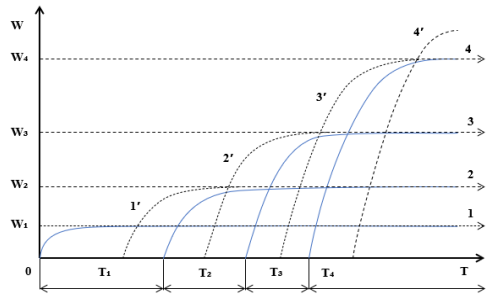

Fig.3 Technical regularities.

Therefore, the future development of industrial activities will be characterized by ever higher technical levels, ever higher productivity, rapid innovative obsolescence and global intensification of processes and activities [11]. At the same time, these dependencies form new spheres, generating a new development environment, flexibly balanced by the impact of internal and external factors.

Now we cannot talk only about individual innovations and innovation processes, but about innovative production, viewed in a complex manner. The impact of the external environment determines the basic requirements for the technological behaviour of companies and creates the prerequisites and conditions for a new attitude to innovation as an integral and necessary part of the global development of industry and society [14].

From the above presented fig. 1.3 it can be 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 public 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- period of electricity and automation; T_3- period of computerization and high degree of automation; T_4- period of artificial intelligence and cyber systems.

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 takes precedence over physical obsolescence. Therefore, a particularly important point in this direction is the correct determination of the degree of innovative obsolescence. The goal is to establish the impact of innovations on the technical, economic and social results of industrial activity. The correct assessment of their impact on the scale and timing of innovative obsolescence is of utmost importance for timely elimination of the negative consequences of their impact [9].

Taking into account the factors that characterize the qualitative side of innovation development allows to reveal not only the mechanism of its impact on the indicators of production efficiency, but also its influence on different sides of the production process. To facilitate the further clarification of the problem, we will group the influence of these factors in several directions [7].

The influence of innovative development on technology is expressed in the improvement of existing ones and the construction of fundamentally new machines, devices and equipment. According to their purpose and rates of productivity growth, they can be divided into two main groups:

- special machines and equipment designed for the production of uniform products on a mass scale; and

- universal machines and equipment designed for the performance of a variety of activities.

In recent years, a trend of strong unification and standardization of the elements in machine assemblies based on the modular principle has been noticed. The goal is to create conditions for the rapid assembly of machines with different technological purposes, but with a universal purpose (the principle of mechatronic machines). The study of the regularities of the development and improvement of the technique with a special and universal purpose makes it possible to determine the period in which the greatest effect can be obtained from the given generation of machines intended for a specific production process, and at the same time the period of transition to the production of new types of machines [12].

In the modern conditions of accelerated scientific and technical progress, the importance of this direction and its manifestation on the rates and scales of the innovative obsolescence of the technique has significantly increased. The real consequence of this impact is expressed in increasing the scope and terms of the innovative obsolescence of the machines and equipment in operation and the rapid change of their structural composition [15].

Innovative development is also expressed in the creation of new materials that have an active impact in accelerating the innovative obsolescence of existing technology. This influence is due to the wide application of new materials adapted for processing on certain types of machines. The extent of their use in production depends on the proportion of unnecessary equipment adapted to processing the old materials.

Innovative development affects technological processes. The changes occurring from the application of these new technologies in all cases play an active role in the production process, because of which the relative share of the old technological pro-cesses is constantly reduced, and together with them, the machines and equipment used for the purpose. It is related to the professional training and improvement of the methods, increasing the qualification and training of the personnel. Substantial changes occur in the qualification composition of the personnel, because of which a large number of new professions appear, old ones disappear, changing the ratio between individual groups of professions. This is the subject of Industry 5.0 [15].

The greatest potential for innovation in the industry is reflected in the application of advanced digital technologies. The era of advanced digital technologies has

been started by the fourth-industrial revolution, better known as Industry 4.0. Many industries expect Industry 4.0 to have a significant impact on their supply chains, manufacturing processes, and business models. Thus, Industry 4.0 is essentially a technological concept offering a promise of enhancement in efficiency through digital connectivity and artificial intelligence. This data-driven digital concept has been initiated by advanced technologies, such as Industrial Internet of Things (IIoT), Cyber Physical Systems (CPS), Industrial Big Data Analytics (IBDA), Artificial Intelligence (AI) and Cloud/Fog/Edge computing. However, the techno-logy-centered approach of Industry 4.0 has proved improper since the lack of a human impact in the application of this concept. Therefore, the wave of change has effects that go far beyond technological transformation [2]. Such as a transformed industry requires new knowledge and skills of both engineers and workers. Hence, the European Commission adopted an official document presenting Industry 5.0 and emphasizing the mean role of the research and innovation sector to support industry in its long-term service to humanity. Therefore, the concept of Industry 5.0 is not based on technologies, but is centered around values, such as human-centricity, ecological or social benefits. This paper represents the shift from Industry 4.0 to Industry 5.0 addressing the issue of how-to bring humans back to the forefront while maintaining the digital agenda and emphasizing sustainability and resilience with the aim to develop human-centric smart manufacturing systems [8].

The development of the technique leads to significant changes in the methods of its exploitation on the one hand, and on the other hand to improvement of the methods for changing the nature of the work and increasing the qualification of the personnel [15].

From what has been stated so far, it can be concluded that: the influence of innovative development is globalizing, because of which innovative obsolescence of technology occurs and the level of technologies put into operation lags behind modern ones. The continued use of innovatively outdated equipment and technological processes leads to certain losses, the amount of which will depend on the degree of this backwardness.

Trends in the relative change in the parameters of products and processes under the influence of innovation 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 to improve and change their parameters. The tendency to change the parameters of innovative products and processes because of their rapid innovative obsolescence forms a new alternative concept of innovative development. It also sets new requirements, both for the consumer essence of innovative products, and for the methods, approaches, and methods of their production.

The main directions, providing an effective way out of the limitations imposed by 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, is already showing its advantages in the following directions:

- Application of modular principle of construction and production of innovative products.
- Design and production of modules with differ-rent technological purpose.
- Design and manufacture of innovative pro-ducts with the highest possible reliability and short service life.
- Viewing the design and production cycle as a continuous process and using the methods of competitive engineering, simulation, virtual representation, etc. in order to shorten the cycle as much as possible.
- The shortest possible cycle from an idea to a manufactured innovative product.

Programmed aging is a purposeful and con-trolled human activity with the aim of solving some industrial, economic, and social problems of society's development. The satisfaction of specific individual needs can also be included here. From this point of view and from this point of view, planned obsolescence increasingly begins to play the role of an alternative to the rapid innovation obsolescence of products and processes.

The basic principles of planned obsolescence are shown in fig. 4.

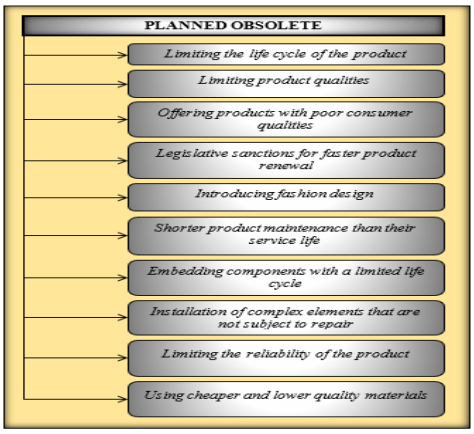

Fig. 4 Principles of programmed aging.

Patterns in innovative obsolescence and the role of programmed early obsolescence.

There are many industrial products on the market that are designed so that they are easier to replace with new ones than to repair, and manufacturers in practice massively use this market approach. In addition, there is also an alternative to innovative obsolescence, which is actively applied by many companies, both in household appliances and electronics, and in automotive and aircraft manufacturing. This new complex alternative approach, adopted quickly by industrial companies, shows its advantages in the following directions:

- It is accepted that innovative aging is an integral part of every stage of our lives. It is the main engine that drives science, technology, and the economy forward.

- Planned obsolescence as an established practice of modern industry has deepened in recent years. Experts together with some of the manufacturers believe that the frequent change of models also leads to waste of resources and damage to the environment. It turns out that the average life of home appliances has decreased by more than 3 years in recent years.

- The goal at the beginning of the 21st century was for industrial companies to produce better while keeping almost the same price. Or that longer product life is possible at the same price. This was the goal in the past, and today with the global economy and competition, everyone wants to sell more and faster. This means that the repair stage of industrial products is lost [13].

- The shortened life of industrial products and machinery is believed to be achieved in part by using lower quality materials.

- Strong impact of environmental factors in the global environment.

The advantages of this new approach are shown in Fig. 5.

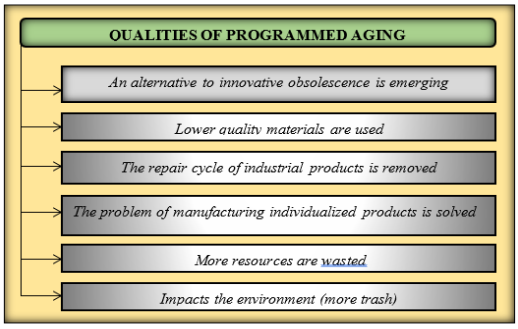

Fig. 5 Qualities of programmed obsolescence.

Technical progress and innovation/program-med obsolescence

Technical progress, innovative development, innovative obsolescence and planned obsolescence are known to be interrelated, but they are not mutually exclusive. They are not the same manifestation, although there is a certain interrelationship between them. This relationship essentially defines the objective interactions and impacts on both world progress and the social relationships of society as a whole.

The relationship between innovation development, innovation obsolescence and planned obsolescence is shown in Fig. 6.

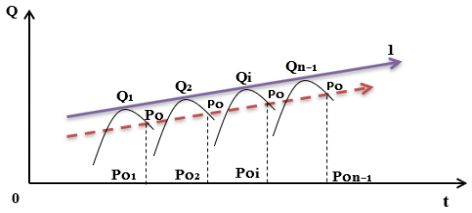

Fig. 6. Interrelationship between innovative development, innovative obsolescence and planned obsolescence.
(1-innovative development; Q_1, Q_2, Q_i… Q_{n-1} - innovative obsolescence (reduction in productivity); P_o- programmed obsolescence; Q- productivity of new innovations).

Manifestation of innovation obsolescence in mechanical engineering

In industrial development, there is a qualitative change based on innovations and high technologies. The development of technologies has the strongest impact on such basic activities as: energy, communications, nanotechnology, etc. There are three factors determining the effect of new technologies in the current stage of industrial development and form the concept of the modern production development of mechanical engineering, namely: technological, social and ecological.

The technological one dictates the tendency to constantly reduce manual, heavy and unattractive labour at the expense of higher productivity, and the object of this activity are all basic and auxiliary technological, production and information processes and activities.

The social presents the requirements for opening new or keeping the old jobs.

Ecological defines the permanent trend of compliance with ecological norms and the parameters of sustainable development of the ecological environment. All this shows that the prerequisites are already in place and conditions and opportunities have been created for a complex solution to the problems of industrial enterprises, and the formation of a new engineering policy based on communications, informatics, the Internet, Intranet, etc.

The innovation process is the most important part of the overall strategy of the enterprise. It is one of the means to achieve the goals of the engineering company, and the goals of every company are related to the sale of the products that it manufactures, trades and from which it derives maximum profit. In this sense, the innovation process is the main way to achieve the company's long-term goals [10]. It is a must for every company. The development and implementation of innovation projects allows the company to be a leader and main competitor on the market. A company that neglects innovation activity is doomed to market failure and takeover by the competition.

The innovation process can be defined and considered as a process of creating and spreading innovations, i.e. it represents a set of consistent and logically connected activities and tasks that must be performed from the moment of the idea of innovation to its market realization and its distribution.

In modern conditions, the interest in innovations is increasing more and more. They are seen as the main means of securing a firm's competitive advantage. Often in practice and theory, as a result of an etymological approach, the term "innovations" is used as a synonym for renewal. Innovation should be associated only with those forms of renewal that lead to progressive, qualitative changes in the technical-economic, technological, social, and environmental parameters of products.

The connection between innovation development and the coming innovation obsolescence in technique and technology has been proven beyond dispute. Research shows that the variant impacts of this interrelationship, both on rapid innovation obsolescence and on the techno-economic indicators determining this development, have not yet been clarified. Therefore, the interrelationship between the different stages of innovation development and innovation obsolescence should be investigated, to look for forms of impact leading to the reduction of the damage from innovation obsolescence.

Interrelationship between technical categories of development

The most important from the point of view of social development are the categories of the reached technical level of world progress and social labour productivity. Productivity in this case is considered as a category of social productivity and it is accepted to be evaluated by comparing the results of productivity and the total costs of labor (material, living) necessary for its implementation. The achieved technical level of world progress is determined by global indicators of technical progress currently expressed through certain categories of indicators, one of which is social productivity. Between it and the technical level there is a certain interrelationship and dependence. 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 time of development of technical progress [6]. These indica-tors are closely related and dependent on each other because they are defined by the globalization of innovation development at a given time, and the latter is the result of the achieved productivity of the technique, 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 innovation 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 ever higher social productivity. Therefore, future industrial activities will be of higher technical levels, higher productivity, faster innovation obsolescence and global intensify-cation of processes and activities.

Visually, the interdependence between innovation development, innovation obsolescence and productivity is shown in fig. 7.

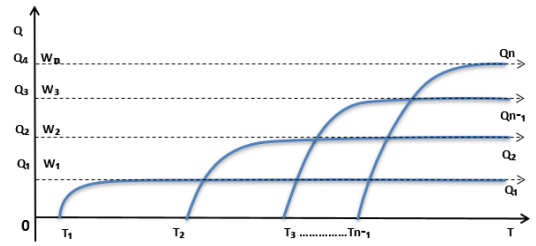

Fig. 7. Interrelationship between innovation development, innovation obsolescence and productivity.
(Q - productivity defined by technical levels; W- periods of emergence of new technical solutions during innovation development ($Q_1 < Q_2 < Q_3 < \dots Q_{n-1}$); T – periods of innovation obsolescence ($T_1 > T_2 > T_3 > \dots T_{n-1}$)).

Innovation development is influenced by several internal and external impacts related to the industrial development of the company shown in fig. 8.

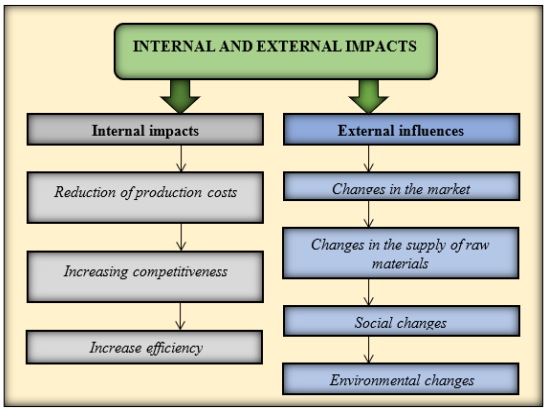

Fig. 8. Impacts influencing innovation obsolescence.

High rates of technical progress require rapid innovation obsolescence of equipment, but this does not mean that the same should 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. Therefore, a balanced ratio between physical wear and tear and innovative and planned obsolescence must be sought. However, practice so far shows that the facts differ significantly from prognostic views. So far, physical wear and tear often exceeds two to three times the innovative obsolescence of the technique. This is particularly characteristic of the so-called universal machines or machines with flexible capabilities. The change in the unit cost of production depending on the operational period is shown in fig. 9.

In practice, various approaches and ways of determining the service life of the equipment are known. These are the method of the total annual costs, the method of reducing the total costs to the sum of the investments, graphic methods, graphoanalytical, analytical, etc.

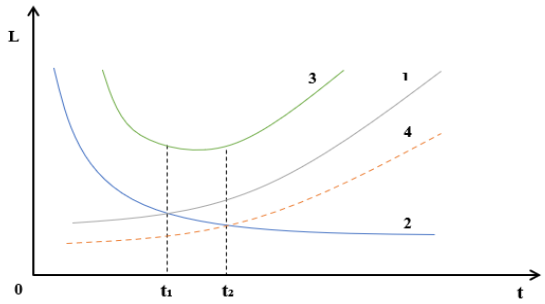

Fig. 9. Change in the cost per unit of production depending on the operational period.
(1–the share of operating costs, growing with an increase in the service life of the equipment; 2–return on capital costs (depreciation deductions); 3–general costs; 4–the share of operating costs that changes during equipment modernization).

III. Results and Discussion

In tabular form (Table 1), a study is presented in 15 Bulgarian machine-building companies, and the following are determined: the degree of innovation (J_{ino}), innovation activity (S), innovation obsolescence (M) and the alternatives for a solution are given (AR).

TABLE 1

Company	J_{ino}, %	$S = m.f(t)$ /бр	M, % $M = W.K = \frac{J}{m}.Mm$		AR
	N_n	S_m	M_m	L	AR
„МОНЕК-ЮГ“ АД	100	1	0,20	20	3
„ДИНАМО СЛИВЕН“ АД	100	1	0,15	15	3
„ЛИБХЕР-ХАУСГЕРЕТЕ МАРИЦА - ЕООД	70/100	2	0,50	50	2
„ВИТТЕ АУТОМОТИВ БЪЛГАРИЯ“ ЕООД	50/80/100	3	0,80	80	1
„ТРАНСВАГОН“ АД	100	1	0,20	20	3
„СКАЙМОНТ“ ООД	100	1	0,30	30	2; 3
„ЗММ–СЛИВЕН“ АД	100	1	0,20	20	3
„ТЕРЕМ–ИВАЙЛО“ ЕООД	100	1	0,40	40	2
„ХЕМ“АД	100	1	0,30	30	2
„МАДАРА АГРО“ЕООД	100	1	0,30	30	2
„ХИДРОПЛАСТФОРМ“ ООД	100	1	0,20	20	3
„ФАБКО“ ООД	100	1	0,10	10	3
„АЛПЕН И СИНОВЕ“ ООД	100	1	0,20	20	3
„ДАРМ“ ООД	100	1	0,40	40	2
„ДИАНЖЕЛИ“ ЕТ	100	1	0,30	30	3

Note: 1 – software obsolescence, 2 – modular constructions, 3 – outsourcing

The experiment proved that there is a functional interrelationship between "programmed" obsolescence and other alternative solutions against rapid innovation obsolescence. It acts as a regulator of the efficiency of the innovation obsolescence process.

The analytical results show that between innovative and "programmed" obsolescence we have both a mutual relationship and a different functional significance. One is a regularity, and the other can be an alternative to rapid innovation obsolescence.

IV. Conclusons

Based on the research, the following conclusions can be drawn:

- 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 because of the occurring change in the technical levels of innovations with the same technical purpose. Between innovation development and innovation obsolescence there are certain interrelation-ships 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 to remove the consequences of innovation obsolescence and creates conditions for higher competitiveness quickly and effectively.
- 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] Berger S., Making in America: From Innovation to Market, USA, 2013.

[2] Balabanova I., Georgiev G., “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] Chipriyanov, M., & Andonovska, M. (2022). Specific character of the media as business organizations and models for analysing the

values created by them. // Business Management, 2022(1), p. 5-16, Retrieved from www.scopus.com , 2022.

[4] Chipriyanova, G., Krasteva-Hristova, R., 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., 2022.

[5] Dais, S., (2014) Industrie 4.0 –Anstoli, Vision, Vorgehen. In: Bauernhansl, Th., ten Hompel, M., Vogel-Heuser, B.(Hrsg.): Industrie 4.0 in Produktion, Automatisierung und Logistik. Anwendung – Technologien – Migration, Wiesbaden: Sprin-ger, Fachmedien, p. 628, 2014.

[6] Damianov, D., 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", pp. 278-283, June 2018.

[7] Naydenov, P.,, П., Evaluating the relevance of virtual cellular manufacturing systems, Conf. Proceedings of 4th Interna-tional conference "Economics and management – based on new technologies", EMoNT 2014, Vrnjacka Banja, Serbia, 12-15 June 2014, ISBN: 978-86-6075-045-9, 2014.

[8] Nikolova, Neli, Entrepreneurial "Blue" Practices for Sus-tainable 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, 2019.

[9] Petrova D., Analysis of SMEs in Bulgaria – Assessment of Their Innovation Activities, Rezekne 2013, Latvia, Rezekne Higher Education Institution, Faculty of Engineering, Scien-tific 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: p. 46-49, June 20-22.2013.

[10] Petrova, D., 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, 2013.

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

[12] Sunbi J., Gallina A., Contemporary Management of Inno-vation: Are We Looking at the Right Things?, USA, 2019.

[13] Totev, H., The deplorable state of the bulgarian economy requires urgent measures for its modernizatioin, but creates enormous difficulties for the investment proces, , Conf. Proceedings of 4th Interna-tional conference "Economics and management – based on new technologies", EMoNT 2014, Vrnjacka Banja, Serbia, ISBN: 978-86-6075-045-9, 12-15 June 2014.

[14] Zlateva-Petkova, Tsanka. The necessity of organizational learning and its relation to knowledge management. International Conference "Economics and management – based on new technologies", EMoNT 2014, Връначка баня, Р. Сръбска, ISBN 978-86-6075-037-4.11, 12-15 June 2014.

[15] Zlateva-Petkova, Tsanka. Human Resources Management In The Knowledge Management, Donetsk National University, ISC "Problems And Prospects Of Cooperation Development Between Countries Of South-Eastern Europe Within Context Of Black Sea Economic Cooperation And Guam", Rostov-On-Don-Donetsk, p. 169-173, ISSN 1990-9187, 2013.