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BASIC INDICATORS FORMING EFFECTIVENESS IN DEVELOPING PRODUCT INNOVATIONS

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ABSTRACT

The article examines the main indicators that characterize a product development as innovative and the design technical solution as an innovation. The requirements for innovation in the development of product innovation projects and their ability to be effective and competitive are analyzed. The conditions and the possibilities for impact of these indicators on the degree of innovation and efficiency of product innovations, as well as on the economic results, have been studied. An attempt has been made to determine the degree of innovation impact, which also serves as a basis for quantifying the indicators included in the project solutions. Conclusions are given on impacts and impacts when using this approach to develop innovative projects.

Keywords: Innovation, Product Innovation, Efficiency, Innovative Projects, Innovation

Introduction

The innovative development of the industry is characterized by the fact that the reserves in its development can be successfully realized by choosing the best project solutions. What is characteristic here is that the effectiveness of innovative projects depends on many indicators, of which more important are: innovation, resource, social, environmental and other indicators. In addition, the main production processes are closely related to ancillary and service processes whose performance also influences production efficiency. Therefore, when developing innovative projects, account must be taken of the impact of all these factors both on the parameters of the project solutions and on the quantifiable indicators for the development of innovation projects. The pursuit through innovative improvement of the

product base, incl. technological, auxiliary and informational activities and minimization of human labor will increasingly be a major factor in the development of the industry. This means that on the basis of new innovative communication and computer achievements, nanotechnology, Technical solutions will not only change the structure of production globally, but also the approaches and ways of designing innovative products will change. In the future, production will be considered as one, involving both technology, technology and information processes, and functionally integrated components that deliver effective innovative solutions.

The creation of an optimal innovation program of the project development, ie. Such project implementations, which would allow for the dynamics of changing the indicators, are of the utmost importance. These projects usually define a set of diverse techno-economic solutions that vary in terms of execution times, costs, deployment modes, and so on. If analysis of these indicators is analyzed, programs can be created that characterize the technical and economical and innovative nature of the system for a certain period of time. The consideration of such tasks where decisions can be executed in this sequence, and their material implementation is done in this order, allows for better use of investments. In addition, conditions for higher innovation efficiency are created.

Looking at the development of production, in which different product innovations are being implemented, we have different cases of realization of project solutions. Experience shows, however, that it is best to implement these decisions selectively, depending on efficiency. Scientifically-applied projects are the most typical case in this sequence of product innovation. They are developed on the basis of a feasibility or other information technology study, which proves the innovation of the future development. The experience gained so far in the development and assessment of innovative projects undoubtedly proves that the consistency of the development and evaluation of project solutions depends on the impact of a number of factors influencing and creating restrictive conditions in this process. The nature of the influencing factors allows them to be grouped by nature into three main and two complementary indicators. Their algorithmic order of magnitude is given in Figure 1.

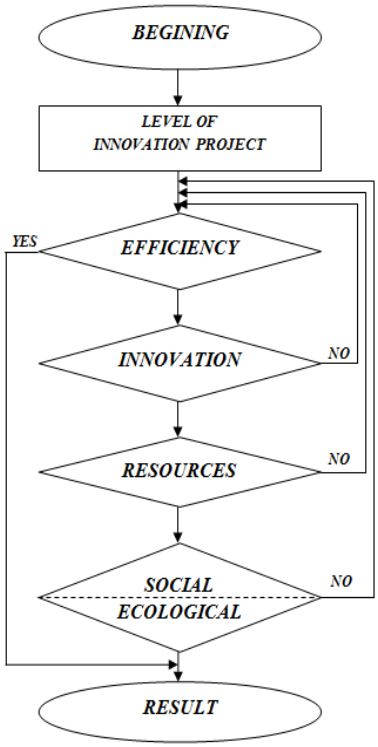

FIGURE 1. ALGORITHM OF DEVELOPING INNOVATIVE PROJECTS

Consequently, the level of innovation projects (N) depends and is a function of the following indicators:

$$N = F\left(E_f, In, Rs, Sc, Ec\right) \quad (1)$$

where:

Ef - Efficiency;

In - Innovation

Rs - Resourcefulness;

Sc - Social;

Ec - Ecological.

1. Efficiency

Efficiency is determined by the following indicators: return on funds (years), profitability and expected profit, economic outlook (years). Efficient economic strands are related to the market outlook of products or technology to produce these products. This is done through a

generalized marketing study with a rationale for the efficiency of manufacturing the innovative product.

1.1. Return on funds /investments/ for innovative solutions is done with the following methods for quantification of indicators:

Payback period (PBP). It determines the time period during which the investments made must be returned using the calculations:

$$CO = \frac{IP}{PP + A} \quad (2)$$

where:

CO – Payback period;

IP – Investment;

PP – Average annual net cash flow;

A – Amortization.

Internal rate of return. It equates to zero the net present value (NPV) to a provisionally deducted discount rate. The so-called discount rate for each innovation project is compared to the required income rate for projects with similar risk. The investment is profitable only if NPV>0 or IRR = NPV = 0, where IRR - internal rate of return.

1.2. Profitability. The profitability index (IP_p) is determined by the following formula:

$$IP_p = \frac{PP}{IP} \quad (3)$$

1.3. Economic Perspective. This means that the innovative product will have a guaranteed market for at least three years. Practice shows that many innovative products have no place on the market, making them unrealistic and non-marketable despite good innovation.

2. Innovation

Innovativeness is determined by the criteria of innovation and their quantitative measurement - a degree of novelty. Classification of innovation is based on the impact of different factors and the purposes of their research. In this way, they are distinguished and classified by distinctive signs. For the purposes of our research, we will adopt the classification definition, which forms their innovation essence (novelty). That is why the degree of novelty will be appreciated only in the qualitative definition that forms the essence of product innovation. In doing so, we have to distinguish between innovation and an innovative product (machine.) In the latter we can have some innovative solutions. Innovation in pure form is very rare.

Generally more innovative solutions are included in the innovative product, Dimityr Damyanov, (2002), Clayton Christensen, Erik Roth, Scott Anthony, (2013).

The level of innovation is determined by the degree of innovation aging of the previous innovation with the same purpose, the same type and satisfying the same human or social need.

Degree of innovation. The degree of novelty is an evaluation criterion and involves many dependencies. Typically, these are performance, efficiency, resource reliability, etc., such as weight, time, fuel economy, materials, work convenience, serviceability, and more (Table 1). According to Dimityr Damyanov, (2009), the quantitative measurement of these criteria can be determined by comparing the levels reached in leading companies and organizations around the world, including weight and material savings, overall dimensions, energy and fuel savings, reliability, time savings in their production (Productivity), design and workplace convenience, generally new technical, technological, organizational and other solutions, resulting in quantifiable benefits for the user. Other benefits that can be quantified are ecology, hygiene, labor protection, and so on.

There are three novelties for product innovation: a new product (underlying); upgraded product (enhanced); adapted.

TABLE 1. INDICATORS DEFINING THE DEGREE OF INNOVATION OF THE NEW PRODUCT

№ IN ORDER	*TECHNICAL PERFORMANCE OF INDICATORS*	*MEASURE*	*ACHIEVED LEVEL OF INDICATORS*	
			NEW PRODUCT	*ANALOGUE PRODUCT*
1	*2*	*3*	*4*	*5*
1.	Productivity	N / h		
2.	Workload	h		
3.	Weight	kg		
4.	Dimensions	mm		
5.	Reliability	вр		
6.	Energy consumption	kw		
7.	Repairability	h		
8.	Design			
9.	Consumption of materials	kg		
10.	Others	-		

The degree of innovation saturation (Is) of the product can be determined by the formula:

$$Is = \frac{Ka_{n_1} + Ka_{n_2} + Ka_{n_3}}{a}.100\% \qquad (4)$$

where:

a_{n_1} - Relative share of indicators defining the growth of time savings as productivity, efficiency. Etc., expressed in units of value (BGN);

a_{n_2} - The relative share of the indicators determining the growth of the economy of materials, fuels, etc., expressed in value units (BGN);

a_{n_3} - Relative share of the economy resulting from the influence of quality indicators such as design, etc., expressed in value units (BGN);

a_c - Relative share of the value of the same indicators of the analogue product.

a_{n_1} Is defined as the difference in the levels of the indicators between the innovative and the base (analogue) product expressed in terms of time savings. The results are valued in BGN.

a_{n_2} Is defined as the difference in the levels of the indicators between the innovative and the basic (analogous) product, expressed through the economics of material components (materials, energy, etc.). The results are valued in BGN.

a_{n_3} Is defined as the difference in the levels of the indicators between the innovative and the base (analogue) product, expressed through the savings obtained from the quality improvements (design, working comfort, etc.). The results are valued in BGN.

K_1, K_2, K_3 are coefficients of significance (weight) of the groups of indicators $a_{n_1}, a_{n_2}, a_{n_3}$. Usually $K_1=1$, $K_2=1$, $K_3=1$. If one of the indicators is given a heavier weight, then the ratio remains in all cases $C < 100\%$.

If we want to express C with a coefficient, then the formula gets the type:

$$K_I = \frac{a_n}{a_c} \tag{5}$$

where:

$$a_n = (a_{n_1} + a_{n_2} + a_{n_3}) \tag{6}$$

K_I is within the limits: $0 < K_I < 1$

Indicators defining the degree of innovation of an upgraded product

These indicators are similar to those used with a new product, but the benchmark is defined and calculations are easier.

The degree of innovation saturation is determined by the formula:

$$Is = \frac{a_м}{a_c}.100\% \tag{7}$$

where:

$a_м$ - Relative share of the value of the upgraded product (BGN);

a_c - Relative share of the value of the old product (BGN).

Indicators defining the degree of innovation of an adapted product

The same indicators are used for a new and upgraded product, but the final calculations are considerably simplified.

The degree of innovation saturation is determined by the formula:

$$Is = \frac{a_a}{a_b}.100\% \quad (8)$$

where: a_a - relative share of the fittest (adapted) product expressed in a single dimension;

a_b - relative share of the underlying product, expressed in a single dimension.

3. Resourcefulness

Resource is determined by resource areas such as human resources (H_R), material resources (M_R) and financial resources (F_R) or:

$$R = f(H_R, M_R, F_R)$$

3.1. Human Resources

According to Mark Huselid ,(1995), Patrick Wright, Gary Mahan, (1992), R. Amit, Monica Belcourt, (1999), successful management of human resources is of strategic importance and creates competitive advantages for each organization [4,5,6]. It is an extremely important element in the success of both the execution of the project and the rapid marketing of the product. It is important for the company to have its own working team, incl. Researchers, organizers, workers, etc. In addition, it must also have newly appointed researchers, incl. Contract workers. It is also desirable to have a partner organization such as Bulgarian Academy of Sciences, Universities and others.

3.2. Material resources

Material resources are the other important component of the firm to have the necessary technical capacity to complete the project. It is of particular importance that you have your own material base to carry out the project with your own strengths. It can also use subcontractors using the facilities of subcontractors or partners. Or material resources can essentially be regarded as the most important resource because they are the basis and essence

of production opportunities. The process of rational use of material resources in the development of product innovation also influences the profits from product realization. With equal other conditions, the maximum resource usability rate may increase if product innovation is highly effective.

3.3. Financial resources

These include the conditions and alternatives for project financing. If the company has its own funds, it can invest in project activities. But it can only invest with some of the means to implement the project and the other part to complement it with borrowing, bank and other resources. That is why the financial resource is of the utmost importance because it is related to the return and the efficiency of the production as a whole. One of the important strands in the development of production is the decision to introduce innovative products. Typically, in practice, individual solutions are implemented without the necessary technical and economic justifications, but only on the basis of subjective assessment or reporting data. Therefore, the problem of searching for and choosing a good option arises from the fact that the development of production needs is most often determined under the conditions of limited financial resources. Most often, cash is available. Moreover, money resources are not always optimized for production needs.

Additional Indicators

The additional indicators refer to the so-called Social and environmental indicators.

4. Social Indicators are those that relate to the creation of new jobs, with the project being able to achieve other social benefits for the company's employees, etc. Adapting to the social environment is a very important issue for increasing the efficiency of the production of innovative products. In such cases, the ambition is to meet the social requirements not only of the environment in which it operates but also of the social requirements of the area or of the country in which it operates. It should seek to create new jobs and improve working conditions, participate in various social events that will lead to building an image that meets the company's interests for greater efficiency and well-being. Martina Huemann, Anne Keegan, J Rodney Turner, (2007) examined that namely, ensuring well-being and ethical treatment of employees is a matter of vital importance to the organization.

5. Environmental Indicators are those through which ecology is improved - company environmental requirements are respected and others. Here we take into account the environmental norms of behavior and control that must be respected by enterprises producing

innovative products. This means compliance with environmental standards and standards that are mandatory in the production of a particular product. Because every innovative product defines strictly the individual environmental impacts that must be known and respected. These environmental norms and standards will in the future be an integral part of the euphoric assessment of the effectiveness of product innovation.

Apart from the suggested indicators, other ones may also be used. They are usually specific and have a higher quality character such as: educational level and qualification of staff, industrial motivation of staff, electronic adaptation and electronic environment, psychological attitude towards the technical arming of activities, processes, etc.

Conclusions

On the basis of this analytical study of the influencing factors on innovation projects (product innovation), the following conclusions can be drawn:

1. The innovativeness of project solutions depends on many factor effects, forming additional restrictive conditions for the efficiency of the implementation of the innovation project.
2. Novelty in the innovation project is a mandatory condition, but it is not always decisive for the marketability of the innovative product. The overriding influence of other factors may not provide the required performance of the product.
3. Innovative efficiency can not be seen as a permanent aggregation of the quantitative measurement of these indicators due to the fact that each of them at different times and different impacts changes its relative share in it.

In conclusion, it can be assumed that an approach is proposed to use quantifiable indicators in the development of innovative projects such as product innovation. The impact factors have been studied and a selection of the key indicators determining the effectiveness of the project solutions has been made. It has been proven that the effectiveness of innovative projects depends on the manifestation of these factors, creating new impacts, dynamically changing over time. Under different production and market conditions, they have a different impact on impact and different impact on the innovations of project solutions. The proposed sequencing of the impact of these dependencies can also serve as a practical tool for companies and organizations developing and evaluating innovative projects such as product innovation.

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