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FUZZY-MULTIPLE APPROACH TO RISK ASSESSMENT UNDER THE CONDITIONS OF MANAGEMENT DIGITALIZATION IN ENTERPRISE ACTIVITY

Abstract. The success of the enterprise in the market depends on the level of its competitiveness, which, in turn, is determined by the level of competitive advantages of products developed and supplied to the market. Constant updating of the product range by modern enterprises allows them to extend the time of their effective life and ensure success in the long run. To do this, companies must constantly carry out innovative activity aimed at developing, implementing, and bringing new products to market to best meet consumer needs. However, companies must not only explore the main factors of success, but also the sources of risk that accompany the introduction of innovative products to market. The effectiveness of product innovation policy of the dairy industry is determined by the optimal combination of traditional and new products (new convenient packaging, new flavors, size, etc.). The article considers a fuzzy multiple approach to assessing the risk of bringing innovative products of the dairy industry to market. This approach is based on the «RWW» criteria for assessing the risk of bringing new products to market (Real, Win, Worth it), which is considered in the work of George S. Day. Based on the risk assessment criteria, a fuzzy-multiple model of risk assessment for bringing innovative products to market was built. As a result, an assessment for the risk of launching a novelty on the market was obtained for the three components o the RWW instrument and the integrated generalized one. The advantage of using the proposed method is the possibility of forming an aggregate risk indicator for the introduction of a new product on the market, which takes into account not only quantitative but also qualitative characteristics of the evaluation indicators.

Keywords: digitalization, risk, digitalization, new product, innovative product, fuzzy multiple, fuzzy logic.

JEL Classification C63, 81, M21

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НЕЧІТКО-МНОЖИННИЙ ПІДХІД ДО ОЦІНКИ РИЗИКУ В УМОВАХ ЦИФРОВІЗАЦІЇ УПРАВЛІНСЬКОЇ ДІЯЛЬНОСТІ ПІДПРИЄМСТВА

Анотація. Успішність підприємства на ринку залежить від рівня його конкурентоздатності, яка, у свою чергу, визначається рівнем конкурентних переваг продукції, що розробляють і поставляють на ринок. Постійне оновлення продуктового асортименту сучасними підприємствами дозволяє їм продовжити час свого ефективного життя і забезпечити успіх у довгостроковій перспективі. Для цього підприємства повинні постійно здійснювати інноваційну діяльність, яка спрямована на розробку, впровадження і виведення новинки на ринок для забезпечення найкращим чином потреб споживача. Однак підприємства повинні не тільки досліджувати основні фактори успіху, а й джерела ризику, які супроводжують виведення інноваційної продукції на ринок. Ефективність товарної інноваційної політики підприємств молочної галузі визначається оптимальним поєднанням традиційних і нових товарів (нові зручні упаковки, нові смаки, розмір та інше). Розглядається нечітко-множинний підхід до оцінювання ризику виведення інноваційної продукції підприємства молочної галузі на ринок. В основу підходу покладено критерії оцінювання ризику виведення нової продукції на ринок «RWW» (Real, Win, Worthit — «Чи це реально?», «Чи ми можемо виграти?», «Чи варто цим займатись?»), які розглянуто в роботі Джорджа С. Дея. На базі критеріїв оцінки ризику було побудовано нечітко-множинну модель оцінки ризику виведення інноваційної продукції на ринок. У результаті було отримано оцінку ризику виведення новинки на ринок за трьома складовими інструменту «RWW» та інтегральну узагальнену. Перевагою використання запропонованого методу є можливість формування агрегованого показника ризику виведення нового продукту на ринок, який ураховує не тільки кількісні, а й якісні характеристики індикаторів оцінки.

Ключові слова: діджиталізація, ризик, новий продукт, інноваційний продукт, нечіткі множини, нечітка логіка.

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Analysis of research and publications. Entrepreneurship is always associated with risk, as it is impossible to predict all the economic characteristics of the future. The entrepreneurs who take risks on the path to profit are the driving force for the development of any economic system. Therefore, an important task is to identify sources of risk, assess their consequences, and develop measures that can reduce their dangerous impact on entrepreneur activity. Innovative activity is more associated with risk than other areas of entrepreneurial activity, as there is almost no full guarantee of obtaining the desired result, but innovation also allows you to get the most reward while doing business. An important part of innovation is the creation of new or improvement of existing products and bringing them to market. This means that identifying and assessing sources of risk is an important part of success ensuring.

Many scientists have studied the risks of bringing new products to market. The questions of determining the components of the risks assessing when bringing innovative products to market and risk factors that affect this process were considered by George S. Day [1], J. J. Lamben [2]. Yu. S. Kravchuk [3], O. M. Nifatova [4].These works are dedicated to the criteria of estimation for innovations introduction and features of new production testing for market potential estimation. In the works of Chan Kim W. [5], T. Robertson [6], I. O. Bashinskaya, N. S. Popovenko [7],

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B. Nagji [8], E. E. Ibragimov [9] we can study new approaches to the development and marketing of new product types. The issues of determining the sources of risk when launching new products on the market, indicators, and tools for identifying risks when promoting innovation on the market were considered in theworksof V. F. Oberemchuk, T. O. Samilo [10]; V. R. Kigel, K. S. Musienko [11]; I. B. Bachalo [12]; I. V. Boyko, N. M. Litvin [13]; A. O. Zaripova [14].

Some scientists have dealt with the introduction of new products to the market in the dairy industry, in particular: N. S. Kubyshyna, A. P. Stasevich [15]. They considered the industry features for the introduction of new products in the dairy industry. However, tools and methods for assessing the risk of introducing an innovative product to the market need further development. There are many different risk assessment tools, including risk assessment of innovative projects and innovative products. All tools are based on the study of the innovative activity peculiarities and substantiation of indicators that can be used to investigate the risks for bringing a novelty to market.

Problem statement. The successful operation of industrial enterprises and the level of their competitiveness is entirely determined by innovation and, above all, by the development, production, and introduction of new products to market. Constant updating of the product range by modern enterprises allows them to extend the time of their effective life and ensure success in the long run.

Introducing new products or services means providing unique or better functionality to the customers, which allows to dictate better prices, gives higher profits, or significantly expands market share. The success of innovations depends on the level of offers diversification and the level of novelty (*Table 1*).

Table 1

The success of innovations depending on the level of novelty

Highly differentiated offers	Offers with minor benefits	Offers similar to other innovations
Success 82%	Success 58%	Success 18%
Market share growing 54%	Market share growing 34%	Market share growing 12%

Source: [16].

The study of the main success factors in bringing a new product to the market allows to assess the prospects for the producer's work with these products and form the optimal range. But sometimes it is better to look at success not only in terms of benefits for consumers and producers but also in terms of the risks that may be associated with this activity. To a greater extent, companies form a mixed portfolio of new products, which includes traditional and innovative products. Common approaches to the formation of an effective product range are to expand the product line and improve existing products, they are typical for almost all enterprises. Most companies do not want to take risks by creating completely new products. It directly depends on consumer preferences and enterprise capabilities. The higher the technological level of enterprise and industry development, the more innovative the industry, the lower the risk of new products. Enterprises that occupy a stable position in the market switch to the manufacturing of new products almost every 6—7 years.

Innovative activity of the enterprise involves the identification of important consumers' needs and meet these needs either earlier than competitors or better. Identifying and mastering the features that make a product different from others requires a better assessment for the Voice of the Customer (WOC) than the traditional combination of focus groups, research, surveys, and competitive analysis. Identifying and mastering the properties that make a product different from others requires a better assessment of the Voice of the Customer (WOC) than the traditional combination of focus groups, research, surveys, and competitive analysis. Today's market environment is very competitive, consumer needs are growing, preferences are changing rapidly, and often become unpredictable. The process of globalization and informatization in the world is increasingly blurring the boundaries in the awareness of producers and consumers. The consumer has the opportunity to research the offer of goods and compare them with each other, share the experience of purchase and operation, regardless of location income, level and knowledge.

To maintain their positions, the producers have to compete not only with domestic but also with well-known world leaders. Producers are forced to adapt to new requirements and actively influence them. Adaptation is due to the differentiation of the goods characteristics, their quality, as well as the markets and consumer groups. There is a transition from mass and large-scale production to small-scale and single, which allows quicker reorientation to the production of other goods. Businesses are not only reorganizing, but they are also changing consumer demands. Using modern marketing tools, they actively influence the formation of consumer demands, adapting them to their products or their capabilities. The innovative activity of food and dairy enterprises in Ukraine is low, but their success and competitiveness in conditions of high competition are fully determined by the ability to bring innovations to the market (*Table 2*).

Table 2

Indicators of innovative products introduced to the market of food and dairy industry in Ukraine

Indicator	Years				
	2015	2016	2017	2018	2019
Number of product units that are new to the market in the food industry	455	885	563	893	591
Number of product units that are new to the market in the dairy industry	85	92	101	175	109
% of market novelties in the dairy industry to the number of market novelties in the food industry	18,6	10,8	18,1	29,6	18,3
% of sold innovative products to all sold dairy products	1,6	…[1]	1,1	1,8	1,6
%of sold innovative dairy products new to the market to all innovative dairy products	13,4	…[1]	8,1	32,8	25,2

[1]The indicator was not calculated.

Note: compiled and calculated on sources [17; 18].

Despite the limited and low quality of raw milk, the Ukrainian dairy market is deficit-free and is developing quite rapidly. Manufacturers compensate for the lack of raw materials by increasing the use of milk powder and various additives, emulsifiers, and vegetable fats. The assortment line of the dairy industry is developing towards the production of high-tech products with less milk and more content of biological components. Along with traditional goods, new goods, new convenient packaging, new tastes appear. Product innovations of dairy enterprises depending on the criterion are divided as follows: products with different changes in production characteristics; products for dietary nutrition with low-fat content; functional dairy products; products with new consumer characteristics; products for certain groups of population; products in new packaging; lactose-free products.

Process innovations in the dairy industry relate to the introduction of energy-intensive and low-waste technologies, low-temperature processing to preserve the useful properties of milk, nanotechnology, technologies to extend the shelf life.

Fig. 1 shows the share of market novelty products in the total number of innovative products in the food and dairy industry of Ukraine.

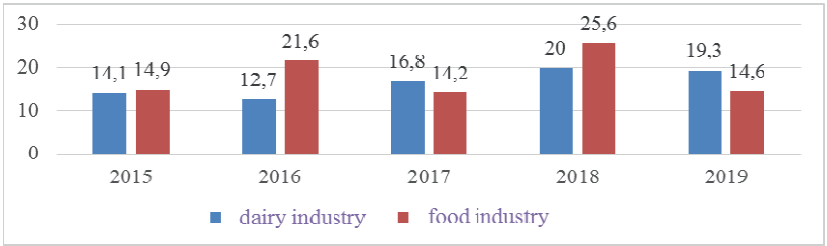

Fig. 1. **The share of market novelty products in the total number of innovative products in the food and dairy industry of Ukraine**

Note: compiled and calculated on sources [17; 18].

M. R. Mardar, G. M. Lozovskaya, S. A. Pambuk, G. K. Gozhelova [19] consider the following world trends in the development of dairy products: healthy eating; increasing demand for lactose-free products; growth of the «vegetable milk» sector.

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Today, trends in healthy and high-quality nutrition are being actively formed in food consumption, without the addition of preservatives and other additives. Dairy products are essential products and their diversity in the market is quite high, so to maintain competitive advantage and expand production, the producer must ensure the naturalness of the ingredients. Moreover, the consumer is ready to pay a higher price for naturalness, which is an incentive for the producer.

To analyze the risk of launching a new product, we can use the tool «RWW» (Real, Win, Worth it — «Is it real?», «Can we win?», «Is it worth doing?»), which was created by Dominic M. Schrello and considered in the work of George S. Day to assess the risks of innovative projects George C. Day recommends using this tool to assess the risk potential of enterprise innovation portfolios. He is sure that the RWW tool helps to assess the feasibility of projects. The first step in using this tool is to answer the question «Is it real?», which helps to decide whether customers want to see your innovation, and if so, whether you can create it. The next question of this technique is «Should we do this?» helps to assess the company's potential in ensuring the competitiveness of the product in terms of the company's ability to provide the product with competitive advantages. And the third question «Can we win?» allows you to assess the adequacy of product profitability level to ensure strategic goals.

This tool is used throughout the product development process, allows identifying erroneous assumptions, knowledge gaps, sources of risk, and problems that need to be addressed as soon as possible. It turned out to be interesting to translate such a comprehensive tool for risk assessment of innovative projects into the language of fuzzy multiples and use it for the risk of bringing new products to market in the dairy companies.

To study the risk of launching the novelty on the market, five products of «Favor» LLC were selected: cocoa milk (glass) (P1); sour milk product «For breakfast» with mushrooms, a mixture of herbs, and paprika (P2); albumin cheese (P3); cheese with chili peppers (P4); cottage cheese with herbs (P5). All investigated products have various characteristics of novelty: structure, a new taste, fat content %; weight, type of packaging; shelf life (days) at *t* (-2) — +4.

Research methodology. Fuzzy multiplies a concept introduced by Lotfi Zade [20], he expanded the classical concept of multiples, assuming that the characteristic function (membership function of the element) can take any intermediate values of membership on the segment [0,1], not just the value 0 (complete lack of affiliation) or 1 (full affiliation). Thus he replaced the concept of characteristic function with the concept of membership function.

This idea has given impetus to various studies on the representation of fuzziness and its properties analysis, as well as the use of fuzzy multiples to analyze and evaluate various economic and not only economic phenomena.

To do this, L. Zade introduces the concept of fuzzy variable as a triple $\langle A, U, \mu A(u)\rangle$,
where A is the name of the fuzzy variable; U is a universal multiple (domain); $\mu A(u)$ — restriction on possible values (content) of variable A.

The linguistic variable is the five $\langle A, T(A), U, G, M\rangle$,
where A is the name of the linguistic variable; T (A) is the term multiple of the linguistic variable A, ie the multiple of its linguistic values; U is a universal multiple in which the values of the linguistic variable A are determined; G is a syntactic rule that generates the meaning of the linguistic variable A (often in the form of grammar); M is a semantic rule that corresponds to each element T (A) its content as a fuzzy submultiple U.

To analyze the risk of innovative products that are planned to be placed on the market, related to uncertainty and risk sources parameters are formed. This list is individual for each company, it depends on the industry and business model. Selected indicators should reflect the impact of the most significant risks. The set of these parameters is reflected in the tool «RWW», specified for risk assessment, presented in *Table 3*.

As can be seen from *Table 3*, accurate measurement is not available for these parameters, and, accordingly, a subjective component appears in evaluation, which is expressed by such fuzzy evaluations as «high», «medium», «low». In fuzzy multiples theory, this is described as a linguistic variable with its term multiple of values, and the relationship between the quantitative value of a

factor and its qualitative linguistic description is given as a function of the factor belonging to the fuzzy multiple. In this case, the membership function is based on: data from objective tests for employees; diagnostic cards; intuitive ideas of experts.

Table 3

Criteria for assessing the risk of launching a new product on the market under the methodology «RWW»

Group of indicators	Marking	Product risk criteria
The risk of the product existence	X_1	How exactly the characteristics of the product correspond to its description
	X_2	The extent to which the use of existing technologies or materials allows the development of a new product.
	X_3	To what extent the product in its final form satisfies the market.
Risk of a market exists for the product	X_4	The extent to which the customers need the product or want to buy it.
	X_5	How affordable is the product for customers (for example, do they have enough money?)
	X_6	How many potential buyers?
	X_7	How ready are the customers to buy (for example, they are ready to switch to your products).
Risk of product competitiveness deterioration	X_8	The extent to which the product has a competitive advantage.
	X_9	How stable are the competitive advantages of the product?
	X_{10}	How likely are competitors to react to the appearance of the product?
Risk of enterprise competitiveness deterioration	X_{11}	How many available resources we have.
	X_{12}	Managers have relevant experience and skills.
	X_{13}	How clear the market is and we know how to respond to it correctly.
Risk of achieving the required product profitability	X_{14}	How much the expected return exceeds the amount of expenditure.
	X_{15}	What is the acceptable level of risk?
	X_{16}	Is it possible to control production costs, is it possible to reduce them?
Risk of the product strategic meaning	X_{17}	The extent to which the product is in line with our overall development strategy.
	X_{18}	How much higher management will support this product.

Source: specified on [1].

Thus, the functions of belonging of parameters to fuzzy multiples act as a quantitative measure of information uncertainty concerning the analyzed parameters, the values of which are described in the linguistically fuzzy form by N. A. Karpov [21].

We propose to use the method of fuzzy multiple theory to aggregate a set of risk parameters into a single «comprehensive» risk indicator for the introduction of a new product on the market.

This approach involves the following sequence of steps:

1. Definition of fuzzy multiples. S is the full multiple of risk states for bringing new products to market. Including: S_1 — fuzzy submultiple of states «complete absence of risk for launching a new product on the market»; S_2 — fuzzy submultiple of states «average level of risk for launching a new product on the market»; S_3 — fuzzy submultiple of states «high level of risk for launching a new product on the market».

2. Selection and ranking of indicators.

The ranking of indicators for a new product is carried out individually, taking into account the business model. The indicators are arranged in descending order of importance. Let r be the weight of the significance of the indicator. If it is known that $r_1 > r_2 > \ldots > rn$, then the weight of the i-th index is determined by the Fishburne rule:

$$r_i = \frac{2(N-\mathrm{i}+1)}{(N+1)N}, \quad (1)$$

where N is the number of indicators in the ranked series.

3. Compilation of membership functions for risk assessment indicators. For a single indicator X_i, the linguistic variable V_i is set to the level of the indicator $X_\mathrm{i} \gg$ on the following term multiple of values:

Bi_1 — submultiple «low risk of X_i»;

Bi_2 — submultiple «average risk level of indicator X_i»;

Bi_3 is a submultiple of «high level of risk of X_i».

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The construction of membership functions for each of the fuzzy variables usually occurs by the following methods (V. A. Kaid [22]): direct group method of a statistical experiment; statistical data method; method of pairwise comparisons. We use for our problem the method of statistical experiment, which was proposed by A. A. Uskov [23].

To do this, the group of experts is asked to consider randomly the numbers from each segment, which are interpreted as point values of the level of risk. The expert based on individual ideas relates the proposed values to certain values from the term multiple. During such an experiment, an empirical matrix is formed, each element of which a_{ij} is the total number of assignments of a random variable from the segment *j* to the *i*-th term.

If each interval contains the same number of experiments, the degree of belonging of a value can be calculated as the ratio of the number of experiments in which it occurred in a certain interval of the scale, to the maximum number of experiments for this interval for all intervals). In practice, this condition may not be met (for example, an expert cannot assign an evaluative value to any interval).

The properties of the membership function are the presence of one maximum and smooth, attenuating to zero fronts. Therefore, erroneous data must be removed from the empirical table before processing. The criterion for removal is the presence of several zeros in the line around the element (I. V. Sibikina [24]).

The value of the membership function on the empirical matrix can be calculated by the following algorithm (A. V. Leonenkov [25]).

First, the auxiliary matrix is built:

$$R_{1xN} = \{r_1;\ r_2; \dots\ r_1; \dots r_n;\}, \tag{2}$$

where *N* — the number of breakdown intervals for possible changes.

$$r_j = \sum_{i=1}^{n} a_{ij}, \tag{3}$$

where *n* is the number of terms.

$$r_{max} = \max_{j=1,..,N} r_j. \tag{4}$$

The elements of the empirical matrix are transformed by the formula:

$$c_{ij} = \frac{a_{ij} r_{\max}}{r_j}, \tag{5}$$

$i = 1,\dots, n; j = 1,\dots, N.$

For columns where $r_j = 0$, a linear approximation is used

$$c_{ij} = \frac{c_{i(j-1)} + c_{i(j+1)}}{2}. \tag{6}$$

By the rows of the empirical table the maximum elementsarehighlighted

$$c_{max} = \max_{j=1,..,N} c_{ij}.$$

The value of the membership function is determined by the formula:

$$\gamma_{ij} = \frac{c_{ij}}{c_{\max}}. \tag{7}$$

As a result of the statistical experiment data processing, we obtain *n* fuzzy multiples.

4. A matrix of the actual distribution of values of risk indicators of launching a new product on the market by fuzzy sets, where columns — qualitative levels, rows — indicators of risk of launching a new product on the market, and their intersection — is the level of belonging λ_{ij} quantitative indicators to quality classes. Accordingly, there is an abstraction from numerical values and the transition to fuzzy multiples of linguistic variables.

5. The formation of an aggregate risk indicator for bringing a new product to market is carried out according to the formula proposed in the works of A. O. Nedosekin [26]:

$$G_k = \sum_{j=1}^{N} g_i \sum_{j=1}^{N} r_i \lambda_{ij}, \tag{8}$$

where *g* is the probability coefficient of fuzzy multiples (g_j = 0.9—0.2 (*j*—1)); *j* is the column number; *i* — line number; *N* — the number of factors; r_i is the weight of the *i*-th factor; λ_{ij} is the level of belonging of the carrier X_i to fuzzy subsets B_j; *k* is a group of risk assessment indicators. The lower the *G*, the higher the level of risk for bringing a new product to market and vice versa.

6. Integral risk assessment of a new product on the market for three groups of RWW instrument is used by the formula:

$$G = \sqrt[3]{G_1 \cdot G_2 \cdot G_3}, \quad (9)$$

where *G_1* is the risk assessment indicator for the group «Is it real?», *G_2* is the risk assessment indicator for the group «Is it worth doing?»; *G_3*— risk assessment indicator for the group «Can we win?»

Research results. We will assess the risk of bringing new products to market (P1—P5) following the considered sequence of stages.

1. Define fuzzy multiples of the risk level for launching a new product on the market in *Table 4.*

Table 4

Fuzzy multiples of the risk level for launching a new product on the market

The numerical value of a comprehensive risk indicator for launching a new product on the market	Linguistic meaning
[0; 0,33]	Low risk
[0,33; 0,66]	Average risk
[0,66; 1]	High risk

Source: built by the authors.

Following the dual nature of the risk, its absence is not the goal of the activity, but rather the lack of opportunities, which indicates a reduction in profits.

2. Selection and ranking of indicators for determining the risk of launching a new product on the market is under the method of «RWW». The list of indicators for assessment is shown in *Table 3*, it has three groups of indicators and includes 18 indicators of risk assessment.

The ranking of factors for assessing the level of risk for launching new products on the market is done separately for each of the three groups of indicators in the analysis of «RWW». Ranking and significance of risk assessment indicators for the introduction of a new product on the market for the three components of the analysis made by the method of pairwise comparisons. The results are shown in *Table 5.*

Table 5

Ranking of risk assessment indicators for launching new products on the market for the group «Is it real?»

	X_1	X_2	X_3	X_4	X_5	X_6	X_7	$\sum_i^n \varphi_i$	Weight
X_1	x	0	1	1	1	1	0	4	0,19
X_2	1	x	0	0	1	1	0	3	0,14
X_3	0	1	x	0	1	1	0	3	0,14
X_4	0	1	1	x	1	1	1	5	0,24
X_5	0	0	0	0	x	1	0	1	0,05
X_6	0	0	0	0	0	x	1	1	0,05
X_7	1	1	1	0	1	0	x	4	0,19

Source: calculated by the authors.

Similarly, a study was conducted to rank the risk assessment indicators for the introduction of new products on the market for the other two risk assessment components.

3. *Table 6* shows the results of a statistical experiment obtained from a survey of experts to construct fuzzy multiples for each indicator.

Table 6

The results of a statistical experiment for the indicator X_1

The linguistic variable «risk level»	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
High	0	0	0	0	0	0	1	3	4	5
Average	0	0	0	1	4	5	4	2	0	0
Low	5	5	5	4	1	0	0	0	0	0

Source: calculated by the authors.

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According to the proposed methodology, experts are asked to assess the level of risk from each of the studied sources. To make this assessment in the values of the linguistic variable «risk degree», it is necessary to determine in which ranges the degree of risk takes its values. In the proposed method, the assessment of the degree of risk is carried out from 0 to 1. Accordingly, if the parameter that is considered as a source of risk has a high level of risk if its value is close to 0, and, conversely, has a low level of risk if its value is close to 1.

Table 7 shows the resulting matrix of the membership function for the variable X_1.

Table 7

The membership function of the variable X_1

The linguistic variable «risk level»	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
High	0	0	0	0	0	0	0,2	0,6	0,8	1
Average	0	0	0	0,2	0,8	1	0,8	0,4	0	0
Low	1	1	1	0,8	0,2	0	0	0	0	0

Source: calculated by the authors.

According to the data in *Table 7*, the membership function of the fuzzy variable X_1 is constructed (*Fig. 3*).

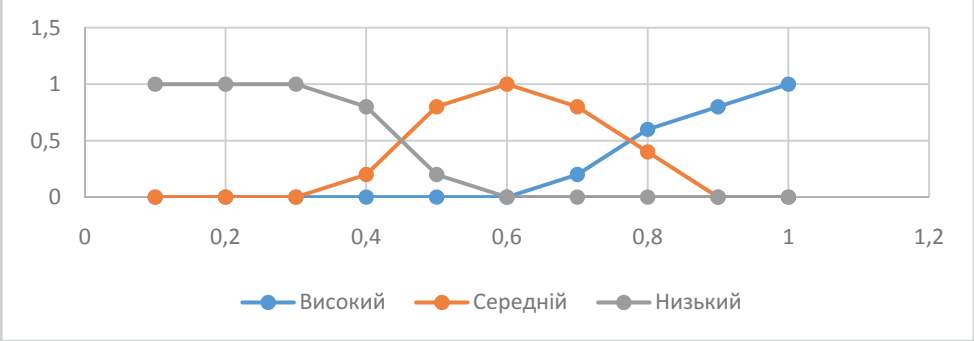

Fig. 3. **The membership function of the variable X_1 — How exactly the characteristics of the product correspond to its description**

Source: constructed by the authors.

Similarly, the membership functions for all variables of risk assessment for a new product on the market are constructed.

Thus, as a result of the statistical experiment method to construct the membership function, we obtain linguistic multiples for all risk assessment indicators (*Table 8*), which will be used to construct a fuzzy inference system. As a result, term multiples of variable values are formed for each of the indicators.

Table 8

Term multiples of risk assessment indicators for launching a new product on the market

Risk assessment indicators	*T* — numbers for the linguistic variable «Parameter value»			Significance (weight)	Indicator rank within the group
	High	Average	Low		
Is it real?					
*X*1	[0; 0,45]	]0,45; 0,75]	]0,75; 1]	0,24	2
*X*2	[0; 0,43]	]0,43; 0,78]	]0,78; 1]	0,19	4
*X*3	[0; 0,43]	]0,43; 0,78]	]0,78; 1]	0,15	5
*X*4	[0; 0,45]	]0,45; 0,83]	]0,83; 1]	0,10	1
*X*5	[0; 0,52]	]0,52; 0,83]	]0,83; 1]	0,11	7
*X*6	[0; 0,45]	]0,45; 0,78]	]0,78; 1]	0,09	6
*X*7	[0; 0,37]	]0,37; 0,75]	]0,75; 1]	0,13	3
Is it worth doing?					
*X*8	[0; 0,45]	]0,45; 0,75]	]0,75; 1]	0,15	4
*X*9	[0; 0,38]	]0,38; 0,72]	]0,72; 1]	0,18	4
*X*10	[0; 0,38]	]0,38; 0,75]	]0,75; 1]	0,20	1
*X*11	[0; 0,45]	]0,45; 0,72]	]0,72; 1]	0,12	1

Table 8 (continued)

Risk assessment indicators	*T*—numbersforthe linguistic variable «Parameter value»			Significance (weight)	Indicator rank within the group
	High	Average	Low		
*X*12	[0; 0,35]	]0,35; 0,75]	]0,75; 1]	0,22	4
*X*13	[0; 0,45]	]0,45; 0,76]	]0,76; 1]	0,13	1
Can we win?					
*X*14	[0; 0,36]	]0,36; 0,78]	]0,78; 1]	0,14	1
*X*15	[0; 0,42]	]0,42; 0,78]	]0,78; 1]	0,14	1
*X*16	[0; 0,45]	]0,45; 0,82]	]0,82; 1]	0,25	3
*X*17	[0; 0,42]	]0,42; 0,78]	]0,78; 1]	0,23	4
*X*18	[0; 0,42]	]0,42; 0,78]	]0,78; 1]	0,23	4

Source: calculated by the authors.

4. The defined linguistic ranges are used to compile a coagulation matrix, which compares the values of the risk assessment for a new product on the market within each of the three groups «RWW» to a fuzzy submultiple of the membership function so that if the value satisfies the range, in the matrix is set to «1», otherwise «0».According to this technique, a matrix of the actual distribution for risk assessment indicators in each component of the assessment system is compiled.

5. The formation of an aggregate risk indicator for each group of the evaluation system is based on Formula (8). The calculations for each component of the evaluation system are in *Table 9*.

Table 9

Calculation of aggregate risk indicators for the launch of product P_1 for each assessment component

j	g_i	$\sum_{j=1}^{N} r_i \tilde{\lambda}_{ij}$	$g_i \sum_{j=1}^{N} r_i \tilde{\lambda}_{ij}$
G_1 Is it real?			
3	0,17	0,63	0,1071
2	0,5	0,28	0,14
1	0,85	0,1	0,085
G_1			0,3321
G_2 Is it worth doing?			
3	0,17	1	0,17
2	0,5	0,190476	0,095238
1	0,85	0	0
G_2			0,265238
G_3 Can we win?			
3	0,17	0,62	0,1054
2	0,5	0,14	0,185
1	0,85	0	0
G_3			0,2904

Source: calculated by the authors.

6. *Table 10* shows the results on the assessment of the risk assessment integrated indicator for the introduction of new products on the market according to Formula (9).

Table 10

Integrated indicator of risk assessment for new products on the market and its components

Product	G_1	G_2	G_3	G
P_1	0,332	0,265	0,290	0,295
P_2	0,554	0,233	0,261	0,322
P_3	0,241	0,265	0,346	0,281
P_4	0,290	0,347	0,168	0,257
P_5	0,215	0,264	0,480	0,301

Source: calculated by the authors.

The higher G and G_i, the lower the level of risk for launching a new product.

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But to identify the level of risk and its three components «RWW» it is necessary to carry out linguistic recognition, it is necessary to justify the limit values of the terms. For this purpose, we propose to use the method created by N. I. Prytula, which takes into account the rule of three sigma's and the correction factor *k* taking into account the right and left asymmetry. According to this approach, the range of values for the generalized risk indicator and its components is as follows:[0; M– 3σk]; (M –3σk ; M + 3σ(k+1)]; (M + 3σ(k+1);1] [27].

Table 11 shows the distribution scale of the integrated risk indicator for the introduction of new products on the market and its components according to linguistic estimates.

Table 11

The distribution scale of the integrated risk indicator for the introduction of new products on the market and its components according to linguistic estimates

Linguistic assessment of the level	The range of indicator values	Intervals of values
High	[0; M–3σk]	[0; 0,29]
Average	M –3σk; M + 3σ(k+1)]	]0,29; 0,32]
Low	(M + 3σ(k+1);1]	]0,32; 1]

Source: calculated by the authors.

Table 12 shows the results of linguistic assessments of risk assessment by individual components and a generalized risk indicator.

Table 12

Linguistic risk assessments of new product

Product	G_1	G_2	G_3	G
P_1	Low	High	Average	Average
P_2	Low	High	High	Average
P_3	High	High	Low	High
P_4	Average	Low	High	High
P_5	High	High	Low	Average

Source: calculated by the authors.

According to the estimates obtained, all tested products have different levels of risk. However, if we examine separately the risks of their structural parts, we can see a list of priorities in overcoming possible problems that the company may face when launching a new product.

Conclusion. The advantage of using the proposed method is the possibility of forming an aggregate risk indicator for the introduction of a new product on the market, which takes into account not only quantitative but also qualitative characteristics of the evaluation indicators.

Further research concerns the development of measures that can affect the level of risk for the tested products and mitigate it if necessary. The entrepreneur will be able to see exactly what parameters of danger can cause the problem and be the source of risk. Thus, the entrepreneurs will have an important tool for identifying risks on the list of the most important strategic characteristics.

The advantage of this technique is also that you can always adjust the risk assessment according to the specifics of the project, the company's activity and industry development, which will be reflected by introducing specific risk assessment criteria into the model.

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