

Management

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FUZZY APPROACH TO ASSESSING THE STRATEGIC POTENTIAL OF A DAIRY PROCESSING ENTERPRISE

НЕЧІТКИЙ ПІДХІД ДО ОЦІНЮВАННЯ СТРАТЕГІЧНОГО ПОТЕНЦІАЛУ МОЛОКОПЕРЕРОБНОГО ПІДПРИЄМСТВА

Summary. *The article develops a methodical approach to assessing the strategic potential of a dairy processing enterprise based on the use of strategic diagnostic tools, fuzzy set theory and fuzzy multi-criteria analysis. To solve the task we built a hierarchy of the problem situation where the local potentials of the enterprise were identified and divided into components by decomposition. The calculation of the importance of local potentials is calculated on the basis of the integration of two fuzzy schemes using the analytical hierarchy method. To build fuzzy matrices of pairwise comparisons of the importance of local potentials, expert linguistic assessments are used according to the classical 9-level term set of the Saati method, that are transformed into fuzzy numbers with a triangular representation form and triangular membership functions. A similar approach was also applied to determine the weight coefficients of the components of local potentials. The Fuzzy SAW method is used to calculate*

integral estimates of the level of local potentials and strategic potential of the enterprise. The obtained results and their graphical interpretation enable top management to develop recommendations aimed at improving the strategic potential of the dairy enterprise.

Key words: *strategic potential of the enterprise, theory of fuzzy sets, linguistic variables, term-set, membership function, Fuzzy AHP, Fuzzy SAW.*

Анотація. У статті розроблено методичний підхід до оцінювання стратегічного потенціалу молокопереробного підприємства на основі застосування інструментарію стратегічної діагностики, теорії нечітких множин та нечіткого багатокритерійного аналізу. Для розв'язання поставленої задачі побудована ієрархія проблемної ситуації, де ідентифіковані локальні потенціали підприємства, які шляхом декомпозиції розбиті на складові. Обчислення важливості локальних потенціалів здійснюється на основі інтеграції двох розрахункових схем нечіткого методу аналітичної ієрархії. Для побудови нечітких матриць попарних порівнянь важливості локальних потенціалів використовуються експертні лінгвістичні оцінки за класичною 9-рівневою терм-множиною методу Сааті, які трансформуються у нечіткі числа з триангулярною формою представлення та трикутними функціями належності. Аналогічний підхід застосовано й для визначення вагових коефіцієнтів складових локальних потенціалів. Для оцінювання стратегічного потенціалу підприємства за складовими локальних потенціалів використовуються експертні оцінки за 7-рівневою терм-множиною з переведенням їх у трикутні нечіткі числа. Для обчислення інтегральних оцінок рівня локальних потенціалів і стратегічного потенціалу підприємства використовується метод Fuzzy SAW. У випадку неузгодженості оцінок експертів рекомендується застосовувати Fuzzy Delphy-метод. Для практичної реалізації запропонованого методичного

підходу в програмному додатку Excel розроблено фреймворк, який містить такі основні блоки: блок уведення лінгвістичної інформації попарних порівнянь важливості локальних потенціалів, їх складових та експертних лінгвістичних оцінок потенціалу за ними, блок трансформації цієї інформації у нечіткі числа в трикутному вигляді, блоки розрахунку важливості локальних потенціалів та їх складових за двома розрахунковими схемами, блок обчислення нечітких інтегральних значень рівня локальних потенціалів та стратегічного потенціалу підприємства. Одержані результати та їх графічна інтерпретація дають змогу вищому керівництву розробити рекомендації, спрямовані на вдосконалення стратегічного потенціалу молокопереробного підприємства.

Ключові слова: *стратегічний потенціал підприємства, теорія нечітких множин, лінгвістичні змінні, терм-множина, функція належності, Fuzzy AHP, Fuzzy SAW.*

Statement of the problem. At this stage, the development of enterprises takes place under the conditions of the VUCA world (Volatility, Uncertainty, Complexity and Ambiguity), namely in an unstable, uncertain, complex and ambiguous environment. The capabilities of an enterprise under these circumstances are determined not by the maximum possibilities of output, but by its ability to foresee potential changes in the macro- and microenvironment, willingness to respond flexibly to these changes and determine strategic development guidelines. To this end, the term "strategic potential of an enterprise" (SPE) is used in the scientific literature that can be defined as a system of interrelated resources, competencies and a set of opportunities for their effective use in order to fully satisfy the needs of target consumers, create competitive advantages and, as a result, ensure the successful development of an enterprise [5].

In conditions of the instability of the external environment and increasing competition any enterprise seeking to have a strong market position should pay due attention to the formation, diagnosis and improvement of strategic potential management.

Enterprises of the domestic dairy industry show significant potential for development. The key to the successful functioning of dairy enterprises is the ability to quickly adapt to the influence of business environment factors, creating sustainable competitive advantages, which is especially relevant during a pandemic crisis and martial law.

The complexity of the market environment, turbulence, uncertainty and dynamism of its development along with increased competition determine the need to study issues related to the management of the strategic potential of dairy enterprises, with the improvement of the methodological support for its assessment.

Analysis of recent researches and publications. The need for the introduction of strategic management by enterprises is substantiated in the works of foreign and domestic scientists, such as Ansoff I. [7], David Fred R. [11], Fahey L., Randall R.M. [12], Fleisher K., Bensoussan B. [13], Grant R.M. [14], Lambin J.J. [15], Thompson A.A., Strickland A.J. [18], Dovghanj L.Je., Karakaj Ju.V. [3], Artemenko L.P. [1], Shershnjova Z.Je etc.

Various aspects of SPE research and the process of its formation, analysis and evaluation were reflected in the works of such scientists as Gh. Klejner, O.I. Maslak, I.P. Otenko, T.M Kibuk, N.S. Krasnokutsjka, P.M. Makarenko, L.S. Ladonjko [4], V.A. Pavlova [5], Gh.T. P'jatnycjka [17], O.V. Berezin, O.V. Gholovash [2], V.N. Ghavva, V.B. Ghorbanj, I.V. Tokmakova [6] etc.

The issues of managing the strategic potential of agricultural enterprises, in particular, processing ones, have recently caught the attention of many domestic economists. The authors [5] presented a general classification of SPE, developed a model for transforming the external and internal capabilities of an

enterprise into strategic success factors. The study [6] considers the issues related to the formation of the SPE of the railway transport in order to ensure its competitiveness in modern conditions. The essence and characteristic features of the SPE have been clarified, the stages of managing the SPE of the railway industry have been revealed. A critical analysis and systematization of definitions of the concept of "strategic potential of the enterprise" was carried out in the study [17]. Possible types of local potentials as indicators of SPE are presented based on the data processing from studies by a number of scientists. In [2] a methodical approach to the comprehensive assessment of the level of SPE is proposed, which is based on the determination of integral indicators of the main components of the strategic potential of resource and adaptation potential on the example of health care facilities of JSC "Ukrzaliznytsia". The study [4] is devoted to the generalization and systematization of methods for analyzing and evaluating the SPE, a set of local potentials as structural components of the SPE is proposed. The scientific paper [1] explores the concept of strategic development, proposes the structuring of the SPE, and determines the interdependence of a set of local potentials that ensure the maximum efficiency of the implementation of the enterprise development strategy on the example of the All-Ukrainian State Enterprise "Kyivprilad". Two methodical approaches to the assessment of SPE are proposed: the graph-analytical method and the assessment matrix based on local potentials.

However, despite significant progress in solving a significant number of theoretical and practical issues in this field of knowledge, issues related to improving the methodological support of its analysis and evaluation based on the fuzziness and vagueness of incoming information remain insufficiently studied.

Formulation of the purpose of the article. The purpose of the study is to develop a methodical approach to assessing the strategic potential of a dairy

processing enterprise based on the application of strategic analysis tools and fuzzy set theory, in particular methods of fuzzy multi-criteria analysis.

Presentation of the main material. Assessment of SPE represents one of the key stages in managing the strategic potential of an enterprise. As evidenced by the international practice of conducting business, correctly organized diagnostics of the strategic potential of an enterprise not only allows to identify hidden opportunities for the best use of the internal organizational capabilities and resources of the enterprise, but is also a prerequisite for making sound management decisions on the further development of individual components of SPE [17]. The strategic potential characterizes the possibility of accomplishing the goals of the enterprise through the use of various resources, and its assessment lies in clarifying the possibilities for more efficient use of specific resources.

In tough competition for successful market survival in the long run it's not longer enough to utilize only the classical methods of studying SPE and, in particular its assessment focused on the use of deterministic approaches, since this issue is characterized by a high level of complexity and unstructured.

The authors have developed a methodical approach to assessing the strategic potential of a dairy processing enterprise, taking into account the fuzziness of data received from experts, based on the use of tools for strategic diagnostics of the enterprise's activities, fuzzy set theory [8, 19] and fuzzy multi-criteria analysis, in particular, the Fuzzy AHP [9] and Fuzzy SAW methods. The main stages of applying this approach are shown in fig. 1.

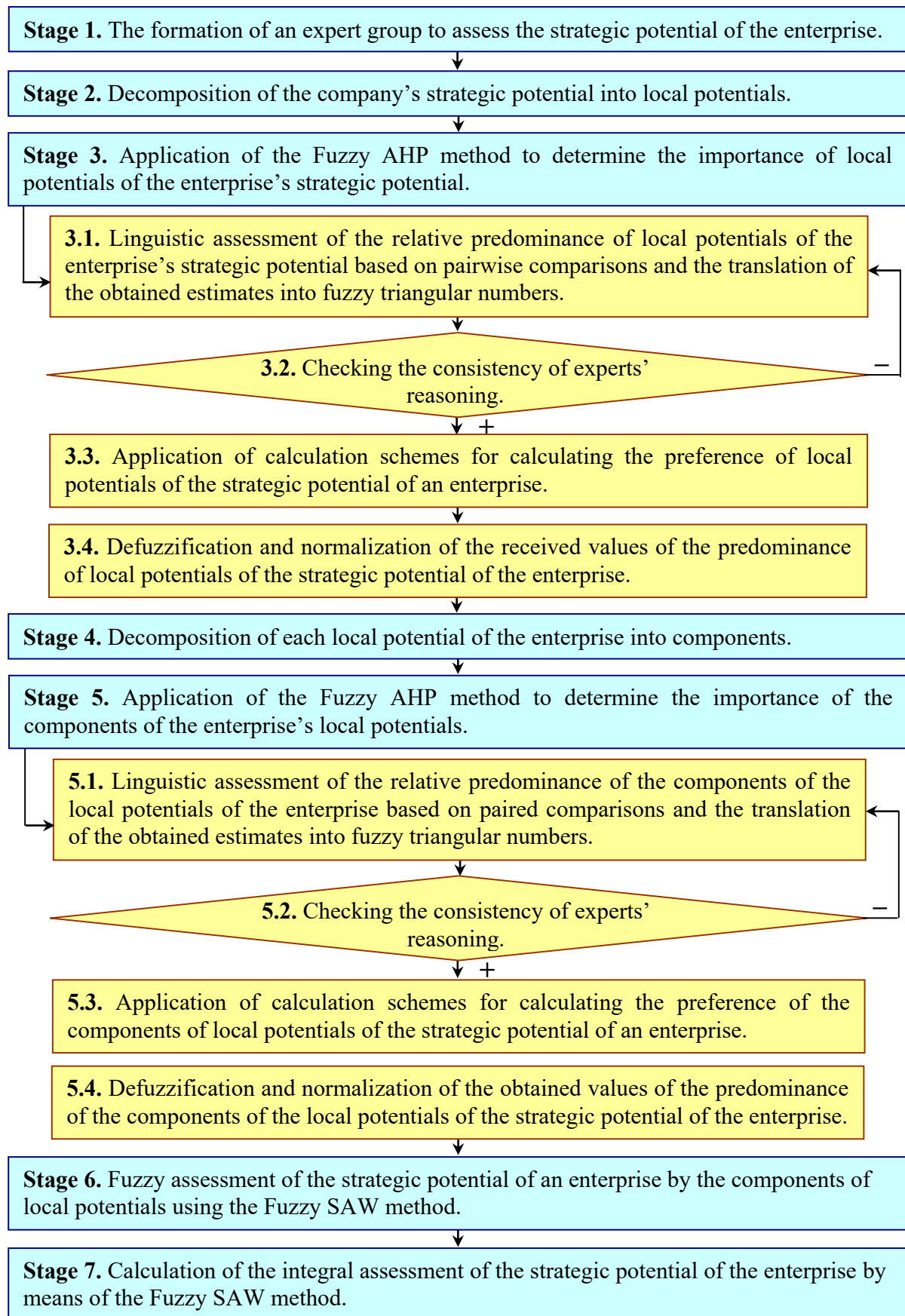


Fig. 1. Stages of assessing SPE

Source: developed by authors

The success of the application of the proposed methodological approach largely depends on the selection of experts at **stage 1** involved in the procedures for assessing SPE. For this purpose, both managers and specialists of the relevant departments of the enterprise, as well as external experts and consultants can be involved.

Stage 2. When assessing SPE it is essential to assume that its structure is a complex, dynamic, polystructural system consisting of a set of interdependent and interconnected local potentials. In [3], the authors define the strategic potential of the enterprise as a specific interdependent set of local potentials that should ensure the most effective implementation of the enterprise's development strategy. In accordance with this the most important and crucial stage of the developed methodology is the selection of generalized criteria (local potentials) for assessing the strategic potential of the enterprise, and then their decomposition into partial criteria.

As a result of the decomposition of the strategic potential of a dairy processing enterprise, we obtain the following local potentials: P_1 – resource-based potential; P_2 – production potential; P_3 – marketing (market) potential; P_4 financial and economic potential; P_5 – institutional and management potential; P_6 – innovation and investment potential; P_7 – personnel potential; P_8 – information potential; P_9 – ecological potential; P_{10} – export potential.

At stage 3, taking into account the specifics of the task, we propose to apply the Fuzzy AHP method to determine the importance of local potentials of the strategic potential of an enterprise. For this purpose you should perform the following sequence of actions.

3.1. Experts use the Saati fuzzy rating scale [9] (table 1) with corresponding fuzzy triangular numbers and membership functions (fig. 2) for a pairwise comparison of local potentials and their components to determine their relative predominance.

Table 1

Scale of linguistic terms and corresponding fuzzy triangular numbers [9]

Linguistic term-sets for determining the relative importance of local potentials (their components) (i^{th} comparing to j^{th})	designation	$\tilde{a}_{ij}$	$\tilde{a}_{ji}$	designation
Equal	E	(1;1;1)	(1;1;1)	$_E$
Moderate	M	(2;3;4)	(1/3;1/3;1/2)	$_M$
Strong	S	(4;5;6)	(1/6;1/5;1/4)	$_S$
Very Strong	VS	(6;7;8)	(1/8;1/7;1/6)	$_VS$
Extremaly Strong	ES	(8;9;9)	(1/9;1/9;1/8)	$_ES$
intermediate				
between E and M	EM	(1;2;3)	(1/3;1/2;1)	$_EM$
between M and S	MS	(3;4;5)	(1/5;1/4;1/3)	$_MS$
between S and VS	SVS	(5;6;7)	(1/7;1/6;1/5)	$_SVS$
between VS and ES	VSES	(7;8;9)	(1/9;1/8;1/7)	$_VSES$

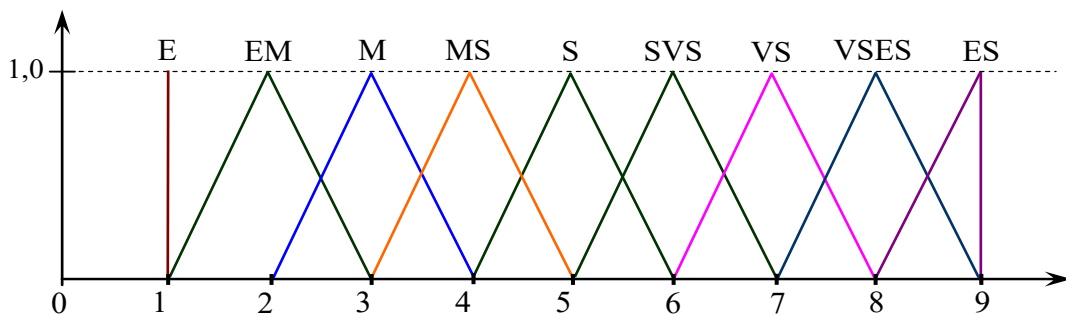


Fig. 2. Triangular functions of membership of term-sets when applying Fuzzy AHP [9]

Let us designate the matrix of estimates of pairwise comparisons of the relative importance of local potentials based on the linguistic scale (table 2) through $S^{ling} = \|s^{ling}\|_{10 \times 10}$ (table 2) and the corresponding matrix with fuzzy estimates in triangular form through $\tilde{S} = \|\tilde{s}_{ij}\|_{10 \times 10} = \|(x_{ij}; y_{ij}; z_{ij})\|_{10 \times 10}$ (table 3).

Table 2

Linguistic assessments of pairwise comparison of local potentials

	P_1	P_2	P_3	P_4	P_5	P_6	P_7	P_8	P_9	P_{10}
P_1	E	EM	EM	M	E	MS	M	MS	S	SVS
P_2	$_EM$	E	E	EM	$_EM$	EM	EM	EM	M	M
P_3	$_EM$	E	E	EM	$_EM$	EM	EM	EM	M	M
P_4	$_M$	$_EM$	$_EM$	E	$_M$	E	E	E	EM	EM
P_5	E	EM	EM	M	E	MS	M	MS	S	SVS
P_6	$_MS$	$_EM$	$_EM$	E	$_MS$	E	E	E	E	EM
P_7	$_M$	$_EM$	$_EM$	E	$_M$	E	E	E	EM	EM
P_8	$_MS$	$_EM$	$_EM$	E	$_MS$	E	E	E	E	EM
P_9	$_S$	$_M$	$_M$	$_EM$	$_S$	E	$_EM$	E	E	E
P_{10}	$_SVS$	$_M$	$_M$	$_EM$	$_SVS$	$_EM$	$_EM$	$_EM$	E	E

Table 3

Fuzzy values of estimates of pairwise comparison of local potentials

	P_1	P_2	P_3	P_4	P_5	P_6	P_7	P_8	P_9	P_{10}
P_1	(1;1;1)	(1;2;3)	(1;2;3)	(2;3;4)	(1;1;1)	(3;4;5)	(2;3;4)	(3;4;5)	(4;5;6)	(5;6;7)
P_2	(1/3;1/2;1)	(1;1;1)	(1;1;1)	(1;2;3)	(1/3;1/2;1)	(1;2;3)	(1;2;3)	(1;2;3)	(2;3;4)	(2;3;4)
P_3	(1/3;1/2;1)	(1;1;1)	(1;1;1)	(1;2;3)	(1/3;1/2;1)	(1;2;3)	(1;2;3)	(1;2;3)	(2;3;4)	(2;3;4)
P_4	(1/4;1/3;1/2)	(1/3;1/2;1)	(1/3;1/2;1)	(1;1;1)	(1/4;1/3;1/2)	(1;1;1)	(1;1;1)	(1;1;1)	(1;2;3)	(1;2;3)
P_5	(1;1;1)	(1;2;3)	(1;2;3)	(2;3;4)	(1;1;1)	(3;4;5)	(2;3;4)	(3;4;5)	(4;5;6)	(5;6;7)
P_6	(1/5;1/4;1/3)	(1/3;1/2;1)	(1/3;1/2;1)	(1;1;1)	(1/5;1/4;1/3)	(1;1;1)	(1;1;1)	(1;1;1)	(1;1;1)	(1;2;3)
P_7	(1/4;1/3;1/2)	(1/3;1/2;1)	(1/3;1/2;1)	(1;1;1)	(1/4;1/3;1/2)	(1;1;1)	(1;1;1)	(1;1;1)	(1;2;3)	(1;2;3)
P_8	(1/5;1/4;1/3)	(1/3;1/2;1)	(1/3;1/2;1)	(1;1;1)	(1/5;1/4;1/3)	(1;1;1)	(1;1;1)	(1;1;1)	(1;1;1)	(1;2;3)
P_9	(1/6;1/5;1/4)	(1/4;1/3;1/2)	(1/4;1/3;1/2)	(1/3;1/2;1)	(1/6;1/5;1/4)	(1;1;1)	(1/3;1/2;1)	(1;1;1)	(1;1;1)	(1;1;1)
P_{10}	(1/7;1/6;1/5)	(1/4;1/3;1/2)	(1/4;1/3;1/2)	(1/3;1/2;1)	(1/7;1/6;1/5)	(1/3;1/2;1)	(1/3;1/2;1)	(1/3;1/2;1)	(1;1;1)	(1;1;1)

3.2. To check the consistency of the expert's individual considerations, the standard procedure of the hierarchy analysis method is used to calculate the organicity index for the constructed matrix of pairwise comparisons according to

the formula $J = \frac{|\lambda_{\max} - N|}{N-1}$ ($\lambda_{\max}$ – the largest eigenvalue of a matrix $\tilde{S} = \|\tilde{s}_{ij}\|_{10 \times 10}$;

$N = 10$ – its dimension). If the value of this index is not more than 10% relative to the reference index J^* ($N = 10$ $J^* = 1,49$), the results of the expert's survey are considered satisfactory. In the opposite case, the expert should check his estimates regarding the relative predominance of local potentials.

It should be noted that if several experts participate in stage 2, it is necessary to check the consistency of each of the individual matrices of pairwise comparisons $\tilde{S}^k = \|\tilde{s}_{ij}^k\|_{10 \times 10}$, $k = \overline{1;K}$, де K – number of experts.

3.3. The importance of local potentials is calculated based on the integration of two calculation schemes:

– **in the first integration scheme** it is necessary to calculate the following values:

$$\tilde{R}_i = \bigoplus_{j=1}^m (x_{ij}; y_{ij}; z_{ij}) = \left(\sum_{j=1}^m x_{ij}; \sum_{j=1}^m y_{ij}; \sum_{j=1}^m z_{ij} \right) = (x_i^R; y_i^R; z_i^R), \quad (1)$$

$$\tilde{R} = \bigoplus_{i=1}^m (x_i^R; y_i^R; z_i^R) = \left(\sum_{i=1}^m x_i^R; \sum_{i=1}^m y_i^R; \sum_{i=1}^m z_i^R \right) = (x^R; y^R; z^R). \quad (2)$$

Then

$$\tilde{W}_i^R = \frac{\tilde{R}_i}{\tilde{R}} = \left(\frac{x_i^R}{z_i^R}, \frac{y_i^R}{y_i^R}, \frac{z_i^R}{x_i^R} \right) = (X_i^R; Y_i^R; Z_i^R) \quad (3)$$

– in the second scheme values are calculated

$$\tilde{C}_j = \bigoplus_{i=1}^m (x_{ij}; y_{ij}; z_{ij}) = \left(\sum_{i=1}^m x_{ij}; \sum_{i=1}^m y_{ij}; \sum_{i=1}^m z_{ij} \right) = (x_j^C; y_j^C; z_j^C). \quad (4)$$

Then

$$\tilde{W}_i^C = \frac{1}{\tilde{C}_i} = \left(\frac{1}{z_i^C}; \frac{1}{y_i^C}; \frac{1}{x_i^C} \right) = (X_i^C; Y_i^C; Z_i^C). \quad (5)$$

Coefficients of importance of local potentials $\tilde{W}_i$ ($i=1; 2; \dots; 10$) are calculated as an arithmetic mean $\tilde{W}_i^R$ та $\tilde{W}_i^C$:

$$\tilde{W}_i = (W_i^x; W_i^y; W_i^z) = \frac{1}{2} (\tilde{W}_i^R + \tilde{W}_i^C) = \left(\frac{X_i^R + X_i^C}{2}; \frac{Y_i^R + Y_i^C}{2}; \frac{Z_i^R + Z_i^C}{2} \right). \quad (6)$$

The results of the calculated fuzzy values of the significance of local potentials are given in table 4.

3.4. This table shows their calculated defuzzified values according to formula (7) [16], as well as normalized values W_i , which will be used at stage 7:

$$def(\tilde{W}_i) = ((W_i^x - W_i^z) + (W_i^y - W_i^z))/3 + W_i^z. \quad (7)$$

Table 4

Fuzzy values of the importance of local potentials are calculated

	$\tilde{W}^R$	$\tilde{W}^C$	$\tilde{W}$	$def(\tilde{W})$	W
P_1	(0,121; 0,216; 0,370)	(0,164; 0,221; 0,258)	(0,142; 0,218; 0,314)	0,225	0,211
P_2	(0,056; 0,119; 0,228)	(0,078; 0,115; 0,171)	(0,066; 0,117; 0,200)	0,128	0,120
P_3	(0,056; 0,119; 0,228)	(0,078; 0,115; 0,171)	(0,066; 0,117; 0,200)	0,128	0,120
P_4	(0,038; 0,067; 0,123)	(0,050; 0,067; 0,094)	(0,044; 0,067; 0,109)	0,073	0,069
P_5	(0,121; 0,216; 0,370)	(0,164; 0,221; 0,258)	(0,142; 0,218; 0,314)	0,225	0,211
P_6	(0,037; 0,059; 0,101)	(0,046; 0,057; 0,075)	(0,041; 0,058; 0,088)	0,063	0,059
P_7	(0,038; 0,067; 0,123)	(0,050; 0,067; 0,094)	(0,044; 0,067; 0,109)	0,073	0,069
P_8	(0,037; 0,059; 0,101)	(0,046; 0,057; 0,075)	(0,041; 0,058; 0,088)	0,063	0,059
P_9	(0,029; 0,042; 0,090)	(0,033; 0,042; 0,056)	(0,031; 0,042; 0,073)	0,049	0,046
P_{10}	(0,028; 0,035; 0,070)	(0,026; 0,036; 0,050)	(0,024; 0,035; 0,060)	0,040	0,037

At **stage 4**, it is necessary to decompose local potentials into separate components: $P_i \rightarrow (P_{i1}; P_{i2}, \dots, P_{in_i})$, n_i – the number of components of the i^{th} local potential. The result of this procedure is shown in table 5.

Table 5

Components of local potentials of the strategic potential of a dairy processing enterprise

	Local potentials	
	Components of local potentials	
Strategic potential of a dairy processing enterprise	Resource- based potential: P_1	P_{11} – stability of resource base
		P_{12} – potential of dairy raw materials suppliers
		P_{13} – availability of materials (container, packaging materials)
		P_{14} – availability of storage facilities
	Production potential: P_2	P_{21} – production costs
		P_{22} – availability and sufficiency of refrigeration equipment
		P_{23} – condition and efficiency of use of fixed assets (capital productivity, capital output - ratio, wear)
		P_{24} – production capacity
		P_{25} – logistics infrastructure
	Marketing (market) potential: P_3	P_{31} – share of the enterprise in the dairy market
		P_{32} – quality of dairy products
		P_{33} – range of dairy products
		P_{34} – products recognition rate (image, trademark)
		P_{35} – consumers potential (well-established sales system)
		P_{36} – product competitiveness
	Financial and economic potential: P_4	P_{41} – sales revenue
		P_{42} – liquidity indicators
		P_{43} – business activity indicators
		P_{44} – financial stability indicators
		P_{45} – profitability indicators
	Organizational and managerial potential: P_5	P_{51} – management level
		P_{52} – organizational production support
		P_{53} – organizational management structure
		P_{54} – planning, accounting and control system
		P_{55} – wage system
	Innovation and investment potential: P_6	P_{61} – modernization, technical re-equipment and milk production and processing automation
		P_{62} – the scale of the introduction of scientific and technical developments
		P_{63} – use of innovative approaches and product modification
		P_{64} – investment climate
		P_{65} – access to credit resources
	Labor (personnel) potential: P_7	P_{71} – personnel qualification
		P_{72} – age and educational composition of the staff
		P_{73} – staff turnover
		P_{74} – labour productivity
		P_{75} – organizational culture
		P_{76} – state and working conditions
	Information potential: P_8	P_{81} – availability of information technologies
		P_{82} – technical characteristics of the information system
		P_{83} – information resources
	Ecological potential: P_9	P_{91} – environmental friendliness of raw materials (products)
		P_{92} – availability of environmental protection technologies
		P_{93} – processing of production waste
		P_{94} – share of organic production
	Export potential: P_{10}	P_{101} – share of products for export
		P_{102} – number of commodity items for export
		P_{103} – potential of importing countries

Source: developed by authors based on [1; 2; 4]

At **Stage 5** sequence of steps is similar to stage 3, only the Fuzzy AHP method is used to compare the relative importance of the components of local potentials. For this purpose, it is necessary to perform the following steps:

Table 6

Comparison matrices (linguistic and fuzzy evaluations) of resource- based potential components

	P_{11}	P_{12}	P_{13}	P_{14}
P_{11}	E	EM	M	M
P_{12}	$_EM$	E	EM	EM
P_{13}	$_M$	$_EM$	E	E
P_{14}	$_M$	$_EM$	E	E

→

	P_{11}	P_{12}	P_{13}	P_{14}
P_{11}	(1;1;1)	(1;2;3)	(2;3;4)	(2;3;4)
P_{12}	(1/3;1/2;1)	(1;1;1)	(1;2;3)	(1;2;3)
P_{13}	(1/4;1/3;1/2)	(1/3;1/2;1)	(1;1;1)	(1;1;1)
P_{14}	(1/4;1/3;1/2)	(1/3;1/2;1)	(1;1;1)	(1;1;1)

Table 7

Comparison Matrices (linguistic and fuzzy evaluations) of production potential components

	P_{21}	P_{22}	P_{23}	P_{24}	P_{25}
P_{21}	E	E	E	$_EM$	$_MS$
P_{22}	E	E	E	$_EM$	$_M$
P_{23}	E	E	E	$_EM$	$_M$
P_{24}	EM	EM	EM	E	$_EM$
P_{25}	MS	M	M	EM	E

→

	P_{21}	P_{22}	P_{23}	P_{24}	P_{25}
P_{21}	(1;1;1)	(1;1;1)	(1;1;1)	(1/3;1/2;1)	(1/5;1/4;1/3)
P_{22}	(1;1;1)	(1;1;1)	(1;1;1)	(1/3;1/2;1)	(1/4;1/3;1/2)
P_{23}	(1;1;1)	(1;1;1)	(1;1;1)	(1/3;1/2;1)	(1/4;1/3;1/2)
P_{24}	(1;2;3)	(1;2;3)	(1;2;3)	(1;1;1)	(1/3;1/2;1)
P_{25}	(3;4;5)	(2;3;4)	(2;3;4)	(1;2;3)	(1;1;1)

Table 8

Comparison Matrices (linguistic and fuzzy evaluations) of marketing potential components

	P_{31}	P_{32}	P_{33}	P_{34}	P_{35}	P_{36}
P_{31}	E	$_EM$	E	$_EM$	$_M$	$_MS$
P_{32}	EM	E	EM	E	$_EM$	$_EM$
P_{33}	E	$_EM$	E	$_EM$	$_M$	$_MS$
P_{34}	EM	E	EM	E	$_EM$	$_EM$
P_{35}	M	EM	M	EM	E	E
P_{36}	MS	EM	MS	EM	E	E

→

	P_{31}	P_{32}	P_{33}	P_{34}	P_{35}	P_{36}
P_{31}	(1;1;1)	(1/3;1/2;1)	(1;1;1)	(1/3;1/2;1)	(1/4;1/3;1/2)	(1/5;1/4;1/3)
P_{32}	(1;2;3)	(1;1;1)	(1;2;3)	(1;1;1)	(1/3;1/2;1)	(1/3;1/2;1)
P_{33}	(1;1;1)	(1/3;1/2;1)	(1;1;1)	(1/3;1/2;1)	(1/4;1/3;1/2)	(1/5;1/4;1/3)
P_{34}	(1;2;3)	(1;1;1)	(1;2;3)	(1;1;1)	(1/3;1/2;1)	(1/3;1/2;1)
P_{35}	(2;3;4)	(1;2;3)	(2;3;4)	(1;2;3)	(1;1;1)	(1;1;1)
P_{36}	(3;4;5)	(1;2;3)	(3;4;5)	(1;2;3)	(1;1;1)	(1;1;1)

Table 9

Comparison Matrices (linguistic and fuzzy evaluations) of financial and economic potential components

	P_{41}	P_{42}	P_{43}	P_{44}	P_{45}
P_{41}	E	M	MS	M	EM
P_{42}	$_M$	E	E	E	$_EM$
P_{43}	$_MS$	E	E	E	$_EM$
P_{44}	$_M$	E	E	E	$_EM$
P_{45}	$_EM$	EM	EM	EM	E

→

	P_{41}	P_{42}	P_{43}	P_{44}	P_{45}
P_{41}	(1;1;1)	(2;3;4)	(3;4;5)	(2;3;4)	(1;2;3)
P_{42}	(1/4;1/3;1/2)	(1;1;1)	(1;1;1)	(1;1;1)	(1/3;1/2;1)
P_{43}	(1/5;1/4;1/3)	(1;1;1)	(1;1;1)	(1;1;1)	(1/3;1/2;1)
P_{44}	(1/4;1/3;1/2)	(1;1;1)	(1;1;1)	(1;1;1)	(1/3;1/2;1)
P_{45}	(1/3;1/2;1)	(1;2;3)	(1;2;3)	(1;2;3)	(1;1;1)

5.1. Linguistic evaluation of the relative predominance of the components of each local potential according to the scale of the table 1 and converting the obtained estimates into fuzzy numbers in a triangular form (table 6 – table 15).

Table 10

Comparison matrices (linguistic and fuzzy evaluations) of the organizational and management potential components

	P_{51}	P_{52}	P_{53}	P_{54}	P_{55}
P_{51}	E	M	M	EM	MS
P_{52}	M	E	E	EM	E
P_{53}	M	E	E	EM	E
P_{54}	EM	EM	EM	E	EM
P_{55}	MS	E	E	EM	E

→

	P_{51}	P_{52}	P_{53}	P_{54}	P_{55}
P_{51}	(1;1;1)	(2;3;4)	(2;3;4)	(1;2;3)	(3;4;5)
P_{52}	(1/4;1/3;1/2)	(1;1;1)	(1;1;1)	(1/3;1/2;1)	(1;1;1)
P_{53}	(1/4;1/3;1/2)	(1;1;1)	(1;1;1)	(1/3;1/2;1)	(1;1;1)
P_{54}	(1/3;1/2;1)	(1;2;3)	(1;2;3)	(1;1;1)	(1;2;3)
P_{55}	(1/5;1/4;1/3)	(1;1;1)	(1;1;1)	(1/3;1/2;1)	(1;1;1)

Table 11

Comparison Matrices (linguistic and fuzzy evaluations) of innovation and investment potential components

	P_{61}	P_{62}	P_{63}	P_{64}	P_{65}
P_{61}	E	M	EM	EM	MS
P_{62}	M	E	EM	EM	E
P_{63}	EM	EM	E	E	EM
P_{64}	EM	EM	E	E	EM
P_{65}	MS	E	EM	EM	E

→

	P_{61}	P_{62}	P_{63}	P_{64}	P_{65}
P_{61}	(1;1;1)	(2;3;4)	(1;2;3)	(1;2;3)	(3;4;5)
P_{62}	(1/4;1/3;1/2)	(1;1;1)	(1/3;1/2;1)	(1/3;1/2;1)	(1;1;1)
P_{63}	(1/3;1/2;1)	(1;2;3)	(1;1;1)	(1;1;1)	(1;2;3)
P_{64}	(1/3;1/2;1)	(1;2;3)	(1;1;1)	(1;1;1)	(1;2;3)
P_{65}	(1/5;1/4;1/3)	(1;1;1)	(1/3;1/2;1)	(1/3;1/2;1)	(1;1;1)

Table 12

Comparison matrices (linguistic and fuzzy evaluations) of personnel potential components

	P_{71}	P_{72}	P_{73}	P_{74}	P_{75}	P_{76}
P_{71}	E	M	MS	M	EM	S
P_{72}	M	E	E	E	EM	EM
P_{73}	MS	E	E	E	EM	E
P_{74}	M	E	E	E	EM	EM
P_{75}	EM	EM	EM	EM	E	M
P_{76}	S	EM	E	EM	M	E

→

	P_{71}	P_{72}	P_{73}	P_{74}	P_{75}	P_{76}
P_{71}	(1;1;1)	(2;3;4)	(3;4;5)	(2;3;4)	(1;2;3)	(4;5;6)
P_{72}	(1/4;1/3;1/2)	(1;1;1)	(1;1;1)	(1;1;1)	(1/3;1/2;1)	(1;2;3)
P_{73}	(1/5;1/4;1/3)	(1;1;1)	(1;1;1)	(1;1;1)	(1/3;1/2;1)	(1;1;1)
P_{74}	(1/4;1/3;1/2)	(1;1;1)	(1;1;1)	(1;1;1)	(1/3;1/2;1)	(1;2;3)
P_{75}	(1/3;1/2;1)	(1;2;3)	(1;2;3)	(1;2;3)	(1;1;1)	(2;3;4)
P_{76}	(1/6;1/5;1/4)	(1/3;1/2;1)	(1;1;1)	(1/3;1/2;1)	(1/4;1/3;1/2)	(1;1;1)

Table 13

Comparison matrices (linguistic and fuzzy evaluations) of information potential components

	P_{81}	P_{82}	P_{83}
P_{81}	E	E	EM
P_{82}	E	E	EM
P_{83}	EM	EM	E

→

	P_{81}	P_{82}	P_{83}
P_{81}	(1;1;1)	(1;1;1)	(1/3;1/2;1)
P_{82}	(1;1;1)	(1;1;1)	(1/3;1/2;1)
P_{83}	(1;2;3)	(1;2;3)	(1;1;1)

Table 14

Comparison Matrices (linguistic and fuzzy evaluations) of ecological potential components

	P_{91}	P_{92}	P_{93}	P_{94}		P_{91}	P_{92}	P_{93}	P_{94}
P_{91}	E	M	EM	MS	P_{91}	(1;1;1)	(2;3;4)	(1;2;3)	(3;4;5)
P_{92}	M	E	EM	E	P_{92}	(1/4;1/3;1/2)	(1;1;1)	(1/3;1/2;1)	(1;1;1)
P_{93}	EM	EM	E	EM	P_{93}	(1/3;1/2;1)	(1;2;3)	(1;1;1)	(1;2;3)
P_{94}	MS	E	EM	E	P_{94}	(1/5;1/4;1/3)	(1;1;1)	(1/3;1/2;1)	(1;1;1)

Table 15

Comparison Matrices (linguistic and fuzzy evaluations) of export potential components

	P_{101}	P_{102}	P_{103}		P_{101}	P_{102}	P_{103}
P_{101}	E	M	EM	P_{101}	(1;1;1)	(2;3;4)	(1;2;3)
P_{102}	M	E	E	P_{102}	(1/4;1/3;1/2)	(1;1;1)	(1;1;1)
P_{103}	EM	E	E	P_{103}	(1/3;1/2;1)	(1;1;1)	(1;1;1)

5.2. Both for the comparison matrix of the relative importance of local potentials, and for the obtained fuzzy matrices for comparing the components of these potentials (table 6 – table 15), it is necessary to check the consistency of the expert's (or experts') considerations.

5.3. To calculate the importance of the component local potentials, let's use the two calculation schemes given in step 3.3 of stage 3. Let us denote the fuzzy values of the weight coefficients of the components of local potentials obtained by formulas (1) – (3), (4) – (5) and (6) based on table 6 – table 15 $\tilde{w}_{ij}^R$, $\tilde{w}_{ij}^C$ та $\tilde{w}_{ij}$ ($i = \overline{1; 10}$, $j = \overline{1; n_i}$) respectively (table 16).

5.4. Defuzzification of $\tilde{w}_{ij}$ is carried out according to the formula (7). Table 6 shows their calculated defuzzified ($def(\tilde{w}_{ij})$) and normalized w_{ij} value ($i = \overline{1; 10}$, $j = \overline{1; n_i}$).

Table 16

Weighting coefficients of component local potentials

		$\tilde{w}^R$	$\tilde{w}^C$	$\tilde{w}$	$def(\tilde{w})$	w
P_1	P_{11}	(0,333; 0,462; 0,545)	(0,222; 0,446; 0,828)	(0,278; 0,454; 0,687)	0,473	0,441
	P_{12}	(0,167; 0,250; 0,375)	(0,123; 0,273; 0,552)	(0,145; 0,261; 0,463)	0,290	0,270
	P_{13}	(0,111; 0,143; 0,200)	(0,096; 0,140; 0,241)	(0,103; 0,142; 0,221)	0,155	0,145
	P_{14}	(0,111; 0,143; 0,200)	(0,096; 0,140; 0,241)	(0,103; 0,142; 0,221)	0,155	0,145
P_2	P_{21}	(0,091; 0,111; 0,143)	(0,085; 0,117; 0,180)	(0,088; 0,114; 0,162)	0,121	0,115

	P_{22}	(0,100; 0,125; 0,167)	(0,087; 0,120; 0,187)	(0,093; 0,123; 0,177)	0,131	0,124
	P_{23}	(0,100; 0,125; 0,167)	(0,087; 0,120; 0,187)	(0,093; 0,123; 0,177)	0,131	0,124
	P_{24}	(0,143; 0,222; 0,333)	(0,105; 0,235; 0,458)	(0,124; 0,229; 0,396)	0,249	0,236
	P_{25}	(0,300; 0,414; 0,492)	(0,218; 0,407; 0,707)	(0,259; 0,411; 0,600)	0,423	0,401
P_3	P_{31}	(0,059; 0,077; 0,111)	(0,049; 0,076; 0,144)	(0,054; 0,076; 0,128)	0,086	0,080
	P_{32}	(0,100; 0,143; 0,214)	(0,073; 0,148; 0,298)	(0,087; 0,146; 0,256)	0,163	0,152
	P_{33}	(0,059; 0,077; 0,111)	(0,049; 0,076; 0,144)	(0,054; 0,076; 0,128)	0,086	0,080
	P_{34}	(0,100; 0,143; 0,214)	(0,073; 0,148; 0,298)	(0,087; 0,146; 0,256)	0,163	0,152
	P_{35}	(0,200; 0,273; 0,316)	(0,126; 0,254; 0,477)	(0,163; 0,264; 0,396)	0,274	0,255
	P_{36}	(0,214; 0,286; 0,326)	(0,157; 0,297; 0,536)	(0,186; 0,291; 0,431)	0,303	0,282
P_4	P_{41}	(0,300; 0,414; 0,492)	(0,218; 0,407; 0,679)	(0,259; 0,411; 0,585)	0,418	0,400
	P_{42}	(0,100; 0,125; 0,167)	(0,087; 0,120; 0,180)	(0,093; 0,123; 0,173)	0,130	0,124
	P_{43}	(0,091; 0,111; 0,125)	(0,085; 0,117; 0,173)	(0,088; 0,114; 0,149)	0,117	0,112
	P_{44}	(0,100; 0,125; 0,167)	(0,087; 0,120; 0,180)	(0,093; 0,123; 0,173)	0,130	0,124
	P_{45}	(0,143; 0,222; 0,333)	(0,129; 0,235; 0,439)	(0,136; 0,229; 0,386)	0,250	0,239
P_5	P_{51}	(0,300; 0,414; 0,492)	(0,218; 0,407; 0,707)	0,259; 0,411; 0,600	0,423	0,401
	P_{52}	(0,100; 0,125; 0,167)	(0,087; 0,120; 0,187)	0,093; 0,123; 0,177	0,131	0,124
	P_{53}	(0,100; 0,125; 0,167)	(0,087; 0,120; 0,187)	0,093; 0,123; 0,177	0,131	0,124
	P_{54}	(0,143; 0,222; 0,333)	(0,105; 0,235; 0,458)	0,124; 0,229; 0,396	0,249	0,236
	P_{55}	(0,091; 0,111; 0,143)	(0,085; 0,117; 0,180)	0,088; 0,114; 0,162	0,121	0,115
P_6	P_{61}	(0,261; 0,387; 0,472)	(0,187; 0,380; 0,713)	(0,224; 0,384; 0,593)	0,400	0,371
	P_{62}	(0,083; 0,111; 0,167)	(0,068; 0,106; 0,200)	(0,076; 0,108; 0,184)	0,123	0,114
	P_{63}	(0,143; 0,200; 0,273)	(0,101; 0,206; 0,401)	(0,122; 0,203; 0,337)	0,221	0,205
	P_{64}	(0,143; 0,200; 0,273)	(0,101; 0,206; 0,401)	(0,122; 0,203; 0,337)	0,221	0,205
	P_{65}	(0,077; 0,100; 0,143)	(0,067; 0,103; 0,193)	(0,072; 0,101; 0,168)	0,114	0,106
P_7	P_{71}	(0,279; 0,382; 0,455)	(0,194; 0,372; 0,650)	0,237; 0,377; 0,552	0,389	0,360
	P_{72}	(0,091; 0,118; 0,158)	(0,073; 0,120; 0,212)	0,082; 0,119; 0,185	0,129	0,119
	P_{73}	(0,083; 0,100; 0,125)	(0,072; 0,098; 0,151)	0,078; 0,099; 0,138	0,105	0,097
	P_{74}	(0,091; 0,118; 0,158)	(0,073; 0,120; 0,212)	0,082; 0,119; 0,185	0,129	0,119
	P_{75}	(0,133; 0,207; 0,400)	(0,100; 0,217; 0,424)	0,117; 0,212; 0,412	0,247	0,229
	P_{76}	(0,056; 0,071; 0,100)	(0,049; 0,073; 0,134)	0,052; 0,072; 0,117	0,081	0,075
P_8	P_{81}	(0,200; 0,250; 0,333)	(0,179; 0,250; 0,391)	(0,190; 0,250; 0,362)	0,267	0,255
	P_{82}	(0,200; 0,250; 0,333)	(0,179; 0,250; 0,391)	(0,190; 0,250; 0,362)	0,267	0,255
	P_{83}	(0,333; 0,500; 0,600)	(0,231; 0,500; 0,913)	(0,282; 0,500; 0,757)	0,513	0,490
P_9	P_{91}	(0,353; 0,480; 0,561)	(0,251; 0,474; 0,841)	(0,302; 0,477; 0,701)	0,493	0,464
	P_{92}	(0,111; 0,143; 0,200)	(0,093; 0,134; 0,227)	(0,102; 0,139; 0,213)	0,151	0,142
	P_{93}	(0,167; 0,250; 0,375)	(0,120; 0,261; 0,518)	(0,143; 0,255; 0,446)	0,282	0,265
	P_{94}	(0,100; 0,125; 0,167)	(0,091; 0,130; 0,216)	(0,096; 0,128; 0,191)	0,138	0,130
P_{10}	P_{101}	(0,400; 0,545; 0,632)	(0,296; 0,554; 0,932)	(0,348; 0,550; 0,782)	0,560	0,543
	P_{102}	(0,167; 0,200; 0,250)	(0,167; 0,215; 0,291)	(0,167; 0,208; 0,271)	0,215	0,209
	P_{103}	(0,200; 0,250; 0,333)	(0,173; 0,231; 0,350)	(0,186; 0,240; 0,341)	0,256	0,248

To assess the level of component local potentials of the strategic potential at **stage 6**, we will use the following term-set; $T = \{ \text{Extremely High (EL), Very Low (VL); Low (L); Moderate (M); High (H); Very High (VH), Extremely High (EH)} \}$. The semantics of term sets is given by fuzzy numbers on the interval $[0; 6]$ (fig. 3) with the corresponding membership functions and fuzzy numbers in a triangular representation: EL: (0; 0; 1); VL: (0; 1; 2); L: (1; 2; 3); M: (2; 3; 4); H: (3; 4; 5); VH: (4; 5; 6); EH: (5; 6; 6).

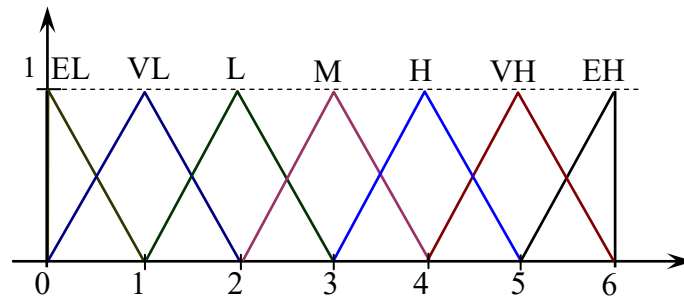


Fig 3. Membership functions of the term sets for assessing the level of strategic alternatives

The results of linguistic assessment by experts of the level of components of local potentials of SPE are given in table 17, and the corresponding fuzzy estimates in triangular form – in the table 18.

Table 17

Linguistic assessments of the level of components of local potentials

Local potentials		Experts				
		E_1	E_2	E_3	E_4	E_5
Resource-based potential: P_1	P_{11}	H	H	M	H	H
	P_{12}	VH	H	H	H	M
	P_{13}	VH	VH	H	H	H
	P_{14}	H	H	H	M	M
Production potential: P_2	P_{21}	M	M	M	H	H
	P_{22}	VH	H	H	VH	H
	P_{23}	M	H	M	M	H
	P_{24}	H	VH	H	VH	EH
	P_{25}	VH	VH	H	H	H
Marketing (market) potential: P_3	P_{31}	H	M	M	H	M
	P_{32}	VH	VH	H	H	VH
	P_{33}	VH	H	H	VH	VH
	P_{34}	EH	VH	VH	H	VH
	P_{35}	H	H	H	M	H
	P_{36}	VH	VH	H	H	VH
Financial and economic potential: P_4	P_{41}	H	M	M	H	H
	P_{42}	VH	H	VH	H	H
	P_{43}	H	H	M	H	M
	P_{44}	H	M	H	H	M
	P_{45}	H	VH	H	M	H
Organizational and managerial potential: P_5	P_{51}	VH	H	H	VH	H
	P_{52}	H	H	VH	H	M
	P_{53}	H	M	M	M	H
	P_{54}	H	H	H	H	VH
	P_{55}	M	M	H	H	M
Innovation and investment potential: P_6	P_{61}	VH	VH	H	H	VH
	P_{62}	H	M	L	M	M
	P_{63}	VH	H	H	H	VH
	P_{64}	H	H	VH	VH	H
	P_{65}	M	M	H	M	M
Labor (personnel) potential:	P_{71}	H	VH	H	H	H
	P_{72}	H	M	H	H	H

P_7	P_{73}	M	M	L	M	L
	P_{74}	H	VH	H	H	M
	P_{75}	M	M	H	M	H
	P_{76}	H	H	M	H	H
Information potential: P_8	P_{81}	H	M	H	H	H
	P_{82}	M	H	H	M	H
	P_{83}	H	VH	H	H	VH
Ecological potential: P_9	P_{91}	H	VH	H	H	H
	P_{92}	H	M	H	M	H
	P_{93}	M	H	H	H	M
	P_{94}	L	M	M	L	L
Export potential: P_{10}	P_{101}	M	L	L	M	M
	P_{102}	M	M	M	L	M
	P_{103}	H	M	M	H	M

Aggregation of fuzzy estimates of the components local potentials is carried out by means of formula (8):

$$\tilde{p}_{ij} = \frac{1}{K} \bigoplus_{k=1}^K \tilde{p}_{ij}^k = \left(\frac{1}{K} \sum_{j=1}^K \alpha_{ij}^k; \frac{1}{K} \sum_{j=1}^K \beta_{ij}^k; \frac{1}{K} \sum_{j=1}^K \gamma_{ij}^k \right) = (\alpha_{ij}; \beta_{ij}; \gamma_{ij}). \quad (8)$$

The calculated aggregated fuzzy values of the level of the components of the local potentials of SPE are given in table 18.

Table 18

Fuzzy values of estimates of the level of components of local potentials

Local potentials		Experts					Aggregated estimates
		E_1	E_2	E_3	E_4	E_5	
Resource- based potential: P_1	P_{11}	(3;4;5)	(3;4;5)	(2;3;4)	(3;4;5)	(3;4;5)	(2,8; 3,8; 4,8)
	P_{12}	(4;5;6)	(3;4;5)	(3;4;5)	(3;4;5)	(2;3;4)	(3,0; 4,0; 5,0)
	P_{13}	(4;5;6)	(4;5;6)	(3;4;5)	(3;4;5)	(3;4;5)	(3,4; 4,4; 5,4)
	P_{14}	(3;4;5)	(3;4;5)	(3;4;5)	(2;3;4)	(2;3;4)	(2,6; 3,6; 4,6)
Production potential: P_2	P_{21}	(2;3;4)	(2;3;4)	(2;3;4)	(3;4;5)	(3;4;5)	(2,4; 3,4; 4,4)
	P_{22}	(4;5;6)	(3;4;5)	(3;4;5)	(4;5;6)	(3;4;5)	(3,4; 3,4; 5,4)
	P_{23}	(2;3;4)	(3;4;5)	(2;3;4)	(2;3;4)	(3;4;5)	(2,4; 3,4; 4,4)
	P_{24}	(3;4;5)	(4;5;6)	(3;4;5)	(4;5;6)	(5;6;6)	(4,0; 5,0; 5,6)
	P_{25}	(4;5;6)	(4;5;6)	(3;4;5)	(3;4;5)	(3;4;5)	(3,4; 4,4; 5,4)
Marketing (market) potential: P_3	P_{31}	(3;4;5)	(2;3;4)	(2;3;4)	(3;4;5)	(2;3;4)	(2,4; 3,4; 4,4)
	P_{32}	(4;5;6)	(4;5;6)	(3;4;5)	(3;4;5)	(4;5;6)	(3,6; 4,6; 5,6)
	P_{33}	(4;5;6)	(3;4;5)	(3;4;5)	(4;5;6)	(4;5;6)	(3,6; 4,6; 5,6)
	P_{34}	(5;6;6)	(4;5;6)	(4;5;6)	(3;4;5)	(4;5;6)	(4,0; 5,0; 5,8)
	P_{35}	(3;4;5)	(3;4;5)	(3;4;5)	(2;3;4)	(3;4;5)	(2,8; 3,8; 4,8)
	P_{36}	(4;5;6)	(4;5;6)	(3;4;5)	(3;4;5)	(4;5;6)	(3,6; 4,6; 5,6)
Financial and economic potential: P_4	P_{41}	(3;4;5)	(2;3;4)	(2;3;4)	(3;4;5)	(3;4;5)	(2,6; 3,6; 4,6)
	P_{42}	(4;5;6)	(3;4;5)	(4;5;6)	(3;4;5)	(3;4;5)	(3,4; 4,4; 5,4)
	P_{43}	(3;4;5)	(3;4;5)	(2;3;4)	(3;4;5)	(2;3;4)	(2,4; 3,4; 4,4)
	P_{44}	(3;4;5)	(2;3;4)	(3;4;5)	(3;4;5)	(2;3;4)	(2,6; 3,6; 4,6)
	P_{45}	(3;4;5)	(4;5;6)	(3;4;5)	(2;3;4)	(3;4;5)	(3,0; 4,0; 5,0)
Organizational and managerial potential: P_5	P_{51}	(4;5;6)	(3;4;5)	(3;4;5)	(4;5;6)	(3;4;5)	(3,4; 4,4; 5,4)
	P_{52}	(3;4;5)	(3;4;5)	(4;5;6)	(3;4;5)	(2;3;4)	(3,0; 4,0; 5,0)
	P_{53}	(3;4;5)	(2;3;4)	(2;3;4)	(2;3;4)	(3;4;5)	(2,4; 3,4; 4,4)
	P_{54}	(3;4;5)	(3;4;5)	(3;4;5)	(3;4;5)	(4;5;6)	(3,8; 4,8; 5,8)

Innovation and investment potential: P_6	P_{55}	(2;3;4)	(2;3;4)	(3;4;5)	(3;4;5)	(2;3;4)	(2,4; 3,4; 4,4)
	P_{61}	(4;5;6)	(4;5;6)	(3;4;5)	(3;4;5)	(4;5;6)	(3,6; 4,6; 5,6)
	P_{62}	(3;4;5)	(2;3;4)	(1;2;3)	(2;3;4)	(2;3;4)	(2,0; 3,0; 4,0)
	P_{63}	(4;5;6)	(3;4;5)	(3;4;5)	(3;4;5)	(4;5;6)	(3,4; 4,4; 5,4)
	P_{64}	(3;4;5)	(3;4;5)	(4;5;6)	(4;5;6)	(3;4;5)	(3,4; 4,4; 5,4)
	P_{65}	(2;3;4)	(2;3;4)	(3;4;5)	(2;3;4)	(2;3;4)	(2,2; 3,2; 4,2)
Labor (personnel) potential: P_7	P_{71}	(3;4;5)	(4;5;6)	(3;4;5)	(3;4;5)	(3;4;5)	(3,2; 4,2; 5,2)
	P_{72}	(3;4;5)	(2;3;4)	(3;4;5)	(3;4;5)	(3;4;5)	(2,8; 3,8; 4,8)
	P_{73}	(2;3;4)	(2;3;4)	(1;2;3)	(2;3;4)	(1;2;3)	(1,6; 2,6; 3,6)
	P_{74}	(3;4;5)	(4;5;6)	(3;4;5)	(3;4;5)	(2;3;4)	(3,0; 4,0; 5,0)
	P_{75}	(2;3;4)	(2;3;4)	(3;4;5)	(2;3;4)	(3;4;5)	(2,4; 3,4; 4,4)
	P_{76}	(3;4;5)	(3;4;5)	(2;3;4)	(3;4;5)	(3;4;5)	(2,8; 3,8; 4,8)
Information potential: P_8	P_{81}	(3;4;5)	(2;3;4)	(3;4;5)	(3;4;5)	(3;4;5)	(2,8; 3,8; 4,8)
	P_{82}	(2;3;4)	(3;4;5)	(3;4;5)	(2;3;4)	(3;4;5)	(2,6; 3,6; 4,6)
	P_{83}	(3;4;5)	(4;5;6)	(3;4;5)	(3;4;5)	(4;5;6)	(3,4; 4,4; 5,4)
Ecological potential: P_9	P_{91}	(3;4;5)	(4;5;6)	(3;4;5)	(3;4;5)	(3;4;5)	(3,2; 4,2; 5,2)
	P_{92}	(3;4;5)	(2;3;4)	(3;4;5)	(2;3;4)	(3;4;5)	(2,6; 3,6; 4,6)
	P_{93}	(2;3;4)	(3;4;5)	(3;4;5)	(3;4;5)	(2;3;4)	(2,6; 3,6; 4,6)
	P_{94}	(1;2;3)	(2;3;4)	(2;3;4)	(1;2;3)	(1;2;3)	(1,4; 2,4; 3,4)
Export potential: P_{10}	P_{101}	(2;3;4)	(1;2;3)	(1;2;3)	(2;3;4)	(2;3;4)	(1,6; 2,6; 3,6)
	P_{102}	(2;3;4)	(2;3;4)	(2;3;4)	(1;2;3)	(2;3;4)	(1,8; 2,8; 3,8)
	P_{103}	(3;4;5)	(2;3;4)	(2;3;4)	(3;4;5)	(2;3;4)	(2,4; 3,4; 4,4)

It is worth noting that in case of inconsistency in experts' assessments, it is recommended to use the Fuzzy Delphi method [10].

To assess the level of local potentials, the Fuzzy SAW method is used according to the formula (9):

$$\tilde{p}_i = \bigoplus_{j=1}^{n_i} w_{ij} \times \tilde{p}_{ij} = \bigoplus_{j=1}^{n_i} w_{ij} \times (\alpha_{ij}; \beta_{ij}; \gamma_{ij}) = \left(\sum_{j=1}^{n_i} w_{ij} \alpha_{ij}; \sum_{j=1}^{n_i} w_{ij} \beta_{ij}; \sum_{j=1}^{n_i} w_{ij} \gamma_{ij} \right) = (\alpha_i; \beta_i; \gamma_i). \quad (9)$$

For "clarification" (reduction of the level of fuzziness and vagueness) of the obtained fuzzy estimates, the α -section is used that for a given fuzzy number in a triangular form $\tilde{u} = (a, b, c)$ is calculated by the formula $\tilde{u}_\alpha = (a(1-\alpha) + \alpha b, b, c(1-\alpha) + \alpha b)$ [16], (table 19).

Table 19

Fuzzy values of the level of local potentials for different values of α

	$\alpha = 0$	$\alpha = 0,5$	$\alpha = 0,7$
p_1	(2,915; 3,916; 4,917)	(3,415; 3,916; 4,416)	(3,616; 3,916; 4,216)
p_2	(3,303; 4,303; 5,208)	(3,803; 4,303; 4,755)	(4,003; 4,303; 4,574)
p_3	(3,364; 4,365; 5,336)	(3,865; 4,365; 4,851)	(4,065; 4,365; 4,657)
p_4	(2,770; 3,769; 4,768)	(3,269; 3,769; 4,268)	(3,469; 3,769; 4,069)
p_5	(3,206; 4,206; 5,206)	(3,706; 4,206; 4,706)	(3,906; 4,206; 4,506)
p_6	(3,191; 4,192; 5,193)	(3,691; 4,192; 4,692)	(3,892; 4,192; 4,492)
p_7	(2,757; 3,756; 4,755)	(3,257; 3,756; 4,256)	(3,456; 3,756; 4,056)
p_8	(3,043; 4,043; 5,043)	(3,543; 4,043; 4,543)	(3,743; 4,043; 4,343)

p_9	(2,725; 3,726; 4,727)	(3,226; 3,726; 4,227)	(3,426; 3,726; 4,026)
p_{10}	(1,840; 2,840; 3,840)	(2,340; 2,840; 3,340)	(2,540; 2,840; 3,140)

Fig. 4 provides a graphic interpretation of the obtained results in the form of a Polygon Chart of the assessment of the level of local potentials of a dairy processing enterprise.

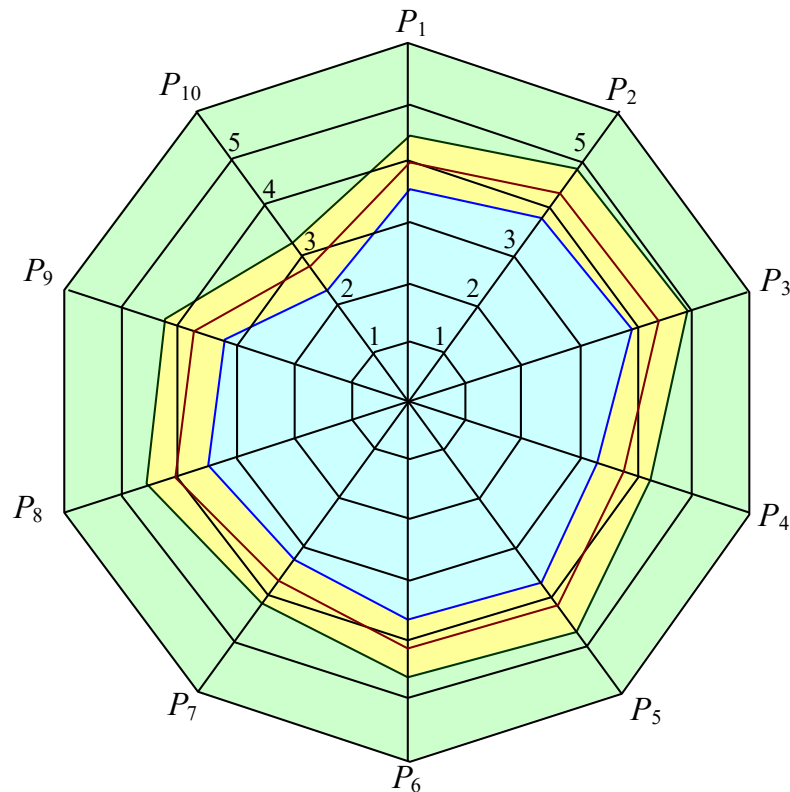


Fig. 4. Polygon Chart for assessing the level of local potentials of a dairy processing enterprise

Stage 7. An integral assessment of SPE is also carried out using the Fuzzy SAW method based on formula (10):

$$\tilde{P} = \bigoplus_{i=1}^{10} W_i \times \tilde{p}_i = \bigoplus_{i=1}^{10} W_i \times (\alpha_i; \beta_i; \gamma_i) = \left(\sum_{i=1}^{10} W_i \alpha_i; \sum_{i=1}^{10} W_i \beta_i; \sum_{i=1}^{10} W_i \gamma_i \right). \quad (10)$$

Calculated with different values of α ($\alpha = 0$; $\alpha = 0,5$; $\alpha = 0,7$) fuzzy values for assessing SPE are given in table 20.

Table 20

Fuzzy values for assessing the strategic potential of an enterprise for different values of α

	$\alpha = 0$	$\alpha = 0,5$	$\alpha = 0,7$
P	(3,034; 4,035; 5,022)	(3,534; 4,035; 4,522)	(3,735; 4,035; 4,331)

For the practical implementation of the proposed methodological approach a framework has been developed in the Excel software application containing the following main blocks:

B_1 – a block for inputting linguistic information on paired comparisons of the importance of local potentials (B_{11}), their components (B_{12}) and expert linguistic assessments of the potential for them (B_{13});

B_2 – a block for transforming this information into fuzzy numbers in a triangular form;

B_4 – blocks for calculating the importance of local potentials (B_{41}) and their components (B_{42}) by two calculation schemes;

B_5 – block for calculating fuzzy integral values of the level of local potentials (B_{51}) and enterprise's strategic potential (B_{52}).

The framework makes it possible to carry out simulation modeling depending on the correction of experts' input estimates. The obtained results can serve as a basis for developing recommendations for improving the management of the strategic potential of a dairy processing enterprise.

Conclusions and prospects for further research. In a competitive economic environment, the successful operation of an enterprise depends on the formation and effective use of its strategic potential, since it determines the strategic capabilities of the enterprise, ensures the efficient use of resources and reserves, creation and implementation of development strategies. Therefore, domestic enterprises, in particular dairy enterprises, face the problem of effective analysis and assessment of strategic potential with the aim of further development of management measures aimed at ensuring the maximum efficiency of its use or development within the framework of the implementation of strategic goals and objectives set by the management of the enterprise.

The methodical approach proposed by the authors to assess the strategic potential of a dairy processing enterprise is based on the use of strategic

diagnostic tools, fuzzy set theory and fuzzy multi-criteria analysis, including Fuzzy AHP and Fuzzy SAW. To solve the task we built a hierarchy of the problem situation where the local potentials of the SPE are identified, divided into components by decomposition. The calculation of the importance of local potentials and their components is carried out on the basis of the integration of two calculation schemes of the fuzzy analytical hierarchy method (Fuzzy AHP). To assess the strategic potential of an enterprise in terms of components of local potentials, expert assessments are used on a 7-level term-set with their conversion into triangular fuzzy numbers. The Fuzzy SAW method is used to calculate integral estimates of the level of local potentials and the strategic potential of an enterprise. The outcome of applying the proposed methodological approach is an integral assessment of the level of strategic potential and its local potentials, allowing, based on the concept of benchmarking, to determine the strengths and weaknesses of the researched enterprise, develop an effective mechanism for activating the potential, and improve the competitive position of the enterprise in the dairy products market.

Further research on the topic of this study can be directed to:

- expanding the possibilities of this methodical approach to enterprises of other industries by using the appropriate decomposition
 - a) strategic potential into local potentials;
 - b) local potentials into components;
- applying logical-linguistic models based on Mamdani fuzzy inference systems to determine the level of strategic potential of the enterprise and its local potentials.

Література

1. Артеменко Л.П., Фурсік О.І. Підвищення стратегічного потенціалу як напрям стратегічного розвитку підприємства. *Ефективна економіка*.

2014. № 1. URL: <http://www.economy.nayka.com.ua/?op=1&z=2670>
(дата звернення: 5.01.23)
2. Головаш О.В. Оцінювання рівня стратегічного потенціалу розвитку закладів охорони здоров'я АТ «Укрзалізниця». *Економічний простір*. 2019. № 151. С. 136–147.
 3. Довгань Л.Є., Каракай Ю.В., Артеменко Л.П. Стратегічне управління. Навч. посіб. 2-ге вид. К.: Центр учбової літератури, 2011. 440 с.
 4. Ладонько Л.С., Ганжа М.В. Стратегічний потенціал підприємства: формування та оцінка. *Науковий вісник Полісся*. 2015. Вип. 2. С. 109–114.
 5. Павлова В.А., Потупало Н.В. Управління стратегічним потенціалом успіху підприємства. *Європейський вектор економічного розвитку*. 2015. № 2. С. 166–176.
 6. Токмакова І.В., Войтов І.М., Паламарчук Т.О. Формування стратегічного потенціалу підприємств залізничного транспорту. *Вісник економіки транспорту та промисловості*. 2019. № 66. С. 130–139.
 7. Ansoff I. Strategic Management. Wiley, 1979. 236 p.
 8. Bellman R.E., Zadeh L.A. Decision-Making in Fuzzy Environment. *Management Science*. 1970. Vol. 17(4). P. 141–160.
 9. Buckley J.J. Fuzzy Hierarchical Analysis. *Fuzzy Sets and Systems*. Vol. 17. 1985. P. 233–247.
 10. Chang P.T., Huang L.C., Lin H.J. The fuzzy Delphi via fuzzy statistics and membership function fitting and an application to human resources. *Fuzzy Sets and Systems*. 2000. Vol. 112. P. 511–520.
 11. David Fred R. Strategic management: concepts and cases. 13th ed. Prentice Hall, 2011. 290 p.
 12. Fahey L., Randall R.M. The portable MBA in strategy. 2nd edition. Wiley, 2000. 432 p.

13. Fleisher K., Bensoussan B. Strategic and Competitive Analysis: Methods and Techniques for Analyzing Business Competition. Prentice Hall, 2002.
14. Grant R.M. Contemporary Strategy Analysis, 11th Edition. Wiley, 2021. 544 p.
15. Lambin J.J. Strategic Marketing Management. McGraw-Hill, 1996. 692 p.
16. Leekwijck W., Kerre E.E. Defuzzification: criteria and classification. *Fuzzy Sets and Systems*. 1999. Vol. 108(2). P. 159–178.
17. Piatnytska G., Yatsyshyna K., Berezin V. Enterprise's strategic potential. *Вісник КНТЕУ*. 2019. № 4. doi: [http://doi.org/10.31617/visnik.knute.2019\(126\)04](http://doi.org/10.31617/visnik.knute.2019(126)04).
18. Thompson A.A., Strickland A.J. Strategic Management: Concepts and Cases. 13th edition. McGraw-Hill, 2003. 902 p.
19. Zadeh L.A. Fuzzy Sets as a Basis for a Theory of Possibility. *Fuzzy Sets and Systems*. 1978. Vol. 1(1). P. 89–100.

References

1. Artemenko L.P., Fursik O.I. Pidvyshhennja strategichnogo potencialu jak naprjam strategichnogo rozvytku pidpryjemstva. *Efektivna ekonomika*. 2014. № 1. URL : <http://www.economy.nayka.com.ua/?op=1&z=2670>.
2. Gholovash O.V. Ocynjuvannja rivnja strategichnogo potencialu rozvytku zakladiv okhorony zdorov'ja AT «Ukrzaliznycja». *Ekonomichnyj prostir*. 2019. № 151. S. 136–147.
3. Dovghanj L.Je., Karakaj Ju.V., Artemenko L.P. Strategichne upravlinnja. Navch. posib. 2-ghe vyd. K.: Centr uchbovoji literatury, 2011. 440 s.
4. Ladonjko L.S., Ghanzha M.V. Strategichnyj potencial pidpryjemstva: formuvannja ta ocinka. *Naukovyj visnyk Polissja*. 2015. Vyp. 2. S. 109–114.

5. Pavlova V.A., Potupalo N.V. Upravlinnja strategichnym potencialom uspihu pidpryjemstva. *Jevropejskyj vektor ekonomichnogho rozvytku*. 2015. № 2. S. 166–176.
6. Tokmakova I.V., Vojtov I.M., Palamarchuk T.O. Formuvannja strategichnogho potencialu pidpryjemstv zaliznychnogho transportu. *Visnyk ekonomiky transportu ta promyslovosti*. 2019. № 66. S. 130–139.
7. Ansoff I. Strategic Management. Wiley, 1979. 236 p.
8. Bellman R.E., Zadeh L. A. Decision-Making in Fuzzy Environment. *Management Science*. 1970. Vol. 17. № 4. P. 141–160.
9. Buckley J.J. Fuzzy Hierarchical Analysis. *Fuzzy Sets and Systems*. 1985. Vol. 17. P. 233–247.
10. Chang P.T., Huang L.C., Lin H.J. The fuzzy Delphi via fuzzy statistics and membership function fitting and an application to human resources. *Fuzzy Sets and Systems*. 2000. Vol. 112. P. 511–520.
11. David Fred R. Strategic management: concepts and cases. 13th ed. Prentice Hall, 2011. 290 p.
12. Fahey L., Randall R.M. The portable MBA in strategy. 2nd edition. Wiley, 2000. 432 p.
13. Fleisher K., Bensoussan B. Strategic and Competitive Analysis: Methods and Techniques for Analyzing Business Competition. Prentice Hall, 2002.
14. Grant R.M. Contemporary Strategy Analysis, 11th Edition. Wiley, 2021. 544 p.
15. Lambin J.J. Strategic Marketing Management. McGraw-Hill, 1996. 692 p.
16. Leekwijck, W., Kerre, E.E. Defuzzification: criteria and classification. *Fuzzy Sets and Systems*. 1999. Vol. 108(2). P. 159–178.
17. Piatnytska G., Yatsyshyna K., Berezin V. Enterprise's strategic potential. *Visnyk KNTEU*. 2019. № 4. doi: [http://doi.org/10.31617/visnik.knute.2019\(126\)04](http://doi.org/10.31617/visnik.knute.2019(126)04).

18. Thompson A.A., Strickland A.J. Strategic Management: Concepts and Cases. 13th edition. McGraw-Hill, 2003. 902 p.
19. Zadeh L. A. Fuzzy Sets as a Basis for a Theory of Possibility. *Fuzzy Sets and Systems*. 1978. Vol. 1(1). P. 89–100.