ISSN 1648-0627 / eISSN 1822-4202

VILNIUS TECH Vilnius Gediminas Technical University

BUSINESS: THEORY & PRACTICE

2025
Volume 26
Issue 1
Pages 1–16
https://doi.org/10.3846/btp.2025.20922

ASSESSING THE COMMERCIAL POTENTIAL OF HIGH-TECH PRODUCTION BUSINESS TARGETS IN RISK-GENERATED INNOVATION ECONOMIES USING FUZZY SET METHODS

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Article History:
- received 2 February 2024
- accepted 22 September 2024

Abstract. The purpose of the article is to develop a methodology that will make it possible to use attitudes and expressions of professional language to the maximum extent when selecting business goals of high-tech entrepreneurship during the development, production and sale of the latest products and to reduce the sensitivity of the assessment to small deviations of the factors and increase its reliability. It is proven that the proposed method allows to use the attitude and expression of professional language to the maximum when choosing a business goal. At the same time, the sensitivity of the assessment to small deviations of the factors decreases, and the reliability increases. It has been investigated and established that when using fuzzy methods in the decision-making process in high-tech production, unlike the existing ones, there is an opportunity to actively use fuzzy estimates and different points of view of people who carry out planning or decision-making, as well as fuzzy information expressed in words.

Keywords: commercial potential, business goal, high technologies, fuzzy sets, rapid assessment, risk, innovative economy.

JEL Classification: O32, L26, M13, C65, O33, G32.

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1. Introduction

Since Ukraine's independence, a unique situation has developed: the economic base, characterized by the size of industrial capital that is gradually becoming obsolete, is combined with a highly developed scientific infrastructure. Over the past decades, research institutes of the National Academy of Sciences of Ukraine and universities have accumulated a huge stock of unique scientific and technical developments that have great commercial potential, which, unfortunately, is currently not being used to its full extent. This can be explained by not only the reasons related to the lack of sufficient demand for science-intensive products from the domestic industry, but also by the problems related to the promotion of scientific and technical developments to the foreign high-tech market, and reasons related to high risks, which characterize high-tech business. Strategy – 2030, which is based on the data of the State Statistics Service of Ukraine, states: "During the last 15 years investments in intangible assets have accounted for about 2–4% of all capital investments, and the share of activities related to high-tech (with the total intensity of research and development expenditure in relation to gross value added – 13.6% and more) and medium-tech (with the total intensity of research and development expenditure in relation to gross value added – 3.2–13.5%) was 11.3% in the volume of industrial products sold in 2019".

To remedy the situation, it is necessary to promote the development of activities with the high knowledge intensity, i.e., to move from a low-tech resource economy to a high-tech innovative economy. In addition, the state policy should create favorable conditions, first, for the development of the production of intellectual products, including the possibility of their commercialization both in Ukraine and in the rest of the world (Government Portal, 2022). This will not only create new jobs, ensure an influx of investments, but also help to win the economic competition and resist the military invasion of the country. In the conditions of the military aggression, it is vital to pay attention to the creation of industrial enterprises for developing and manufacturing military products, especially those of dual purpose (Yermak, 2017; Zakharchenko & Yermak, 2021). Therefore, it is necessary to invest in promising developments, in the production of elemental bases and finished products, in personnel potential; to attract active groups of scientists from various domestic research institutes and talented young people who can be offered a decent salary; to cooperate closely with specialists from other countries.

In recent years, we have seen a decrease in the number of innovative projects launched in Ukraine, especially since the beginning of the war, due to high risks. High-tech enterprises, as a rule, prefer to move in the opposite direction. However, now, such bottlenecks have gradually begun to be overcome, tension in the high-tech entrepreneurial sector has decreased and the ability to achieve intermediate goals has increased. In conditions of increased risks, high-tech enterprises need a clearer vision of how efforts are distributed across the entire range of manufactured products.

The place of high-tech products in any project can be determined by points, which in turn are related to the following factors: how much the behavior of a new customer corresponds to the requirements of an existing customer; what technological capital a high-tech enterprise already has; how much the available technological capabilities correspond to the release of new products.

A more accurate assessment of the return on the production of new high-tech products is compared with production costs (assessment based on the break-even point, costs of bringing new products to market, prospective marketing costs). And this will correspond to the growth strategy of a high-tech enterprise, improving relations with customers, opening new opportunities for high-tech business.

To ensure the attractiveness of investments in the high-tech sector of the economy, it is necessary to understand the possibility of a reliable assessment of innovations, especially at their early stage; to understand the process of transforming business ideas into business goals of the enterprise, assessing their commercial potential; to find possible ways to reduce uncertainty and risk.

In in war conditions, any enterprise inevitably faces uncertainty and risk in its activities, including in high-tech ones. An enterprise does not have sufficient data about its present and future; it is not able to predict all the changes that may occur in the external environment. Planning is one of the components of controlling business processes, which serves as a means of explaining the internal conditions of activity, reducing uncertainty and risk (Ilyash et al., 2021). However, any enterprise is unable to eliminate uncertainty and fully plan its activities. It is because eliminating uncertainty means eliminating the market itself, the variety of conflicting interests and actions. To reduce risks and prevent the irrational use of resources, it is necessary to develop a procedure for selecting the most promising products at the intermediate stages of R&D, i.e., evaluating their commercial potential. Consequently, the novelty of the technical solution will be determined, and a decision will be made to transform a business idea into a business goal. It is quite natural that the need to consider uncertainty, its analysis and elimination requires the use of adequate mathematical models and methods.

Due to the inherent ambiguity of commercial potential, this study uses fuzzy logic to measure and quantify the commercial potential of a candidate technology for development.

This paper is organized as follows: Section 2 will review the literature related to decision making under uncertainty and risk, assessing the commercial potential of technologies, and the use cases of fuzzy set theory; then, the research methodology, its background, and the purpose of the paper will be discussed. Then, the design of a rapid assessment method for the commercial potential of high-tech manufacturing business goals using fuzzy sets is discussed. In the next step, to test the proposed model based on an empirical study, we will assess the commercial potential of business goals using a traditional methodology and our proposed methodology on a mobile application as an example. Finally, we summarize the results of our study and suggest further areas of research.

2. Literature review

While preparing this article, the authors studied the works of leading experts on decision-making in the conditions of uncertainty and risk of the market situation, on economic and mathematical modelling and innovative activities. For example, Tsihanok and Roik (2018) proposed a model that effectively ensures the conditions of consistency of expert assessments in the group, which are necessary for performing aggregation. Different methods of evaluating innovations, decision-making algorithms regarding their implementation were considered in the works of Yermak and Bugaenko (2016), Filyppova et al. (2019, 2021), Kovtunenko et al. (2019), Mokiy et al. (2020), suggested a model for assessing the possibilities of increasing the innovative activity of an enterprise, which is based on the growth rate of capital investment of industrial enterprises, the growth rate of foreign direct investment in industry and the share of industry in total foreign direct investment. Dziallas and Blind (2019) were also interested in the question of evaluating innovation, especially at the beginning of the development of a new product. The issues of security and overcoming uncertainty are currently becoming more and more topical in the scientific community. Ilyash (2015) tried to forecast the results of assessing the impact of technological and social growth on economic security. Kiseliova et al. (2016) proposed a mathematical model for assessing the investment attractiveness of startups based on neuro-fuzzy technologies, which considers the uncertainty of not only statistical, but also linguistic nature.

Based on the objective of this research, the authors thought it would be more interesting to turn to specialists in the theory of fuzzy sets. However, until 1980, the studies with a fuzzy-multiple application were mainly carried out in the field of technical systems management, and separate works represented the economic orientation (Frolova et al., 2021). Abroad, the research on the economic use of the fuzzy set theory is developing at an increasing pace, starting with individual works, for example, in the collection of scientific papers edited by Yager (2009, 2013), the works by Fishburn (1978, 1999) and Kofman (1983) concluding with the research being conducted under the auspices of the International Association for Fuzzy-Set Management & Economy (SIGEF). A wide range of research is presented in the works of Nedosekin (2003) and Kozlovskyi et al. (2018).

The work Sotnyk et al. (2022) considered mathematically based limits of technology criticality using fuzzy logic and building a decision-making model in technological forecasting. In the study Eseoglu et al. (2022) fuzzy sets are used to evaluate both the weight of criteria and the rank of alternatives in the decision-making process to obtain compromise solutions under uncertainty. By employing fuzzy fuzzy Best-Worst Method (BWM), the Olawore et al. (2023) study offers a nuanced approach to decision-making in a complex and uncertain environment, where traditional methods may fall short. The Makedon et al. (2024) research systematically constructs a fuzzy logic model that incorporates three critical components of technology transfer-technological, financial, and marketing – as input variables. By selecting appropriate membership functions and establishing a system of 27 logical rules, the study employs Mamdani's fuzzy inference method to determine the overall efficiency of technology transfer projects. Sarfaraz et al. (2023) make a notable contribution to the science of decision-making methods by integrating fuzzy logic into the technology transfer process, specifically in the context of selecting a licensor; their study introduces a decision framework that combines a Fuzzy Inference System (FIS) with a two-step Fuzzy Quality Function Deployment (F-QFD), offering a sophisticated approach to decision-making under uncertainty, which is crucial for optimizing licensing decisions in technology transfer.

A number of researchers in their scientific papers have proposed new models for evaluating processes in high-tech production, as follows: Ozdemir (2022) Aleixo and Tenera (2009) proposed a new evaluation model for performance management in Industry 4.0 for small and medium-sized manufacturing companies (fuzzy sets have been used to incorporate linguistic uncertainties into the criteria evaluation process; performance was evaluated using the new SF-AHP-WSM hybrid approach to WSM Industry 4.0 performance evaluation); Xiao et al. (2022) introduced a new q-ROF-BWM based on q-ROF preference relations to determine fuzzy criteria weights; Afrasiabi et al. (2022) proposed a comprehensive model that combines well-defined and robust fuzzy MCDM methods to measure suppliers based on sustainable and resilient criteria; Liao et al. (2013) proposed combining the concepts of fuzzy set theory, entropy, ideal, and grey relation analysis, a fuzzy grey relation method for multiple criteria decision-making problems. Zhang (2024) makes a significant contribution to the science of decision-making methods, particularly in the context of using fuzzy logic techniques. The primary contribution of the article lies in proposing and substantiating the use of fuzzy logic for risk assessment in the labor market of Southeast Asia, which represents an important advancement in improving decision-making processes under conditions of uncertainty and complexity.

In the study Bilenko et al. (2022), the use of fuzzy set theory to assess the effectiveness of tax measures in European countries against the consequences of Covid-19 proved the advantage of this economic and mathematical apparatus in solving this class of problems. The authors of this work should add to the previous statement that most of the studies on the economic application of the fuzzy sets theory refer to separate issues. In this case, they refer to the commercial potential of business goals of high-tech production.

Back in 2008, Bandarian (2008) stressed the importance of defining the commercial potential of technologies as a necessary additional element for devising a successful commercialization strategy. Thus, using the Strategic Technology Evaluation Program (STEP), his work was based on the development of a fuzzy system to measure the commercial potential of a candidate technology at an early stage of its development, before spending time and effort. Lithuanian scientists Zemlickienė et al. (2018) emphasised the need to ensure the coordinated activity of R&D institutions and reduce the uncertainty of technology commercialisation. That is why they presented a scientifically based model for assessing the commercial potential of a technology, which is focused on an early stage of commercialisation of the technology by assessing its commercial potential. However, the proposed models have not been widely used in the practice of high-tech enterprises.

3. Methodology

Not all new business ideas reach the market; in general, they are unable to recoup the costs of their development. For example, according to the data of ZM Corporation, on average, only one out of about 540 business ideas reaches the stage of mass production. During the process of developing and launching a new product to the market, as a result of hi-tech production, we distinguish the following stages: 1) search and development of business goals; 2) selection of the business goals; 3) analysis of the selected business goals; 4) product development; 5) testing (including on the market); 6) production launch; 7) launching a product.

(1) The activity at the stage of a search and development of ideas aims to develop as many of them as possible; the aim of the next stages is reduction of their number (Gbadegeshin, 2017; Hung et al., 2007; Aleix & Tenera, 2009; Evers et al., 2016). The

first step here is to select business ideas for hi-tech production results.

(2) All this starts with analysis of market attractiveness of a business idea. In order to promote a business idea at a market as a license or product, it is necessary to assess it i.e., to define its technical advantages and commercial potential; analyze the market environment and develop a marketing strategy.

(3) The result of the assessment of the business ideas answers the question of expedience of further actions of their commercialization. It should be noted that methodical approaches used by enterprises and consulting companies operating in this field are frequently regarded as trade secrets and are hardly available.

(4) The selected ideas should be transformed into product concepts. Having taken the decision of product concept, the administration can start assessing business attractiveness of the supply. Attention should be paid to the outlined sales benchmark, expenditures and revenues to ensure its enterprise aims conformity. In case, that the analysis results prove to be satisfactory, the stage of immediate product development starts.

(5) The department of development examination creates one or multiple variants of physical manifestation of the concept hoping to get a prototype that meets such criteria as: 1) consumers perceive it as a bearer of all the main properties laid out in the description of product concept; 2) it is safe and works reliably in common use in usual conditions; 3) its self-cost doesn't exceed the outlined and estimated production expenditures (Bowen, 2009).

(6) If the product has successfully passed functional tests and consumer testing, then an enterprise releases its small batch to test in market conditions. At this stage, the product and the marketing program are tested under conditions close to real ones. Testing methods in market conditions vary depending on the type of product. Tests in market conditions provide the management with enough information to make a final decision about the expediency of the product launching.

(7) If an enterprise begins deploying high-tech commercial production, large expenditures are expected. When launching a product, the enterprise must decide when, where, to whom and how to offer it, a decision should be made about the timeframes of the new product's release to the market. The enterprise must also decide whether to market the product in one region, in several regions, nationally or internationally. Not all enterprises have the confidence, means and opportunities to immediately launch new products onto the national market. Usually, they establish a time schedule for successive development of markets, and the enterprise should choose the most profitable ones and focus its main efforts on their sales promotion.

Attention should be paid to the growth of expenditures at various stages of development and launching a product to the market according to the extent of its promotion to the market (Hindle & Yenken, 2004). So, if the volume of the expenditures at the stage of the research is taken as a unit of measure, then the expenditures at the stage of development work will be 10 times more, and the expenditures at the stage of starting serial production will be 100 times more. That is why work on the selection of business goals at an early stage is extremely important, since, by skipping to the next stages of ideas implementation that do not have a commercial perspective, much more money has to be spent at the next stages on working with business ideas that will not reach the market. Clearly defining the goals of a high-tech project is the most underestimated part of the high-tech process. With the help of experts, hypotheses are formed, which are then refined and tested experimentally, and a limited range of key issues is determined on which the management team should concentrate.

The results of the assessment of business goals answer the question of the feasibility of further actions regarding their commercialisation. It should be noted that the methodological approaches used by enterprises and consulting companies working in this business often have the status of commercial secrets and are practically inaccessible. Evaluating the commercial potential of a business goal is a necessary part of the process of making a decision about its commercialisation (Lytvynenko et al., 2022).

The commercial potential of a business goal depends on a large number of factors, which are often difficult to formalise and which contain considerable uncertainty, making its assessment a very difficult task.

Traditionally, an assessment of commercial potential is carried out in the following main areas:

- business attractiveness – an assessment of its size, dynamics, market entry barriers, intensity of competition, market profit rate;
- business synergy – an assessment of how it correlates with the experience and capabilities of an enterprise;
- reasonableness of the goal – an assessment of the level of complexity and novelty of the goal;
- need for resources – an assessment of additional resources needed to implement the goal;
- benefits for the user – an assessment of the price and non-price qualities of the goal implementation, whether the goal solves the consumer's problems, whether it has unique properties;
- protection of the idea of achieving the goal of high-tech production – an assessment of the available opportunities for its protection.

The traditional evaluation method consists in the fact that each indicator presented in the tables (matrices) is evaluated on a 5-point scale – from the minimum evaluation – 2 points to the maximum evaluation +2 points. Next, points are added for each table, and then for all tables. The final values provide an expert assessment of the commercial potential (or riskiness) of the business goal.

If necessary, weighting factors can be introduced, which consider the importance of one or another indicator for a specific type of high-tech business. The structure of the factors for each assessment area adapted for high-tech enterprises is shown in Tables A1–A6 (Appendix). Table 1 – with the help of this matrix, the size of the market, prospects for its growth, barriers to entering the market, intensity of competition, and the size of profit in the high-tech industry are estimated. Table 2 – with the help of this matrix, it is determined how the goal correlates with the general direction of activity of a high-tech enterprise. Table 3 – with the help of this matrix, the validity and novelty of the business idea is evaluated. Table 4 – with the help of this matrix, the need for qualified personnel, high-tech equipment, and the amount of external financing is estimated. Table 5 – evaluates what unique functional and price advantages the consumer receives from the sale of high-tech products. Table 6 – evaluates the possibility of legal protection, simplification of duplication, licensing possibilities.

As practice shows, the use of selection matrices makes it possible to successfully solve the problem of selecting a business goal. However, this method is not without its drawbacks, which are mainly related to carrying out a quantitative assessment of a specific evaluated factor. Very often, experts first carry out some linguistic assessment, for example: "the market is too small", and only then translate it into a quantitative one. Thus, when selecting a business goal, it is considered appropriate to employ fuzzy set methods that use not only numbers, but also words and sentences of natural language.

A common modeling methodology based on fuzzy sets theory involves the step-by-step solution of the following tasks: identification of the main factors; formalizing the relationship between the factors of influence in a generalized form; definition and formalization of linguistic assessments of factors of influence; building a fuzzy knowledge base that identifies relationships between factors of influence; inference of fuzzy logical equations on the basis of linguistic assessments and fuzzy knowledge base; optimization of fuzzy model parameters (Kozlovskyi et al., 2020; Zakharchenko, 2013).

The *purpose of the article* is to develop a methodology that will make it possible to use attitudes and expressions of professional language to the maximum extent when selecting business goals of high-tech entrepreneurship during the development, production and sale of the latest products and to reduce the sensitivity of the assessment to small deviations of the factors and increase its reliability.

4. Research results

Method of express assessment of the commercial potential of business goals of high-tech production using fuzzy sets

The next step is building a method of express evaluation of the commercial potential of business goals of high-tech production using the apparatus of fuzzy sets, which is based on the well-known approach (Nedosekin, 2003). It is possible to evaluate the commercial potential of the business goal based on the qualitative levels of individual factors that determine the commercial potential of the business goal (Tables 1–6). The structure of their data helps to assess the commercial potential of the business goal by aggregating the information at all levels of the hierarchy of the factors based on the qualitative data about their level and relationship at one level of the hierarchy (Figure 1).

The assessment of the commercial potential of the business goal can be presented in the form of the following model:

$$CP = G,L,S, \quad (1)$$

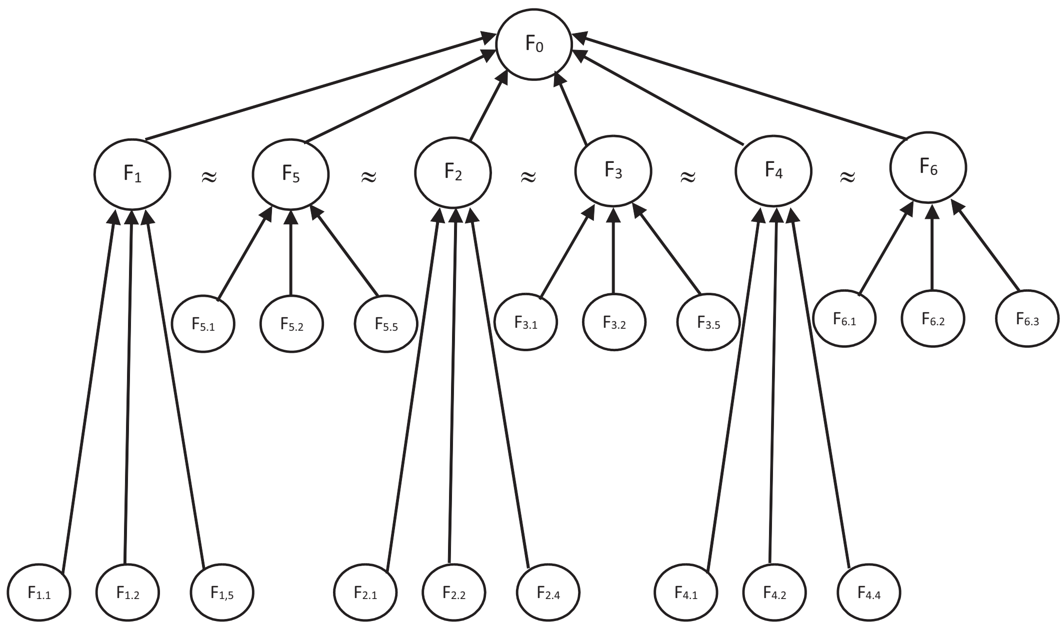


Figure 1. A tree-like hierarchy of F assessments in the S system of the factor relationships for determining the commercial potential of business goals

where G is a tree-like hierarchy of the factors of commercial attractiveness; L is a set of qualitative assessments of the levels of each factor in the hierarchy; S is a system of relationships of preferences for one factor over another for one level of the factor hierarchy.

In addition:

L = very low level (VL), low level (L), average level (A), high level (H), Very high level (VH)},

$$S=\left\{F_i(\varphi)F_j \,|\, \varphi \in (\succ, \approx)\right\}, \quad (2)$$

where $\succ$ – the preference ratio; $\approx$ – the indifference ratio.

Next formula describes how subfactors $P(i)$ contribute to the value of factor F_i through their weight coefficients w_j and qualitative assessments L_j. It aligns with the tree-like hierarchy G, where each node F_i depends on its subfactors at the lower level of the hierarchy.

$$F_i=\sum_{j\in P(i)} w_j L_j, \quad (3)$$

where: F_i – the value of factor i at a specific hierarchy level; $P(i)$ – the set of all subfactors (children) of factor i; w_j – the weight coefficient of subfactor j, reflecting its relative importance; L_j – the qualitative assessment level of subfactor j from the set L = {VL, L, A, H, VH}.

The tree-like hierarchy G can be described by a directed graph (without cycles, loops, horizontal edges within one ranking level) containing one root vertex:

$$G=\left\langle \{F_i\},\{V_{ij}\} \right\rangle, \quad (4)$$

where $\{F_i\}$ is the vertex set of the factors; $\{V_{ij}\}$ is the set of arcs; F_0 is the root vertex corresponding to the assessment of the commercial potential of the business goal as a whole. At the same time, the arcs in the tree-like graph should be arranged as follows: the top of the lowest level of the hierarchy (rank) corresponds to the beginning of the arc, and the top of the rank one less than the previous corresponds to the end of the arc.

The tree-like graph corresponds to the hierarchy (Tables 1–6) with a system of relationships at each level (Figure 1), where G=<; . {F_0 is an assessment of the commercial potential of the business goal as a whole. F_1 – an assessment of the market attractiveness. F_2 – an assessment of business synergy. F_3 – an assessment of the reasonableness of the business goal. F_4 – an assessment of the need for resources. F_5 – an assessment of user benefits. F_6 – an assessment of the business goal protection. $F_{1.1}$ – market prospects. $F_{1.2}$ – market growth rates. $F_{1.3}$ – market entry barriers. $F_{1.4}$ – the level of competition. $F_{1.5}$ – the profitability level of the segment. $F_{2.1}$ – moving in line with the company's mission. $F_{2.2}$ – the use of the existing client base. $F_{2.3}$ – the need for new professional knowledge. $F_{2.4}$ – the use of the existing production and product distribution system. $F_{3.1}$ – the novelty of the principles and concepts on which the business goal is based. $F_{3.2}$ – the novelty of the product concept. $F_{3.3}$ – dependence on other developments. $F_{3.4}$ – the need for the integration of complex subsystems. $F_{3.5}$ – the level of permission and approvals. $F_{4.1}$ – the amount of additional resources. $F_{4.2}$ – the time required to implement the business goal. $F_{4.3}$ – access to cheap sources of financing. $F_{4.4}$ – the need for additional specialists. $F_{5.1}$ – the uniqueness of user benefits. $F_{5.2}$ – operational characteristics. $F_{5.3}$ – price advantages. $F_{5.4}$ – the impact on the environment. $F_{5.5}$ – the confirmation of needs for benefits gained from the implementation of the business goal. $F_{6.1}$ – the difficulty of copying. $F_{6.2}$ – the effectiveness of patent protection. $F_{6.3}$ – additional income from the sale of licenses).

The connection of the vertices in the graph is displayed by the numbering of the vertices, in accordance with the level of the hierarchy occupied by the vertex.

$$F=\{F_1 \approx F_5 \succ F_2 \approx F_3 \approx F_4 \approx F_6; \\ F_{1.2} \approx \ldots F_{1.5} \approx F_{2.1} \approx \ldots F_{2.4} \approx F_{3.1} \approx \ldots F_{3.5} \approx \\ F_{4.1} \approx \ldots F_{4.4} \approx F_{5.1} \approx \ldots F_{5.5} \approx F_{6.1} \approx \ldots F_{6.3}\}. \quad (5)$$

In order to assess the commercial potential of business goals, it is necessary to aggregate the data collected within the tree-like hierarchy; at the same time, the process of aggregation is carried out in the direction of the arcs of the hierarchy.

For aggregation, it is possible to use a matrix scheme (Nedosekin, 2003), with the only difference – it is obligatory to aggregate not just a separate value of the selected membership function in the structure of the linguistic variable «factor level», but the entire membership function as a whole. In this case, Yager's (2017) OWA operator is used for aggregation, and the scales are the Fishburn (1978, 1999) coefficients (OWA – Ordered Weighted Averaging).

Let us apply this approach to our task. First, it is necessary to form the linguistic variable "Factor Level" with the term-infinity of L values of the specified type. Then, the standard five-level 01-classifier (Nedosekin, 2003) can act as a family of membership functions, where the membership functions are trapezoidal triangular numbers (Figure 2):

$$VL: m_1(x)=\begin{cases}1, 0\le x\le 0{,}15\\ 10(0.25-x), 0.15\le x<0.25\\ 1, 0{,}45\le x\le 0.55\\ 10(0.65-x),\ 0.55\le x<0.65\\ 0, 0{,}65\le x\le 1\end{cases}; \quad (6.1)$$

$$L: m_2(x)=\begin{cases}0. 0\le x<0.15\\ 10(x-0.25), 0.15\le x\le 0.25\\ 1, 0{,}25\le x<0.35\\ 10(0.45-x),\ 0.35\le x<0.45\\ 0, 0{,}45\le x\le 1\end{cases}; \quad (6.2)$$

$$A: m_3(x)=\begin{cases}0. 0\le x<0.35\\ 10(x-0.35),\ 0.35\le x\le 0.45\\ 1, 0{,}45\le x\le 0.55\\ 10(0.65-x),\ 0.55\le x<0.65\\ 0, 0{,}65\le x\le 1\end{cases}; \quad (6.3)$$

$$H: m_4(x) = \begin{cases} 0.0 \le x < 0.55 \\ 10(x-0.55),\ 0.55 \le x \le 0.65 \\ 1,0,65 \le x \le 0.75 \\ 10(0.85-x),\ 0.75 \le x < 0.85 \\ 0,0,85 \le x \le 1 \end{cases}; \quad (6.4)$$

$$VH: m_5(x) = \begin{cases} 0.0 \le x < 0.75 \\ 10(0.75-x),\ 0.75 \le x < 0.85. \\ 0,0,85 \le x \le 1 \end{cases} \quad (6.5)$$

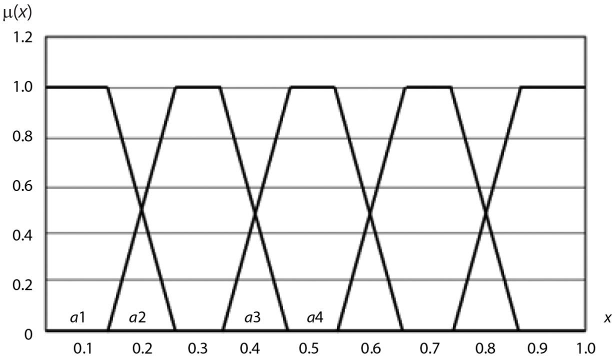


Figure 2. A system of trapezoidal membership functions on the 01 carrier

In Equations (6), x is everywhere – it is the 01-carrier (segment) [0,1] of the essential axis). The standard classifier projects a fuzzy linguistic description onto the 01-carrier, while doing so in a non-contradictory way by symmetrically placing the classification nodes (0.1, 0.3, 0.5, 0.7, 0.9). At these nodes, the value of the corresponding membership function is equal to one, and the values of all other functions are equal to zero. An expert's uncertainty in the classification decreases (increases) linearly when moving away from the node (approaching the node, respectively); at the same time, the sum of the membership functions at all points of the carrier is equal to one.

The constructed classifier is a variant of Pospelov's so-called "gray" scale, which is a polar (oppositional) scale in which the transition from the A+ property to the A- property (for example, from the "big house" property to the "medium-sized house" property of the linguistic variable "the size of the house") occurs smoothly, gradually. Similar scales satisfy such requirements:

- mutual compensation between the properties of A+ and A– (the more A+ is manifested, the less A– is manifested, and vice versa);
- the presence of a neutral point A0, which is interpreted as the point of the greatest dispute, in which both properties are present in an equal degree (for example, when the house seems to be both large and average in size at the same time).

Our fuzzy classifier displays the abscissa of the neutral points on the 01-carrier: (0.2, 0.4, 0.6, 0.8). This means that the transition is made from the qualitative description of the parameter level to the standard quantitative form of the corresponding membership function (trapezoidal number). This representation in the model turns out to be the most optimal. There is no doubt that a similar classifier could be built on smooth bell-shaped membership functions, but this complication turns out to be impractical for the intended purposes.

The next step is considering the procedure for constructing the scheme of the Fishburn weighted values. It is known (Fishburn, 1978) that a set of scales decreasing by the arithmetic progression rule best corresponds to the system of decreasing preference of N alternatives:

$$p_i = \frac{2(N-i+1)}{(N+1)N},\ i = 1...N, \quad (7)$$

in the system of mutually indifferent N alternatives – a set of equal scales:

$$p_i = N^{-1},\ i = 1...N. \quad (8)$$

It can be seen from Equation (7) that (Fishburn, 1999) scales are rational fractions, in the denominator of which there is the sum of the arithmetic progression of N first terms of the natural series with a step of 1, and in the numerator there are elements of the natural series decreasing by 1, from N to 1 (for example, 3/6, 2/6, 1/6, the sum is one). That is, the preference according to Fishburn is expressed in following way: the numerator of the rational fraction of the weighting coefficient of the weaker alternative decreases by one.

To find a set of Fishburn scales for a mixed system of preferences, when, along with the preferences, the system includes indifference relations, it is necessary to determine the numerators r_i of rational fractions according to a recursive scheme:

$$r_{i-1} = \begin{cases} r_i, F_{i-1} \approx F_i \\ r_i + 1, F_{i-1} \succ F_i \end{cases},\quad r_N = 1,\ i = N...2. \quad (9)$$

Then the sum of the obtained numerators is the common denominator of the Fishburn fractions:

$$K = \sum_{i-1}^{N} r_i \quad (10)$$

and

$$p_i = {r_i}/{K}. \quad (11)$$

It can be verified that from the relations in Equations (9)–(11) it is easy to pass to special cases in Equations (7) and (8). In fact, if only preference relations are included in the system, then

$$r_N = 1,\ r_{i-1} = r_i + 1,$$
$$K = 1 + 2 + ... + N = N(N+1)/2 \quad (12)$$

is true and it simultaneously corresponds to Equations (7) and (11). On the other hand, if the system includes only indifference relations, then:

$$r_N = 1,\ r_{i-1} = r_i,\ K = 1 + 1 + ... + 1 = N, \quad (13)$$

which simultaneously corresponds to Equations (8) and (11).

Hence, the proposed Fishburn scale system for mixed systems of preferences is consistent and generalises the special cases of known systems in Equations (7) and (8). For the purposes of illustration, Table 1 summarises the Fishburn fractions for all mixed systems of preference relations at N = 2…4.

Table 1. A system of the Fishburn weighting coefficients

N	Φ	p_1	p_2	p_3	p_4
2	$F_1 \approx F_2$	1/2	1/2	–	–
	$F_1 \succ F_2$	2/3	1/3	–	–
3	$F_1 \approx F_2 \approx F_3$	1/3	1/3	1/3	–
	$F_1 \succ F_2 \approx F_3$	2/4	1/4	1/4	–
	$F_1 \approx F_2 \succ F_3$	2/5	2/5	1/5	–
	$F_1 \succ F_2 \succ F_3$	3/6	2/6	1/6	–
4	$F_1 \approx F_2 \approx F_3 \approx F_4$	1/4	1/4	1/4	¼
	$F_1 \succ F_2 \approx F_3 \approx F_4$	2/5	1/5	1/5	1/5
	$F_1 \approx F_2 \succ F_3 \approx F_4$	2/6	2/6	1/6	1/6
	$F_1 \approx F_2 \approx F_3 \succ= F_4$	2/7	2/7	2/7	1/7
	$F_1 \succ F_2 \succ F_3 \approx F_4$	3/7	2/7	1/7	1/7
	$F_1 \succ F_2 \approx F_3 \succ F_4$	3/8	2/8	2/8	1/8
	$F_1 \approx F_2 \succ F_3 \succ F_4$	3/9	3/9	2/9	1/9
	$F_1 \succ F_2 \succ F_3 \succ F_4$	4/10	3/10	2/10	1/10

In total, there are 2N-1 options of preference systems for each number of N comparable alternatives.

Finally, for each indicator (F*.1…F*.N) on the selected sublevel (*) of the G hierarchy of the type in Equation (4), the linguistic evaluations L = (L*.1…L*.N) are known and the system of Fishburn scales P = (p*.1…p*.N) is determined based on the system of Φ preferences of the type in Equation (3). Consequently, the indicator of the F* sublevel is characterised by its linguistic evaluation, which is determined by the membership function on the 01-carrier x:

$$M_*\left(x\right)=\sum_{i=1}^{N} M_*.i\left(x\right)\times p_1, \qquad (14)$$

where

$$\mu_{*.1}(x)=\begin{cases}(6.1), & \text{if } L_{*.i}=\text{“very low”}\\(6.2), & \text{if } L_{*.i}=\text{“low”}\\(6.3), & \text{if } L_{*.i}=\text{“average”}\\(6.4), & \text{if } L_{*.i}=\text{“high”}\\(6.5), & \text{if } L_{*.i}=\text{“very high”}\end{cases}. \qquad (15)$$

The relation in Equation (14) is Jager's OWA operator, and since the membership functions in Equation (15) have a trapezoidal form, the linear superposition in Equation (14) is also a trapezoidal fuzzy number (which can be easily proved using the segment rule of calculations). Accordingly, operations with the membership functions can be reduced to operations with their vertices. If the trapezoidal number in Equation (15) is presented as ($a1$, $a2$, $a3$, $a4$), where a_i corresponds to the abscissas of the vertices of the trapezoid, then the following is true:

$$\sum_{i=1}^{N} p_i\left(a_{i1},a_{i2},a_{i3},a_{i4}\right)= \left(\sum_{i=1}^{N} p_i\times a_{i1},\sum_{i=1}^{N} p_i\times a_{i2},\sum_{i=1}^{N} p_i\times a_{i3},\sum_{i=1}^{N} p_i\times a_{i4}\right). \qquad (16)$$

The resulting function of the form in Equation (14) must be linguistically recognised in order to make a judgment about the qualitative level of the F* indicator. For this, it is obligatory to correlate the obtained function $\mu_*(x)$ and the function $\mu_i(x)$ of the form in Equation (6). If:

$$\left(\forall x\in\left[0,1\right]\right)\ \sup\min\left(\mu_*\left(x\right),\mu_i\left(x\right)\right)=0, \qquad (17)$$

then the level of the F^* indicator is clearly not recognised as the level to which the i-th "reference" membership function corresponds. One hundred percent recognition occurs if the following is true:

$$\left(\forall x\in\left[0,1\right]\right)\ \min\left(\mu_*\left(x\right),\mu_i\left(x\right)\right)=\mu_i\left(x\right). \qquad (18)$$

In all intermediate cases, a measure of the level recognition must be set. This measure can be a variant of the Hamming norm υ (Ryzhov, 1998). Supposing two trapezoidal numbers ($a1$, $a2$, $a3$, $a4$) and ($b1$, $b2$, $b3$, $b4$) are given on the 01-carrier. Then the degree of similarity υ of two such numbers can be defined as:

$$0\le\upsilon= 1-\max\left\{\left|a_1-b_1\right|,\left|a_2-b_2\right|,\left|a_3-b_3\right|,\left|a_4-b_4\right|\right\}\le 1. \qquad (19)$$

Therefore, the indicators of the bottom level of the G hierarchy were aggregated and the aggregated factor was recognised on the L scale of the form in Equation (2). After passing successively from the bottom to the top through all the levels of the G hierarchy and applying the relations in Equations (14)–(19), in the end one will get the membership function of the F_0 factor and the linguistic interpretation of the level of this factor, which is accompanied by the degree of similarity of the type in Equation (19).

The assessment of the commercial potential of the business goal and its linguistic assessment are directly derived from the previous presentation. If one compares the linguistic variables "Level of the F_0 factor" and "Commercial potential of the business goal", it is possible to establish a mutually unambiguous correspondence of the form (Table 2).

At the same time, the linguistic variable "Commercial potential of the business goal" as well as the linguistic variable "Level of the factor" can also be described by a standard five-level 01-classifier (Figure 2).

Assessing the commercial potential of business goals using the traditional method and the express assessment method using fuzzy sets using the example of choosing mobile applications.

Table 2. Correspondence of linguistic variables

Term sets	Level of the F_0 factor	Commercial potential of the business goal
1	VL	Very low
2	L	Low
3	A	Average
4	H	High
5	VH	Very high

According to the stages mentioned above, let us provide an example. The experts have generated a bunch of ideas and taken two different but relatively close ideas in order to compare them using the method in the article. They have withdrawn other ideas and focused on those two:

"A" – is a mobile app for dating, which has been very common and popular for the last 5–8 years.

The Mission statement is, "makes being single more fun and rewarding by connecting people who may not have otherwise met in real life. We think that being single is a journey. And a great one. Being single is not the thing you do unhappily before settling down. We stand up for how a whole generation chooses to live their lives."

The focus is on 18–30-year-old people. Considering the time 18–30-year-old people spend on social media and chat – here is a great opportunity for creating content. As a result, they meet up and spend time with each other. The focus is also on creating online events to make it the favorite place for 18-year-olds so that they spend more time on the app and hang out with each other. Monetization of the app is so-called "Freemium" – free to start, premium to stay.

"B" – is a mobile app for studying comprehensive engineering, which is more specific and oriented towards certain people.

The Mission statement is, "non progredi est regredi; people and society need to increase their knowledge of social technologies since those are surrounding them all the time. Moreover, "basic knowledge" is an essential skill for anyone." The focus is on 15–30-year-old people. At this age, parents try to educate their children, who are very familiar with mobile devices for education. Monetization is based on providing paid access to education courses, and charging educators for uploading (with royalty) the materials.

Now it is time to calculate the prospects of the Ideas "A" and "B" by all the parameters (Tables 3–8).

Table 3. Attractiveness of the market of high-tech products (calculation)

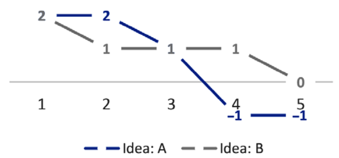
Range of opportunities		Idea: A	Idea: B
Positive opportunities	Negative opportunities		
max assessment +2 points	min assessment –2 points		
The idea has good market prospects	The market for the idea is too small to start business		
This market sector is growing very fast	This market sector is static or declining		
Entry to the market will be relatively easy	There are serious barriers to market entry		
Competitors are weak and do not join together against the new structure	Market leaders are large enterprises with vast resources		
The profit in this sector is quite big	Fierce competition in this sector reduces the profit		
TOTAL		+3	+5

Table 4. Synergy of high-tech business (calculation)

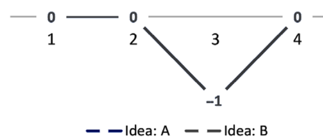
Range of opportunities		Idea: A	Idea: B
Positive opportunities	Negative opportunities		
max assessment +2 points	min assessment –2 points		
The innovation is in line with the company's mission	The idea makes diversification possible		
The idea can be sold to existing customers	The idea needs the development of a new customer base		
New professional knowledge is not required when developing and implementing the idea	New knowledge and experience will be needed when developing the idea		
The existing production and product distribution system can be used in the operation of the idea	The operational stage requires investments in the production and/or distribution system		
TOTAL		–1	–1

Table 5. Reasonableness of high-tech business goals (calculation)

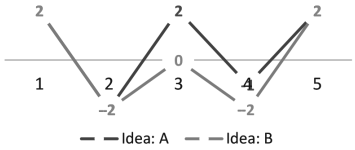
Range of opportunities		Idea: A	Idea: B
Positive opportunities	Negative opportunities		
max assessment +2 points	min assessment –2 points		
The principles behind the idea are confirmed and understood	The idea is based on new principles and concepts		
The idea is contained in a new application of the product or process	The idea involves a new product concept		
The success of the idea implementation does not depend on other developments	The success of the idea implementation depends on the results of other developments		
The innovation does not require complex and unfamiliar subsystems	The successful implementation of the idea requires the integration of several complex systems		
Use of the idea is not regulated by permission or approvals	Permission and approvals are required		
TOTAL		+3	0

Table 6. High-tech production needs for resources (calculation)

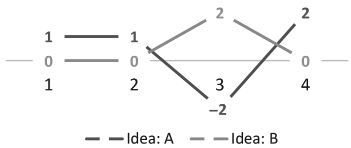
Range of opportunities		Idea: A	Idea: B
Positive opportunities	Negative opportunities		
max assessment +2 points	min assessment –2 points		
A small amount of additional resources is required	A significant amount of additional resources is required		
The idea can be quickly developed and implemented	It takes a lot of time to develop and implement the idea		
There is access to funds/grants for development	Development is entirely dependent on external funding		
Additional specialists are not required	Additional specialists are required		
TOTAL		+2	+2

Table 7. Consumer benefits of achieving the business goal of high-tech production (calculation)

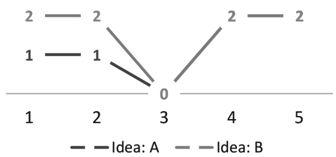
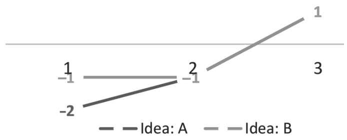
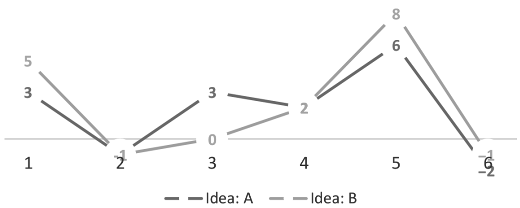
Range of opportunities		Idea: A	Idea: B
Positive opportunities	Negative opportunities		
max assessment +2 points	min assessment –2 points		
The idea will provide users with unique benefits	The idea does not provide users with any special benefits		
The idea will provide users with improved operational qualities of the product	The operational qualities of the product will be at the level of the existing ones		
The price advantages of the product will be great	The new product will not have any price advantages		
The idea does not have a negative impact on the environment	Special efforts will be needed to reduce the environmental impact of the idea implementation		
There is a clear and proven need for conveniences derived from the idea implementation	There is no reason to think that the benefits of implementing the idea will be appreciated by users		
TOTAL		+6	+8

Table 8. Protection of business goals of a high-tech enterprise (calculation)

Range of opportunities		Idea: A	Idea: B
Positive opportunities	Negative opportunities		
max assessment +2 points	min assessment –2 points		
It will be difficult for other companies to copy the business goal	Once the sales start, the idea can be easily copied		
The business goal can be protected by patenting	The prospects for effective patent protection are rather weak		
Additional income can be received through licensing agreements	Income from licensing will not be able to cover the costs		
TOTAL		–2	–1
Summarizing the tables			
			

Without weighted coefficients Idea: B obtained +13 points, and Idea: A obtained +11 points. That means that app B is more preferred in terms of development than app A.

Next, the two cases should be considered and the model mentioned above should be used.

Table #N corresponds to Factor #N and all the factors with "indifference attitude" are chosen (Figure 3).

$$F_1 \approx F_2 \approx F_3 \approx F_4 \approx F_5 \approx F_6 \text{ or}$$

$$p_1 = p_2 = p_3 = p_4 = p_5 = p_6 = 1/6.$$

According to Equation (14)

$$M_*(A) = 1.83(3);\ M_*(B) = 2.16(6).$$

According to Equation (19)

$$\upsilon = 0.5.$$

The second case factors (Figure 4) are:

$$F_1 > F_2 \approx F_3 \approx F_4 > F_5 \approx F_6.$$

In this case:

$$p_1 = 3/11;$$

$$p_2 = p_3 = p_4 = 2/11;$$

$$p_5 = p_6 = 1/11.$$

According to Equation (14):

$$M_*(A) = 1;$$

$$M_*(B) = 1.18(18).$$

According to Equation (19):

$$\upsilon = 0.5.$$

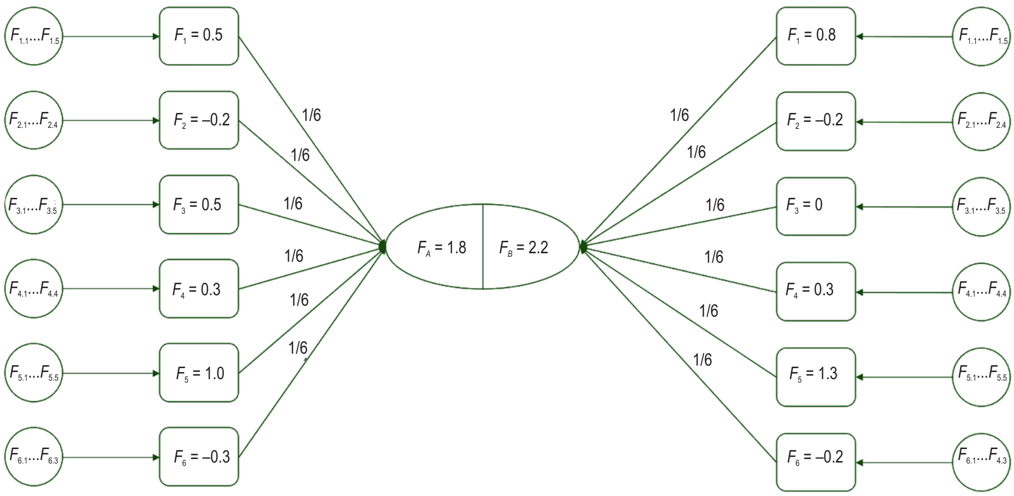


Figure 3. The adaptation level

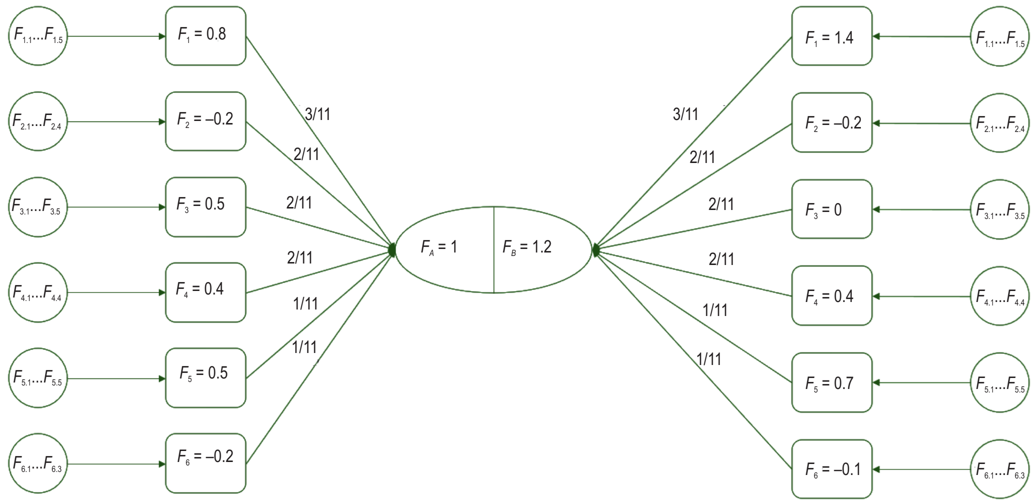


Figure 4. The adaptation level

In both cases still Idea: B is more relevant than Idea: A (not obligatory for all numbers), with the same level of similarity but with a different level of adaptation and overall assessment.

5. Discussion

This study represents a significant contribution to the development of a methodology for rapid assessment of the commercial potential of business goals of high-tech enterprises, which is especially relevant in the conditions of high uncertainty and risk characteristic of the innovative economy and the current situation in Ukraine. The main contribution of this work is the use of fuzzy set methods to formalize and assess the factors affecting the commercial potential, which allows integrating not only quantitative indicators, but also qualitative factors expressed through professional language. A key aspect worthy of discussion is the flexibility of the proposed methodology. Using fuzzy logic, the methodology reduces the sensitivity of the assessment to small variations in factors, thereby increasing the reliability of decision-making. This is especially important in high-risk conditions, where traditional assessment methods may be inadequate due to the complexity and uncertainty of the influencing factors. However, despite significant advantages, the study faces certain limitations. Firstly, the subjectivity of expert assessments used to construct fuzzy sets can affect the final assessment results. Further empirical research is needed to reduce this uncertainty and develop more objective evaluation criteria. Secondly, the methodology requires further validation through practical application in various high-tech manufacturing sectors, namely dual-use manufacturing, to confirm its versatility and effectiveness.

In addition, although the fuzzy logic model provides a more sophisticated approach, one challenge is the complexity of its implementation. Businesses may need to invest in training and software to effectively apply fuzzy logic methods. This could potentially limit the adoption of the methodology, especially among small and medium-sized businesses with fewer resources to implement advanced decision-making tools. Further research should focus on simplifying the application of fuzzy logic models to make them more accessible to a wider range of companies.

Finally, another area for future research is to expand the scope of the fuzzy logic model to account for dynamic market conditions. High-tech industries often face rapid technological change and changing market demands. Including these variables in the assessment process can further enhance the robustness of the model and make it a more comprehensive tool for strategic decision-making in high-tech enterprises.

Overall, the proposed methodology, in our opinion, is a powerful tool for quickly assessing the commercial potential of business goals and may be necessary for decision makers navigating in conditions of uncertainty. The ability of the methodology to include multiple perspectives and reduce sensitivity to fluctuations in input factors makes it a flexible and reliable solution for high-tech enterprises.

6. Conclusions

The proposed technique allows for the maximum use of professional language when choosing business goals, attitudes, and expressions, reducing the sensitivity of the assessment to small deviations of factors and increasing its reliability. In the proposed methodology, the following stages of development and introduction of new products to the market are distinguished: search and generation of business goals, product development, testing, production launch, market entry.

As a result of the study, six matrices for the selection of high-tech products for the market are proposed, which, unlike the existing ones, consider the attractiveness of the high-tech products market, the synergy of high-tech business, the validity of its goals, the needs of high-tech production in resources, the benefits of realizing the business goals of high-tech production for consumers and the possibility of protecting business – the goals of a high-tech enterprise.

It is proposed to use the fuzzy set method when choosing business goals of high-tech production, which, unlike the existing ones, involves the use of not only numbers, but also words and sentences of natural language. In the theory of fuzzy sets, there is no requirement for the statistical homogeneity of the variables of the process under study and the homogeneity of the membership functions used for them. An expert, in accordance with the general rules for constructing membership functions for various process variables, according to his subjective preferences, can generally choose membership functions that are different in form and parameters. In many cases, the enterprise does not have reliable information for an objective choice of a particular solution. Obtaining information takes time and money. And since the ability of a person to assimilate and use it is limited, such information does not always contribute to making the right decisions. Behavioral factors, subjective preferences also significantly affect the quality of decisions made. Therefore, the proposed methodology can be considered as a flexible methodology that helps in the field of high-tech activities in a constantly changing market.

The effectiveness of proposed methods application is proven on the example of the selection of mobile application ideas, which made it possible to successfully solve the task of selecting one of the business ideas. That is, the process of transforming a business idea into a business goal has been successfully and well-reasoned.

Hence, the proposed method will make it possible to use to the maximum degree the attitude and expression of professional language when selecting a business goal. This will reduce the sensitivity of the assessment to small deviations of the factors, increasing its reliability. In the case of applying fuzzy methods in the decision-making process in high-tech production, unlike the existing ones, there is an opportunity to actively use fuzzy estimates and different points of view of planning or decision-makers, as well as fuzzy information expressed in words.

The novelty and originality of this study are presented in the following aspects: *use of fuzzy logic*: unlike traditional evaluation methods, this study applies fuzzy set methods to evaluate the commercial potential of business objectives. This approach allows for the integration of both quantitative and qualitative factors expressed through linguistic variables, making it more adaptable to the uncertainty and complexity inherent in high-tech industries; *focus on high-tech enterprises*: the methodology is specifically designed for high-tech manufacturing enterprises, making it original in its approach to evaluating complex, innovation-oriented business objectives that are usually associated with a high degree of scientific and technological risk; *rapid evaluation:* the study presents a rapid evaluation methodology, which is a key innovation for managers and investors working under time and resource constraints. It allows them to make timely decisions without sacrificing the accuracy of the evaluation process.

Future research could focus on expanding the model to include dynamic changes in the market. High-tech industries often face rapid technological changes and changing consumer demands. Developing a model that can account for such changes in real time would enhance its relevance and flexibility.

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APPENDIX

Table A1. Attractiveness of the market of high-tech products (methodology)

Range of opportunities		Points	Points
Positive opportunities	Positive opportunities		
max assessment +2 points	max assessment +2 points		
The idea has good market prospects	The idea has good market prospects		
This market sector is growing very fast	This market sector is growing very fast		
Entry to the market will be relatively easy	Entry to the market will be relatively easy		
Competitors are weak and do not join together against the new structure	Competitors are weak and do not join together against the new structure		
The profit in this sector is quite big	The profit in this sector is quite big		
Total			

Table A2. Synergy of high-tech business (methodology)

Range of opportunities		Points	Points
Positive opportunities	Positive opportunities		
max assessment +2 points	max assessment +2 points		
The innovation is in line with the company's mission	The innovation is in line with the company's mission		
The idea can be sold to existing customers	The idea can be sold to existing customers		
New professional knowledge is not required when developing and implementing the idea	New professional knowledge is not required when developing and implementing the idea		
The existing production and product distribution system can be used in the operation of the idea	The existing production and product distribution system can be used in the operation of the idea		
Total			

Table A3. Reasonableness of high-tech business goals (methodology)

Range of opportunities		Points	Points
Positive opportunities	Positive opportunities		
max assessment +2 points	max assessment +2 points		
The principles behind the idea are confirmed and understood	The principles behind the idea are confirmed and understood		
The idea is contained in a new application of the product or process	The idea is contained in a new application of the product or process		
The success of the idea implementation does not depend on other developments	The success of the idea implementation does not depend on other developments		
The innovation does not require complex and unfamiliar subsystems	The innovation does not require complex and unfamiliar subsystems		
Use of the idea is not regulated by permission or approvals	Use of the idea is not regulated by permission or approvals		
Total			

Table A4. High-tech production needs for resources (methodology)

Range of opportunities		Points	Points
Positive opportunities	Positive opportunities		
max assessment +2 points	max assessment +2 points		
A small amount of additional resources is required	A small amount of additional resources is required		
The idea can be quickly developed and implemented	The idea can be quickly developed and implemented		
There is access to funds/grants for development	There is access to funds/grants for development		
Additional specialists are not required	Additional specialists are not required		
Total			

Table A5. Consumer benefits of achieving the business goal of high-tech production (methodology)

Range of opportunities		Points	Points
Positive opportunities	Positive opportunities		
max assessment +2 points	max assessment +2 points		
The idea will provide users with unique benefits	The idea will provide users with unique benefits		
The idea will provide users with improved operational qualities of the product	The idea will provide users with improved operational qualities of the product		
The price advantages of the product will be great	The price advantages of the product will be great		
The idea does not have a negative impact on the environment	The idea does not have a negative impact on the environment		
There is a clear and proven need for conveniences derived from the idea implementation	There is a clear and proven need for conveniences derived from the idea implementation		
Total			

Table A6. Protection of business goals of a high-tech enterprise (methodology)

Range of opportunities		Points	Points
Positive opportunities	Positive opportunities		
max assessment +2 points	max assessment +2 points		
It will be difficult for other companies to copy the business goal	It will be difficult for other companies to copy the business goal		
The business goal can be protected by patenting	The business goal can be protected by patenting		
Additional income can be received through licensing agreements	Additional income can be received through licensing agreements		
Total			