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DIRECTIONS OF TRANSFORMATIONAL CHANGES IN MOTOR TRANSPORT ENTERPRISES

Summary. The efficiency of a significant part of motor transport enterprises is unsatisfactory due to their inability to respond quickly to changes in the external

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and internal environments. One of the ways to solve this problem is to implement transformational changes across functional, organizational, structural, and managerial domains. These changes are implemented through a set of external and internal measures aimed at developing the enterprise in a dynamic external environment to ensure the efficiency of its operations and the necessary level of competitiveness. A model of transformational changes in motor transport enterprises has been developed. This model and the developed modelling algorithm allow us to identify promising strategies and to form and explore options for implementing transformational changes. To select the optimal transformational change in the work, an objective function that includes a competitiveness indicator (an integrated competitiveness indicator) and economic indicators (profitability index, net present value, and internal rate of return) has been justified. It is proposed to select the optimal option based on the “worst-case method”. Through this approach, the weight coefficients for the objective function criteria have been identified as follows: 0.308 for the integral competitiveness indicator; 0.154 for net present value; 0.462 for the profitability index; and 0.076 for the internal rate of return. Utilizing the developed models and algorithms, strategies have been outlined, and various options for implementing transformational changes have been formulated for the Vinnytsia branch of the private enterprise “Avtotranskom” (Ukraine). Using the set objective function and the “worst-case method”, the optimal transformational change among those developed was determined. By implementing this option, enterprises can operate more efficiently and compete more successfully in the market.

Keywords: transformational changes, commercial operation of automobiles, transformational change strategy, strategy implementation options, motor transport enterprise, competitiveness, economic efficiency

1. INTRODUCTION

During the transition to market economic conditions, amid stagnation and intensifying crisis, production volumes in numerous sectors of the national economy declined substantially. A significant reduction in transportation demand has led to increased competition between modes of transport and between individual enterprises. There have also been changes in the strategic objectives of enterprises, as meeting and exceeding targets set by management bodies have been replaced by maximizing long-term profits. This has made it impossible to use traditional management principles and methods. Insufficient readiness on the part of management at motor transport enterprises to new business conditions prompts them to make decisions aimed at survival. This ignores the negative consequences that these decisions may lead to in the future, such as the sale of motor vehicles, production equipment, production space, and the dismissal of skilled workers. To achieve positive results from production, economic activities, and development in new economic conditions, it is necessary to respond quickly to changes in the external and internal environments. It is also required to implement transformational changes grounded in theoretical and practical knowledge and existing experience.

The lack of theoretical developments and clear recommendations on specific directions, strategies, and options for transformational change in motor transport enterprises, along with criteria for assessing their effectiveness, underscores the relevance of this study.

2. BRIEF LITERATURE REVIEW

Scientific research on the development of motor transport enterprises typically focuses on one of two areas: either addressing general aspects of organization and management related to development processes or examining specific components of development in isolation from others. Most works on transformational changes focus on structural changes [1, 2, 3].

Volynets et al. (2022) investigated the readiness of motor transport enterprises for economic growth and their financial stability [4]. A two-component methodological approach was developed to optimize the assessment of enterprises' development capacity by calculating an integrated indicator of material costs and investment adequacy. According to the research, many motor transport enterprises face inflated material costs. This can be explained by the obsolescence of truck rolling stock, as well as the production and technical bases of such enterprises. The main disadvantage of this approach is that it relies solely on financial indicators and does not assess a motor transport enterprise's competitiveness in the transport services market.

Functional direction strategies for changing the type of production activity of a motor transport enterprise and organizational direction strategies for creating production sites as a means of its development have been considered [5]. The first type of strategy concerns improving the transport system when a transport company introduces a new mode of transportation not previously used in its operations. The second type of strategy focuses on improving production and the technical base and involves providing car service. However, when developing the first type of strategy, the author does not explore the need to modernize the production and technical base to introduce new truck rolling stock. When creating a second strategy, there is uncertainty about whether the motor transport enterprise plans to continue providing transport services, given that its truck fleet is outdated and inefficient.

Shatilo et al. (2023) developed a methodological approach to define and justify a strategy for developing innovative processes in enterprises, enabling consideration of alternatives, determination of adaptation priorities, and enhancement of adaptability to evolving business conditions [6]. The research relies on various resources and materials from 21 Ukrainian motor transport enterprises. The methodological framework employs a three-dimensional multifactor model that incorporates correlation, regression, and cluster analyses. Using the strategy of developing the innovative process of a motor transport enterprise by emphasizing the asymmetry of its directions increases efficiency, bringing it to the control value or close to the maximum practical value. The main drawback of this approach is that it does not examine the competitiveness of motor transport enterprises in the transport services market.

Mazur et al. (2022) proposed developing and implementing a development strategy for motor transport enterprises based on a strategic map as a means of implementing a functional plan [7]. Key performance indicators for each business projection have been identified, including finances, market (market position, customer relations, marketing), management (internal business processes), personnel, safety, and the carrier's business reputation. Strategic maps are based on a balanced scorecard and serve as a tool for achieving an optimal balance among a set of economic factors. The suggested set of metrics is centered on assessing management mechanisms rather than competitiveness.

Thus, the analysis of literary sources revealed a lack of well-grounded scientific research on the problem of transformational changes in motor transport enterprises that would take into account all priority areas of possible transformations, including structural, functional, organizational, and managerial ones, and would meet modern business conditions. This, in turn, requires solving a significant number of scientific, methodological, technical, organizational,

and economic problems related to the implementation and development of strategies and options for transformational change in motor transport enterprises.

3. METHODS

The purpose of the study is to deepen the theoretical foundations and methodological provisions and to provide practical recommendations for identifying and implementing effective transformational changes in motor transport enterprises to increase their competitiveness and profitability.

This study aims to solve the following tasks:

- to substantiate a system of criteria for assessing the effectiveness of options for transformational change strategies and to propose a method for determining the optimal choice in multi-criteria conditions;
- to identify strategies and options for transformational changes at the motor transport enterprise;
- to perform modeling of the resulting change options under the operating conditions of a specific motor transport enterprise.

The object of the study is the processes of transformational changes at motor transport enterprises.

The scientific novelty of the research involves solving the current problem, namely:

- determining and scientifically substantiating the main directions of transformational changes in a motor transport enterprise;
- developing new methodological provisions for the formation of a rational strategy for the transformation of the enterprise and options for its implementation to improve the competitiveness and effectiveness of its activities;
- an economic and mathematical model of the operation of a motor transport enterprise has been developed, which makes it possible to choose a rational strategy of transformational changes and options for its implementation in real internal and external environments;
- an algorithm for forming directions of change has been developed, which will make it possible to determine strategic directions for the development of motor transport enterprises, according to which it is necessary first to choose promising strategies and form options for implementing transformational changes.

4. RESULTS

4.1. Criteria for evaluating the effectiveness of transformational change strategy options

The production and economic activities of enterprises across diverse sectors of the country's economy, operating in market conditions, are accompanied by several problems, including decreased demand for goods and services and increased market competition [8]. The accumulation of these problems over the past 25 years, along with the lack of effective mechanisms to improve work efficiency and competitiveness, has led to their crisis state and the impossibility of further development.

One of the ways to solve this problem is through transformational changes. When effectively implemented at the enterprise level, they enable rapid development with minimal losses.

In market conditions, to assess the financial effectiveness of strategy implementation options, especially when it is time-consuming, it is advisable to use dynamic methods based primarily on cash flow discounting, reflecting the cash flows generated during the implementation of various transformational changes.

Substantiating economic criteria for the effectiveness of options for implementing transformational change strategies that meet modern business realities is a rather complex and vital task. Current performance assessment methods developed for enterprises are outdated and do not meet modern business conditions, as in a market economy, transformational changes in most cases require capital investments. Given this, the implementation of strategies and options for transformational change should be considered within an investment project, thereby allowing for consideration of investors' interests [9].

Based on various methods of comparing the given costs and performance results, it is proposed to use a system of indicators for evaluating the effectiveness of options, such as: net present value (*NPV*) [thousand EUR], profitability index (*PI*) [dimensionless quantity, the higher the profitability index among the strategy options, the more effective this strategy implementation option will be ($PI > 0$)], internal rate of return (*IRR*) [dimensionless quantity, the higher the internal rate of return among the strategy options, the more effective this strategy implementation option will be and the lowest investment risk will be observed ($IRR > 0$)], which are determined according to [10, 11, 12].

The selection of effective options for transformational change involves a phased screening of options: initially using an integrated competitiveness indicator K^c options that do not increase the competitiveness of the enterprise are eliminated, and then, using criteria such as the *NPV* of future cash flows, *PI*, *IRR*, options that have a negative value are eliminated, i.e. $NPV \leq 0$, $PI \leq 1$, $IRR < NRR$, where *NRR* is a required rate of return of the option [dimensionless quantity, can take values from 0.15 to 1.0 depending on the adopted rate of return of the transformational change option] [13]. When $NPV = 0$, the enterprise's financial condition will not change, but it is worth mentioning that management personnel can accept options for change, as implementing them will increase production volumes.

This approach will allow rejecting inappropriate change options at the initial stages, thereby significantly improving the search for the final, most effective change option.

The task of determining the most appropriate option for transformational change is a typical multi-criteria choice problem. The set of selection criteria, in this case, are the above-accepted performance indicators: an integral indicator of competitiveness (K^c) [dimensionless quantity, the higher the integrated competitiveness indicator among the options for transformational change strategies, the more competitive this option for implementing the plan will be for the enterprise ($K^c > 0$)], *NPV* of future cash flows, *PI*, *IRR*.

For the proposed indicators for assessing the effectiveness of transformational change options, the optimization objective function when applying a multi-criteria approach can be written as follows:

$$U = f(K^c, NPV, PI, IRR). \quad (1)$$

In this case, the change in the parameters and the constraints of the objective function can be determined:

$$\begin{cases} IRR > NRR; \\ NPV > 0; \\ IRR \rightarrow \max; \\ PI \rightarrow \max; \\ K^c \rightarrow \max. \end{cases} \quad (2)$$

A favorable decision is possible only for options that have passed all selection stages, because the outcome of the transformational change process depends on them.

Considering the above, the optimal choice among a set of feasible options occurs when the consequences of implementing it at the enterprise are precisely unknown. In this case, the final decision to approve a specific change option, made by the management of the motor transport enterprise, is taken under conditions of uncertainty.

Today, there is no single, generally accepted method for solving the multi-criteria selection problem. In engineering, scalarization methods are frequently applied, particularly those that account for the relative importance of different criteria. At the same time, the issue of determining the criteria's weights, along with several others, remains unresolved. Methods based on the principles of fuzzy set theory have become widely used for multi-criteria selection of alternatives under uncertainty.

In models of decision-making under uncertainty, the Bellman-Zadeh principle is quite often used [14]. According to it, the optimal option for transformational change should be determined in accordance with the following principles:

- each criterion c_l is presented as a fuzzy set given on the universal set of options V ;
- the intersection of fuzzy criteria results in a fuzzy set containing potentially optimal solutions v_{opt} ;
- the optimal option from a fuzzy set of potentially good solutions is the one that corresponds to the highest degree of membership.

Based on these principles, the best option is inside the intersection (\cap) of fuzzy sets of criteria:

$$v_{opt} \in D = c_1 \cap c_2 \cap \dots \cap c_l, \quad (3)$$

where c_l is the criteria for assessing the effectiveness of change options;

l is the criterion number.

This expression is valid if all criteria for assessing the effectiveness of change options are of equal importance, which is quite relative.

To determine the best option, under conditions of uncertainty, with different weights of all criteria for assessing its effectiveness in multi-criteria selection according to Bilichenko (2011) [15], it is worth using the “worst-case method”, which combines the principle of intersection of Bellman-Zadeh fuzzy criteria with the 9-point Saati's linguistic assessment scale [16].

According to the “worst-case method”, the best option is inside the intersection (\cap) of fuzzy sets of criteria:

$$v_{opt} \in D = (c_1)^{\mu_1} \cap (c_2)^{\mu_2} \cap \dots \cap (c_l)^{\mu_l}. \quad (4)$$

Using the “worst-case method” [15], we will determine the importance of the above-mentioned criteria for assessing the effectiveness of transformational change options:

- c_1 is K_c ;
- c_2 is NPV of future cash flows;
- c_3 is PI .
- c_4 is IRR .

IRR (c_4) has the lowest priority among the objective function criteria. Based on Saati's linguistic assessments (integer from 1 to 9, dimensionless quantity, score of the l -th criterion on Saati's scale) [16] $\frac{J_1}{J_4} = 4$, $\frac{J_2}{J_4} = 2$, $\frac{J_3}{J_4} = 6$, $\frac{J_4}{J_4} = 1$, its weight will be equal to [the higher

the weight of the internal rate of return among performance indicators, the more influential this indicator is when choosing the final option for transformational changes, $0 < \mu_4 < 1$]:

$$\mu_4 = \frac{1}{4 + 2 + 6 + 1} = 0.076.$$

The weight of other criteria of the objective function will be equal to:

- K_c [the higher the weight of the integral competitiveness indicator among the efficiency indicators, the more influential this indicator is when choosing the final option for transformational changes, $0 < \mu_1 < 1$];

$$\mu_1 = \frac{4}{4 + 2 + 6 + 1} = 0.308;$$

- NPV of future cash flows [the higher the weight of the net present value among the performance indicators, the more influential this indicator is when choosing the final option for transformational changes, $0 < \mu_2 < 1$];

$$\mu_2 = \frac{2}{4 + 2 + 6 + 1} = 0.154;$$

- PI [the higher the weight of the profitability index among the efficiency indicators, the more influential this indicator is when choosing the final variant of transformational changes, $0 < \mu_3 < 1$]

$$\mu_3 = \frac{6}{4 + 2 + 6 + 1} = 0.462.$$

If we take into account the weight coefficients that determine the importance of each criterion, then the objective function can be represented as a fuzzy set:

$$C = \{K^c^{0.308}, NPV^{0.154}, PI^{0.462}, IRR^{0.076}\}.$$

Thus, systematizing various approaches to assessing the effectiveness of implementing transformational changes at enterprises and considering them from the perspective of investment projects enabled the formation of a system of indicators to evaluate the expected economic efficiency of each change option.

4.2. Defining strategies and options for transformational changes at the motor transport enterprise

The economic and mathematical model of the enterprise's activities, aimed at achieving the set goals, contains the following notations:

$k = \overline{1, K}$ – main types of rolling stock of trucks available at a motor transport enterprise [units];

$j = \overline{1, J}$ – number of the direction of transformational changes of the enterprise, according to which strategies (structural, functional, organizational, managerial) will be developed;

$s = \overline{1, S}$ – number of the transformational change strategy in the j -th direction;

$v = \overline{1, V}$ – number of the alternative implementation option according to the s -th strategy in the j -th direction of transformational changes;

$t = \overline{1, T}$ – time stages of implementation of the v -th option of implementation of the s -th strategy in the j -th direction of the enterprise [years];

I_{vsj} – initial investments required to implement the v -th option of implementing the s -th strategy in the j -th direction of transformational changes at the motor transport enterprise, [thousand EUR];

NCF_{kvsjt} – cash flows from the performance of transport work by the k -th type of rolling stock of trucks according to the v -th option of implementing the s -th strategy in the j -th direction of

the enterprise in the t -th period of time [thousand EUR];

R – discount rate for the term of the option, which is approximately from 15% to 100% depending on the interest rate of loan repayments;

ΔR_{vsj} – necessary resources to perform a unit of transport work according to the v -th option of implementing the s -th strategy in the j -th direction of transformational changes at the motor transport enterprise (for fuel and lubricant materials – liters or kilograms, the monetary equivalent of the cost of a particular resource – thousand EUR);

C_{vsj} – restrictions that can significantly affect the implementation of the v -th option for implementing the s -th strategy in the j -th direction of transformational changes of a motor transport enterprise (limitations in terms of a sufficient amount of working capital, the possibility of gradually raising finances to cover the working capital deficit, limitations in terms of access to markets for operating resources in sufficient quantities, etc.) [thousand EUR];

W_{kvsjt} – the volume of transport work performed by the k -th type of rolling stock of trucks according to the v -th option of implementing the s -th strategy in the j -th direction of the enterprise in the t -th period of time [tonne-kilometers or tons];

$K^c K_{vsj}^c$ – integral indicators of competitiveness, respectively, before and after the implementation of the v -th option of the implementation of the s -th strategy in the j -th direction of transformational changes of the motor transport enterprise [dimensionless quantity, $K^c > 0$, $K_{vsj}^c > 0$];

$T_{vsj}^{act} T_{vsj}^{plan}$ – respectively, the actual and planned (set by the investor) deadlines for the implementation of the v -th option of the implementation of the s -th strategy in the j -th direction of transformational changes [years].

Using the introduced notations, the total cash flows from the implementation of the v -th option of the s -th strategy in the j -th direction of changes of the motor transport enterprise are determined:

$$NCF_{vsj} = \sum_{k=1}^K \left(\sum_{t=1}^T \frac{NCF_{kvsjt}}{(1+R)^t} \right) - II_{vsj} \rightarrow \max. \quad (5)$$

When considering the system of restrictions imposed on the option, it is necessary to take into account the enterprise's motor transport services' competitiveness in the market, as a decrease in competitiveness leads to a reduction in the volume of services provided, the number of clients, etc.

As an indicator of competitiveness when determining the most effective option for implementing transformational change strategies at a motor transport enterprise, K^c is used, which is determined by the following formula:

$$K^c = \frac{\sum_{z=1}^Z \left(\frac{\sum_{l=1}^L \frac{M_{zl}^s W_{zl}}{M_{zl}^c} \cdot V_z}{\sum_{l=1}^L W_{zl}} \right)}{\frac{\sum_{z=1}^Z \frac{C_z^s V_z}{C_z^c}}{\sum_{z=1}^Z V_z}}, \quad (6)$$

where M_{zl}^S is the value of the individual l -th quality indicator of the z -th type of transportation at the enterprise under study [dimensionless quantity, determined by the method of expert estimates]; M_{zl}^C is weighted average value of the same quality indicator among competitors [dimensionless quantity, determined by the method of expert estimates]; $\frac{M_{zl}^S}{M_{zl}^C} > 1$ – with positive qualities, $\frac{M_{zl}^S}{M_{zl}^C} < 1$ – with negative qualities; W_{zl} is importance coefficient of the l -th quality indicator of the z -th type of transportation [dimensionless quantity], $0 \leq W_{zl} \leq 1$; L is number of quality indicators; V_z is importance coefficient of the z -th kind of service [dimensionless quantity, $0 < V_z < 1$]; C_z^S is tariff for the z -th kind of service at the enterprise under study [EUR/tonne-kilometers or EUR/kilometers, the dimension is accepted depending on the adopted calculation scheme]; C_z^C is weighted average tariff for the z -th type of service from competitors [EUR/tonne-kilometers or EUR/kilometers, the dimension is accepted depending on the adopted calculation scheme]; Z is the quantity of services provided by the motor transport enterprise.

Taking this into account, the cost of transportation services (tariff) performed by the k -th type of rolling stock of trucks should not be higher than the average market price, because when choosing a carrier, a consumer who is not connected to a specific enterprise by contractual relations most often pays attention to the cost.

Time constraints are also critical, as delaying the implementation of a strategy option results in both overspending and substandard work.

The highest costs of implementing transformational change options at a motor transport enterprise are limitations on the ability to attract the resources necessary for its operation, as their absence requires searching for additional investments or other forms of financing.

Taking into account the above, the system of constraints of the economic and mathematical model of choosing the optimal option of transformational changes at the motor transport enterprise will be as follows:

$$\left\{ \begin{array}{l} W_{kvsjt} \geq 0; \\ PI \rightarrow \max; \\ II_{vsj} \leq II_{\max}; \\ \Delta R_{vsj} \leq C_{vsj}; \\ K^c \leq K_{vsj}^c; \\ T_{vsj}^{act} \leq T_{vsj}^{plan}, \end{array} \right. \quad (7)$$

where II_{\max} is the maximum amount of investment that the enterprise will be able to attract [thousand EUR].

As a result, the set of equations (5) and inequalities (7) serves as a generalized economic-mathematical representation of the options of transformational processes occurring at motor transport enterprises.

The essence of this model is to describe the cash flows that result from implementing the change strategies being modeled. The modeling interval should be set to 1 year, and incoming and outgoing cash flows occur on the last banking day of each time interval.

The search for optimal transformational change options is performed using the modeling algorithm shown in Fig. 1.

In “block 1”, input data is entered to characterize the motor transport enterprise’s state.

To determine a rational option for transformational change in an enterprise, it is necessary to define input data characterizing the enterprise's current state, including profitability, cost price, financial stability, and competitiveness.

Analysis of trends in the efficiency of an enterprise’s production activities is the initial step in identifying ways to strengthen its market position. With negative trends in business efficiency, there is a need to implement transformational changes and to search for strategies and options for their implementation.

“Block 2” involves conducting marketing research in three areas: the transport services market, competitors, and the enterprise under study.

Researching the consumer market and the market for motor transport services is very important, as consumer needs and desires constantly change with changes in human socio-economic life.

In “block 3”, the evaluation indicators for the effectiveness of the structural, functional, organizational, and managerial directions of transformational changes in the motor transport enterprise are determined, the maximum (reference) values are selected, and the relative integral indicators of effectiveness are calculated.

Significant attention is paid to determining the reference values for the efficiency indicators of the directions of transformational change among competing enterprises. When developing strategies for transformational change, the reference method is used, comparing the actual values of the efficiency indicators for the enterprise under study with those of the most successful enterprises in this direction.

In “block 4”, the external factors affecting the motor transport enterprise are studied and analyzed, and the most influential ones are identified under specific conditions. This will allow you to choose the priority transformational changes with greater accuracy.

“Block 5” identifies potential problem areas in the enterprise's operations that are also priorities for implementing changes.

It is proposed to assess the priority of the direction of transformational changes of the enterprise on a scale in which, according to the conducted expert survey, the following limits are accepted:

$0.7 < w_j < 1$ – provided that the external environment is stable, the enterprise does not need to carry out transformational changes (where w_j is the indicator of the priority of the direction of transformational changes in the enterprise [dimensionless quantity]);

$0.35 < w_j < 0.7$ – the motor transport enterprise needs to make changes;

$0 < w_j < 0.35$ – the motor transport enterprise needs to make immediate changes.

To highlight the calculated values of relative integral indicators of the efficiency of directions, we assign the following designations: structural – S_r [dimensionless quantity, $S_r > 0$], functional – F_r [dimensionless quantity, $F_r > 0$], organizational – Q_r [dimensionless quantity, $Q_r > 0$], managerial – Y_r [dimensionless quantity, $Y_r > 0$].

The direction in which the calculated numerical value of the relative integral efficiency indicator is as close as possible to “0” is the most problematic and therefore requires priority changes at the studied motor transport enterprise.

“Logical operator 6” compares the relative integral indicator of the effectiveness of the structural direction with the value of the evaluation scale of 0.7. If $S_r \geq 0.7$, the structural direction of the enterprise under study is better or on par with that of the best competitors, and management is transferred to “block 11”. Otherwise, control is transferred to “block 7”.

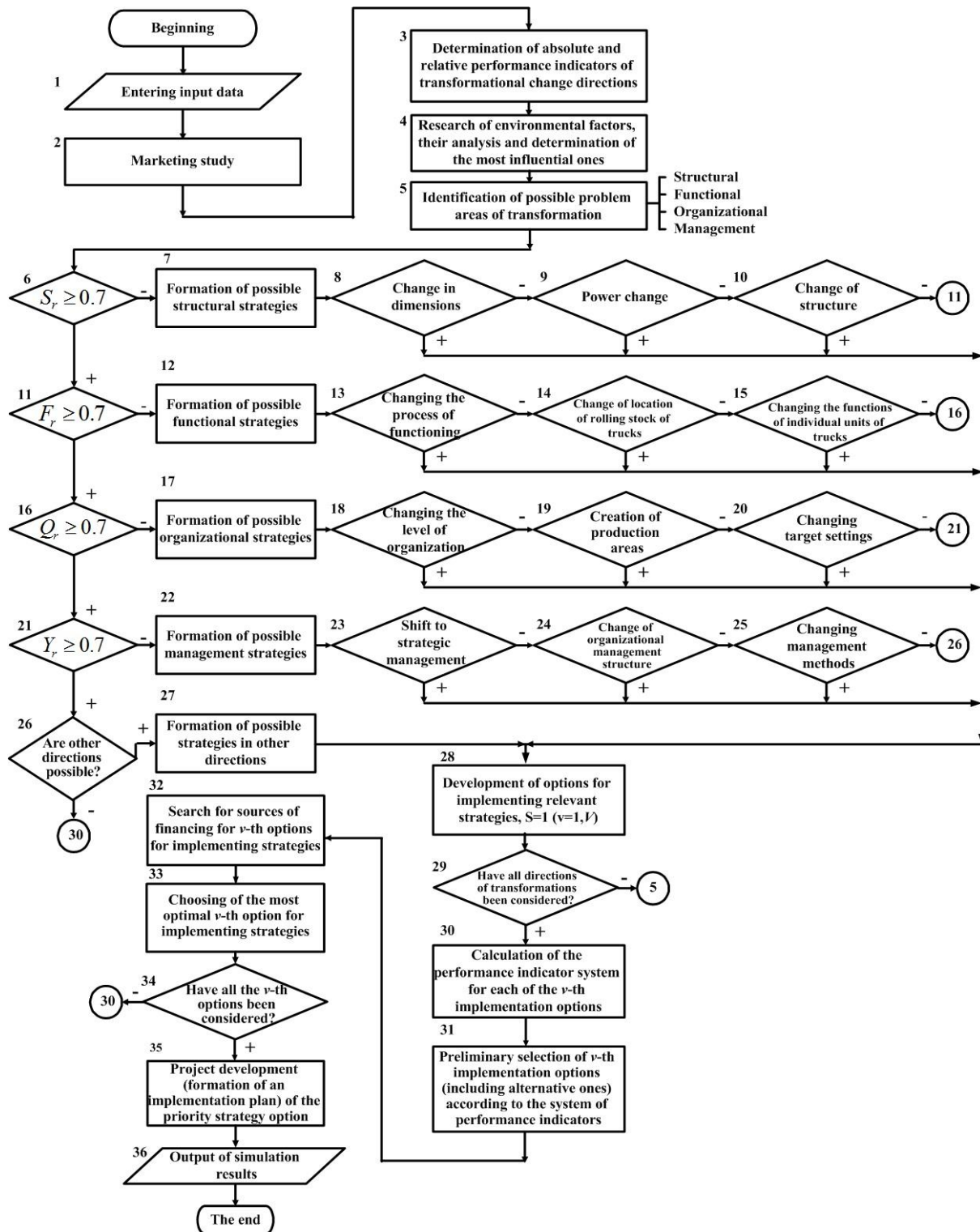


Fig. 1. Algorithm for modeling options for transformational changes at a motor transport enterprise (Source: Authors' own research)

“Block 7” uses SWOT analysis to formulate possible structural strategies for the motor transport enterprise under study. When determining the strengths and weaknesses of an enterprise’s activities, it is necessary to take into account both technical characteristics and economic ones: age of vehicles, state of the production and technical base, progressiveness of the technology used in the transportation of goods or passengers and in the performance of technical maintenance and repair of rolling stock of trucks, transportation tariffs for each model of rolling stock of trucks, cost of material resources used at the enterprise, qualification of personnel. When assessing opportunities and threats, it is necessary to consider external environmental factors that have the most significant influence on the enterprise’s activities under specific conditions, as analyzed in the previous block.

“Logical operators 8, 9, 10” check which of the strategies in this direction (change in capacity, expansion, specialization) can be implemented. If none of them is possible, control passes to “logical operator 11”.

“Logical operator 11” compares the relative integral indicator of the effectiveness of the functional direction with the value of the evaluation scale of 0.7. If $F_r \geq 0.7$, control passes to “block 16”. Otherwise, control passes to “block 12”.

“Block 12” forms possible strategies for the functional direction. Among the functional strategies, the following ones should be highlighted: changes in the process of motor transport enterprise functioning (variable production mode), changes in the location of rolling stock (dislocation), and changes in the functions of individual units of rolling stock. “Operators 13, 14, 15” check which of the strategies of the functional direction of transformation can be implemented. If none of them is rational, control passes to “block 16”.

“Logical operator 16” compares the relative integral indicator of the effectiveness of the organizational direction with the value of the evaluation scale of 0.7. If $Q_r \geq 0.7$, control passes to “block 21”. Otherwise, control passes to “block 17”.

“Block 17” forms possible strategies for the organizational direction of transformation. The possibility of implementing organizational change strategies (changing the organizational structure of production processes, creating new production areas, adjusting target settings for the future) is evaluated by “operators 18, 19, 20”. If no organizational transformation strategy is suitable, management passes to “block 21”.

“Logical operator 21” compares the relative integral indicator of the effectiveness of the management direction with the evaluation scale value of 0.7. If $Y_r \geq 0.7$, control passes to “block 26”. Otherwise, control passes to “block 22”.

“Block 22” is formulating possible strategies for managerial transformation. The reality of implementing management strategies (strategic management, innovation with investor search, changes in management methods) is assessed through “blocks 23, 24, 25”. If any transformational changes are possible, control passes to “block 28”.

“Block 26” is examining the possibility of implementing transformational changes in other areas.

In “block 27”, possible strategies are emerging in other directions of transformation.

In “block 28”, options for implementing (including mutually exclusive) relevant strategies are being formed, $S=1$ ($v=1, V$). As a result of careful execution of this block, a set of all possible transformation strategies S and options for their implementation is obtained V^S :

$$S = \{S_1, S_2, S_3, \dots, S_i\},$$

$$V^S = \{V_1^S, V_2^S, V_3^S, \dots, V_i^S\},$$

where $S_1, S_2, S_3, \dots, S_i$ is actually implemented transformational change strategies; $V_1^s, V_2^s, V_3^s, \dots, V_l^s$ is options for implementing transformational change strategies at motor transport enterprise; s is the number of the strategy, the implementation of which is provided by the corresponding option (this index is used to highlight mutually exclusive options within the same plan).

“Block 29” checks whether all areas of transformational change have been considered. If not all areas of transformational change have been considered, management returns to “block 5”. If all possible directions have been considered, control is transferred to “block 30”.

In “block 30”, the numerical values of the performance indicators are calculated. When determining financial efficiency indicators, it is necessary to calculate the truck operation plan, the vehicle maintenance and repair plan, the logistics plan, the workers’ wages, the financial plan, and the general investment needs for implementing each transformation strategy option.

In “block 31”, a preliminary selection of the v -th options (including mutually exclusive ones) takes place according to the efficiency criterion.

In “block 32”, sources of financing for implementation options for strategies are being searched for. Funding for these alternatives for implementing transformational change strategies can be provided both from own funds and borrowed funds.

In “block 33”, the options for implementing strategies are compared, and the most optimal one is selected according to the adopted system of efficiency criteria. At the same time, all implementation options that meet the system of efficiency criteria are arranged in order of decreasing quantitative value of the net present value indicator.

“Block 34” checks whether all v -th implementation options have been considered. If not all options have been considered, control returns to “block 30”. If all options are considered, control passes to “block 35”.

In “block 35”, a plan for implementing the priority option for transformational change strategies (or a portfolio of transformational changes) is formed, and its financial feasibility is determined.

“Block 36” outputs the simulation results. This concludes the modeling of possible strategies for implementing transformational change in the motor transport enterprise.

The developed algorithm for modeling options for transformational changes at a motor transport enterprise will enable determining the optimal choice for a given enterprise.

4.3. Determination of options of transformational changes

To verify the adequacy of the simulation model, the Vinnytsia branch of the private enterprise “Avtotranskom” was selected as the research object. This enterprise is a typical motor transport company in the Vinnytsia region (Ukraine) that requires improvement measures.

The adequacy of the simulation model at a real enterprise was assessed by comparing the simulated performance indicators for the Vinnytsia branch of the private enterprise “Avtotranskom” with actual 2024 data. The calculation results showed that the discrepancy between the calculated values and the actual performance indicators is no more than 3.76%, indicating the adequacy of the developed model.

The main client for cargo transportation and freight forwarding services is the Vinnytsia branch of the private joint-stock company “Concern Galnaftogaz”, which is the largest customer for transporting petroleum products.

In accordance with the methodology for selecting priority areas for transformational change, to determine the direction in which strategies and options for their implementation will be developed, it is necessary to identify the main competitors in the transport services market.

The main competitors of the Vinnytsia branch of the private enterprise “Avtotranskom” in cargo transportation include the Limited Liability Company “Nazaret Trans”, the private enterprise “Berkut-trans”, the Limited Liability Company “Trans-Legion Ukraine”, and the Closed Joint-Stock Company “Ukrtrans-Vinnytsia”. Private cars are a fairly serious competitor, since the cost of services provided by them is lower than the prices set at the Vinnytsia branch of the private enterprise “Avtotranskom”.

When analyzing the external environmental factors that most influence the strategy choice for the Vinnytsia branch of the private enterprise “Avtotranskom”, according to the proposed methodology, economic factors are the most influential.

The results of modeling the state of transformational change among competing enterprises in the motor transport industry in Vinnytsia (Ukraine) are shown in Tables 1 and 2.

Analysis of the modeling results for integral indicators 1 and 2 shows that the management efficiency indicator is the lowest among the other areas. Still, for this enterprise, it is the highest and equals 0.903, indicating a satisfactory state.

Tab. 1

Absolute values of integral indicators of the effectiveness of transformational change directions among competing enterprises of Vinnytsia (Ukraine)

Indicators	Private Joint-Stock Company “Vinnytsia Motor Transport Enterprise 10554”	Limited Liability Company “Nazareth Trans”	Private enterprise “Berkut-trans”	Limited Liability Company “Trans-Legion Ukraine”	Closed Joint-Stock Company “Ukrtrans-Vinnytsia”
Structure efficiency	0.493	0.470	0.465	0.543	0.878
Function efficiency	0.627	0.850	0.847	0.949	0.698
Organizational efficiency	0.691	0.996	0.789	0.716	0.896
Management efficiency	0.824	0.685	0.859	0.727	0.857

Note: The maximum absolute value of the integral indicator of the effectiveness of the corresponding direction of transformational changes among competing enterprises of Vinnytsia (Ukraine) is highlighted.

Source: Authors' findings

The integral indicators of the production structure have the lowest absolute and relative values, 0.493 and 0.562, respectively. Therefore, in accordance with the recommendations [4, 15], based on the analysis of the modeling results, it was established that structural transformation is the most priority direction.

The formation of the most effective strategies for structural transformational changes was carried out based on a SWOT analysis of the Vinnytsia branch of the private enterprise “Avtotranskom” [15]. The following options for transformational changes were proposed:

- “option 1” – purchase of DAF FT CF85.430 tractor units together with PPS 3064229 semi-trailers in the amount of 15 units and specialization in the transportation of petroleum products;
- “option 2” – purchase of KrAZ 63221-ATSB-20 cars in the amount of 24 units and specialization in the transportation of petroleum products.
- “option 3” – purchase of TST 3064229 semi-trailers in the amount of 15 units, which will be operated with existing MAN tractor units and specialization in the transportation of petroleum products.

Tab. 2

Relative integral indicators of the efficiency of the areas of the studied enterprise compared to the best ones of competitors

Structural direction	Functional direction	Organizational direction	Management direction
0.562	0.661	0.694	0.903

Source: Authors' findings

The results of calculating the efficiency indicators of transformational change options are presented in Table 3.

Tab. 3

Performance indicators of transformational change options

Indicators	Option 1	Option 2	Option 3
1. Investment volumes provided by the option [thousand EUR]	1,812.5	2,237.5	593.75
2. Present value of future cash flows [thousand EUR]	2,129.25	2,351	1,072.17
3. <i>NPV</i> of future cash flows [thousand EUR]	316.75	113.5	478.42
4. Payback period [years]	2.83	3.17	1.84
5. <i>PI</i>	1.17	1.05	1.81
6. <i>IRR</i> [%]	0.32	0.27	0.53
7. Integral competitiveness indicator	1.47	1.18	1.19

Source: Authors' findings

To select the optimal transformational change, fuzzy sets of potentially good solutions were formed based on the scientific and methodological developments [17, 18, 19]. The least essential option by all criteria (K^c , *NPV*, *PI*, *IRR*) is “option 2”. Based on Saati's linguistic estimates, we will determine the rank correlations for the criteria by the options (Tab. 4).

Next, according to the proposed methodology [15], we will determine the option weights using the efficiency indicators in Table 5.

We determine the weight of each option by considering the efficiency indicators' weights. The results of the calculations are given in Table 6.

Tab. 4

Correlation of ranks of options on the Saati's scale

Performance indicator	Transformational change options		
	Option 1	Option 2	Option 3
<i>NPV</i>	3	1	5
<i>K^c</i>	4	1	2
<i>IRR</i>	2	1	5
<i>PI</i>	3	1	7

Source: Authors' findings

Tab. 5

Weight of options by performance indicators

Performance indicator	Transformational change options		
	Option 1	Option 2	Option 3
<i>NPV</i>	0.333	0.111	0.556
<i>K^c</i>	0.571	0.143	0.286
<i>IRR</i>	0.25	0.125	0.625
<i>PI</i>	0.273	0.091	0.636

Source: Authors' findings

Tab. 6

Weight of options taking into account the weight of performance indicators

Performance indicator	Transformational change options		
	Option 1	Option 2	Option 3
<i>NPV</i>	0.844	0.713	0.914
<i>K^c</i>	0.841	0.549	0.680
<i>IRR</i>	0.900	0.854	0.965
<i>PI</i>	0.549	0.330	0.811

Source: Authors' findings

Applying the intersection operation of fuzzy sets $D = K^c \cap NPV \cap PI \cap IRR$, we will obtain a fuzzy solution set:

$$D = \left\{ \frac{0.549}{v_1}; \frac{0.330}{v_2}; \frac{0.680}{v_3} \right\}.$$

4.4. Discussion

Transformational changes at motor transport enterprises aim to increase the efficiency of vehicle fleet use and the functioning of the production and technical base, thereby improving economic performance and meeting the required level of competitiveness. To implement transformational changes in practice, the authors developed a mathematical model and an algorithm, and substantiated a set of criteria and a methodology for managerial decision-making. Based on scientific and methodological developments, the modeling of

transformational change options for the Vinnytsia branch of the private enterprise “Avtotranskom” was conducted, and the optimal option was identified.

According to Table 3, implementing any of the proposed options $K^c > 1$ will increase the enterprise's competitiveness. If we compare the integral competitiveness indicator by options, it is the largest for "option 1", indicating the enterprise's best competitive position in the transport services market during its implementation, exceeding the corresponding values for "option 2" by 20% and "option 3" by 19%.

When comparing the initial investment amounts by options, it is clear that “option 2” is the most cost-effective. The volume of its initial investments exceeds that of “option 1” by 1.23 times and that of «option 3» by 3.77 times. If we compare the net present value (*NPV*) of these options, it is the largest for “option 3”, which exceeds the corresponding value of «option 1» by 1.51 times and “option 2” by 4.21 times.

When comparing the profitability indices (*PI*) for the options, it is clear that “option 3” has the highest value, indicating the most significant economic effect when implemented, as it requires the least investment. Its profitability index exceeds the corresponding value for “option 1” by 35% and for “option 2” by 42%.

When comparing the internal rates of return (*IRRs*) for the options (see Table 1), it is clear that “option 3” has the highest IRR, indicating the lowest investment risk. The internal rate of return of “option 3” will exceed the corresponding value of “option 1” by 40%, and “option 2” by 49%.

Analyzing the fuzzy set, we can conclude that the best option for transformational change for this enterprise is “option 3”, which aims to improve the enterprise’s efficiency.

As a result of implementing this option, the motor transport enterprise will become specialized and will supply fuel to the “Okko” gas station network throughout Ukraine.

Another significant advantage is that this option requires minimal investment for implementation, which is quite essential given the current economic situation in our country.

The following effects are predicted as a result of the implementation of this option:

- growth of the enterprise’s market potential, which makes it possible to organize work on the implementation of services more effectively;
- expanding the sphere of influence, i.e., increasing the circle of potential customers;
- more efficient use and reduction of personnel, in particular managerial personnel, which affects the reduction of costs for maintaining the management apparatus;
- increasing the prestige and image of a strong, reliable, and experienced partner among service consumers, which will allow using your brand name in the markets of Ukraine and abroad, which is also an important circumstance in the context of growing competition.

Taking into account all of the above, under these conditions, “option 3” is the most optimal one and is recommended for implementation at the Vinnytsia branch of the private enterprise “Avtotranskom”.

In this research, the economic efficiency of transformational change options is determined using the net present value method. Compared with the research [5], this study shows that the effective development of a motor transport enterprise largely depends on how comprehensively it pursues renewal, including modernizing its truck fleet and improving its production and technical base.

This research resulted in the development of a transformational change option, which is the most acceptable one in modern conditions. The modeling results indicate that "option 3" is the most effective.

5. CONCLUSION

- 1) A mathematical model of transformational changes in a motor transport enterprise has been developed. This model, unlike those considered in works [3] and [6], allows making informed decisions regarding the systematic renewal of rolling stock and the production and technical base in conditions of limited resources. This, in turn, contributes to achieving the highest possible profit and maintaining the appropriate level of enterprise competitiveness.
- 2) A system of criteria has been substantiated, thoroughly assessing the effectiveness of transformational change measures, and an objective function has been constructed to determine the optimal option of transformational changes in a motor transport enterprise. This objective function, unlike the objective function considered in work [6], includes a competitiveness indicator – an integral competitiveness indicator, and unlike the objective function considered in work [5], economic indicators – profitability index, net present value, and internal rate of return.
- 3) An algorithm for modeling transformational change options has been developed, which, unlike the approach to developing two types of strategies considered in work [5], allows for the formation and identification of promising transformational change strategies and the development of effective options for their implementation in modern business conditions. Based on modeling data, a set of effective options for transformational change has been identified. According to each option, the performance indicators of the motor transport enterprise and the values of the efficiency criteria have been determined.
- 4) To determine the most optimal option of transformational changes, it is suggested to use the “worst-case method”, which, unlike the approaches considered in works [1], [4], and [5], is based on the Bellman-Zadeh fuzzy set principle in combination with the 9-point Saati’s linguistic assessment scale. The weight coefficients for the objective function criteria have been determined as 0.308 for the integral competitiveness indicator, 0.154 for the net present value, 0.462 for the profitability index, and 0.076 for the internal rate of return.
- 5) Using the example of the Vinnytsia branch of the private enterprise “Avtotranskom”, a modeling of the proposed options for transformational changes has been performed to determine the criteria for the effectiveness of the target function, the performance indicators of the enterprise, and to determine the possibility of implementing the options. Based on the proposed method for selecting the optimal strategy and transformational change option, it has been found that “option 3”, which is aimed at expanding the enterprise's share in the petroleum products transportation market, is the most effective. “Option 3” has some of the best profitability indices, the highest net present value and internal rate of return, and the integrated competitiveness index among the proposed transformational change options.

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