

STRATEGIC ROAD PLANNING CONCEPT

КОНЦЕПЦІЯ СТРАТЕГІЧНОГО ПЛАНУВАННЯ ДОРОЖНЬОГО ГОСПОДАРСТВА



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Abstract. The article discusses possible expert-analytical approaches to the formation of concepts for the road sector development, depending on the capabilities of the participants involved in specific work programs implementation processes and the formation of an infrastructural basis for their successful implementation. At the first stage of a model for determining the preferred option for strategic modeling forming, the initial opportunities and prospective trends in the employment of each participant in the development of the road sector are analyzed, aimed at reliable support in the operational condition of the roads. The cross-section and combination of perspective trends of different participants form the so-called local strategies of possible options for their activities planning. Information processing of local strategies is possible using various approaches - mathematical data processing, expert analysis or graphical interpretation. The choice of the best cumulative strategy for the activity of participants is carried out according to the criterion of minimizing the costs of their activities.

Key words: road sector, participants in activities, local strategies, comprehensive assessment.

Introduction

Planning the activities of any enterprise is a basic function in the management system, the implementation of which provides information on the timing and resources for its successful and reliable operation. Strategic (or long-term) planning is the most general stage in the overall planning system, which includes, in addition to long-term, such types of planning as long-term (five-year), annual and operational. The solution of the constituent tasks of each type of planning has its own characteristics and uses different approaches and methods. But the best way to solve each problem is to use the minimum amount of initial information and the simplicity of the method for solving it. The proposed approach to solving the problem of finding the best option for long-term planning of the road sector, covering a certain part of the road network, is focused on such requirements.

Modeling the processes of possible long-term planning is based on the concept of a systematic approach - a number of participants are identified in the structure of performers involved in the development of the road sector. Based on the analysis of employment opportunities and trends for each participant, so-called local strategies are drawn up, which form various options for long-term plans for the development of the road sector. The processing of information describing the position of each strategy makes it possible to determine the best long-term road planning option. In this case, the value of small costs for the total activity of all participants is taken as a criterion. The proposed method for determining the best option for long-term planning

is distinguished by its simplicity of interpretation, the use of minimal amounts of initial information, and the possibility of using various approaches to solving this problem.

Main material

Strategic planning (or long-term forecasting) plays a significant role both in fundamental research of systems theory [1, 2] and in applied models of searching for possible ways of rational prospects for the development of the road sector [6, 7]. At the same time, various criteria are used as criteria for achieving the goal - the best long-term plan, for example, long-term assets [6] or minimum road transport costs [7]. Despite the achievements in the field of long-term forecasting of systems development, there is still no simple and comprehensive method that allows, based on the minimum amount of initial information, to give an answer to the behaviour of the system as a whole in the long term. So, today the long-term planning of the road economy uses various models - PMS, HDM, CYCII and other similar models. But the disadvantage of this approach, first of all, is that only the road surface is taken as a predictive element of the development of the road economy. Therefore, there is an objective need to create such an approach to forecasting the development of the road sector, taking into account the activities of the entire complex of participants in various processes of its maintenance.

The creation of a strategic (long-term) planning system is based on the formation of a complex economic system, the features of the functioning of which are its multi-criteria and multi-parametric nature. Therefore, at the stage of such a system structural formation, it is necessary to avoid these problems to the maximum extent, which, first of all, is possible under the condition of independent forecasting of its constituent subsystems development. The results of each subsystem independent forecasting are taken into account in the procedures for evaluating the complex result according to one complex criterion.

Therefore, the development of the strategic planning model can be represented as follows. Firstly, in the process of creating a comprehensive model of strategic planning, the capabilities and interests of different participants should be taken into account. - p ($p = 1, 2, \dots, P$), whose activities are related to the road sector. For example, $p = 1$ is a group of enterprises engaged in the state roads development, $p = 2$ is a group of enterprises engaged in the material infrastructure development, $p = 3$ is a group of enterprises whose activities are related to the creation and provision of all participants with basic production assets, $p = 4$ is the activity of enterprises involved in the local roads development, and so on. Depending on the purpose of strategic planning, for example a different number of participants can be allocated, these are groups of enterprises that train personnel of different categories or groups of enterprises involved in the projects development and implementation. The activity of each participant is determined in a certain end result, which can be evaluated by different units of measurement. But for the first interpretation of the strategic planning model, it is proposed to evaluate the activities of each participant in monetary terms, that is, it can be a program of work in monetary terms, a budget for staff training, and the volume of material resources in monetary terms. In general, the activity of each participant is defined as a certain monetary equivalent – Vp , spent or attracted by a specific participant for a certain period of time – Tp .

Each of the road economy processes participants – p may have their own interests and trends over time. All trends of any participant at the time of the strategic planning conceptual model formation can be compiled according to the following features:

- volumes of activity do not change over time, that is, remain constant;
- volumes of activity tend to decrease;
- the volume of activity increases over time.

Determining the trends in the activities of each participant is a separate engineering and economic task. For example, the interests of participants and trends in the enterprises activities involved in the national roads development can be determined using the CYCII model.

A graphical interpretation of the strategic planning model can be found as follows. In Fig. 1, on the V axis, the location of the cost positions of the activities of different participants is fixed at the initial moment of determining the best strategy for the development of the road sector as a whole – t_0 . It should be noted that under "road facilities" in this case, a certain roads network, measured in kilometers, is considered. For each of the participants in Fig. 1, thin lines reflect the possible trends in their activities. It should be noted that some participants after a certain time may end their activities for certain reasons. So, for example, for the first participant – p_1 , the period of activity is determined as t_{1kp} .

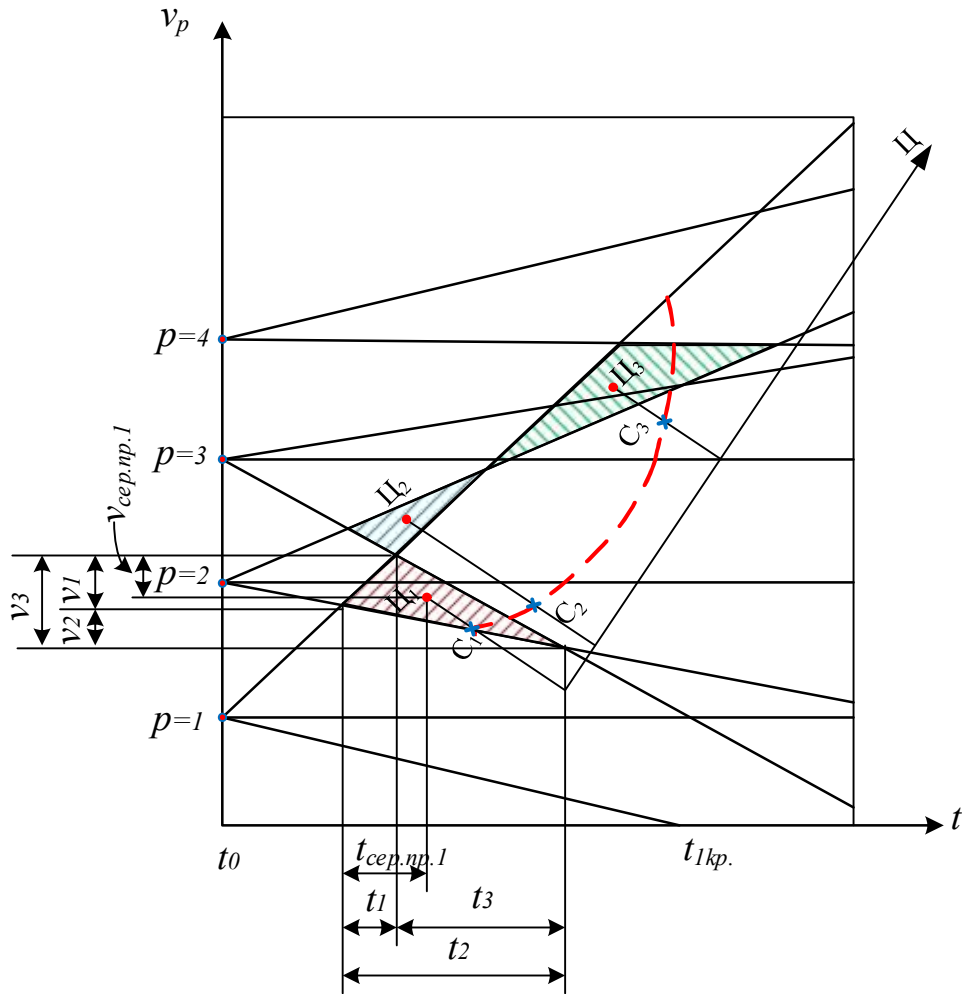


Figure 1 – Logic-structural graphic model of determining the participants rational strategy in the road management activity

Рисунок 1 – Логіко-структурна графічна модель визначення раціональної стратегії учасників в діяльності дорожнього господарства

Trends in the development of individual participants activities are determined by the certain local strategies formation – s , where $s = 1, 2, \dots, S$ is the type of local strategy. Such local strategies in Fig. 1 are indicated by shaded triangular zones. So, the first local strategy is determined by the fact that:

- trends in the volume of activities of the first participant – p_1 increase;
- trends in the volume of activities of the second participant – p_2 are decreasing;
- trends in the volume of activities of the third participant – p_3 are also decreasing.

For the one shown in Fig. 1 of the first connected local strategy, each of the participants carries out certain activities in volumes, respectively – v_1, v_2, v_3 at certain time periods – t_1, t_2 and t_3 . Using these parameters, it is possible to determine the so-called conditional centers of local strategies – U_s , which will determine the coordinates of the average values of each participant activity volumes and the time of this strategy implementation given for the corresponding local strategy. For the first local strategy – $s = 1$, these coordinates are denoted as $v_{сеп.нр.1}$ and $t_{сеп.нр.1}$ and can be determined by the corresponding formulas 1.1 and 1.2:

$$v_{сеп.нр.1} = (t_1 \times v_1 + t_2 \times v_2 + t_3 \times v_3) / (t_1 + t_2 + t_3), \quad (1.1)$$

$$t_{сеп.нр.1} = (v_1 \times t_1 + v_2 \times t_2 + v_3 \times t_3) / (v_1 + v_2 + v_3). \quad (1.2)$$

In general, the coordinates of the each strategy conditional center– $v_{cep,np,s}$ and $t_{cep,np,s}$ are determined by formulas 1.3 and 1.4:

$$v_{cep,np,s} = (\sum (t_s \times v_s) / \sum t_s), \quad (1.3)$$

$$t_{cep,np,s} = (\sum (v_s \times t_s) / \sum v_s). \quad (1.4)$$

Thus, for each local strategy – s , conditional centers – $\Pi_s(v_{cep,np,s}, t_{cep,np,s})$ will be determined. Further calculations to determine the best strategies for the activities of all participants will include the following stages.

Stage 1: Determination of the set of possible local strategies within the limits indicated by the development trends of the individual road sector participants activities. It should be noted that possible local strategies are formed depending on the number of participants and trends in their activities. Therefore, graphically, local strategies can have different representations. So, when the number of participants is 4, the graphical representation of each local strategy is a quadrangle of a certain outline. But, despite the number of participants who form local strategies, approaches to determine their conditional centers are carried out using formulas 1.3 - 1.4.

Stage 2: From the conditional centers of each local strategy Π_s , perpendicular lines should be drawn to the main axis of the strategies L .

Stage 3: On perpendicular lines from the Z -axis, the value of the estimates of each local

$$C_s = (\sum (C_{sp} \times v_{sp} \times t_{sp}) / \sum (v_{sp} \times t_{sp})), \quad (1.5)$$

where C_{sp} is the evaluation of the s -strategy carried out by the p -participant. This estimate is determined by dividing the volume of activity of the p -participant per unit of road economy, that is, the number of kilometers of roads that form a certain network.

Stage 4: The obtained values of the assessment of each local strategy– C_s are subject to processing in order to obtain a certain relationship between them – U .

Stage 5: By processing the U function, a rational C_{so} strategy is found, which corresponding to the minimum value of the C_s estimates.

Note: Steps 4 and 5 can be replaced by performing a simple expert analysis of the C_s score values distribution across different strategies.

Stage 6: To substantiate a rational strategy – C_{so} , the initial conditions for its achievement are determined, that is, the volumes of individual participants activities, trends in these volumes and their implementation timeframes.

In general, the above algorithm for rational strategy for the outlined road sector determining is a set of expert and analytical procedures, and an important place is played by the number of elected participants and the development trends of their activities. The article outlines only the basic algorithm for determining rational strategies for the activities of individual participants, which is the basis for the formation of indicators for long-term plans. To simplify the understanding of the presented algorithm, some parameters are not detailed in the above formulas, for example, the mechanism for calculating of multi-temporal costs and the economic and mathematical foundations for determining the conditional centers of local strategies.

Conclusions

The procedures for strategic planning of a certain level road sector given in the article generally determine a possible algorithm for solving the problem. At the same time, emphasis is placed on possible mathematical modeling and interpretation of local strategies determining processes for the individual participants activities. A complete description of a general mathematical model formation is presented as a description of the linear functions of the individual participants activities development and each type of activity economic interpretations. It is possible that the formation of a complete mathematical model, which will be quite cumbersome and has no practical meaning. A more realistic way of practical implementation of the stated idea of long-term planning is the use of an expert-graphical approach based on a large-scale drawing of

strategies development for the various participants activities (such as Fig. 1) and further expert interpretation of both each local strategy and a common rational strategy definition.

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Анотація. В статті розглянуті можливі експертно – аналітичні підходи до формування концепцій розвитку дорожнього господарства в залежності від можливостей учасників, які зайняті в специфічних процесах виконання програм робіт, так і формуванні інфраструктурної основи для їх успішної реалізації. На першому етапі формування моделі визначення кращого варіанту стратегічного моделювання аналізуються початкові можливості та перспективні тенденції зайнятості кожного учасника в розвитку дорожнього господарства, що спрямовані на надійне підтримання в експлуатаційному стані виділеної мережі доріг. Перетин та сполучення перспективних тенденцій різних учасників формують так звані локальні стратегії можливих варіантів планування їх діяльності. Обробка інформації локальних стратегій можлива із використанням різноманітних підходів – математичної обробки даних, експертного аналізу або графічного трактування. Вибір кращої сукупної стратегії діяльності учасників здійснюється за критерієм мінімізації витрат на їх діяльність.

Ключові слова: дорожнє господарство, учасники діяльності, локальні стратегії, комплексна оцінка.

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