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MODELLING AND PREDICTION OF RISK FOR TRANSPORT COMPANIES

The methods of modelling and prediction of risk as possible directions to increase the stability and sustainable development of transport enterprises of Ukraine are determined. The basic modelling techniques which should be used in solving these problems are determined as well.
Keywords: mathematical modelling, prediction of risks, uncertainty in the economy, competitiveness increasing, financial stability.

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МОДЕЛЮВАННЯ ТА ПРОГНОЗУВАННЯ РИЗИКІВ НА ПІДПРИЄМСТВАХ ТРАНСПОРТУ

В умовах конкуренції прийняття рішень на підприємствах залізничного транспорту завжди пов'язане з ризиком. Підприємство може мати значні втрати коштів, вкладених у розвиток, якщо потенційні замовники звернуться до інших підприємств. Крім того, фактичні обсяги перевезень можуть відхилятися від рівня плану через різкі зміни динаміки попиту на транспортні послуги, зміни у структурі перевезень.. Компенсація таких змін можлива за рахунок створення резервів, але необхідним є ефективне поєднання математичних і евристичних методів обліку та управління ризиками.

Важливими методами оцінки ризиків є економіко- математичне моделювання. Дані методи припускають графічну побудову варіантів рішень, які можуть бути прийняті. Головне у застосуванні цих методів – правильний вибір моделі, зважаючи на конкретну ситуацію. Досить перспективною є імітаційне моделювання фінансового ризику підприємства. Майже кожне підприємство має можливість змоделювати свій фінансовий ризик.

При економіко-математичному моделюванні вибір критеріїв (цільової функції) і факторів (системи обмежень) є головними.

Для оцінки оптимального рівня ризику в умовах ринку розроблений комплекс моделей, що дозволяє варіювати рівень ризику, змінюючи характеристики господарської ситуації, з вибором у кожному разі найкращого планового рішення з урахуванням подань особи, що приймає рішення.

Ключові слова: математичне моделювання, ризики прогнозування, невизначеність в економіці, конкуренція і фінансова стабільність.

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МОДЕЛИРОВАНИЕ И ПРОГНОЗИРОВАНИЕ РИСКОВ НА ПРЕДПРИЯТИЯХ ТРАНСПОРТА

В условиях конкуренции принятие решений на предприятиях железнодорожного транспорта всегда связано с риском. Предприятие несет финансовые убытки, если потенциальные заказчики могут обратится к другим поставщикам услуг. Кроме того, фактические объемы перевозок могут отличаться от плановых из-за резких изменений динамики спроса на транспортные услуги, изменений в структуре перевозок. Компенсация таких изменений возможна за счет создания резервов , но при этом необходимо эффективное сочетание математических и евристических методов учета и управления рисками.

Важными методами оценки рисков являються методы економико-математического моделирования. Данные методы предполагают графическое построение возможных вариантов решения проблемы, которые могут быть приняты в конкретных условиях. Главное в применении этих методов – правильный выбор модели. Перспективным является имитационное моделирование. Почти каждое предприятие может моделировать свой риск. В экономико-математическом моделировании выбор критериев (целевой функции) и факторов (системы ограничений) являются главными.

Для оценки оптимального уровня риска в условиях рынка разработан комплекс моделей, позволяющий варьировать уровень риска, изменяя характеристики хозяйственной ситуации, с выбором в любом случае лучшего планового решения с учетом представлений лица, принимающего решение.

Ключевые слова: математическое моделирование, риски прогнозирования, неопределенность в экономике, конкуренция, финансовая стабильность.

Problem statement and topic urgency. Today economics does not always offer to the society either effective tools for solving pressing current development problems or fundamental approaches for the idea forming of the future society development. The category «uncertainty» is an integral part of the economic activities' conditions and interrelates with many economic phenomena and processes, and society as a whole. Economic

activity in the modern society supposes the selection of the direction development in conditions of the constant environment changes, which complicate the prediction of future actions being required. The development conception of modern society provides the priority investments in the human capital, its quality increasing, including the life quality, product quality improvement, services and competitiveness of the innovative economy.

Beginning or aggravation of the crisis phenomena in the economies of many countries those are traditionally considered as economical developed and successful, rich and social oriented ones make review approaches to business conducting, including the risk prediction and minimization. Therefore, it is necessary to improve the risks research methodology on the transport enterprises.

Basic research analysis. Such Ukrainian and foreign advanced scientists as A.R. Posner and P. Drucker, R. Kaplan, D. Bell, M. Young, T. Stewart, L. Edvinson, M.V. Vachevskyy, V.A. Zharov, P.P. Krainev, V.A. Potekhina, V.P. Soloviev, V.D. Bazylevych and many others deal with the problems of uncertainty and risks in the economy.

Despite of the great amount of scientific papers and significant achievements in theory and practice the problem of the risk modelling and management in transport is not lit enough and requires a further study.

The purpose of the research. The purpose of this article is to analyze methods of the risk modelling and prediction as one of the possible ways for increasing the efficiency of the transport companies' activities.

The object of the research is the study of transport enterprises in the modern conditions of uncertainty.

The main material presentation. The features of modern development is a probability of abrupt, often negative changes in the enterprise environment, provoking instability of its internal environment. The unpredictability and spontaneity of the external manifestations that are on the surface, have deep, often essential changes of understanding which allows us to predict these changes and anticipate their results. For transport enterprises the adaptation problem to sudden and unpredictable environment changes (if it is a market, a political environment, etc.) is transformed into the prediction and minimization problem of the risks' actions which are associated with it.

The economic systems' management, including transport systems, in terms of adaptation to changing and unpredictable environmental conditions (which consists of consumers, customers, amounts and conditions of supply and procurement) provides the strategic plans' variability of the systems' development management, the adaptation of the production programs and plans, the adjustment of economic activities, the modeling of economic risks, searching of mutually beneficial relations with other economic entities. The company risk management (including transport risks) must be carried out both in current management, which includes adjustment of current activities, and in the sphere of the formation of strategic activity alternatives.

In competitive conditions of a decision-making is always associated with risk for railway transport enterprises. The company can incur a significant loss of funds invested in the development, if potential customers turn to other companies. Besides, the actual traffic volumes may deviate from the plan level because of sudden changes in the demand dynamics for transport services, changes in the transport structure under the influence of competitors. A compensation for such changes is possible for account of the creation of various reserves, but it is necessary to have an effective combination of mathematical and heuristic methods of accounting and the risk management [2].

One of the risk assessment methods is the economic and mathematical modelling. This method admits the graphical construction of solutions that can be taken. The main thing is a right model choice based on the concrete situation. The imitation modelling of financial company risk is quite long-term. Nearly every company has an opportunity to model its financial risk. In the economic and mathematical modelling a choice of criteria (an objective function) and factors (a limit system) are main ones.

For the optimal risk level assessment under the market conditions a set of models are developed that can vary a risk level by changing the characteristics of the economic situation with a choice of the best planning decision considering applications from a person who makes decisions every time. The modelling process is presented in the diagram:
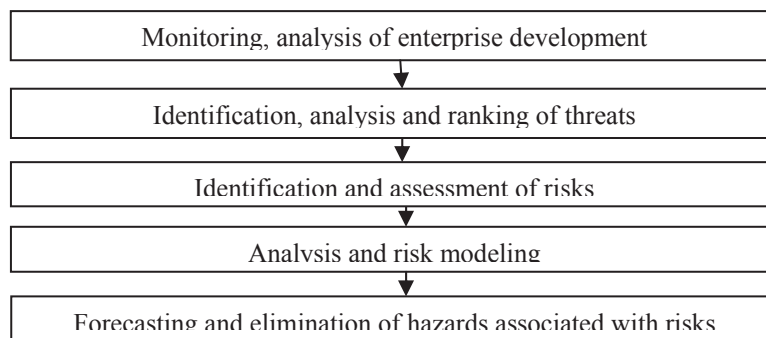
Monitoring, analysis of enterprise development
Identification, analysis and ranking of threats
Identification and assessment of risks
Analysis and risk modeling
Forecasting and elimination of hazards associated with risks

Fig. 1. **The modelling process**

The essence of the process includes the following: during the first stage the necessary output information for each certain case is input, then a series of intermediate calculations is carried out, the results of which there are separate elements within the overall model of optimal risk level determining. At various stages of the calculations additional information is input.

According to the modelling results before making a final decision a manager receives the following information:

1. An optimal risk level which is calculated by the optimization of any index of the transport company.

2. An appropriate predicted optimal variant to this index.

3. An economic evaluation of the received expected variants (revenues, expenses, profits that the company may have in a case of this case agreement).

4. Losses are possible related to the possible risk variants.

The calculation of certain time features and, as a result, the quantitative risk assessment are the main things in the risk assessment.

The risk is mathematical expressed by the probability of coming losses which is based on the statistic data and can be calculated by the very high accuracy. To quantify a risk value it is necessary to know all the possible consequences of any certain action and the probability of the consequences by themselves. Probability characterizes the measure of uncertainty in the occurrence of a certain event in the future.

In the statistical analysis the risk value is measured by an average expected value and a variation.

In this case the dispersion measures a probable average result and is an average weighted value from the squared of the deviations of the financial results of risky investments from the average expected ones:

$$\sigma^2 = \frac{(\chi - \bar{\chi})^2}{n},$$

(1)

where – a dispersion;

X – an expected value for each case of financial resource investments;

X – an average expected value;

n – an investment amount of the financial resources (frequency).

For a final decision-making the variability degree of a possible result should be determined. For this the average quadric deviation is calculated:

$$\sigma = \sqrt{\frac{(\chi - \bar{\chi})^2}{n}}.$$

(2)

The variation shows the extent or degree of a deviation from an actual average value. With the help of a variation coefficient it is possible to compare the variability of characteristics, expressed by different measurement units. The variation coefficient is calculated:

$$v = \frac{\sigma}{\bar{\chi} \cdot 100}.$$

(3)

where V – a variation coefficient;

 – an average quadric deviation;

X – an average expected value.

As a variation coefficient is higher, then fluctuations are greater. In modern conditions a probability calculation of financial enterprise risks on the basis of a dispersion, a variation coefficient and average values as parameters of statistical analysis is a primary method of the financial risk assessment of the company.

With the help of a statistical method of a risk assessment, that is, on the basis of a dispersion calculation, a basic deviation and a variation coefficient we can estimate a risk not only a certain agreement, but a business activity in general for a certain period of time.

The advantage of this method is the simplicity of mathematical calculations, and the disadvantage is the need for a great amount of output data.

Other analytical methods of a risk assessment are used. The factor analysis of financial risks is the most promising. For example, an investment risk is assessed by the presence of the investee prospects' development, the competitiveness level, the number of signed contracts and the received applications. Then the coefficients of business activity, financial stability are calculated, the probability of bankruptcy is determined. The analysis of these indexes allows us to estimate the financial stability which, in its turn, is a criterion of a risk assessment. The relationship between the financial stability of a transport enterprise and a risk is directly proportional and as soon as the company becomes financially unstable a risk of bankruptcy is emerged.

Recently, the expert evaluation method is widely used. It is implemented by the way of the conclusions' analysis of experienced professionals. It is desirable that experts accompany their assessment estimates with calculations of the probability of the various losses' emergence. Each expert, who works individually, is given a list of possible risks and proposed to assess them. Then the experts' assessments are analyzed in their contradictory that is they must meet the following rule: a maximum allowable difference be-

tween the estimates of two experts of any kind of risk does not exceed 50%, what allow to eliminate unacceptable differences in the estimates of experts probability realization of an individual risk.

The method of Delphi is a variety of an expert method. It is characterized by the anonymity and a controlled feedback. The anonymity of the committee members is provided by the way of their opportunity depriving to interact, that not giving them an opportunity to jointly discuss answers to the questions. The purpose of this approach is to avoid «traps» of a group decision-making and a leader opinion dominance. After analysis of all assessments through the controlled feedback a generalized result is reported to each member of the commission. The main purpose of this action is to allow experts to get acquainted with estimates of other committee members, without feeling pressure through the understanding of who exactly gave a particular assessment. After this action the evaluation can be done again. During the expert risk assessment much attention should be paid to the selection of experts, because from the correctness of their estimates depends on what decision will be taken.

In a general case the process of a decision-making and risk evaluation with the help of a decision tree involves the following five steps.

Step 1. The task statement. It will allow us to make a task description of a decision-making to the mathematical formalization. The following basic procedures must be carried out: an identification of opportunities for information gathering for an experimentation and real actions; a list of events with a certain probability which may be occurred; an interim order of events is established.

Step 2. The building of a tree of goals.

Step 3. The estimation of probabilities of environment states, that is, a comparison of chances of each concrete event emergence. It should be noted that these probabilities are defined either on the basis of the present statistics or an expert way.

Step 4. The establishment of winnings (or losses, as winnings with a "minus" sign) for each possible combination of alternatives and environment states.

Step 5. The decision of a task, systems, which are summed up in a number of papers.

A method of social and economic experiment is rather perspective that provides individual experiments on standard financial situations holding. In practice, the method of analogies is widely used to assess a risk. The method of analogy is used in that case if other methods of a risk assessment are not acceptable. On the basis of scientific publications or practical experience of other enterprises experts assess probability of the certain events' coming, obtaining of desirable financial results, a degree of a financial risk.

On the basis of a method of analogies a financial strategy and tactics of many businesses are built.

Conclusions. In the present situation the transport companies' functioning is possible only with taking into account all risk factors and a minimization of their consequences. The risk modelling process should be focused on the company efficiency improvement. It is possible in a case of transferring of responsibility and appropriate authority of an operative decisions-making to lower government levels, leaving only issues of a strategic planning and a general strategy constructing of the transport company activity to the central apparatus. Strategic planning questions are required the fundamental researches of the problem of uncertainty and risks. A system of indicators should be formed to help assess a risk level on based of statistical data. It can be implemented by a system of economic and mathematical modelling, an aim of which is to identify scientific-grounded alternatives of development taking into account risk situations.

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