Abstract and References. Control processes

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DEVELOPMENT OF THE METHOD FOR THE OPTIMAL MANAGEMENT OF OCCUPATIONAL RISKS (p. 6-13)

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Within the framework of this research, we analyzed international normative and legal documents on risk management in the field of occupational health and safety and identified the following shortcomings:

– uncertainty of the aims of risk management;
– complexity of performance of the appropriate procedure and its insufficient substantiation;
– lack of available approaches to possibility of the optimal risk management, taking into consideration resource capacities of the business entity.

It was noted that one of the main ways of occupational risks management is the reallocation of financial resources of an enterprise. However, based on the result of the analysis, the available methodological tools for implementation of this method were not detected.

To solve this relevant problem, the method for optimal management of occupational risks was developed. The method was developed based on construction of the optimization models, based on the criteria of minimization of average estimated total costs of an enterprise for occupational safety and health. It was noted that harmful production factors operate with random intensity within the working zone over a period of time. And the risk is measured by the probability of exceeding permissible concentrations (levels) of certain factors, which operate in the workspace, as well as with relevant consequences. The variables of the developed models are costs of an enterprise for measures, related to ensuring safe and healthy working conditions.

Direct and inverse optimization problems were stated that were reduced to certain problems of convex programming. The direct problem is to minimize probability of a risk event at the assigned constraint for total costs of occupational safety and health. The reverse problem is how to minimize the average costs for prevention and elimination of consequences of the risk of exceeding permissible concentration at constraint for probability of such excess.

Calculation of the models identified dependence, which is expressed in a decrease in permissible probability of a risk event at an increase in costs of occupational safety and health. This makes it possible to recommend them for using by business entities in the international format.

Keywords: occupational risk, occupational health, risk management, convex programming, occupational diseases.

References

14. The basic statistical data is shown by the economical analytics of the customs agencies EU Countries. Available at: http://ec.europa.eu/eurostat/search?p_auth=QPejFti6&p_p_id=estatsearchportlet_WAR_estatsearchportlet&p_p_action=VIEW&estatsearchportlet_WAR_estatsearchportlet_text=Eurostatistics+DATA+FOR+SHORT-TERM+ECONOMIC+ANALYSIS&estatsearchportlet_WAR_estatsearchportlet_text=Eurostatistics+DATA+FOR+SHORT-TERM+ECONOMIC+ANALYSIS&estatsearchportlet_WAR_estatsearchportlet_text=Eurostatistics+DATA+FOR+SHORT-TERM+ECONOMIC+ANALYSIS&estatsearchportlet_WAR_estatsearchportlet_text=Eurostatistics+DATA+FOR+SHORT-TERM+ECONOMIC+ANALYSIS&estatsearchportlet_WAR_estatsearchportlet_text=Eurostatistics+DATA+FOR+SHORT-TERM+ECONOMIC+ANALYSIS&estatsearchportlet_WAR_estatsearchportlet_text=Eurostatistics+DATA+FOR+SHORT-TERM+ECONOMIC+ANALYSIS&estatsearchportlet_WAR_estatsearchportlet_text=Eurostatistics+DATA+FOR+SHORT-TERM+ECONOMIC+ANALYSIS&estatsearchportlet_WAR_estatsearchportlet_action=SEARCH&estatsearchportlet_WAR_estatsearchportlet_pageNumber=3

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A COMPARATIVE ANALYSIS OF THE ASSESSMENT RESULTS OF THE COMPETENCE OF TECHNICAL EXPERTS BY METHODS OF ANALYTIC HIERARCHY PROCESS AND WITH USING THE RASCH MODEL (p. 14-21)

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Known scales (criteria) for assessing the competence of experts in the field of technical regulation using the method of analytical hierarchy process (AHP) and Rasch model are investigated. The main features of constructing the mathematical Rash model are presented. The results of the analysis of scales for assessing the competence of experts in the field of technical regulation on a specific example of questioned specialists in measurement of time and frequency were considered. The results were processed using the specialized software "Competence MAI 1.1" (Ukraine) and MINISTEP 4.0.1 (USA).

A comparative analysis of the results was carried out in order to determine the effectiveness of the assessment scales. The obtained results showed the possibility of applying the Rasch model for the analysis of the scale of expert assessment in the field of technical regulation. The analysis of the results obtained on the multidimensional Rasch model showed that the chosen criteria scale for experts corresponds to the requirements set by the Rash model. The obtained measurement data for this model allow you to calculate the established statistics for both the criteria and for the evaluated experts.

A comparative analysis of the results obtained with the use of AHP and Rasch model showed convergence, suitability and correlation of the obtained values for experts. Only two out of twenty one (9.5 %) evaluated experts have data that are unsuitable for the analysis by the Rasch model, which indicates a low level of competence. AHP to a lesser extent allows for the consideration of less competent experts than with the use of the Rash model. This is evidenced by a lower coefficient of competence for the AHP than in the application of the Rasch model. AHP and Rasch model should be used in various fields of activity as a useful tool for comparative assessment of the competence of technical experts on the basis of objective data according to established criteria.

Keywords: analytical hierarchy, Rasch model, characteristic curve, competence of experts, scale of evaluation, software.

References


24. When studying the kinetics of high-temperature wheat drying, it is found that at the end of the constant drying period, there is a sharp increase in the grain heating temperature. The temperature jump occurs due to the grain surface dehydration, when the average relative moisture is close to standard and makes 15...16 %. Based on this regularity, the method of exposure control of grain drying in high-temperature dryers without using continuous-flow moisture meters is developed.

The method is based on simultaneous control of the material heating temperature by temperature sensors over the entire length of the drying chamber. The measured values from the temperature sensors are transmitted to the microcontroller in order to periodically approximate them with the cubic polynomial and find the derivative of the second-order function.

The microcontroller is programmed to determine the second-order critical point – the location of the grain, having standard moisture. The obtained result is compared with the maximum length of the grain path along the drying chamber in order to subsequently influence the discharger performance.

The developed method of exposure control of grain drying in high-temperature dryers provides the necessary time for the temperature effect of the drying agent on the grain, process quality and reduction of energy consumption for grain drying. On the basis of this method, the drying process without the use of expensive continuous-flow grain moisture meters operating with a high measurement error is automated.

**Keywords:** grain drying, drying control, drying exposure, drying kinetics.

**References**


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DEVELOPMENT OF THE METHOD OF EXPOSURE CONTROL OF GRAIN DRYING IN HIGH-TEMPERATURE DRYERS (p. 22-29)

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When studying the kinetics of high-temperature wheat drying, it is found that at the end of the constant drying period, there is a sharp increase in the grain heating temperature. The temperature jump occurs due to the grain surface dehydration, when the average relative moisture is close to standard and makes 15...16 %. Based on this regularity, the method of exposure control of grain drying in high-temperature dryers without using continuous-flow moisture meters is developed.

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**Keywords:** grain drying, drying control, drying exposure, drying kinetics.

**References**


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ELABORATION OF THE EQUIPMENT REPLACEMENT TERMS TAKING INTO ACCOUNT WEAR AND TEAR AND OBSOLESCENCE (p. 30-39)

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The optimum terms of replacement of equipment subject to wear and tear and obsolescence with more advanced equipment with similar performance are investigated. To this end, the methodology of multi-criteria evaluation of equipment performance indicators when switching to a new type of equipment is proposed. The values of EAC (Equivalent Annual Cost), calculated for several equipment replacement cycles and for an infinite number of cycles, are investigated. Estimates of the dispersion degree of EAC values depending on the service life of old and new equipment under current conditions, when the dynamics of operating costs is subject to random fluctuations are obtained. For this, covariance functions of random processes that describe the dynamics of the operating costs of old and new equipment were used. On the basis of covariance functions, estimates of the functions of standard deviations of EAC values are obtained. Using the obtained estimate of the degree of dispersion of equipment performance indicators, the multi-criteria optimization problem was investigated. This approach is of great practical interest, because for many enterprises, not only the average expected level of equipment performance indicators, but also the dispersion degree of the values of these indicators is of great importance. As a result of the research, the technique for planning the equipment replacement terms was developed. The proposed methodology allows justifying the terms of replacement of old equipment with new equipment, taking into account both the average expected EAC values and their level of fluctuations. The studies have shown that due to choosing the equipment renewal terms, it is possible to significantly reduce the degree of dispersion of equipment performance indicators, slightly sacrificing the average expected value.

Keywords: equipment replacement, equipment performance indicators optimization, equivalent annual cost, multi-criteria evaluation.
References


18. Lutsenko, I. (2016). Efficient functioning of the energy market requires validity and transparency in the management of processes occurring in its system in the form of interaction of subsystems. The proposed holistic system of differential equations makes it possible to assess an energy supply potential of the energy market in accordance with the needs of consumers based on data on the level of reserves at the beginning of a year and production and consumption over the past year. Given such a model, it is possible to fore-
cast daily levels of consumption and supply of energy resources, taking into consideration seasonality of thermal energy production. Despite many equations and dependent variables, we found a numerical solution to the system. We used calculation formulas from the Euler method with step \( h = 1 \) for this purpose. We obtained the solution in the form of tabulated values of functions of production or consumption of the corresponding energy resources. Based on the results of calculations, we built a graph of the corresponding dependences of parameters of the system of differential equations. We used the system of computer algebra wXMaxima for calculations.

Economic-mathematical modeling of energy market management processes is useful because it makes it possible to describe the resulting state of the energy market in Ukraine parametrically and opens up additional possibilities of forecasting taking into consideration stochastic phenomena of price and temperature.

Keywords: energy market, market model of management, liberalization, emergence, energy security, fuel-and-energy resources, market situation.

References

9. Rudkevich, A. On the Supply Function Equilibrium and its Applications in Electricity Markets. Available at: https://sites.hks.harvard.edu/hepg/Papers/Rudkevich.SFE-Feb.03.pdf

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COMPLEXIFICATION METHODS OF INTERVAL FORECAST ESTIMATES IN THE PROBLEMS ON SHORTTERM PREDICTION (p. 50–58)

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We solved the problem of improvement of methodological base for a decision support system in the process of short-term prediction of indicators of organizational-technical systems by developing new, and adapting existing, methods of complexification that are capable of taking into consideration the interval uncertainty of expert forecast estimates. The relevance of this problem stems from the need to take into consideration the uncertainty of primary information, predetermined by the manifestation of NON-factors. Analysis of the prerequisites and characteristics of formalization of uncertainty of primary data in the interval form was performed, the merits of interval analysis for solving the problems of complexification of interval forecast estimates were identified. Brief information about the basic mathematical apparatus was given: interval arithmetic and interval analysis. The methods of complexification of forecast estimates were improved through the synthesis of interval extensions, obtained in accordance with the paradigm of an interval analysis. We found in the course of the study that the introduction of the analytical preference function made it possible to synthesize the
model of complexification in a general way, by aggregating the classes of hybrid and selective models in a single form for the generation of consolidated predictions based on interval forecast estimates. This allows obtaining complexification predictions based on the interval forecast estimates, thereby ensuring accuracy of the consolidated short-term prediction.

Critical analysis of the proposed methods was performed and recommendations on their practical application were developed. Recommendations for parametric setting of the analytic function of preferences were stated. Using the example, the adaptive properties of the interval model of complexification were shown.

Keywords: short-term prediction, complexification of forecast estimates, decision support, interval analysis.

References

We propose a model for the formation of international logistics chains based on an integrated multicriterial analysis of potential cargo transportation routes and delivery cost. The application of the systemic approach when planning a delivery helps to ensure rational allocation and efficient servicing of traffic flows among the objects along the transportation-logistic network.

At the first stage of modeling, the analysis of information about the objects of the transport and logistic system is carried out. We determine the region of efficient use of different modes of transport and construct a set of alternative chains of good delivery. Based on the analysis of the impact factors, the criteria are determined and the constraints are accepted to a given problem for a series of techno-economic, logistical, technological, environmental and other indicators. At the second stage, the multicriterial problem of synthesis (engineering) of the transport and construct a set of alternative chains of good delivery is solved.

We built an algorithm for the substantiation of effective international multi-modal transport and technological schemes of cargo delivery. The proposed algorithm provides a comprehensive assessment of the cost depending on delivery conditions in accordance with the Incoterms rules and the customs regime. To substantiate the route, the region of effective solutions for a DM is determined, based on solving a problem on the vector optimization for multiple criteria.

Formation of effective schemes of cargo delivery from France to Ukraine along the route from Haut-Manco to the warehouse “Agro-Soyuz-Terminal” in the city of Dnipro was explored. Based on modeling applying the package of symbolic computations in the programming environment Maple-7, we obtained a full set of compromise solutions to the vector optimization problem for the criteria of cost, delivery time, and ecological impact. We present a comprehensive assessment of the cost of goods delivery in containers using mixed transportation under the Incoterms EXW, CPT delivery conditions (delivery to Dnipro), FOB and CIF and the customs regime of import and import (warehouse).

The proposed model could be applied by transportation, logistic, customs brokering companies when substantiating alternative routes of goods delivery based on a multicriterial analysis of information.

Keywords: international delivery chains, multi-modal mixed cargo transportation, multicriterial analysis, vector optimization.

References


35. Servis dla rozrakhunku vidstanei mizh mistamy. Available at: https://maps.google.com.ua/maps

36. Taryfna stavka na vantazhni perevezennia. Available at: http://della.ua/price/66/

37. Platnye dorogi v Evrope. Available at: https://autotraveler.ru/spravka/toll-road-in-europe.html#.Wiu-mEpl_IU


41. Dohovir pro Mízhnarodnyi zalisnychyi tranzytnyi taryf ta MTT vid 01.03.2012 roku. Verkhovna Rada Ukrainy. Available at: http://zakon2.rada.gov.ua/laws/show/998_229/page12

42. Mezhdunarodnyy xeolezodorozhnyy tranzitny tarif MTT. Prilozenie k Dogovoru o Mezhdunarodnom xeolezodorozh- nom tranzitnom tarife. Varshav: Oficialnoe izdanie Komiteta OSZHND. Available at: http://portal.kazlogistics.kz/upload/iblock/70b/70bcece7f5d8eaa0850e0b6d65ded4.pdf


44. Online servis dlia rozrakhunku morskoho frakhtu. Available at: http://www.freight-charges.com/


46. Prays-list na posluga TOV «Agro-Soyuz-Terminal». URL: http://asterminal.dp.ua/services/skladskie-uslugi/

