6.3 Modeling of the Optimum Logistic Systems for Shipment by Land Types of Transport with Respect to Risk Drawings of Harm to Environment

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Abstract

This paper is result of research worries environmental pollution during transportation of cargoes by land types of transport. The basic idea of the project consists in calculating the damage put to ecology by the specified kind of transportation, and also try to diversify the risks connected with this process, optimizing a damage put to environment. For object in view achievement tools of the theory of games, namely criteria of definition of optimum strategy, both classical, and modified, the risk theory, construction of models of a diversification of risk and damage calculation, and also simulation modeling, construction of simulation model of transportation of cargoes, taking into account quantity of consumed fuel have been used. The imitating model of transportation of cargoes has been as a result constructed, the matrix of effectiveness which has been checked up by means of criteria of definition of optimum strategy is constructed, and after the specified procedures the damage from the given kind of transportations has been counted up.

Keywords:
Theory of games, Matrix of usefulness, Models of a diversification of risk, Imitating model of transportation of cargoes

In the literature for today statement of problems of storekeeping and models of optimisation taking into account harm put to environment, for such systems do not allow the manager to consider rather important attribute of the corresponding analysis caused by necessity of decision-making in the conditions of uncertainty. At the same time development of new technologies in the conditions of market economy promotes a wide circulation of models of decision-making in the conditions of uncertainty [1]. In particular, for problems and models of optimisation of control systems of stocks such situations take place, when values of some parameters of model and laws of distribution of probabilities of such parameters are unknown. To provide the specified feature at a choice of the best alternative variant for storekeeping strategy, the manager on logistics faces with new statements of problems of optimisation within the limits of such systems and according to new approaches to their decision. Namely, realisation of corresponding optimising models of decision-making in the conditions of uncertainty with reference to concrete situations of business for control systems of stocks, as a rule, demands:

- corresponding formalisation or updating of concrete model of a control system by stocks which should consider specificity of its practical use;

- in particular, within the limits of such formalisation or updating concrete scenarios of development of "external" events which represent possible combinations in practice of realised values for the unknown parameters of model influencing on final economic result should be proved/are stipulated;

- the additional efforts of the manager caused by necessity of special updatings of corresponding models of optimisation of decisions in the conditions of uncertainty, and with reference to specificity of a problem of optimisation.

Methods and models of decision-making in the conditions of uncertainty will be used for the decision of a problem of optimisation of work of a control system by stocks. Thus a number of parameters of model (such parameters as annual consumption of the goods, the price of its realisation etc.) are in advance unknown: they are accepted as uncertain parameters. The problem of optimisation of strategy of storekeeping is considered as a problem of maximisation of profit at the minimum damage put to environment.

The structure of a corresponding problem of optimisation of storekeeping as problems of decision-making in the conditions of uncertainty is analyzed and formalized. Alternative decisions from which it is required to choose the best / optimum, are formalized so that to consider possibility of minimisation of risk to cause a damage of ecology, types of transport for transportation. Such analysis is necessary for an estimation of expediency of a diversification of risks of decrease in profitability (because of possible failures of deliveries) at storekeeping.

- Algorithms of a finding of the best decision with reference to various criteria (both classical, or to derivative criteria) relations LPR to possible losses of profit are presented.

- Within the limits of the theory of decision-making in the conditions of uncertainty the problem of a choice of the best decisions is formalized with reference to a so-called matrix of usefulness. Elements of such matrix are indicators of final economic result (a gain / profits) with reference to concrete analyzed decisions and the possible casual events influencing on specified result. Therefore the store keepings of statement of problems of optimisation standard in the theory as problems of minimisation of the general annual costs at first are necessary to formalize in the form of
problems of maximisation of a gain or profit at the minimum harm put to ecology.

Let's note corresponding basic concepts and designations within the limits of analyzed model:

\( D \) — annual consumption of production;

\( C_h \) — expenses for storage of a unit of production;

\( C_0 \) — an overhead charge for each delivery;

\( q \) — quantity of the units in order

\( C_{II} \) — the price of purchase of a unit of production

\( C_s \) — the price of realization of a unit of production;

\( C_e \) — the general annual charges;

\( P_e \) — the general annual profit (before taxes).

Let's remind that the general annual charges \( C_e \) considered as function from \( q \) (the size of the order), with reference to classical model of storekeeping are defined by a parity:

\[
C_e = C_s(q) = C_0D / q + C_hq / 2 + C_{II}D
\]

Thus the problem of maximization of the general annual profit \( P_e \) can be presented in a kind.

\[
P_e(q) = C_s D - C_0 D / q - C_h q / 2 - C_{II} D \rightarrow \max_{q>0},
\]

And, as it is visible, it is easily reduced (taking into account that the composed \( C_s D \) does not depend on the optimizing parameter \( q \)) to a classical problem of minimization of the general annual charges

\[
C_e(q) \rightarrow \min_{q>0}
\]

Hence, by optimization of profit for the determined model if all its parameters are known, it is possible to find the optimum size of the order under formulas which define the economic size of the order in a format of traditional models of minimization of costs at storekeeping:

\[
q^* = \sqrt{2C_0D / C_h}
\]

In other words, for LPR the specified size of the order \( q \) is optimum not only at minimization of the general annual charges, but also for achievement of a maximum of the general profit (it is natural, with reference to noted determined case of corresponding classical model of storekeeping) [2].

Let's underline that at formalization of model LPR can set corresponding scenarios, generally speaking, arbitrarily, considering demanded accuracy or carefulness of such formalization. Further for definiteness and conveniences of a statement (to avoid unduly bulky constructions) at formalization of considered model for each of the specified parameters two scenarios will be considered only. Thus formalization of full group of the events influencing on economic result, will demand consideration (as it will be presented lower) of sixteen casual various events that will naturally be reflected in a format of a matrix of utility.

Namely, for annual consumption and with reference to the price of realization of a unit of production the following scenarios are accepted further.

Demand for production for a year can be:

- low-scenario \( D (1) \), that is \( D \in [D_1, D_3] \);
- high-scenario \( D (2) \), that is \( D \in [D_3, D_5] \);

Besides, the price of realization of a unit of production can be:

- low-scenario \( C_s (1) \), that is \( C_s \in [C_{s1}, C_{s3}] \);
- high-scenario \( C_s (1) \), that is \( C_s \in [C_{s3}, C_{s5}] \).

Besides, at formalization of optimizing model transportation possibility by various types of transport, and on different delivery terms and with the different price of a unit of production is considered. Thus also the possible various losses of profit caused by claims on environmental contamination, and, as well as for other parameters of model, conformably only to two scenarios are considered:

1) the scenario (+), corresponding to a favorable outcome of formation of profit; 2) the scenario (–), corresponding to a failure of formation of profit. Namely the specified losses of profit are considered by introduction of the "lowering" factor \( \alpha \) for value of an analyzed gain. Corresponding designations are presented in Table 6.3.1.