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A LOGISTIC APPROACH FOR DESCRIPTION OF DECISION-MAKING PROCESS

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Abstract. Managers must make strategic decisions to cope with issues of uncertainty, customer service and the management of a company. The objective of this paper is to analyse the problem of optimisation and search of rational logistic decisions, taking into account the human factor and, in particular, the preferences of people who make decisions and implement them during the logistic activity of an enterprise. The problem of making optimal decisions for transportation of goods, taking into account the factor of urgency was investigated.

Keywords: logistics, management, decision-making process, transportation, logistic system, entropy, uncertainty.

1. Introduction

Any managerial activity, particularly in logistics, is closely connected with the decision-making process. The efficiency of the realisation of managerial activity depends on the validity and reasonability of available information. As a result, this factor directly influences the reliable and appropriate functioning of a logistic system. A decision in managerial activity is a set of actions from the side of the person that makes the decision on the object that allows the restoration of this object to a desired state or achieving assigned objectives.

2. Theoretical aspect

There are several kinds of decisions: binary, standard, multiple-choice, continuous, innovative, etc. All these types of decisions are differentiated depending on

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the amount of alternatives. The decision-making process can be regarded as an outcome of mental processes leading to the selection of a course of action among several alternatives. The decision-making process involves six parts:

a) an objective that can be quantified. Sometimes it refers to 'choice criterion' or 'objective function', e.g. maximisation of profit or minimisation of total costs;

b) constraints. Many decision problems have one or more constraints, e.g. limited raw materials, personnel, etc.;

c) a range of alternative courses of action under consideration;

d) forecasting the incremental costs and benefits of each alternative course of action;

e) application of the decision criteria or objective function, e.g. the calculation of expected profit or contribution, and ranking the alternatives;

f) choice of preferred alternatives.

Decision-making is a process of choice of the most desired decision from existing alternatives. Decision making is based not only on knowledge about the object but also about processes that take place in it and can happen under the influence of criteria that characterise efficiency of accepted decision (so there is the need for an adequate model of the object and also a decision-making model). Many various factors influence the administrative decision-making process. The main ones are:

- Stability of external environment;
- The restricted time for the manager to making decision. A lot of leaders are not possible to analyse all possible alternatives, in time limits;
- Risk probability. Risk is a possibility of losses. In decision making, there is usually some degree of uncertainty, which inevitably leads to risk. By evaluating the risk involved with various options, it is possible determine whether the risk is manageable or not.
- The personal qualities of a manager are one of the most essential factors. Regardless of how managers make decisions and respond to them, they must have the ability to make the right decisions;
- Condition of uncertainty. Uncertainty is a situation when information about the consequences of the accepted decision is partly or fully absent.

In everyday life and in official activity a manager should choose one or another version from a few alternatives. The more difficult the controlled system is, the more factors have an influence on the choice of the decision-maker and the result of a wrong or right decision will be more serious.

Modern life depends on valid and accurate information; that is why the consequences of the wrong decisions can become more tragic and often can not be forecasted. Modern logistic systems have a complicated hierarchical structure and it is necessary to develop new approaches for decision-making support.

A considerable contribution to the development of the theory of organisation-economic systems management was made by such scientists as A. Ashimov, K. Bagrinovskiy, V. Burkov, and A. Granderg. A lot of articles are devoted to the sphere of logistic system analysis. It is necessary to mention research by A. Gadzinskiy, E. Krikavskiy, E. Legeza, M. Miroshnik, B. Plotkina and others.

Studying and accounting of the features noted above becomes important in crises, when instability increases and tension grows in all spheres of public activity (economic, financial, and political) that requires making operative and accurate decisions. That is why the human factor, together with extremely complicated psychophysical features, becomes very important during realisation of logistic activity, taking into account instability and tension in all spheres.

The goal of this article is to describe basic concepts and principles of making administrative decisions, and also the attempt to formalise this process on the base of entropy analysis, taking into account subjectivism and a priority system of decision-makers.

3. Experimental research

Logistics is the management of the flow of goods, information and other resources between the point of origin and the point of consumption in order to meet the requirements of consumers. Logistics involves the integration of information, transportation, inventory, and warehousing. Air freight logistics is necessary for many industries and services to complete their supply chain and functions. It provides delivery with speed, lower risk of damage, security, flexibility, accessibility and good frequency for regular destinations, yet the disadvantage is a high delivery fee. The characteristics of air freight logistics are that:

- airplanes and airports are separated.;
- it allows to speed up delivery to far destinations;
- air freight transport is not affected by landforms (Emmet 2008).

Logisticians must make strategic level decisions in order to manage uncertainty, customer service and costs during transportation or manufacturing. There are several types of decisions in the logistic activity of a company:

- choice of supplier, carrier;
- rational use of warehouse areas;
- organisation of delivery and storage of cargo;
- decisions about outsourcing;
- inventory control;
- supply chain management;

The human factor plays a significant role in the logistic decision-making process. Consideration of this problem can be found in many publications (Legeza *et al.* 2010; Bablu *et al.* 1993; Christopher 1986; Ogden 1992;Yung-yu 2005; Taniguchi *et al.* 2004; Wilson A.G. 1970; Касьянов 2007). In order to produce a numerical analysis we will use the entropy approach (Tseng 2005; Касьянов 2007). It necessary to introduce basic definitions.

Entropy is a system state function and a quantitative measure of disorder in a certain system. The more elements are in the system (the more different carriers take part in the organisation of the transportation process), the

higher the entropy is, and the more difficult it is to control such a system. Destructive processes that arise in controlled systems as a result of their functioning and are accompanied by growth of entropy are decreased by development and use of anti-entropy measures. It is impossible to change the entropy of a system without getting some information from the outside. With the help of information it is possible to regulate the entropy of the system.

The founder of thermodynamics entropy was R. Klausius in 1865. Entropy is a measure of the number of ways in which a system may be arranged, often taken to be a measure of "disorder" (the higher the entropy, the higher the disorder).

Entropy (S) for the independent random events *of* x with n possible states (from 1 to n) can be calculated with the formula:

$$S(x) = -\sum_{i=1}^{n} p_i \ln p_i \qquad (1)$$

p_i - the possibility of i value. Shennon entropy expresses the measure of uncertainty of the realisation of random variables. Thus, entropy is the difference between information that is in the report and that part of the information which is exactly known in the report. Consequently, the concept applied at first in thermodynamics also appeared useful for description of dynamics of information systems state. Due to the efforts of many researchers, this concept found realisation in economics, banks and social systems. Direct connection can be seen with information entropy. For example, a decision a logistic manager adopts depends on current information, which is a difference between the initial and eventual system entropy in which he works. Now we can consider such a term as an active system. The theory of active systems is a part of management theory; that studies functioning of socioeconomic systems conditions, taking into account participants in the system. It should be noted that the overwhelming majority of publications dedicated to this problem does not take into account the role of decision-makers and, in particular, logistic activity that limits possibilities of practical use of obtained results. In addition, there are not enough theoretical approaches and criteria for description of the noted factor in the specialised literature. An effective approach for accounting of this important and essential part of the active system was offered by professor V. O. Kasyanov and is devoted to subjective analysis (Касьянов 2007; Wilson 1970). This approach showed its efficiency on the examples of many difficult systems, such as technical, social and economic. At the same time direct application of this theory to the logistic systems is absent, although the idea of the integration of this approach with traditional methods of solving logistic tasks is perspective (Касьянов 2007).. That is why the task of the author is to find out possibilities for adaptation of this approach to logistic systems analysis and optimisation of their functioning, taking into account the human factor and system of their priorities and advantages.

For example, let us consider a problem investigated among many others, which is devoted to the problem of population migration in town (Касьянов 2007). This problem was set and studied by A. J. Wilson (Wilson 1970). A base problem is considered by V. O. Kasyanov (Касьянов 2007). Taking into account the definition of logistics it is possible to substitute transportation of people for goods. Due to this fact it is possible to find out the amount of goods that should be transported.

Modification of this problem for logistic purposes is formulated in the following way:

T_{ij} – quantity of goods that are produced in zone i and should be delivered to the zone j (freight flow from zone i to j),

Q_{ij} – complete quantity of goods that are produced in zone i ,

D_i – quantity of consumption of certain goods in zone j ,

c_{ij} – transportation costs from zone i to j ,

C – full costs,

$f(x_i)$ – resources that should be spent (money, petrol).

Another important modification of the task described above is connected with urgency of transportation. In such an interpretation it is possible to take into account such a factor as urgency of goods delivery that is reflected in the generalised cost of transportation. For practical example we have taken four of the biggest Ukrainian industrial centers: Kiev, Lviv, Odessa, and Zaporozhye. Taking into account the quantity of consumption of certain goods in each city and transportation costs we determined the optimal quantity of goods that should be redistributed. In order to account urgency of transportation we have to increase the generalised cost of delivery by 50 %. In the example of the modified task, we can see decrease of three times in the quantity of goods. Due to the introduction of the term generalised cost it is possible to describe mathematically a well known fact: the greater the total cost of transportation is, the fewer goods or passengers should be transported from one area to another. So the considered problem is closely related to the task of logistic systems.

A well-known method of expert estimations is quite often proposed as a method of decision-making support, but the use of it is not always effective due to the influence of the following possible factors: experts lacking the necessary qualification, limited time and resources, and rapidly changing market conditions.

4. Conclusions

The importance of calculating the human factor in the managerial and logistic decision-making process is proven. It is shown that the use of this approach, based on a combination of variation principle and entropy analysis, is effective in research concerning the influence of the subjective system of preferences and priorities of decision-makers in solving logistic tasks with choice alternatives. The elaborated approach is fruitful in case of taking into consideration the urgency transportation factor. In the following article, a system of the advantages of pro-

ducers and buyers concerning the terms of goods' delivery and storage, logistic operator, and choice of transportation route is suggested.

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SPRENDIMŲ PRIĖMIMO APRAŠYMAS LOGISTINIU POŽIŪRIU

M. Grigorak, O. Shkvar

Santrauka

Marketingo vadybininkai turi priimti strateginius sprendimus, kaip suvaldyti neaiškias situacijas, organizuoti darbą su klientais bei su įmonės vadovybe. Šio tyrimo tikslas yra problemos optimizavimo analizė bei racionalių logistinių sprendimų paieška, įvertinant subjektyvumą ir iš dalies – pirmenybės sistemą asmenims, kurie priima sprendimus ir užtikrina jų įvykdymą, įgyvendinant logistinę įmonės veiklą. Išanalizuotas optimalaus spendimo priėmimas gabenant krovinius, kai reikia įvertintį skubumo faktorių.

Reikšminiai žodžiai: logistika, vadyba, sprendimo priėmimas, gabenimas, logistikos sistema, entropija , neapibrėžtumas.

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