The influence of the Subjective Preference Vector of the Transport Service Customer on the Selection of the International Transportation Organization Option

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Abstract. This article suggests using the subjective preference vector method to select transport and logistics options for cargo delivery. The main concept of the subjective preference method is the transition from purely logical or algorithmic methods to heuristic methods. It also includes the decision-maker in the decision logic. The article presents an analysis of the preference method used for decision making facilitation. This method can be used for decision making concerning the selection of the transport and logistics system for cargo delivery, provided that the decision-makers have full and consistent information. The main principles of this method’s application are described.

1. Introduction
This article is aimed at solving the problem of transport and logistics system selection for cargo delivery. The management entity is represented by a logistics mediator (DM) or a freight forwarding company manager (the decision-maker), and the management object is represented by the transport and logistics forwarding company responsible for cargo delivery. The problem of transport and logistics option selection lies in the necessity of consideration of both the forwarding agent benefits and the subjective preferences of the customer during the decision making process. The efficiency of the decision taken can be influenced by uncontrolled environmental factors, underlying the various conditions of the management system’s nature, which must be taken into account.

Thus, the selection of transport and logistics options for cargo delivery can be performed using the hierarchy analysis method, according to which the selection act contemplates performing the following analysis stages for the multi-criterion decision-making problem:
– problem structuring and formalized representation of the connection between its components;
– developing DM preference system and evaluation criteria;
– producing the decision rule and determining preferences in the regarded alternative set [1-2].
2. The problem of selecting transport and logistics options for cargo delivery

Transport service customers often have high transportation quality requirements, thus presenting a multi-criteria problem to the company. It is obvious that its successful solution influences the company’s reputation and competitive edge, which makes the ability to solve such problems useful.

In order to promote transport operations and reduce transport costs of the companies that ship and receive the cargo, as well as raising transport efficiency, special freight forwarding companies are established. Their goal is performing all possible additional operations connected to cargo shipment by various means of transportation.

Therefore, freight forwarding services are inextricably connected with the main operation of transport companies, because they are a key element of the transportation process, and without them, this process becomes impossible to carry out.

3. Research methods

The efficient solution set shall be determined in two stages. At the first stage, all possible transport and logistic options of cargo delivery are compiled, and their key parameters (costs and transit time) are calculated. At the second stage, this set is reduced to the efficient solution set taking into consideration the subjective preference vector of the customer.

Subjective preferences of the transport service customer can be presented as a pairwise comparison matrix. The forwarding agent's profit is generated through the shipping fee, which corresponds to freight forwarding activities definition in the existing legislation, irrespective of the transport and logistics delivery options. Therefore, all the alternatives developed at this stage can be assumed equivalent for the forwarding agent.

This research aims to build a hierarchy and perform all the calculations of characteristic preference vector elements for each of the criteria in the regarded alternative set necessary to produce the decision rule. [3]. Four criteria composing the preference system of the transport service customer are suggested as the key ones: $K_1$, the total delivery cost; $K_2$, the total transit time; $K_3$, is the reliability of the transport and logistics options; and $K_4$, the cargo safety.

The elements of these characteristic criteria vectors later form a matrix, which, multiplied by the subjective preference vector values, is used for the production of the decision rule. The product of the aforementioned multiplication is the global priority vector [4].

In this work, the problem of comparing alternatives on seven criteria can be solved if we take certain assumptions:

- according to Bayes’ probability criterion, normed elements of the pairwise comparison matrix characteristic vector are determined for every state of nature. The matrix is obtained by the expert comparing the probability of the respective states relative to one another [5];
- according to Laplace criterion, irrespective of the conformity relation value expressing the transitivity of experts’ opinions, these opinions cannot be trusted and thus the probability of all nature states are absolutely equal.
- according to Hurwitz criterion, the DM is relatively optimistic, i.e. the confidence factor $\gamma = 0.6$; while the conformity relation is over 0.2 and $\nu = 0.4$, and $\nu = 0.7$ if the conformity relation is lower than 0.2 [6-8].

The calculation of the elements of the alternative signification characteristic vector using criterion $K_3$ shall be performed as follows:

- finding out the characteristic vector of the pairwise comparison matrix for the probability of various nature states and checking the expert opinion transitivity;
- developing the payoff matrix and the risk matrix;
- comparing the alternatives in the efficient solution set.

In order to construct global priorities, a special matrix is built. Its first line must have the elements of the criterion comparison matrix characteristic vector. Then each column receives characteristic vector elements of each of the regarded alternatives [9-11].
4. Received result

Let us consider route options for imported cargo (bicycle) delivery in one 40-feet container from the shipping port of Keelung (China) to the client's warehouse in Novokuznetsk (Russia). Within this route (FOB Keelung – DOOR Novokuznetsk), the cargo can be delivered via the ports of the Far East as well as the ports of Saint Petersburg and Novorossiysk.

For this Keelung – Novokuznetsk route, the total amount of all possible transport and logistics delivery options makes up 71 alternatives. Further actions allowed reducing the option set to the alternative set, taking into consideration the criteria signification of the subjective preferences vector of the transportation customer. We chose the alternatives with the least transportation cost. These 4 alternatives guarantee the highest efficiency for the DM while taking into account the customer’s preference vector. The alternative set is shown in table 1.

After the efficient solutions are determined, the DM has all the information necessary to build a hierarchy. Figure 1 shows a matrix with the data of the problem regarded.

Normed values are calculated for the characteristic vectors of each criterion, pointing out the signification of the alternatives [12-14]. Table 2 shows the subjective preferences of the transportation customer as pairwise comparisons and the local priority vector.

The calculations show that key criteria for the customer are delivery costs and transit time. The indicators \(K_1\) and \(K_2\) have numeric evaluations and elements of the alternative preference characteristic vector. In order to illustrate the costs, let us translate all of the multi-currency values to a single currency and determine their normed values, and express local priority vector matrices using the criteria of costs and transit time like in table 2 [15].

Table 1. Alternative transport and logistics options for imported cargo delivery.

| No. | USD   | RUR     | Current value | Number of transshipment | Port          | Line | Transit time (days) |
|-----|-------|---------|---------------|-------------------------|---------------|------|---------------------|
| A1  | 1,032.00 | 152,240.00 | 210,176.00 | 3 | RU VVO (fishery) | MCC | 31 |
| A2  | 1,032.00 | 154,610.00 | 212,546.21 | 3 | RU VVO (commercial) | MCC | 29 |
| A3  | 1,540.00 | 127,235.00 | 213,689.77 | 3 | RU VVO (commercial) | FESCO | 28 |
| A4  | 1,032.00 | 161,140.00 | 224,914.33 | 4 | RU VVO (fishery) | MCC | 33 |

Figure 1. Information hierarchy matrix.
Table 2. Subjective preferences of the transportation customer are presented as pairwise comparisons and the local vector.

|   | K₁   | K₂   | K₃   | K₄   | V₀   |
|---|------|------|------|------|------|
| K₁ | 1.000| 2.000| 3.000| 6.000| 0.773|
| K₂ | 0.500| 1.000| 5.000| 3.000| 0.136|
| K₃ | 0.333| 0.200| 1.000| 6.000| 0.065|
| K₄ | 0.167| 0.333| 0.167| 1.000| 0.026|

The reliability criterion (K₃) determines the alternative that is the most resilient against the environmental factors. This criterion includes: K₃₁, the probability criterion, and K₃₂, the service provider reliability.

Let us perform the calculation of the elements of the alternative signification characteristic vector using criterion K₃₁ as follows:

1) Calculating the expert opinion transitivity value for the pairwise comparison matrix of the nature state probabilities.
2) Building the payoff matrix using the data from paragraph 1).
3) Building the risk matrix using the payoff matrix [16-18].

Comparing each of the alternatives on seven criteria and grouping the results in table 3.

Table 3. The comparison of the alternatives in question from the point of view of their resilience under risks and uncertainties.

| K₃₁ | S₁  | S₂  | S₃  | S₄  | S₅  | S₆  | S₇  | ∑₁ Sᵢ | 1/ ∑₁ Sᵢ | V₃₁ |
|-----|-----|-----|-----|-----|-----|-----|-----|--------|----------|-----|
| A₁  | 1   | 1   | 1   | 1   | 1   | 1   | 10  | 0.1    | 0.385    |
| A₂  | 2   | 2   | 3   | 2   | 2   | 2   | 15  | 0.07   | 0.269    |
| A₃  | 3   | 4   | 3   | 4   | 4   | 4   | 23  | 0.04   | 0.154    |
| A₄  | 4   | 3   | 4   | 3   | 3   | 3   | 22  | 0.05   | 0.192    |

Using the same procedure, let us build the following pairwise comparison matrix for the calculation of the signification of the alternatives in terms of service provider reliability (K₃₂)/

The cargo safety criterion (K₄) determines the transport and logistics delivery alternative providing for the highest cargo safety during transportation. This criterion is composite and it depends on the number of transshipment (K₄₁) and the port infrastructure (K₄₂). In order to calculate the (K₄₁) criterion signification of the alternatives, pairwise comparison matrices are built using the initial data.

Then the normed elements of the global priority characteristic vector determining the share of the alternatives must be found relative to the subjective preference vector of the transportation customer. In order to construct global priorities, a special matrix must be built (Table 4).

Table 4. Global priority construction.

|   | K₁   | K₂   | K₃   | K₄   | λ   |
|---|------|------|------|------|-----|
| A₁ | 0.773| 0.136| 0.065| 0.026|     |
| A₂ | 0.256| 0.241| 0.43  | 0.14  | 0.262|
| A₃ | 0.253| 0.263| 0.28  | 0.45  | 0.261|
| A₄ | 0.252| 0.271| 0.14  | 0.14  | 0.244|
| A₅ | 0.239| 0.225| 0.15  | 0.27  | 0.232|
5. Conclusion

Our calculations show that alternative А1 (transporting the cargo in a container, MCC line affiliation, using the port of RU VVO (FISHERY) is the best option for the international import from FOB KEELUNG to DOOR НОВОКУЗНЕЦК for 5.5 metric tons of bicycles, because its global priority vector index λ1 = 0.262 is the largest. Thus, this option can better satisfy the customer's preferences including the delivery time and the lowest costs.

Decision making necessity is explained by the conscious and result-oriented nature of human activities. It occurs at all stages of the management process and it is an integral part of any managerial function [19]:

1. Making (management) decisions in an organization is different from making personal decisions because this process is not an individual but a group one.
2. The nature of the decisions made is greatly influenced by the fullness and the reliability of the information the manager has. Due to this, decisions can be made under certainty (determined decisions) and under risks and uncertainties (probabilistic decisions).
3. The complexity of the modern management problems requires their comprehensive analysis, i.e. the participation of a group of managers and specialists, which leads to the expansion of collective decision-making forms [20].

Management decisions are a product of the management work and they influence the entire operation of the company and therefore its profits.

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