

DECISION SUPPORT SYSTEMS FOR ALLOCATION OF LOGISTICS CENTRES

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Abstract: *The facility allocation problem is to determine the optimal number of facilities to be opened. Based on multiple criteria evaluation, the optimal location of the facilities is usually solved subsequently. Several aspects as technical parameters, costs and finance must be taken into account. Economic analysis is carried out based on the concrete problem instance.*

KEYWORDS: ALLOCATION TASKS, SET OF CRITERIA, MULTIPLE CRITERIA EVALUATION

1. Introduction

The problem of allocation tasks lies in selecting an optimal number of logistics centres for their subsequent location on the basis of multiple criteria evaluation. The difficulty of multiple criteria evaluation tasks does not result, though, merely from the number of evaluation criteria, but also from how these criteria are expressed and from the degree of their dependence on their nature in various units of measure. It is not uncommon the situation where there is a mixed set of criteria and where some criteria are quantitative, i.e. expressed numerically, and others are of a qualitative nature (expressed in a verbal description).

Decision making is one of the basic managerial activities, where a bad decision may be one of the key causes of a business's failure. The importance of decision making depends directly on the level of resources (primarily financial) that are closely connected with the decision making.

The process of selecting feasible alternatives from a set of proposed alternatives forms a decision-making process and is a part of a broader decision-making task, namely the selection of an optimal alternative.

2. Preconditions and means for resolving the problem

Elements in the decision-making process

The key elements in the decision-making process include: decision-making objective, subject and object, evaluation criteria, decision-making alternatives and their outcomes, states of the world

Decision-making objective(s)

We understand the decision-making objective in solving a decision-making problem as a certain state that we wish to attain by means of a solution to the decision-making problem. In our case the single objective is a decision on the optimal number of logistics centres.

Evaluation criteria

Evaluation criteria represent aspects selected by the decision maker, serving for evaluating the advantageousness of individual decision-making alternatives from the aspect of meeting the objectives of the decision-making problem being solved. The evaluation criteria are usually derived from set objectives.

The selected evaluation criteria for allocation tasks:

- *cost criterion*
 1. one-off acquisition costs for a new logistics centre – direct material (equipping the depot with vehicles by purchase or leasing, with furniture, computers, mobile telephones, fixed telephone line and other office equipment)
 2. monthly operating costs for a branch – direct wages, other direct costs, operating margin, administration margin, etc. (basic wages, supplements and additional payments, bonuses and remunerations, operating expenses, depreciation charges, repair and

maintenance fees, creation of repair fund, transport and travel fees, contributions from wages, fuel costs, telephone fees, energy, insurance, fines, penalties, loan repayments, leasing)

3. costs for providing the branch with the essential supply of materials and spare parts – storage costs, funds tied-up in stocks
4. environmental costs

The one-off costs and costs tied-up in supplies will grow along the curve with the growing number of depots; however, operating costs will decrease as a result of the smaller catchment areas.

- *response times (speed)* – by setting up another depot, the response period will be reduced on the basis of reducing the size of the catchment areas, something which will be reflected in the reduced average number of kilometres driven and subsequently decreased fuel costs
- *technology demands* – equipping the depot with special vehicles, machinery and the handling equipment
- *customer convenience*
- *share of services in the public interest* – fire-fighters, emergency service
- *energy demands*
- *geographical possibilities*
- *economic importance*
- *social aspects* – solution to unemployment
- *importance of the hub as a transit hub*
- *importance of the hub from the aspect of resources* – raw materials
- *importance of the hub from the aspect of customers*

Decision-making subject

The decision-making subject (decision maker) is the person making the decision, i.e. the person selecting the alternative intended for realisation. The decision-making subject may be an individual or a group of people.

Decision-making object

The decision-making object is, as a rule, understood as being the field for which the problem has been formulated, the objective of its solution has been set and that the decision making concerns (a decision-making object may, for example, be to determine the reserve stocks of logistics centre warehouses, equipment of logistics centres, financial provision for development, etc.).

Decision-making alternatives and their outcomes

The alternatives for solving a problem represent for the decision maker a possible course of action that is to lead to the solution of the problem, or, as relevant, to the fulfilment of the set objectives. While many decision-making problems have their solution alternatives given or known, there are many cases (especially in the case of complex decision-making problems) where the creation of alternatives is time-consuming and requires a creative approach for demanding complex processing and searching for information.

Decision-making alternatives are closely linked with their outcomes, which we can understand as being the expected impacts and effects of the alternatives.

The states of the world (scenarios, risk situations) may be understood as future mutually exclusive situations that may occur following the alternative's realisation, and which influence the outcomes of the given alternative with regard to specific evaluation criteria.

3. Solution methodology

- *Determining the decision-making object, subject and objective*
- *Determining the criteria for evaluating the alternatives* – information should be fully exploited in selecting the criteria. The basic key in setting the evaluation criteria may be primarily the objectives to be achieved by the solution to the decision-making problem. Besides the objectives for the problem being solved, the selection of evaluation criteria may be supported also by identifying the subjects whose interests, objectives, or needs may be affected by solving the problem or by choosing one of the alternatives. Furthermore, searching for and clarifying potential adverse impacts and effects of the alternatives are also important. Applying the above-mentioned criteria leads to at least partial elimination of shortcomings arising in decision making.
- *Methods for setting criteria weightings* – most methods of multiple criteria evaluation of alternatives require first that weightings be set for the individual evaluation criteria that will express the numerical importance of these criteria. The greater the importance of the criterion, the higher its weighting. In order to achieve comparability between the weightings of a set of criteria determined by different methods, these weightings are as a rule standardised so that their sum is equal to one.
- *Generation of alternatives* – this is the most important stage in the decision-making problem, the quality of decision of the whole decision-making problem depends on it
- *Evaluation of alternatives and selection of the alternative intended for realisation* – the final objective is to determine such an alternative of the decision-making problem solution that would meet best the solution's objectives of the problem. The alternative intended for realisation should be feasible. Therefore it is necessary to exclude from the set of evaluated alternatives those alternatives that are inadmissible. Inadmissible alternatives are those that:

- do not meet some of the objectives of the solution to the decision-making problem
- do not fulfil some of the limiting conditions

4. Results and discussion

Multiple criteria decision making is modelling of decision-making situations containing a defined set of alternatives and a set of criteria according to which the alternatives will be evaluated.

The result of the alternative evaluation process is the determining of the preferential arrangement of alternatives, i.e. ranking of their overall advantageousness, where the first place is occupied by the most advantageous alternative, i.e. the optimal alternative. Determining the preferential ranking is in general a demanding process, where its complexity grows along with the increasing size of the set of alternatives and with the increasing number of criteria.

If a given criterion is of quantitative nature, it is sufficient to rank the alternatives by their descending or ascending values (where this concerns a cost or revenue type criterion).

The complexity of multiple criteria evaluation of alternatives is often overcome by unjustified simplification of the task, where the number of evaluation criteria is reduced by neglecting less important criteria.

A different, more acceptable approach to multiple criteria evaluation attempts to convert all the criteria into the same unit of measure, which ensures that the individual criteria are enumerable, and thus that they can be converted to a single criterion.

Determining the preferential ranking of alternatives often depends on the importance attributed by the decision maker to individual evaluation criteria, i.e. it depends on the value hierarchy of the decision maker and his subjective appraisal. Different decision makers may reach different preferential rankings of alternatives.

5. Conclusion

Allocation tasks need to be assessed and evaluated from the aspect of a greater number of criteria, i.e. they are problems of a multiple criteria nature. In determining the optimal number of logistics centres it is necessary to take account of the required technical parameters of centres, financial and cost aspects, etc. It is necessary to make an economic analysis based on the particular task assignment. Allocation tasks are, due to their nature, highly individual, therefore we have here merely outlined the theoretical side of using multiple criteria decision making and the solution methodology.

This contribution to the conference has been prepared with the support of the research objective "Development of Methods for the Design and Operation of Transport Networks from the Aspect of their Optimisation", (MSM6840770043).

6. References

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