

Analysis of a multimodal transport network in the region with an extremely cold climate

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Abstract: The role and importance of a multimodal transport network for the territory of the Republic of Sakha (Yakutia) – a region with harsh climatic conditions are defined. The experience of European and, in particular, Scandinavian countries is analyzed with the integration of multimodal technologies into a real operating transport and logistics network. The transport and logistics potential of Yakutia is analyzed. The importance of settlements as potential multimodal centers of transport and logistics network based on combinatorial optimization methods is determined.

Keywords: objects of transport and logistics infrastructure, multimodal transport network, ABC-analysis, combinatorial optimization methods

1. Introduction

Despite of the harsh climate, the Republic of Sakha is an attractive economic environment for investments. The economy of Yakutia is represented by almost all types of minerals, it exerts direct influence on the social environment of the region. However, in order to improve the social and economic indicators of Yakutia, a developed multimodal transport network is needed, from one side it takes into account the harsh climate conditions and from the other side, is built on the basis of the best global practices [1].

Within the recent years in European countries most active integration of multimodal technologies into actual transport and logistics network is taking place. A bright example of such integration is Project Trans-European Transport Networks (TEN-T) [2]. This network is built based on a concept of jointless transport network, in which the multimodal technologies are used on the basis of existing or planning infrastructure and uniform methodology which meets general European quality and safety standards.

The aim of the project is to convert the existing “patches” of European highways, railways, airports and water channels into a unified transport network (TEN-T) [3]. It will result in a modernized infrastructure and simplified trans-border and transport operations for passengers and enterprises in all countries which interact and join the European Union.

One of the areas of the Trans-European Transport Networks, that require a special focus, is the Scandinavian countries (Sweden, Norway and part of Finland). In these countries the project imple-

mentation was hampered for a number of reasons: climatic, ecological, soil-land [4-5]:

1) Scandinavian winter is harsh, in particular, for Sweden, Norway and a part of Finland, it is characterized by heavy snowing.

2) The ecological component of any transport innovation in Sweden, Norway and other countries of Scandinavian Peninsula is one of the priority tasks, the solution of which needs various technical methods.

3) Due to the peculiarities of the location of the mountain ranges and tectonic plates at depth of 2-3 meters, the ground in these countries is rather firm that also seriously slows down the development of the multimodal transport network.

The experience of the Scandinavian countries of organizing the multimodal transport network is absolutely worth to be researched in the Russian Federation, especially for the territories with harsh climatic conditions.

2. Results and discussion

A branched and extensive transport and logistics network is required in Yakutia. However, more than 85% of Yakutia territory has seasonal transport accessibility, and only 15% of the territory - annual. In this article [6], the author notes that the railway density accounts 2 km per 10 thou. km² that is 25 times less than on average in Russia. Currently in Yakutia there are about 490 km of the railways and 7,5 thou. km of the hard-surface roads connecting only separate regions between each other used.

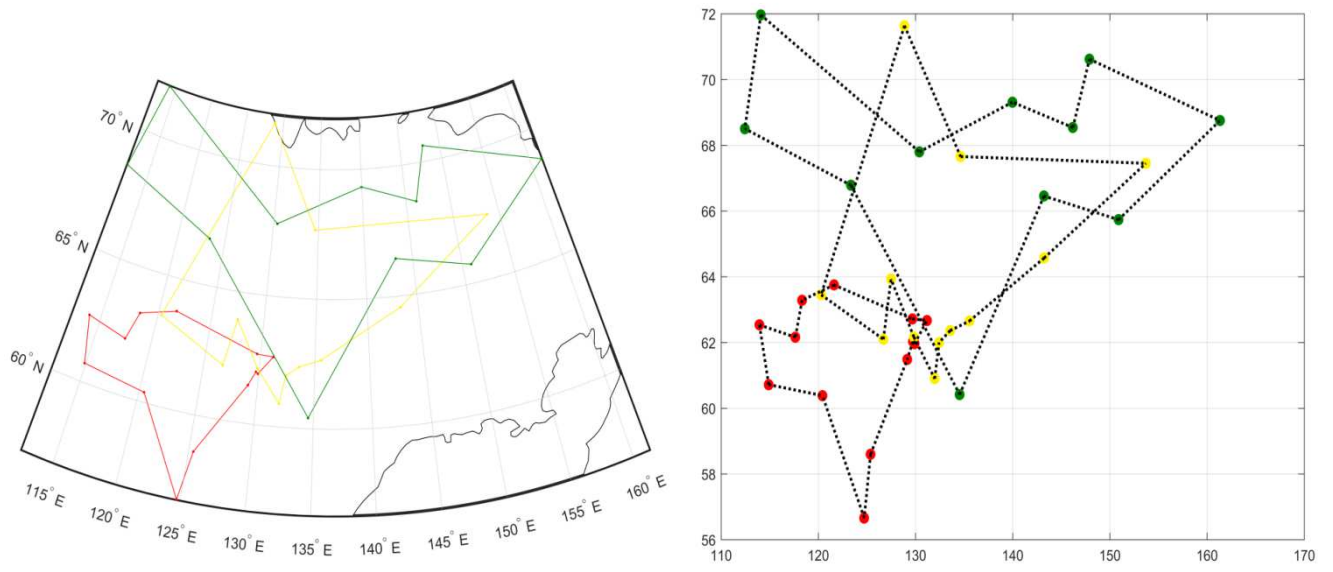


Fig. 1. Combined task solution of traveling agent: a) Spherical coordinates b) Cartesian coordinate system

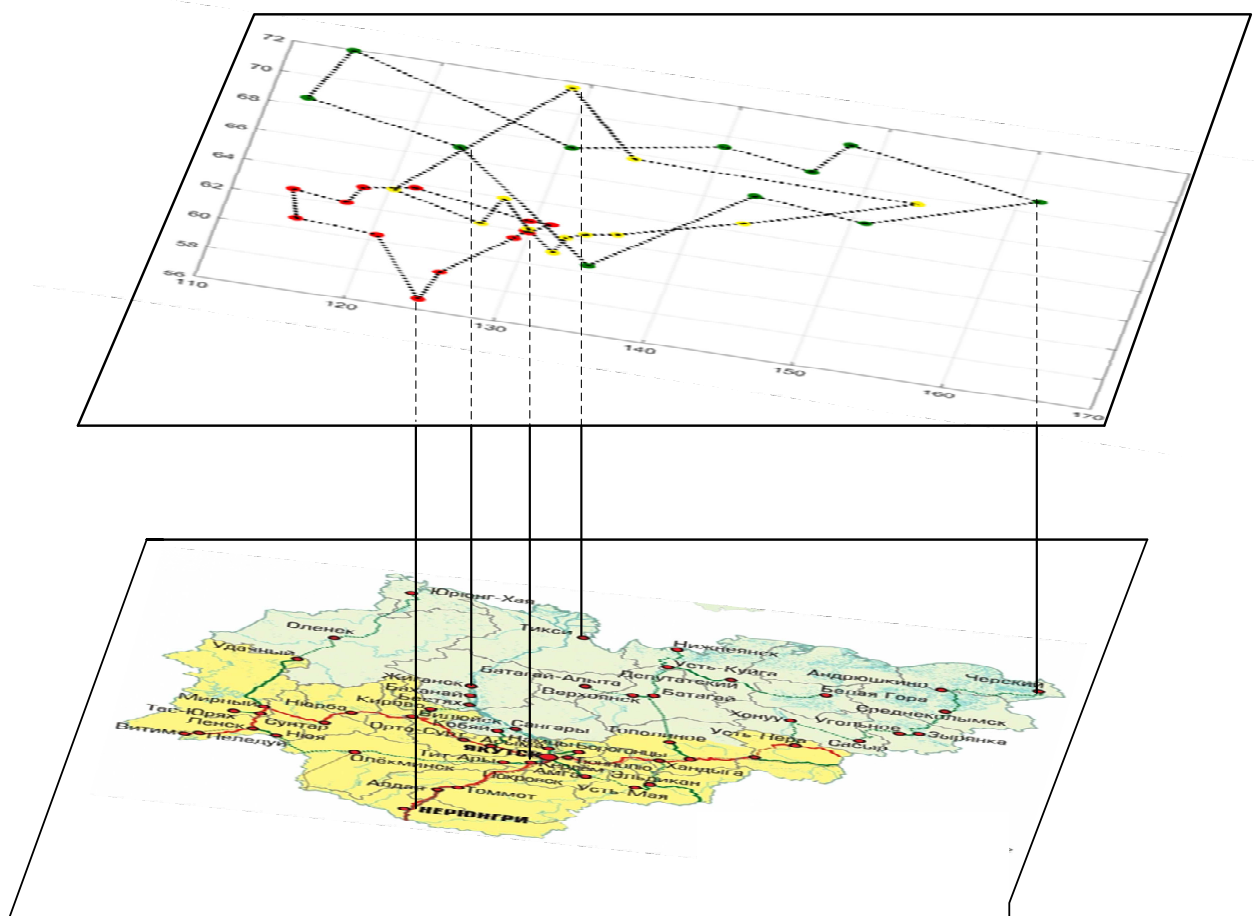


Fig. 2. Combination of the results of modeling and the Republic of Sakha road map

The author of the article [7] states, that out of 33 (settlements) of the Republic of Sakha, 25 of them do not have reliable transport network.

In order to connect all settlements in Yakutia into one multimodal network, the authors of this article have combined the ABC-analysis of settlements in Yakutia and methods of combinatorial optimization, particularly, the task of traveling agent which enabled to mode a rout for each group (Hamilton cycle). The solution was modeled in the Matlab software environment. The solution results of the combined task are represented in Picture 1. For ease of perception, this task is also represented in the Cartesian coordinate system.

It is obvious that the settlements of group A are placed in the southern part of the Republic of Sakha.

3. Summary

While evaluating the objects of multimodal transport network, a statement about an importance of settlements located at the crossing of routes of various groups A-B, A-C и B-C (Pic. 2) became an interesting hypothesis[8].

For example, the Zhigansk village, relating to the group C, but located at the crossing of the routes of the groups B and C, has good potential for transformation into a multimodal transport center.

The combinatorial system of optimization that is considered in this article is a convenient tool for calculating and solving of logistics tasks of similar types. This research is not complete - this is only start for the further analysis of the territory with harsh climatic conditions.

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