Development of a transport network in the Far North and the Arctic for the organization of tourist routes

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Abstract. The article is focused on the organization of leisure activities for the population of the Far North and the Arctic. The factors of successful implementation of people’s intentions, finalized in the commercial success, are determined. The semantic load of three concepts has been clarified, the terms being entertainment, tourism and travel. It is proved that there is a real opportunity for the development and use of decision-making models. An overview of models for predicting entertainment needs for Arctic residents is provided. The following models are considered in detail: time series analysis model and a causal model for forecasting the flow of tourism to the Arctic. The flow models were studied from the point of view of decision making. A number of assumptions, their limitations or recommendations are formulated, adhering to which, one can help an individual make a choice which matches his or her wishes. Some tactical measures ensuring the flow of funds to the Arctic regions are identified and a hybrid model of integer programming for tourism planning in the Arctic is proposed. Also, a decision-making model has been developed for investment in tourism in the Arctic. It is proved that net profit alone should not be used to evaluate gains as it is necessary to take into account marginal utility, which reflects the contribution of a project to the indicator of attractiveness of this region for tourists. A method for evaluating utility is discussed. Weight factors are determined for the appropriateness of the Arctic regions for tourism and the methods to assess non-monetary gains are suggested.

1. Introduction

An increase in leisure time among the population of the Far North and the Arctic shelf can be attributed to a number of factors, including a working week reduction, an increase in the number of household electrical appliances and ready-to-eat food products, and improved means of communication and transportation.

The leisure time increase is accompanied by a simultaneous increase in incomes in the field of leisure activities, with a shift in the balance of income - leisure towards the former. The authors of the paper believe that such a shift in the balance enhances opportunities for the population to make the best use of their free time, which, in turn, stimulates the development of the “leisure industry”, an economic activity aimed at creating opportunities and conditions for spending free time outside the home.

Administrative activities related to the organization of leisure have not yet become the subject of comprehensive studies among systems researchers, although the results indicate the effectiveness of the organization of certain types of recreation outside home.
So far, system researchers have mainly focused on the organization of entertainment, including travel and tourism. A characteristic feature of the existing quantitative research in the field of entertainment is that they almost never use decision-making models. Obviously, this can be explained by the fact that decision-making models need data, which, in turn, should involve forecasting and quantitative measurements of efficiency (profit estimation) of each possible decision.

This paper discusses the application of research methods of operations aimed at organizing entertainment, travel and tourism in the Far North and the Arctic. Special attention is given to the methods developed for the evaluation of the effectiveness and choice of strategy by focusing on the recent approaches to forecasting, building decision-making models and assessing gains.

2. Methods and models
Before considering examples of the methods for organizing entertainment, travel and tourism in the Arctic, it is necessary to clarify the semantic load of these three concepts. The term “entertainment” is difficult to define, as it includes all types of free time or leisure time activities [1]. The essence of this concept is a free choice of occupation, in other words, entertainment is a voluntarily chosen type activity. Tourism can be considered as one of the types of entertainment which involves a change in location. According to the definition given in the Webster dictionary, “a tourist is someone who tours or travels for his own pleasure” [2]. Tourists, as defined by the International Union of Official Travel Organizations, are visitors staying in a foreign country they visit for at least 24 hours; the purpose of such a visit may be rest, business or family events, an assignment or some kind of meeting [3]. Traveling, as opposed to tourism, means making a journey or moving from point to point using any type of transport [4]. This paper discusses primarily travel for entertainment.

Despite some differences, there is a close relationship between the concepts under consideration, especially with regard to tourism and entertainment. Initially, it was assumed [5] that the use of methods for organizing entertainment outside resident’s usual environment is mainly limited to predicting the intensity of the flow of Arctic population from their habitation centers to recreational and leisure facilities, and evaluating the main economic effects obtained in the field of leisure activities. However, an increase in the research conducted in the field of leisure activities researchers seized the opportunity for developing and using decision-making models, in particular, while planning tourism in the Arctic.

2.1. Models for predicting and distributing tourist flows in the Arctic
The review of models predicting the expectations and needs for activities outside home [5] includes forecasting models, models using time series, economic models, attractiveness and system analysis models, and inertial models. The forecasting models are considered in this paper in accordance with the classification proposed in [6], models using time series, cause-effect and qualitative models.

Time Series Analysis. The research papers [7,8] analyze the tourism intensity dependence on the seasonal factor and the use of the series analysis program developed by the U. S. Bureau of the Census for numerically assess seasonal fluctuations and the frequency of various components of tourism in the Arctic. In particular, one of the researches [9] analyzes the time series containing information on the following indicators: the number of tourists using the services of the Aeroflot air company, the number of tourists arrivals, the amount of money flows to the Far North as a result of tourism, the number of permanent residents of the Arctic who leave the place of their permanent residence for the purpose of tourism, the number of hotels bookings by tourists, foreign and domestic, and the total number of hotel bookings.

Based on the information obtained in this way, studies were carried out, the purpose of which was to extend the tourist season by organizing events during the off-season, i.e., introducing the second and, possibly, a third season, etc. The list of some advantages of the extended tourist season includes the following factors:

- better recreation conditions for more people;
• more efficient use of tourist facilities and a more balanced pressure on the economy and the ecology of the corresponding region;
• more even seasonal distribution of employment of hotel and other tourism-related staff, which may also contribute to a higher quality of restaurant and other types of services.

Causal models. The Battelles Research Center in Geneva has created one of the most advanced causal models for predicting the flows of international tourism [10]. The model is stepwise: first, the assumption is made that there is a simple relationship between the number of tourists arriving annually in the j-th country from the i-th country and the population of the latter. Then, a series of independent variables is sequentially introduced into the model, such as per capita income, cultural relatedness of the countries (for example, common language), the attractiveness or popularity of the country among tourists. According to the model, the following relationship exists between the variables:

\[ N_{ij} = \frac{A_i P_i G_i^\beta L_i T_i^\gamma}{D_j^\delta}, \]

where \( N_{ij} \) is the number of tourists from the i-th country whose arrivals in the j-th country is registered;
\( P_i \) is the population of the i-th country;
\( G_i \) is per capita income in the i-th country (gross national product per capita);
\( D_i \) is the distance between the i-th and j-th countries;
\( L_i \) is an assessment of the cultural relatedness, if any exists, for example, a common language of the i-th and j-th countries;
\( A_i \) is an estimate of the popularity index of the j-th country among tourists;
\( T_i \) is fixed time periods;
\( \alpha, \beta, \gamma, \epsilon, \delta \) are the elasticity coefficients of the corresponding variables for the j-th country.

The \( T_i \) variable is used to evaluate progressive change over a certain period of factors such as population distribution, educational level and the amount of free time of the Arctic residents. If by the value of the j-th country we mean the j-th region of the Arctic, then this model can be used to study and organize tourism in the Arctic.

Quality models. Most traditional stream models [11] are developed taking into account subjective (qualitative) data; they demonstrate the effectiveness of the methods to identify a negotiated solution and collective or group decision making. For the first time, such a qualitative approach to solving leisure organization problems was proposed in [12]. The authors used the assumption [12], according to which a trip of one person or family to the lake can be considered as the result of the decision-making process. It is a mental cognitive process, namely, a chain of logical reasoning and the assessment of the results of a possible course of actions based on the needs, purposes and abilities of a given person or family. In accordance with this statement, the decision-making process can be represented as a formalized program of action. To do this, it is necessary to formulate a number of such assumptions, limitations or opportunities, adhering to which, you can help an individual make a choice which matches his or her wishes.

This program or a scheme of exclusions can be useful for planning and management authorities in predicting the actual number of potential tourists, namely, in determining the occupancy level of tourist facilities.

2.2. Decision making models for leisure activities in the Arctic regions
Decision making models form the basis for the operations research [13]. The first attempt to use such models for organizing leisure activities in the Arctic regions was made only in 2017 [14] and was a comprehensive study in the field of tourism planning in the Far North. In the process of analyzing the results of this study, the authors created a model which formed the basis for the development of an appropriate investment strategy in the tourism sector in Russia.

The task is formulated as follows:
to find
\[
\max \sum_{i=1}^{N} \sum_{j=1}^{K_{ij}} d_{ij} X_{ij}
\]
under limitations
\[
\sum_{i=1}^{N} \sum_{j=1}^{K_{ij}} c_{ij} X_{ij} \leq b,
\]
\[
X_{il} - X_{iM} \geq 0 \quad \text{for} \quad i, l = 1, N \quad \text{and} \quad (L, M) \in P_i
\]

where N is the number of tourist areas into which the Arctic is divided;
K_{ij} is the number of projects proposed for implementation in the i-th tourist region during the planning period;
X_{ij} is a variable which takes the value 1 if the j-th project is selected for implementation in the i-th tourist region, and the value 0 otherwise;
d_{ij} is an assessment of the gains received provided that the j-th project is implemented in the i-th tourist region;
c_{ij} is the estimated cost upon completion of the j-th project proposed for implementation in the i-th region;
P_i is the index set of the relative importance of the projects proposed for implementation in the i-th tourist region;
b is funds for tourism development in the Arctic region during the planning period.

The value of d_{ij} should show the relative importance of possible projects and satisfy the additivity in all projects within a distribution plan, which will determine the benefits of the implementation of the general plan.

3. Results

3.1. Benefits to the Arctic residents from the measures aimed at leisure activities
While developing tourism planning methods, a number of approaches to measuring benefits have been developed. The main task being an increase in the purchasing power in the Arctic regions, the creation of the leisure industry, especially in tourism, can be considered one of the crucial tactical measures ensuring the flow of funds to the Arctic regions. The amount of cash flows into the Arctic regions can be viewed as an assessment of the direct gains received from tourism.

At first glance, it might seem that the reduced net profit received from the implemented project can be used to estimate the gains (profit). Upon closer examination, however, such an assessment appears unacceptable. Firstly, this is due to the fact that there is a large number of different projects considered when planning at the regional or national level; secondly, in addition to projected hotels, summer cottages, etc., which cause an influx of funds, there are projects such as building roads, conducting archaeological excavations or opening museums which do not provide monetary gains. Yet, the implementation of such projects is associated with certain costs, which should be taken into account in the distribution of the rather scarce resources for the development of tourism.

The suggested measure of benefits represents the average value of profit from various possible projects. While considering the cumulative impact of tourism development on the Arctic regions due to the flow of funds, a hybrid assessment may be of use. Of particular importance is marginal utility, which reflects the contribution of a project to “strengthening” the indicator of attractiveness of this region for tourists [15]. If \( \bar{A}^{(M)} \) is a vector characterizes the attractiveness of the i-th the Arctic region for tourists in each criteria after the completion of project M, including all projects immediately preceding it, the marginal contribution of project M for each criterion is expressed by the “impact” vector \( T^{(M)}_{il} \) which is determined in the following way:
where \( L \) stands for multiple projects immediately preceding project \( M \).

For example: a hotel construction project in a certain region of the Arctic should only be considered if there is a decision to build a road to the hotel location. Consequently, the road construction project immediately precedes the hotel construction project. Similarly, any project may be preceded by more than one project. It should be emphasized that for each Arctic tourist region, there could be a certain project and a related infrastructure project, and both of these projects are the precursors to any project in this region. Thus, before implementing practical measures, the challenge is to envisage an appropriate level of planning for the development of the region and thus to guarantee proper infrastructure to meet at least the minimum requirements imposed on the quality of tourist services.

If \( \vec{W} \) denotes the vector of weighting factors or the relative importance of attractiveness indicators, then the gains from the implementation of the \( j \)-th project in the \( i \)-th tourist region are determined as follows:

\[
d_{ij} = \vec{W}^T \vec{d}_i, \quad i = 1, N, \quad j = 1, K,
\]

According to the proposed model, the following conclusions can be drawn:

- the model is a static single-period decision-making model;
- the model takes into account the development prospects of the tourism program of the country as a whole, but does not take into account the differences in geographical areas in terms of the intensity of the of the tourist flow;
- the model does not reflect the limited opportunities for tourism development in certain geographical areas.

For comprehensive tourism planning in the Arctic, a mixed integer programming model was suggested [16]. The purpose function of this model reflects the contribution of tourism related cash flows to total net profit in the Arctic regions.

Along with the direct gains from the development of the tourism sector, indirect benefits should also be taken into account. In this regard, the problem arises in determining the multiplier effect caused by cash inflows resulted from tourism [17]. Analyzing the composition of indirect and induced cash flows, it is possible to conclude which sectors of the economy have an influx of funds as a result of this effect [18]. The appropriateness of the analysis based on the multiplier effect while developing a tourism strategy is considered in [19].

Methods of evaluating gains which not expressed in monetary terms for example, from investments in the organization and construction of national parks, public areas of recreation and entertainment, are somewhat subjective. Currently there is no consensus on the feasibility and advisability of assessing such benefits among the researchers. According to some authors [20, 21], the cost of some vacation spots is determined by “willingness to pay”, in other words, the amount of money the consumers are willing to pay for using the facility including transportation cost, the cost of admission ticket, etc. On the other hand, some authors [22] believe that there is no valid and reliable way of assessing benefits which are not expressed in monetary terms, since it is difficult to “evaluate” the significance and usefulness of a vacation spot. In addition, they assume funds should be provided for the leisure industry to maximize social gains. As a measure of this support, man-days of rest weights can be utilized; the weights can be determined on the basis of political, economic and priority indicators approved by the government.

One of the possible approaches to determining the benefits associated with the development of the tourism sector is a utility assessment method, which would reflect the degree of attractiveness of this Arctic region for tourists. The method of such an assessment, considered in [23], determines the usefulness of many indicators, and the procedure proposed to find the weighting factors is proposed in [24]. This approach can be summarized as follows:
• the selection of criteria for evaluating attractiveness indicators;
• the determination of the relative importance of indicators, i.e. of weighting factors;
• the use of expert assessments to clarify the correct choice of assessment criteria;
• the determination of the numerical value of the utility function, or “relative attractiveness”, of the Arctic tourist region.

The data obtained as a result of applying this approach can be used by the Ministry of Tourism of Russia in the development of relevant projects and in the differentiation of various geographical regions of the Russian Arctic which are of interest from the point of view of tourism. It is advisable to fix the numerical values of the utility function as an “inventory” or an assessment of the state of affairs in the field of tourism in Russia.

4. Discussion
A large number of researches devoted to forecasting in the field of leisure organization demonstrate a considerable attention which economists direct to these issues. However, an increased interest in forecasting has led to the fact that it is economic forecasting methods that are mainly used in the field. Obviously, only this can explain the fact that the problems in area of leisure activities outside the home are not tackled used time series methods, not even in cases where a forecast for a short period or a period of medium duration is required.

As for methods for assessing the gains (profits) from the implementation of measures to organize leisure and entertainment, travel and tourism, a number of problems arise, and these are already recognized by the specialists in the field of operations research. The subjective factors which should be considered when assessing the gains pose a serious challenge as the subjective factors need numerical expression.

A significant gap in the application of research methods for operations in the field of recreation and entertainment, travel and tourism is the lack of fundamental work on modeling decision-making processes. However, the results of the some pioneering studies in this direction indicate the possibility of using formal models. Currently, the feasibility of implementation of such an opportunity does not raise any doubts. It should be noted that so much progress has been achieved in solving the problems of forecasting and assessing gains (profits) that the results of these studies can be used as input data in mathematical and simulation models.

5. Conclusions
To conclude, current research in the field of recreation and entertainment outside the home should be carried out in the following areas:

1. Geographic studies at the regional (national) level
   Field data gathering:
   • aesthetic assessment of the landscape expressed through an indicator of the physical environment;
   • attractiveness of the location - natural and artificial (man-made) factors;
   • degree to which the natural landscape is change in order to make it more attractive.
   Gathering and analysis of statistical data:
   • travel for entertainment;
   • organization of tourism;
   • prospective assessment of the needs in the recreational and entertainment areas for a particular region;
   • dissemination of new trends in the design of tourist facilities.

2. Economic, political and sociological research
   Demand and supply studies in the field of recreation and entertainment.
   The allocation of resources analysis, a cost and benefit analysis and related strategies in the field of economics.
   Economic aspects of leisure and entertainment.
   Sociological and psychological effects of travel.
Other possible studies of economic, political, and sociological nature.

3. Other possible areas of research

- Biological research (ecology).
  - Technical feasibility of various projects, the study of terrain features in order to make optimal use of them in various projects.
  - Capacity of recreational areas to accommodate tourists.
  - Nature of the aesthetic evaluation of a given location.

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