

# Determination of Promising Directions for the Development of Geographic Information Systems in the Operation of Vehicles

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**Abstract:** Modern conditions of operation of vehicles determine the need to control this process in real time. All participants in the operational process are interested in such data. The customer of the ride requires information about the location of the vehicle and its estimated time of arrival. The carrier and the state traffic safety authorities need to monitor compliance with the operating rules and the traffic schedule. The article provides a critical analysis of the modern use of geographic information systems in the operation of vehicles. To achieve this result, scientific publications of 2021 were used, which were placed in the world scientometric databases. Such selection criteria among the variety of published scientific works allow using the most significant achievements of the modern scientific society. As a result of studying modern scientific thought in the described issues and a systematic analysis of the results obtained by scientists, promising directions for the development of geographic information systems in the operation of transport means were established. Solved and unsolved problems of modern processes in the operation of transport means are determined. As a result of the work, the scientific and practical relevance of the use of monitoring systems for the operation of transport means when using geoinformation technologies has been proven.

**Keywords:** Operation of Vehicles, Geographic Information Systems, Transport Management, Modeling of Transport Processes

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## 1. Introduction

Modern operating conditions of vehicles require exceeding the speed of movement, the accuracy of adherence to traffic schedules, improving traffic safety and much more. This is due to the scientific interest in studying the operation of vehicles. Modern scholars Akyurek, E., Bolat, P. 6, Żochowska, R., Jacyna, M., Kłos, M. J., Gupta, R., Pena-Bello, A., Streicher, K. N., Roduner, C., Thöni, D., Patel, M. K., Woldeamayyat, E. M., Genovese, P. V., Pászto, V., Burian, J., Macků, K., Van Ginkel, K. C. H., Dottori, F., Alfieri, L., Feyen, L. and many others consider all modes of transport.

As a result of the available scientific achievements, modern problems and goals of the operation of means of transport have been formed, which are proposed to be solved using geoinformation technologies.

For example, the work of the authors Akyurek, E., & Bolat, P. (2021) [1] addresses the issue of informing the maritime industry with information on detained vessels, while the Geographic Information System (GIS) helps to demonstrate the regional variation among the 15 EU countries. Authors Żochowska, R., Jacyna, M., Kłos, M. J., & Soczówka, P. (2021) [2] discuss cycling using GIS for marketing monitoring. Questions and problems of pipeline transport were asked by the authors Gupta, R., Pena-Bello, A., Streicher, K. N., Roduner, C., Thöni, D., Patel, M. K., & Parra, D. (2021) [3], who also proposed to use GIS to monitor the state of sections of individual circuit elements. In the works by Woldeamayyat, E. M., & Genovese, P. V. (2021) [4] the problems of urban planning for the development of transport infrastructure are considered and the use of a remote sensing system of urban areas in GIS for monitoring urban

infrastructure is proposed.

The issues of forecasting the risks of overlapping of certain sections of transport infrastructure with the use of GIS for precipitation monitoring were discussed in the works by Van Ginkel, K. C. H., Dottori, F., Alfieri, L., Feyen, L., Koks, E. E. (2021) [5].

Air transport in terms of meeting the needs of tourists is widely considered in the work of Massaro, A., & Rossetti, S. (2021) [6]. The authors of this study, based on a number of scientific publications ((Thierstein and Conventz, 2018), (Tira et al., 2006), (Freestone, 2009), (Percoco, 2010), (Ventura et al., 2020)), made conclusions about the possibility of analytical assessment using GIS to justify the development of city-airport pairs using geographic tools to support economic and financial planning ((Cook and Billig, 2017) (Graham, 2014).), (AntoninKazdaa et al., 2017) (Young and Wells, 2011). In the work of Borhani, M. (2021) [7], the issues of air transport were considered in terms of solving a number of tasks to optimize the flight network, effective management of airspace resources in order to increase airspace capacity and reduce air traffic congestion.

GIS is also widely used when considering the issues of the pace of motorization, which is considered in the works by Carroll, P., Benevenuto, R., & Caulfield, B. (2021) [8]. The authors proposed the use of GIS to determine rural areas, the transport development of which forces residents to purchase personal transport and abandon public transport.

## 2. Problem Statement

In the modern understanding of the problems and tasks of the transport means operation, science and practice widely uses GIS. Such solutions have been proposed by scientists in the operation of all types of vehicles, both in commercial and private cases. The main problems of such methods of forecasting, accounting, analysis and other management actions include the high cost of specialized software and storage of collected information. As a result of the available scientific achievements, modern problems and problems in the operation of transport means have been formed.

## 3. Tasks of GIS in Transport Sphere and Methods of Their Solution

This method [9] uses four submodels: the system of bicycle sharing stations, the road and street network, the demand for bicycle sharing, the bike ride routing, and the matrix of spatial integration measures. The presented method allows the identification of different categories of road and street network segments used for cycling travel and allows the identification of a set of segments that need to be converted into a cyclist-friendly infrastructure offering cycle paths or cycle paths in order to ensure an appropriate level of spatial integration of bike rental stations. Planning of downtown areas is related to the issues of transport influence on the development of society by the authors Shach-pinsky, D., & Ganor, T.

(2021) [9]. The method of increasing the accessibility of public transport and pedestrian accessibility is adopted to increase social interaction. The main purpose of this method [9] is to determine the routes and spaces that people walk in order to increase the safety of such movement. The construction of a cartographic model of such route zones is proposed on the basis of GIS, which is used to identify and assess safe urban areas in order to improve pedestrian accessibility. The availability of the urban route network is not limited only to pedestrian traffic. Sahitya, K. S., & Prasad, C. S. R. K. (2021) [10] claim that a stable transport system is possible with an effective analysis of the functioning of the transport network, in terms of its accessibility and development. The authors of the work [10] proposed a methodology for modeling a transport network as an engineering one, in which the availability depends on the development of such a network, while the availability is modeled by the method of multiple linear regression. The study [10] uses geographic information systems to quantify, extract and analyze various characteristics of the urban transport network structure. Similar questions about the need for pedestrian traffic in cities were considered by Sun, Y., Lu, W., & Sun, P. (2021) [11]. In their work [11], the authors proposed a methodology for modeling the accessibility of pedestrian traffic based on the structural parameters of the urban road network. At the same time, the authors believe that an effective means of improving the health of the population in megacities is to reduce traffic congestion and improve living conditions.

Study [5] is an object-oriented assessment of the direct flooding risk of the European road network on a continental scale for the current climate using high-resolution impact data from OpenStreetMap. A new set of road-specific damage functions is developed. The movement of pedestrians through the territory of a single settlement in the work of Rybarczyk, G., & Shaker, R. R. (2021) [12] is presented as multimodal and consists of walking and using a bicycle. The study [12] used exploratory spatial data analysis, discrete selection structural modeling, and GIS geovisualization to establish the likelihood of travel mode selection. At the same time, the authors of the work Goliszek, S. (2021) [13] simulate transport accessibility in relation to public and private (road) transport. Public and private transport models are loaded using a programming language and processed using GIS tools. The work by Stanek, R., Kusendová, D., & Horňák, M. (2021) [14-20] presents the possibilities of the model of transport accessibility by individual road transport in the environment of geographic information systems (GIS). An analytical GIS methodology was used to describe the differences between different pairs of airports in the work [6, 21-25]. The purpose of this analytical assessment paper, GIS, is to support various theories about the development of pairs of nearby airports using geographic tools to support economic and financial planning. The proposed topology model [7] of this study is based on a combination of two topologies - point-to-point and hub and spoke - with multiple objectives to reduce the number of airways and path lengths per passenger, and to achieve a minimum number of air transport stops per passenger. Methods of using GIS

technologies in the work of Ruangchoengchum, P., & Uriyapongson, S. (2021) [15, 26-30] are aimed at proposing a method to reduce transportation costs through the use of network analysis on a GIS platform. At the same time, the authors of the work Nelson, T., Ferster, C., Laberee, K., Fuller, D., & Winters, M. (2021) [16, 31] apply spatial analysis techniques using GIS platforms to the study of cycling. is as follows: Place figures and tables at the top and bottom of columns. Avoid placing them in the middle of columns.

## 4. Conclusion

Analysis of modern scientific thought in the use of GIS technologies in the operation of vehicles has shown the relevance of this issue. As a result, it was proved that GIS technologies are applicable to all types of vehicles and are used to collect traffic information, store and analyze it. It has been proven that GIS technologies are used in commercial and non-commercial driving, direct and multimodal driving, walking people. From this study of the relevance of the use of GIS follows the universality of the use of such technologies in the study of transport processes.

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