Formation of geoinformation provision elements of railway networks for logistic transportation management

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Abstract. At present, there is a transition from automated design to information modeling in the road industry. The paper submitted by using modern software to support the design and operation of railway networks based on materials of geodetic support is carried out in the research. When conducting research is using the scientific methods: measurement, analysis, information modeling. The paper presents an overview of results of the formation of geodetic support of railway routes on the example of real projects. On this basis, by means of geoinformation support was created in the form of conceptual information model of the railway network of Ukraine. The model can be used to solve logistical problems in the field of rail transportation. This module provides a number of opportunities to analyze existing road networks and to design new ones. Results are presented with the help of Topomatic Robur and ArcGIS software systems, in which plans and models of railway networks are developed. Also, the conceptual characterization of the use of geoinformation data in solving the logistic problems of transportation is given. An example is given analyze problem of damage or overlap of the railway track section on the route and to predict an alternative route between the cities of Kharkiv and Odessa.

1. Introduction
The research conducted an analysis to obtain data about feasibility of using spatial information for the design of railway networks and their rational use based on modern software.

The study analyzed the works of other authors.

The studies [1-2] addressed issues of solution technical and scientific problems have been solved from the geodetic and surveying point of view.

The studies [3-8] dedicated to solving problems use of GIS to support the design and operation of railway networks based on materials of geodetic support is carried out in the research.

The studies [9-10] the conceptual characterization solving the logistic problems of transportation is given.

2. Geodetic surveys
Geodetic surveys are required to obtain spatial data. These surveys in the field of railway networks have their own peculiarities that consist in the fact that for engineering and geodetic works, in the process of railway design, the process of search and design is inseparable. Research materials are required to develop and justify design decisions, and it is impossible to determine the composition and scope of research without prior design investigations. Special tools are needed to accelerate and
optimize the results of these works, for example, using appropriate, modern software [1, 2]: AutoCAD and Topomatic Robur (figure 1, 2).

Figure 1. Illustration of topographic survey results uploaded to AutoCAD

Figure 2. Illustration of topographic survey results uploaded to Topomatic Robur.

At present, there is a transition from automated design to information modeling in the road industry. A number of questions arises, the solution of which determines the mass introduction of this technology at all stages of the life cycle of railways. This study sets out a comprehensive solution for the organization of the general data environment and the application of the software program Topomatic Robur at the stages of processing engineering and geodetic surveys with subsequent design for the construction and operation of railways of Ukraine (figure 3-5).
Figure 3. Illustration of results of topographic survey of railway tracks Topomatic Robur

Figure 4. Illustration of results of topographic survey of railway tracks Topomatic Robur
The introduction of these technologies makes it possible to receive and convert data with high precision and to save time in data processing.

3. Geoinformation software

By processing the data obtained during engineering and geodetic surveys using specialized software, it is possible to form a geodatabase and create appropriate geoinformation software [3].

Thus, using the ArcGIS software system, a model of the network of the largest railway routes in Ukraine was developed (figure 6).

The model can be used to solve logistical problems in the field of rail transportation. For this purpose ArcGIS uses a special module for processing network geodata - Network Analyst [4]. Among them, for example:

- creation and construction of railway network data sets based on spatial data;
- creation and construction of sets of railway network data from classes of spatial objects stored in the geodatabase;
- define communication rules and network attributes for railway network data sets;
- perform various network analyzes using the network analysis toolbar;
- use network analytics tools to create geoinformation models that perform network analysis.

This module provides a number of opportunities to analyze existing road networks and to design new ones [5, 6, 7, 8].

The task of changing the route in case of damage of the railway tracks is given as an example. Figure 7 presents a model of the optimal route between Kharkiv and Odessa under available conditions.

In the case of damage or overlap of the railway track section on the route, it is possible to predict an alternative route between the cities of Kharkiv and Odessa, which is presented in figure 8.
Figure 6. Illustration of a network model of the largest railway routes of Ukraine

Figure 7. Illustration of the model of the optimal route of the section of railway tracks Kharkiv – Odessa
Figure 8. Illustration of a model of an alternative route of the railway track section Kharkiv – Odessa

This example of the use of modern information technology gives only preliminary acquaintance with the research materials. If you comprehensively present the use of available data on the materials of geodetic and geoinformation support, it is possible to solve a much larger range of problems in the field of logistic transportation management.

Successful management of information flows ensures consistency of supplier and consumer actions, improved inventory management, replacement warehousing of finished goods by warehousing of semi-finished goods or raw materials. In addition, through the development of the information exchange system, agreement is reached in the functioning of all directions of the transport chain. The tasks of formation of information infrastructure, choice of software and hardware, reengineering of business processes on the basis of information systems are solved. Also, assessing the efficiency of the acquisition and use of information resources, the organization of implementation of complex and valuable information systems, ensuring information security [9, 10].

4. Conclusions

Thus, the paper presents an overview of results of the formation of geodetic support of railway routes on the example of real projects. On this basis, by means of geoinformation support was created in the form of conceptual information model of the railway network of Ukraine. The model can be used to solve logistical problems in the field of rail transportation. This module provides a number of opportunities to analyze existing road networks and to design new ones.

Results are presented with the help of Topomatic Robur and ArcGIS software systems, in which plans and models of railway networks are developed. Also, the conceptual characterization of the use of geoinformation data in solving the logistic problems of transportation is given. An example is given
analyze problem of damage or overlap of the railway track section on the route and to predict an alternative route between the cities of Kharkiv and Odessa.

Is planned continue working on this issue.

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