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GIS-Modeling of Multimodal Complex Road Network and Its Traffic Organization

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Abstract

The article throws light on spatial, structural and functional characteristics of Ust-Luga Multi Modal Complex (ULMMC). Geodatabase and cartographic basis of the above complex are established in ArcGIS environment. Network models of roads and railway lines of the above complex are realized via the use of Network Analyst analyzer. Upon investigation of generic rules of mobile facilities behavior within the territory of sea ports and industrial enterprises a part of these generic rules has been reflected (as an example) in geodatabase and road networks. Consideration was given to three-dimensional modeling of ULMMC multiple-bridge intersections and Traffic Management Facilities (TMF) arrangement on them.

1. Introduction

As a rule, a present-day large port is the pole of economic activity involving a number of industrial clusters located within the port's attraction zone. Efficiency of such complex depends on its transport infrastructure functioning organization. Today's port complex including hundreds of moorings, terminals and logistics-and-industrial facilities

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pertaining to the aforementioned clusters should have appropriate on-site road network providing proper exits to outside area.

Modeling (being a constituent part of investigation, designing and management) of spatially-distributed systems of this level demands involvement of advanced GIS (for instance, ArcGIS). Example of such GIS - ArcGIS-model of the port of Rotterdam (PortMaps) [PortMaps (2014), Port of Rotterdam (2014)], covering space and functions of (i) marine (foreland) and (ii) continental (hinterland) constituents of port activities [Rodrigue (2012)].

The author is going ahead trying to develop achievements of these ideas. The author is considering some of his works [Kotikov (2009), Kotikov and Lukinskij (2013), Kotikov (2015), Kotikov and Kravchenko (2015), Kotikov and Evtiukov (2015)] (dedicated to GIS-modeling and optimization of traffic in the sea port of Saint Petersburg) as a humble input into line of research. At the same time, transfer and development of aforementioned ideas and methods towards another spatial object - fast emerging Ust-Luga Multi Modal Complex (ULMMC) - is becoming relevant.

Purpose of investigation - GIS-modeling of prospective ULMMC road network together with respective traffic organization being the basis of port traffic complex optimization.

2. Spatial, structural and functional characteristics of Ust-Luga Multi Modal Complex

Construction of Ust-Luga sea port (ULSP) caused formation of new economic-industrial region of federal level [Shevchenko (2015)]. Project of complex development of ULSP and adjoining territory initially developed on conceptual level (by Ust-Luga Company in the year 2010 [Yerofeyev (2015)] provides for creation and development of five interrelated clusters within Ust-Luga bay: transport-logistical, industrial, residential, recreational and agro-industrial.

Further project detailing performed by different entities complemented the most part of Ust-Luga bay eastern coast by a number of prospective objects: cargo airport and heliport, industrial parks, terminal- terminal-warehouse complexes. It demands (i) modernization of access roads and railways entries to ULMMC from the south and (ii) provision of developed access ways from the North and the East [Yerofeyev (2015)].

Interaction between all ULMMC objects demands provision of appropriate internal road networks and railways complex together with efficient traffic organization within them. Since existing roads are passing through residential settlements it is expedient (in order to avoid traffic jams within ULMMC area) to construct new roads bypassing them [Yerofeyev (2015)].

3. Development of ULMMC geodatabase and cartographic basis in ArcGIS environment.

Systematized modeling of proposed spatially and functionally complex system may be performed only in ArcGIS level environment. We employed this tool for ULMMC models development.

Structure of Database of upper level models contains a number of Geodatabases (GDB) represented (Fig. 1) by "barrel" symbol. Each GDB includes sets of classes of spatial objects represented (Fig.1) by "trefoil" symbol. According to acronyms (conjoint combination of word bases in the name) it is evident that GDB EUBalt_UL+SPb.mdb (integrating data from EU (EC), Baltic region, Ust-Luga and Saint Petersburg) is designed to store classes of objects pertaining to Airport, Sea Port and Utilities System.