Journal scientific and applied research, vol. 19, 2020
International Journal

Original Contribution ISSN 1314-6289

SIMULATION OF MULTIMODAL TRANSPORT WITH ANYLOGIC

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Abstract: *The application of a logistical approach has an impact on transport policy with regard to the development of freight transport systems. It is expressed in the possibility to increase the efficiency of the functioning of both the individual transport industries and the individual transport enterprise, as well as their integration [2].*

In essence, combined transport is an effective integration of different modes of transport, ie. of individual transport operators and infrastructure companies in the context of the transport logistics chain. It is also known as intermodal or multimodal transport (MT).

Key words: *multimodal transport, development, transport.*

INTRODUCTION

The modern market for transport services imposes on operators the need for dynamic development, constant introduction of new technologies for transport, storage and delivery of goods [4]. Of particular importance for the efficient implementation of the transport process is the availability of developed infrastructure, the implementation of full transport services by a single transport operator on a door-to-door basis, strict adherence to delivery times, optimization of logistics schemes and reduction the cost of transportation.

EXPOSURE

Determining factor for the realization of multimodal transport is the need to create cargo units. This means that multimodal operators must have a container fleet and container equipment with standard ISO parameters, which are adapted in terms of size and type to meet the technical and technological requirements for the transport of a wide range of goods with different characteristics [2, 3]. The

container fleet and equipment must be able to meet the transport needs of each cargo submitted for containerization. Also important are the accessibility to the container park and the equipment related to the various forms of ownership, the organization of the operation and their spatial location. An essential element of the multimodal system is the availability and development of the technical infrastructure [2, 7]. It includes:

- container depots and container equipment located in strategic logistics points close to the occurrence of goods, such as production and consumption areas. Landfills must allow for the reception and storage of containers and equipment;
- land container terminals, as specialized transport hubs providing the possibility to service the means of transport from the different land modes of transport. These are the different types of terminals - railway, road, port, airport. These terminals have the necessary infrastructure;
- transshipment facilities and those for the performance of terminal operations and services, workshops for repair and maintenance of containers and container equipment. They also have the necessary organization and management;
- maritime container terminals that specialize in land-maritime transport hubs;
- developed logistics network, covering the logistics centers and points located in important transport points and providing the technological and organizational side of the transport processes, their service and management.

By concluding a contract, the owner of the cargo determines a number of requirements to the carrier. In most cases, the time required for the load to pass through the transport system is crucial for the owners of the goods. At the same time, the indicators for efficiency, reliability and quality of service provision are within the contractual limits. Thus, the following problem arises for freight carriers - it is necessary to know in advance the values of the parameters characterizing the passage of the cargo in possible directions and finding the optimal one, the parameters of which correspond to the contract values [1].

When simulating in logistics software, due to the large number of parameters and factors influencing the accurate description of the transport system only by analytical methods, the characteristics of the system are probabilistic. Therefore, the results of predicting system behavior using functions describing random processes can be completely unreliable.

The solution to this problem can be the tools provided by the simulation apparatus. In simulation modeling, the structure of the modeled system is adequately shown in the model and the processes of its functioning are reproduced on the constructed model. Such modeling can be considered as conditions that determine the state of the system in the future. Simulation modeling makes it possible to obtain the execution of processes over time at specific values. The

accumulated knowledge base for simulation of implementations allows building statistical dependencies and situation analysis [1].

Simulation modeling includes the whole arsenal of analytical modeling at the stage of identification of the simulation model, ideas and techniques for statistical modeling (finding the optimal solution).

In order to create an automated freight traffic management system, a simulation model can be created that describes a fragment of road, rail and sea transport.

One of the softwares for creating a simulation model is AnyLogic and AnyLogistix. The design of a simulation model with AnyLogic is also performed by the built-in libraries for the different types of transport.

Design of a simulation model with AnyLogic

AnyLogic is a modern environment for developing models in the Java language. It contains a large library of visual components that can be used to create and add custom components to the environment. Models are saved as Java applets. The professional version runs a debugger and can create standalone JAR files. AnyLogic models have good tools for 2D - 3D simulation, interactivity and advanced capabilities for conducting experiments (including those for optimization) [5].

When creating a new model, the AnyLogic working window shown in fig. 1. In the center of the work window is the area for building a model - graphic editor (Main section) and on the periphery are work panels with the corresponding sections and control buttons.

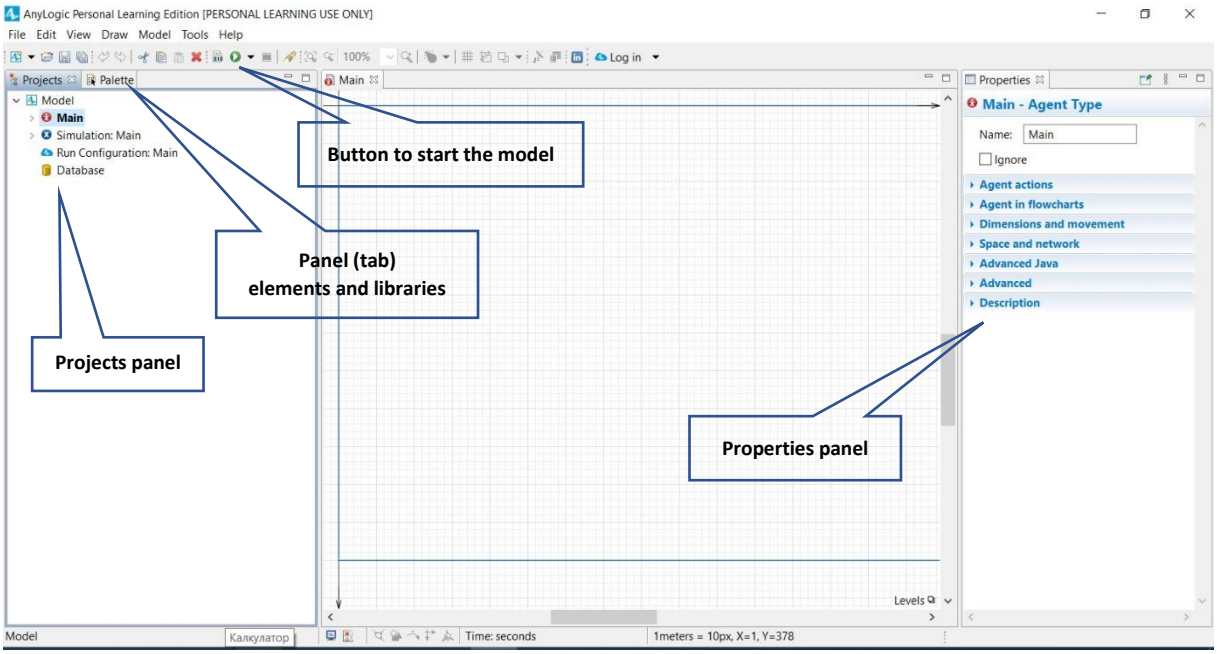

Fig. 1. AnyLogic working window

The design of a simulation model of multimodal transport is performed by the panel with elements and libraries. To create the model, you can initially use the ready-made template Supply Chain GIS Model (Fig. 2) [6, 8] or create a new one by first selecting the required map using the GIS Maps element, on which routes will be drawn. 3.

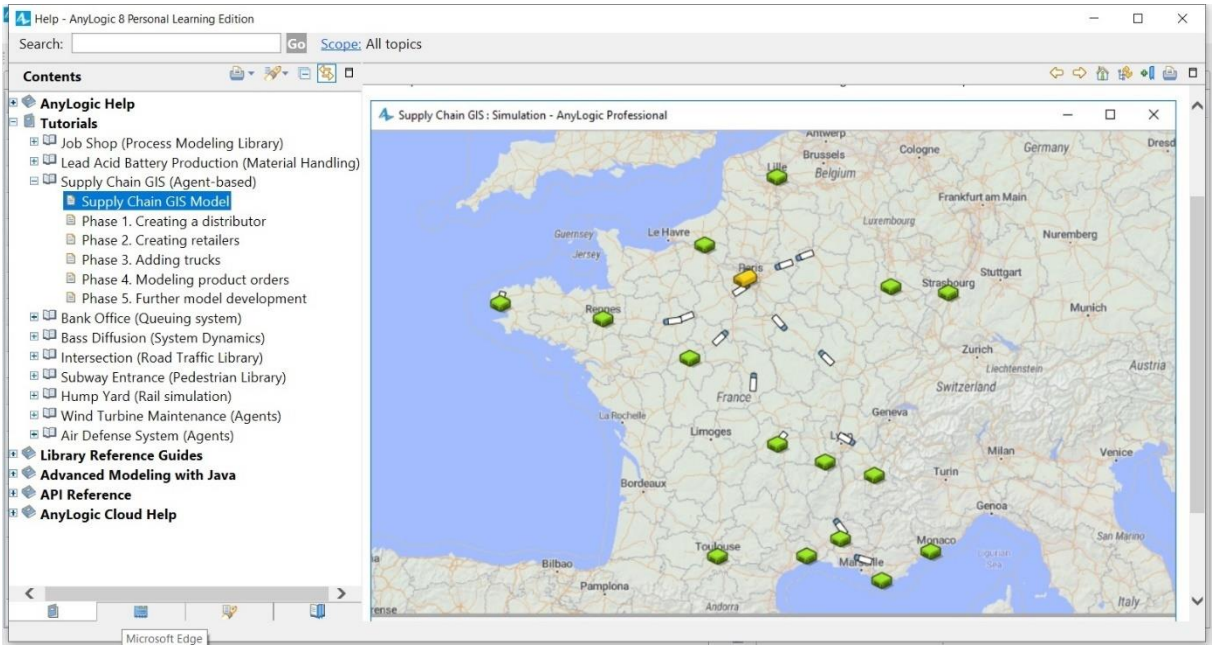

Fig. 2. Supply Chain GIS Model

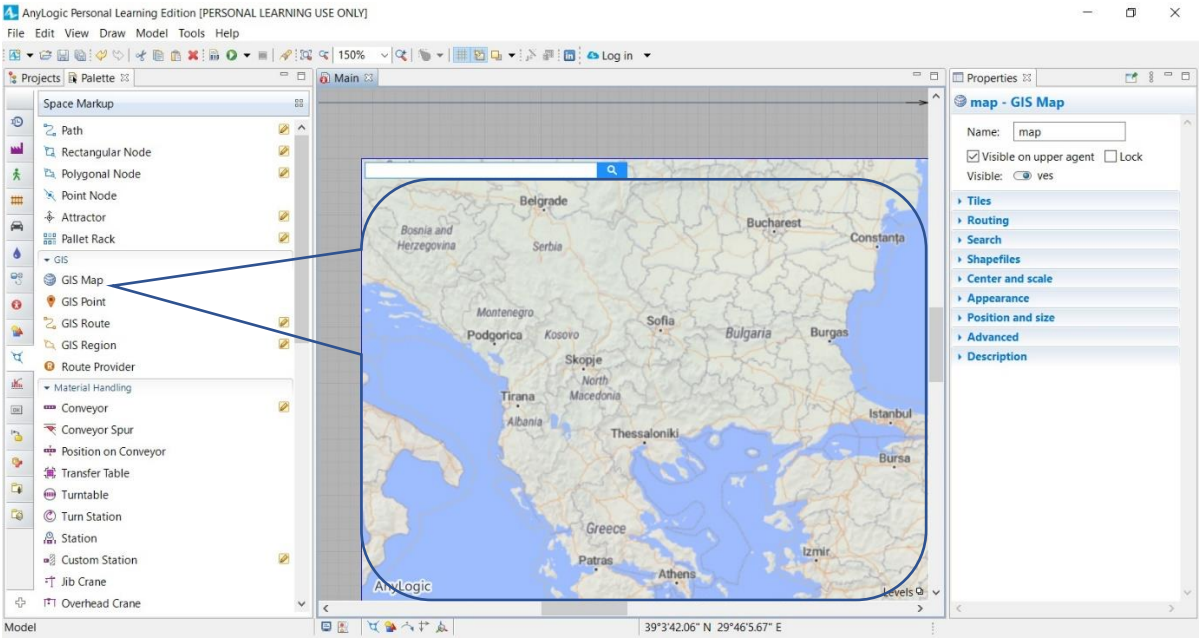

Fig. 3. Select a map from GIS Map

After the development of the model and the planning of the routes (Fig. 4) the simulation of the model is started (Fig. 5) and an analysis of the obtained results is made.

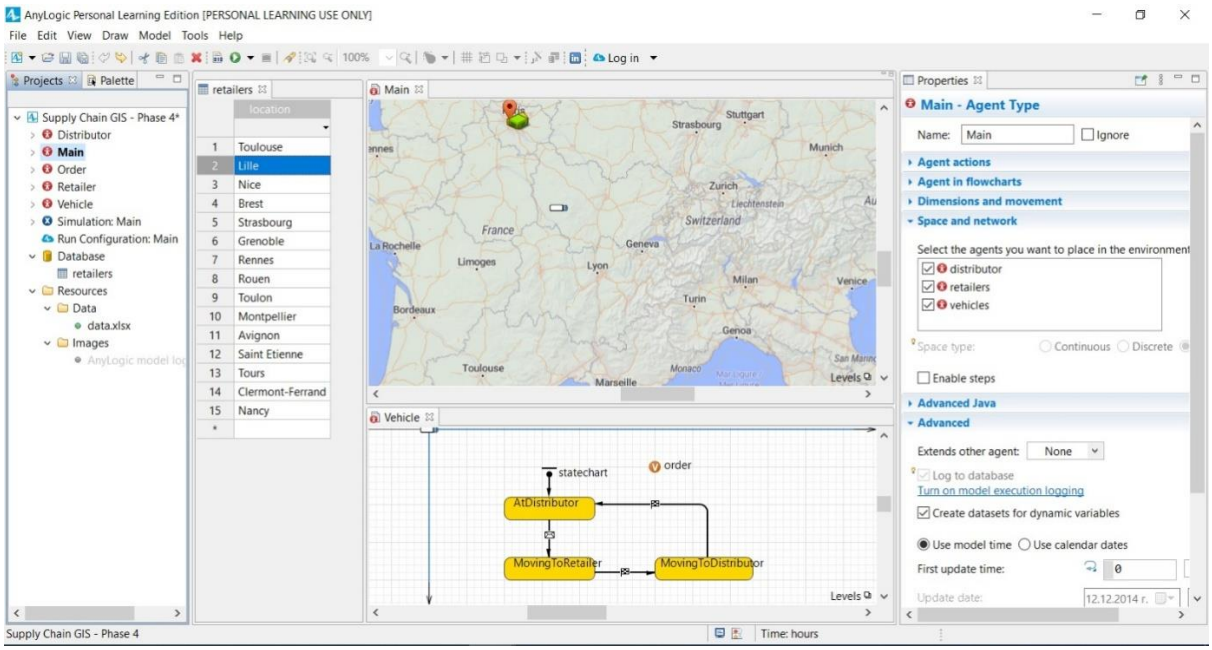

Fig. 4. Route planning

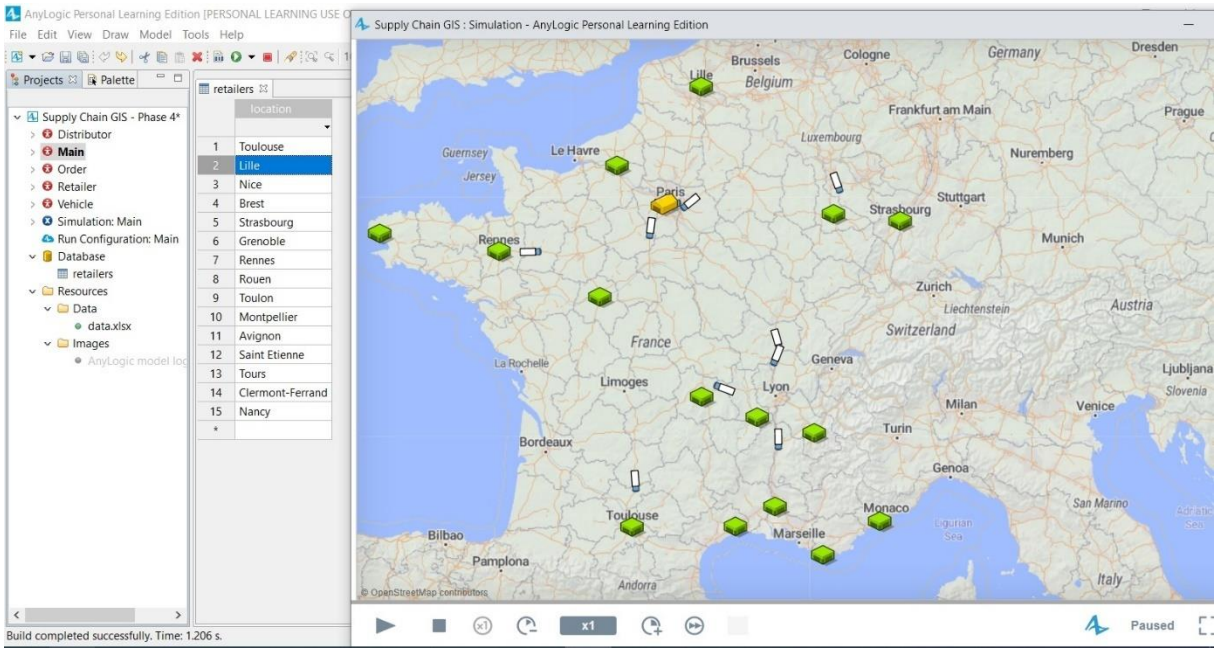

Fig. 5. Simulation model

Implication

After summarizing the results of the simulation, the efficiency of the developed routes can be seen. Errors are found in planning the time to complete the task, such as failing to set time for loading and unloading, waiting for terminals or ferries, as well as rest time.

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