Container Yard Planning and Managem
AnyLogic Simulatio

Ports & Terminals

Problem

The volume of cargo traffic in Russian ports quadrupled during the period from 2000 to 2016. The growth of cargo traffic led to the need to build new modern terminals. Another challenge, in this regard, was the choice between the creation of new terminals and the modernization of the existing ones. This choice would depend largely on the quality of pre-design solutions

managing company hired an engineering company, Morstroytechnologiya, to devise maritime container yard planning.

Simulation model for maritime container yard planning (click to enlarge)

When developing the container terminal simulation models, it is necessary to determine the required technical characteristics of the cargo terminal, including capacity and throughput of warehouses and cargo fronts, as well as the terminal's specific characteristics (for example, the average number of storage tiers for a container terminal). These parameters are determined according to the volume and annual cargo traffic structure.

Previously, analytical methods were used at the maritime container terminal planning stage, but these methods have significant limitations. First, they embrace only the basic probability distributions and define only average indicators at the output. Probability distributions do not include the option of working with the ship arrival schedule, and they do not allow for the consideration of random factors like equipment failure, local violation of the ship arrival schedule, delays within the time frame, and bad weather conditions. Secondly, they do not offer tools to assess resource distribution among transport operations and, therefore, to determine the optimal number of vehicles. Thus, the

Container terminal simulation modeling allows users to consider these shortcomings and make more accurate and feasible calculations. Therefore, to create container terminal simulation model, Morstroytechnologiya sought advice from consultants.

First of all, the consultants needed to coordinate the high-quality service of cargo traffic with the efficient use of terminal capacities. To do this, they had to:

- Determine the technical characteristics of objects inside the terminal.
- Determine the optimal local logistics within the terminal.
- Include in the model the structure and content of the cargo traffic.
- Check the efficiency of the proposed solutions.

For these purposes, they applied AnyLogic simulation modeling.

Solution

When creating the container port simulation model, the following structural elements of the terminal were specified:

- Sea Cargo Front (MGF)
- Railway Cargo Front (ZHF)
- Motor Vehicle Front (AGF)
- Warehouse
- Ports of entry
- ZHF buffer zone

containers.

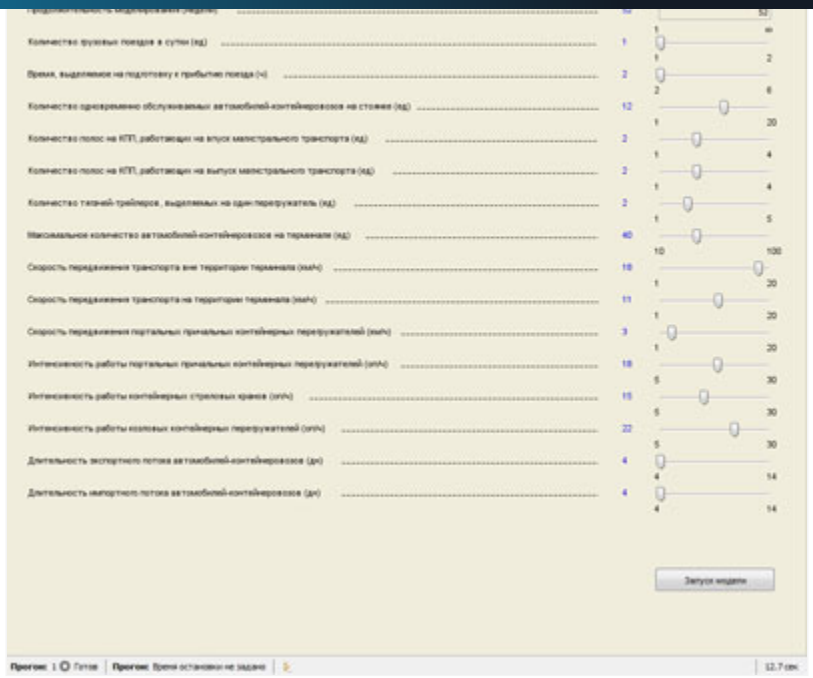
- The intraport logistics parameters - the model allowed them to specify the permitted lengths of queues and to consider various warehouse layouts, the amount of storage equipment, work intensity, storage area, and height.

The container terminal simulation in the AnyLogic environment contained another advantage, which was the additional option of entering data using MS Excel tables (Access). This granted them the possibility to work not only with simple numerical parameters (vehicles' movement speed), but also with complex data structures (ship arrival schedule, cargo volume distribution).

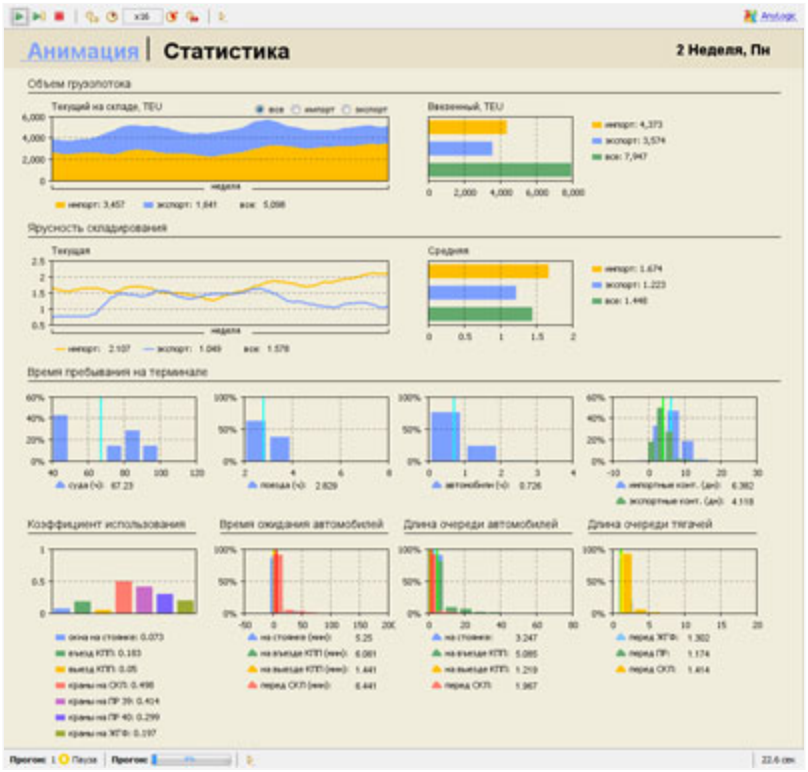
When working with the maritime container yard planning model, the specialists could observe a change in a number of dynamic parameters:

- Export and import cargo traffic volume
- Container storage tiers
- Time of transport stay at the terminal
- Degree of technological equipment usage
- Mainline transport service waiting time
- Main and intraport transport queues' lengths

The simulation results were presented in three formats: graphic, text, and chart, which was another advantage. The use of temporal diagrams and histograms helped to better visualize the results. The results can also be saved to external files.



Parameters of container terminal simulation model
(click to enlarge)



Container terminal simulation model outputs
(click to enlarge)

container effect at multi-tiered storage).

- Proposing the algorithms for elimination of these shortcomings (for example, the optimal storage height for various storage systems).
- Clarifying some technical parameters of the terminal.
- Getting an insight into the process behavior during random and non-random changes in the cargo traffic.

Simulation that acts as a container port simulator and best matches real processes allows users to make well-grounded decisions about internal objects placement within the terminal. Running a model helps them choose the most optimal configuration that will significantly increase the terminal's pass-through capacity, and, therefore, lead to an increase in turnover and improvement of service quality.

Since container terminal simulation met the expectations of the customer and made it possible to solve a number of tasks on facility optimization, the specialists of Morstroytekhnologiya decided to design a universal model of the sea terminal. It can be used as a technological base for creating simulations of other types of terminals (liquid, bulk, etc.). The structure and degree of detailing may vary depending on the needs of a particular project.

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