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Simulation of the Transport Centre Process by Using Special Tools

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Abstract

The simulation software represents progressive contemporary experimental technique, which can support complex processes of infrastructure planning and all of activities on it. It means that simulation experiments, reflecting various planned infrastructure variants, investigate and verify their eligibilities in relation with corresponding expected operation. The paper presents special simulation software made for Department of Railway Transport by Simcon Company for simulation infrastructural layout and technological activities of complex transport centre – marshalling yard, intermodal terminal, warehouse and relations between them.

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Keywords: marshalling yard; intermodal terminal; warehouse; transport technology processes.

1. Introduction

Planning of infrastructure and processes in logistic center within the frame of various kinds of logistic hubs and technological activities in them represent quite complex problem. The main goal is to design appropriate layout, which enables to realize expected operation on the desired levels. The most effective tool for solving problems of transport terminals satisfying these requirements is simulation model of the transport terminal. The principle of simulation techniques is the replacement of the existing or the designed transport hub by dynamic computer model of the hubs, which reproduces well the processes and animate the real system. This method allows the experimenter to verify the computer to simulate the series of different operational scenarios of terminals (Márton 2013).

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Consequently, in practice, it can recommend the implementation of such measures, which verify the simulation model and has led to the terminal operation at the required qualitative and quantitative level.

Creation of models in rail transport is actually dealing with two at first glance significantly distant disciplines (Fabián 2011). The first and also keys' discipline is area of information technology – technology of creation and use of simulation models of complex service systems. The second discipline is the area of transport technologies, in particular technologies in marshalling yards, intermodal terminals and warehouse.

2. Tools of simulation processes used in transport

Computer simulation is a method that is used for analysis, evaluation and optimization of systems that exist or could exist (Kolarovská 2013). The basic process includes building a computer simulation model, abstraction, experimentation, interpretation and use of the results.

Although such connection may be a little unusual, in this case it is deliberate. If the task is to establish the quality transport engineers in rail transport, they shall have acquired not only technological disciplines transport but also the various simulation techniques.

There is displayed the demonstration processing the technological process of ending train in Fig. 1. Some processes with ending train in marshalling station are serial some are parallel.

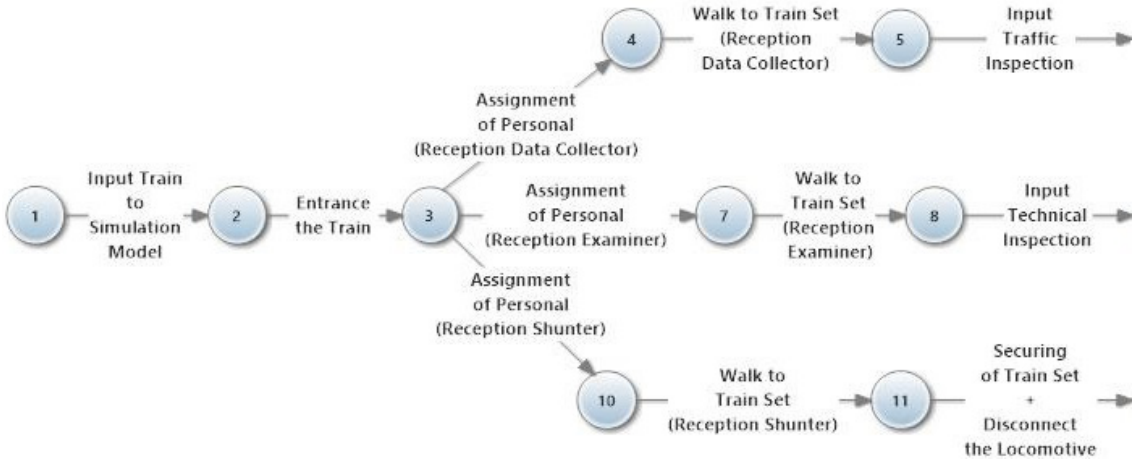


Fig. 1. Example part of technology processes of the ending train.

3. Transport terminals

Transportation terminals are also known as logistics centers. They are places of the transport system which perform the sorting transport elements from one set to another.

Some of the most famous types of transport terminals in railway transport are:

- the marshalling yards, where the wagons are sorted between transport set (freight trains) for individual destinations;
- container terminals, which have multimodal dimension similar as the passenger terminal (typically they meets rail, road and waterborne), but their function is sorting (transshipment) of containers;
- warehouses, which function is to balance unevenly dimensioned material flows in terms of time, space and product range.

Transport terminals are among the most complex and comprehensive service systems. They include expensive and complex technical equipment and complicated technological processes (Buková 2011).

They have been designed and managed so as to ensure the necessary performance and quality of service processes at minimum cost to the utility source. This can be achieved by various means. Some of them are

modification of infrastructure, use of alternative types of resources, improving the work schedule of resources, improvement of technological processes, modification of decision-making strategies or complete reengineering of transport terminals.

Due to the high complexity of transport systems the application of exact mathematical methods are very limited.

Classical expert studies without using objective tools of management do not give sufficiently objective arguments and this may cause concerns for the decision or even aversion to implement any rationalization measures.

In relation to transport terminals various problems are solved and also with varying degrees of complexity. We can divide these problems into two basic categories – spatial planning (design) and planning processes of technological activities, including the management of employees' work.

4. Simulation by using the special tool – Byron

Department of Railway Transport use for simulation of transport technologies software Byron made by Simcon Company for simulation infrastructural layout and technological activities of complex transport centre – marshalling yard, intermodal terminal, warehouse and relations between them.

This simulation model of the transport (logistics) center, enables modelled and simulate the various processes in one common the configurable applications. The aim of the simulation model is a logistics center, which can contain any combination of modules: marshalling yard, warehouse and intermodal terminal.

4.1. Module Marshalling yard

Marshalling yard is an important hub in the process of rail transport. Marshalling yard simulation model allows users to choose from several standard configurations each track groups. For approximation in marshalling yard are activities and especially dimensioning of each source (Márton 2011). The model also allows simulate several variants of technological processes. These options give the technologist and users a comprehensive view of all the factors of individual capacities and processes of marshalling yard. Allows the technologist to choose:

1. Standard configuration of rail groups (serial or parallel);
2. Number of tracks in each group (reception tracks, sorting tracks – shown in Fig. 2, departure tracks, secondary sorting tracks).

The main part of specifying configuration parameters yard is completed with a choice:

1. Configuration from a predefined set of rail groups;
2. Method of sorting wagons.

Input parameter flows are presented by the cars which are transported by in trains. Every wagon, including pallets stored therein, shall be defined destination (Čamaj 2011). Output flows are presented by the outgoing train sets, which are formed by the need to (enough number of wagons – the collection of standard) or on a timetable (scheduled requirement).

4.2. Module Intermodal terminal

The intermodal terminal provides a basic preview of the infrastructure and processes in terminal. Example of 2D model of intermodal terminal is presented in Fig. 3.

The model allows technologist to choose between two basic types of internal infrastructure, with defined handling tools:

1. The first category terminal – rail mounted gantry crane with above and reach stacker with above spreader,
2. The second category terminal – reach stacker or side stacker with above spreader.

Each configuration of intermodal terminal contains the one module with the following parameters:

1. The number of rail tracks for trains;
2. The number of lines on the road and parking lots for trucks;
3. Capacity of storage area (containers, semitrailers);
4. Input flow (by road/rail transport);

5. Output flow (by road/rail transport).

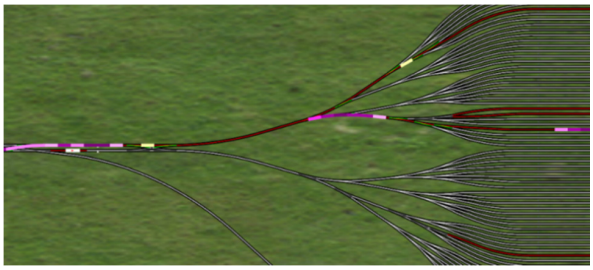


Fig. 2. Sorting process in simulation model.

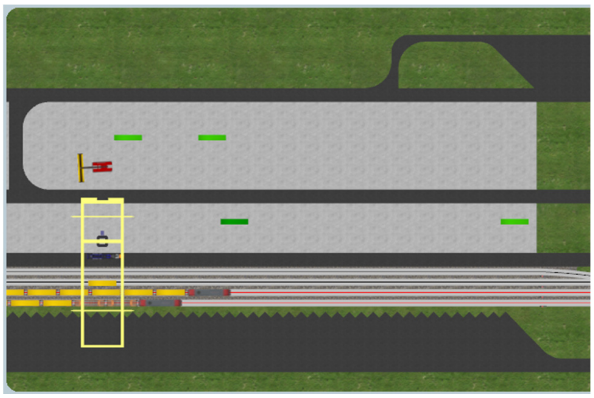


Fig. 3. The intermodal terminal in the simulation model.

Input parameters flows represent containers and semi-trailers, which are loaded on the wagon, then a truck with a container or truck with semitrailer. Output flows represents the requirements for delivery of containers and semi-trailers (Dolinayová 2010). Requirement occurs randomly or according to a fixed time (planned requirement for delivery).

4.3. Module Warehouse

Storage is the inseparable part of every logistics system. Warehouse is the object or area specifically designed and intended for the storage of goods, which is equipped with storage technology and equipment intended for the reception, storage, handling, repair and distribution of goods.

The modelled warehouse allows create links between railway and road transport.

The technologist has a choice of two basic types of infrastructure, with defined handling tools:

1. Type 1 – warehouse with forklift truck or forklift supported;
2. Type 2 – warehouse with vehicles with thrust and twist fork or stacker. The layout of warehouse is defined on the basis of selected type of handling equipment with a specified minimum building module.

Input parameters flow is presented by the palettes that can be loaded in sets of railway wagons or with pallets loaded in the road vehicle, or stored in a container. Example of 2D model of warehouse is presented in Fig. 4.

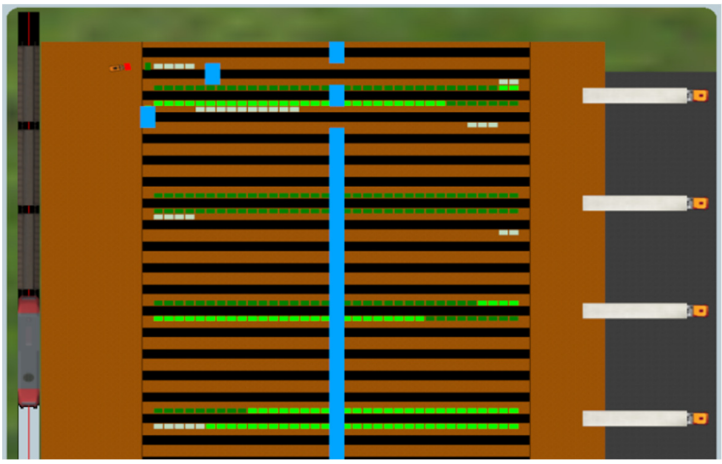


Fig. 4. The part of warehouse in technology process.

Consequently, defined parameters of warehouse are experimentally validated for their ability to store up requests coming in the input stream.

4.4. The relations between modules

There are created relations between all the modelled modules. Output current requirements of any module can be directed to the input current requirements in another module, possibly outside the simulation model (completes went the simulation). A technologist has available all these variants in all modules in process of setting each part. Links between individual modules are shown in Fig. 5.

Fig. 5. Relations between individual modules.

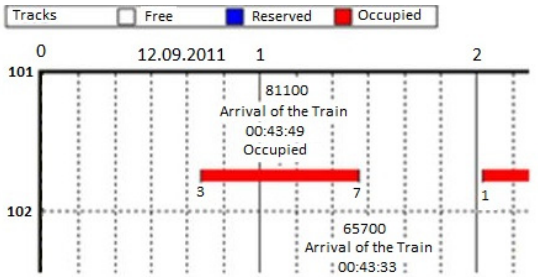
This option explains to technologist all the possibilities of behaviour of the sets. It simplifies the technologist understanding the links between the modelled modules, their interaction and complexity of their management.

Modules can simulate the processes separately, but also all three modules together. The outputs of one module can be input for other modules. Admission requirements to individual modules from outside can enter several alternatives, but also through individual inputs outsourcer.

5. Results of simulation

Evaluation of simulation belongs to the final steps for the simulation run was carried. Technologist evaluates all the set elements in the simulation and interprets individual obtained results. He evaluates adequately all the set parameters of simulation with all restrictions (Kendra 2010.). Technologist also thinks of possibilities to the implementation of a simulation run.

Most of the ongoing processes are 2D or 3D animated according to the input data to the system and runs through the portrayal of a particular infrastructure hub. Successful simulation results can be interpreted in the form of tables or graphical representations of using the various elements over time (Fig. 6.).



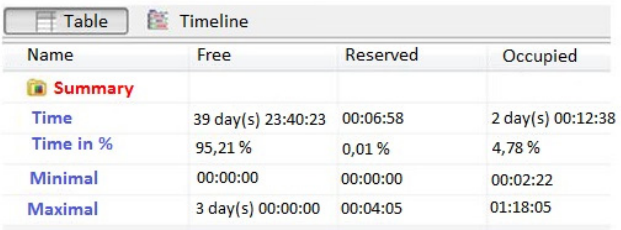


Fig. 6. Results of simulation run: a – graphical results; b – tables results.

Therefore, during the simulation are collected and stored a lot of information about the behaviour of the system. After completion of the simulation, the user has the opportunity to view these collected information in the form of clear graphs and tables. All these graphs and tables (Fig. 6) can be used for analyse the simulation results by user. This ultimately supports the finding of the final decision.

6. Conclusions

1. Planning and infrastructure optimization, scheduling and sources of management practices in transport hubs cannot be done without a thorough and objective assessment of the consequences of the decisions. However, the transport hub represents a complex dynamic system. There are complex links among its elements service processes have a complex interdependencies. A lot of them have stochastic status. Because of this complexity hubs and traffic in them is currently the most effective technique of examining the consequences of decisions experimentation for sufficiently faithful simulation model and operation of infrastructure hub. Obviously, such a complex simulation model hub is also very large and complex. Creating model and its practical use is possible when two conditions are met. The first condition is sufficient performance of the computer used for experimentation. The second condition is the use of such architecture simulation model, which allows creating a model to understand in its complexity, sufficiently intelligible, maintainable and flexible. These architectures are currently the subject of intensive research.
2. The computer simulation as the primary method is used for finding answers to a customer's questions and problems. Simulation of systems enables testing of alternative solutions, proposals and decision-making strategies with essentially lower costs in comparison with experiments on the real system, which are often even not feasible due to financial, ethical and other reasons.
3. Simulation software Byron due to its own variability, construction layout and configuration of applied technology creates the elite place for the evaluation of all parts. Active use of the simulation tool in the teaching of modelling of transport and transport processes is very important for understanding of the synergies activities in all modules. Simulation enables direct visualization and such facilitates the understanding of the activities and feedbacks between them.

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E!6726 LOADFIX – Development of the Software Web Application for Loading and Fixing Goods in Railway Freight Wagons.

References

Buková, B.; Zitrický, V.; Ondráš, Ľ. 2011. Proposal for an information system for support of international rail freight transport. *In LOGI 2011: 12th international scientific conference.* Brno: Tribun EU, 2011.

Čamaj, J.; Mašek, J.; Dolinayová, A 2011. Simulation of marshalling yard in logistic centre. In: *LOGI 2011: 12th international scientific conference, Pardubice, Czech Republic.* Brno: Tribun EU, 2011.

Dolinayová, A.; Kendra, M. 2010. Logistic centres and railway logistic services – economic effects. In: *Railway logistics and rail cargo: proceedings of the 5th SoNorA University Think Tank Conference:* 17th of June 2010, (Erfurt). Erfurt: Institut Verkehr und Raum der Fachhochschule Erfurt, 2010. p. 3–10.

Fabián, P.; Márton, P. 2011. Transportation systems control, optimization and simulation for the 21th century. In: *5th International scientific symposium of transport faculties: "Collaboration creates opportunities":* 14.-15.4.2011, Zilina, Slovakia: proceedings. Zilina: University of Zilina, 2011. p. 107–114.

Kendra, M.; Lalinská, J.; Ližbetin, J. 2010. Using of simulation methodologies in designing of logistics centers. In: *Horizons of railway transport: scientific papers* 1(1): 58–62. Zilina: University of Zilina, 2010.

Kolarovská, Z.; Kolarovski P. 2013. Electronic application for education support at Department of communication. In: *UNINFOS 2013.* The University Information Systems: Ružomberok, Slovakia: VERBUM, 2013. p. 54–59.

Márton, P. 2013. Possibilities of using universal simulation programs for simulating the operation of rail transport. In: *Horizons of railway transport 2013: International scientific conference:* Strečno, Slovak Republic, September 26th and 27th, 2013. Zilina: University of Zilina, 2013. p. 256–261.

Márton, P.; Adamko, N. 2011. *Practical Introduction to Modeling and Simulation*. Zilina: University of Zilina, 2011.