centrum logistyczne,
symulacja, optymalizacja

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LOGISTIC CENTER SIMULATION

Logistic centers are beneficial in the entire scale of their importance, ranging from the economic, ecological up to the social benefits. The costs for the construction of the logistics centers are very high. It is therefore important to set up the sufficient capacity for all partial parts of the logistic center. One possibility is to use the simulation processes to verify the expected future operations in the logistics center. This article deals with the benefits of the simulation processes and their possible use in the design of the new logistics centers.

SYMULACJA CENTRA LOGISTYCZNEGO

Centra logistyczne są korzystne w skali całego ich znaczenia, począwszy od ekonomicznych, ekologicznych do świadczeń socjalnych. Koszty budowy centrów logistycznych jest bardzo wysoki. Dlatego ważne jest, aby ustawić odpowiednią pojemność dla wszystkich częściowych części centra logistycznego. Jedną z możliwości jest wykorzystanie symulacji procesów do sprawdzenia oczekiwanej przyszłej działalności w centru logistycznym. Ten artykuł dotyczy korzyści z procesów symulacji i ich ewentualnego wykorzystania w projektowaniu nowych centrów logistycznych.

1. INTRODUCTION

Transport and logistic is a part of every developing society. The amount of the transported goods increases every year. There is an increasing demand for the quality services. Besides the positive effects of goods transport is growing its negative impact on the environment. They are primarily the exhaust emissions, the occupation of the arable land, the noise, the vibration, the congestion and the accidents. [1] It is necessary to find a compromise between the demand for the transport and the requirement of the environment protection.

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Each mode of transport has its own strengths and weaknesses. It is necessary to do the transport of goods with a combination of such modes of transport where the negative impact on the environment is as low as possible. A combination of different transport modes requires the good places for the transshipment, the storage and the beneficiation of the goods. The modern logistic centers meet these requirements.

The construction of the logistic centers is very expensive. It is very difficult to properly design the capacity and number of the handling areas and equipments.

2. REQUIREMENTS FOR LOGISTIC CENTERS

The logistical centers are inseparable part of forward market economy. Logistical centers not only serve commodity with clients but sustain of useful reserves of products and accelerate international market. The term “logistic centre” has been used to describe centers performing a broad spectrum of logistical functions and business processes. The term combines logistics, which refers to all operations required to deliver products or services excluding producing the goods or performing the services, which stands for a place where a particular activity is concentrated. [2][3]

The foremost tasks of logistical centers can be summarized as follows:

- the integration of the different kinds of the transport to the traffic chains,
- projection and realization complex logistical chains between suppliers and subscribers,
- practice different logistical tasks for clients,
- preparing, realization and repairs of needed infrastructure for partners,
- preparing, realization and repairs of needed informative, managing and communication system. [4]

Every logistic center should be connected to road, rail and water infrastructure. Therefore besides the storehouse, the railway classification yard and intermodal terminal are an important parts of large modern logistic centers. Every part (storehouse, railway classification yard, intermodal terminal) can operate independently and it is possible to monitor all the processes in these partial components. It is necessary to follow the accouplements and the flows between storehouses, railway classification yard and intermodal terminal to optimize logistic processes of the entire logistic center. Optimizing of the processes in partial parts of the logistics center and between them can achieve the great synergies.

All activities in the logistic center are carried out gradually in the partial parts of the logistic center. The service in the next section can be realized only after using the service in the previous section. The logistics center can be seen as a complicated system of queuing. Every queuing system can be characterized by:

- the input current requirements,
- the queue,
- the time operation
- the line services,
- the output current requirements.

3. SIMULATION MODELS

It must be done a sufficiently accurate mathematical scheme (model) to be able to predict the activities of the queuing system. Modeling expected build the model, which has characteristics derived from the real system. It displays all or only those facts that are important for the process. The model is thus a simplified picture of the reality.

In simple the models can be divided into:

- mathematical models - are formulated as a set of the equations, describing the studied system, including the restrictions and requirements on the input and output variables,
- analytical models - providing results in the form of the general functions for a various values of the input data,
- simulation models - in terms of computer they are the algorithms, by which it is possible to simulate the events and processes. [5]

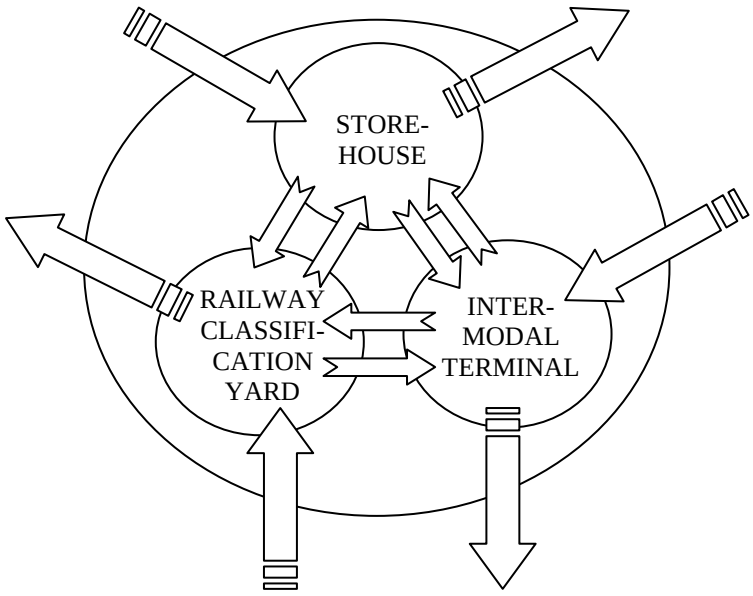

Fig. A simplified scheme of the logistics center

Simulation method currently seems to be practically available method suitable for the examination of the complex technological problems. Its importance is increasing, especially in the designing and upgrading of the technology units. The labor input and material resources necessary to implement the simulation models are now insignificant compared to the costs associated with the experimentation in the practice.

The use of the simulation model can verify the plans and intentions. They can be accordingly changed before the system is placed in the realistic conditions. The

simulation modeling is convenient to use for the designing of the large and modern logistic centers, too.

Key stages of the work in the simulation modeling are:

- analyzing of the problem,
- selecting a solution method,
- modeling of the task,
- selection of the means for the model implementing,
- programming,
- experiment preparation,
- conduct of the trial,
- evaluation.

The model of the logistic center will be done as a common configurable application. The aim is to do the model which can include any module combination of:

- the railway classification yard,
- the intermodal terminal,
- storehouse.

4. LOGISTIC CENTERS - QUEUING SYSTEMS

The processes which take place in the logistics center are stochastic, not deterministic. [6] Therefore, the entry requirements into the system, the time of the handling and output current requirements can be described only by using the various probability distributions, for example normal, Poisson, Erlanger, exponential, gamma,... The disadvantage is that it is necessary to know the expected course of the input variables. They may be inferred from the statistical data obtained from the previous periods. It can be used for example $\chi 2$ test of good compliance to verify the input data.

The basic output characteristics obtained from the simulation modeling could be:

- likelihood of the entry requirements refusal,
- average queue length of the requirements in the systems,
- maximum queue length of the requirements in the systems,
- average waiting time of the requirements in the systems,
- maximum waiting time of the requirements in the systems,
- average time which spent requirements in the systems,
- maximum time which spent requirements in the systems,
- utilization rate of the operating lines in different systems,
- limiting spaces in the systems,
- average number of the requirements contained in the systems,
- variance of the requirements contained in the systems,
- etc.

What can be suggested based on the results obtained during the simulation model:

- number of the operation lines,
- deployment of the operation lines,
- required capacity of the operation lines,
- technological process works,

- desired area for the entire system,
- financial budget of the implementation,
- required reserve funds,
- etc.

5. PRACTICAL APPLICATION

Simulation modeling can verify before the construction of logistic center:

- for the storehouses:
  - number and capacity,
  - type and number of the handling equipment,
  - size of the handling areas,
  - storage technology,
  - staffing demand,
  - process times,
  - load carrying capacity,
- for the railway classification yard:
  - structure of the railyard,
  - number of the tracks in the railyard groups,
  - number of employees and locomotives,
  - technology of the primary and secondary splitting,
  - normative times,
  - operating efficiency,
- for the intermodal terminal:
  - type and number of handling equipment,
  - size of the handling areas,
  - technology of the transshipment cargo units,
  - staffing demand,
  - process times,
  - load carrying capacity.

6. CONCLUSION

Simulation modeling provides a comprehensive and dynamic view on the whole technological process and can provide the necessary information about its behavior. Simulation modeling is advocated as a suitable method for the verification of strategies for the construction and management of the modern logistic centers.

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This paper is prepared with the support of the project "**Transfer of innovative knowledge and technology in logistics and transport processes**", ITMS project code 26220220006, **University of Žilina**.

ERDF – European Regional Development Fund
The project is financed by funds from the EC