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# Implementation of distribution model of an international company with use of simulation method

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**Abstract**

Customers all over the world have great expectations in terms of the delivery and availability of supplied items. It is thought that the most important, both for suppliers and their customers, are short-term orders realisation and flexible services. Simulation methods can be a strongly support for an entrepreneur in decision making process connected to these expectations or short-period and long-period planning. Simulation methods ensure possibilities to test and analyse different kind of "what-if" scenarios of distribution systems such as: potential surplus of orders or other untypical things mostly describes as force majeure. The main aim of the paper is to consider simulation model of distribution system that occur in one international entrepreneur that operates in the area of Poland. The paper consists of literature review, a reference model of the original system with elementary formal notation included and a reference model implementation into simulation software (in form of simulation model), conclusions and potential directions on the model development. The model of the distribution system consists of vertices and edges. Chosen vertices are elementary form of logistics facilities such as warehouses and production facilities such as factories. Meanwhile, edges are real shaped routes between verticals, if they exist.



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## 1. Introduction

Distribution as one of the processes of logistics and transportation is of high importance for many enterprises. This process can be studied as multi-alternatives issue. It is known that simple structure of distribution process for

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a company can be analyzed with use of analytic modeling. It becomes complicated to obtain many alternatives when number of customers and logistics facilities increase in an original system or in other words in a company distribution structure. "*Analytical models are usually applied to obtain exact analytical solutions for planning problems rather simple systems. If a solution of such a mathematical model is available and is computationally efficient, it is usually recommended to study the model analytically rather than by a simulation model*", [7] after [9]. Contrary, in this case simulation methods might be significantly more supportive.

Defining after [3,4,5], a simulation is an imitation of systems and processes occurring in reality. Author of [10] defines simulation as imitation of dynamic process taking place in a system by using a suitable experimenting model to obtain information that are possible to transfer in the reality. These and many other definitions of a simulation indicate that it is an imitation or imitation of reality. It is important to adopt appropriate assumptions that "imitation" was adequate to "reality."

Simulation methods are used when it is impossible or very difficult to obtain analytical solution of given problems. The basic contents of simulation theory are omitted here – these are referred e.g. in [8,11] etc., who identified the main types of simulation, the advantages and disadvantages of using simulation methods and simulation models.

There are various software tools for the construction and analysis of simulation models. From the point of view of logistics and transport, simulation packages of the largest usefulness are characterized by the fact that its operating structure uses the concept of modular graphic implementation, and modeling occurs as a series of discrete events, [6]. Among this type of software *Tecnomatix Plant Simulation* is used in research on logistics aspects (among many other simulation tools such as *Dosimis-3*, *Arena*, *Automode*, *Promodel*, *Quest*, *Witness*, *Mosys*, *Taylor*, *Enterprise Dynamics*, *FlexSim*). *Tecnomatix Plant Simulation* in recent years is becoming widely used in scientific research and industrial applications, mainly in logistics and production. The software is used in the research described below and it is described very precisely in [1,2].

It must be mentioned here that some data considered in the paper were obtained from a successful entrepreneur, whom expressed the wish for anonymity and a part of an original system is fictitious (there are no high-bay warehouses in the company structure).

## 2. Original system

The distribution system of an international company described in the paper (so-called original system) consists of four high-bay warehouses which boost twenty five logistics facilities of company customers. Every of warehouses and logistics facilities is described by numerous organizing and technological characteristics. Among these characteristics can be ascribed data such as: location of the logistics facility, number of docks or ramps per facility, definition of control strategy (e.g.: serve outgoing first, serve incoming first), shift calendars and precise plan of supplies in period of time. Plan of supplies in period of time describes how many pallet load units is transferred between start and destination points of transportation (time of leaving a high-bay warehouse to transfer some load is also given in a plan of supplies). Plan of supplies is realized by trucks that are at company disposal (velocity of trucks depend on daytime, which is given in the Table 1.)

The mentioned characteristics are changeable in the everyday functioning of the company, therefore it is described overall here. More adequate data are given as a case study.

Table 1. Values of trucks velocity in a period of daytime.

| Beginning of period in daytime [hh:mm:ss] | End of period in daytime [hh:mm:ss] | Mean value of trucks velocity in a period of daytime [km/h] |
|---|---|---|
| 00:00:00 | 07:00:00 | 90 |
| 07:00:00 | 12:00:00 | 60 |
| 12:00:00 | 17:00:00 | 70 |
| 17:00:00 | 21:00:00 | 60 |
| 21:00:00 | 00:00:00 | 90 |