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Study of Production Scenarios with the Use of Simulation Models

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Abstract

Simulation studies are gaining in popularity and are used in many scientific fields. Implementing computer solutions in production engineering allows reducing costs that an enterprise incurs due to erroneous decisions while planning and modernising production lines. This is also helpful in the reduction of the time required to develop plans for manufacturing new products. This problem is important in manufacturing companies that seek to reduce the volume of stocks while ensuring the continuity of the production process. The article presents possibilities of applying computer simulation models in studying chosen production scenarios. The basic methods of research used in the study were literature studies and computer simulation.

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1. Introduction

Studying phenomena and processes is the aim of many research programmes. This involves the application of various methods, beginning with practical activities in the form of observations, and ending with theoretical analyses. Such procedures require a mathematical apparatus. In the contemporary world dominated by ICT tools, a computer simulation becomes an exceptionally significant and effective research method. It reflects the studied phenomenon or a process in a form of a computer programme, also called a computer model, which is created with the use of a mathematical model [1].

A computer simulation, as a method, is a system of research activities, i.e. a structure of stage activities aimed at achieving a research objective. These are the following activities [2, 3]:

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- formulating a problem
- creating a mathematical model
- formulating a programme for a computer
- checking the appropriateness of the model
- planning simulation experiments
- performing a simulation process and analysing the results.

Simulation is an approximate imitation of a studied phenomenon or behaviour of a given system in the virtual space with the use of its so-called simulation model. A simulation model is based on a mathematical model frequently recorded in the form of a computer programme. At present, there exist many tools for conducting computer simulations that allow for creating simulation models [4]. Simulation models are used in order to reduce the risk of failure while implementing significant changes into the existing manufacturing systems. Upon generating the model, a simulation analysis is performed so as to determine particular elements of the process. The model of a studied system presents its properties, features and limitations, as well as the manner in which the process in specific conditions takes place. Simulation, by means of adequate tools, allows for a respectively simple and cheap way of verifying different variants connected with the functioning of the processes [5].

With a view to the objective of the simulation, it can be divided into three types [6]:

- a simulation aimed at understanding the principles of the functioning of the system and its properties that are difficult to distinguish on the basis of a formal analysis
- a simulation aimed at facilitating decision making within the functioning of the system
- a simulation, whose aim is to train people within decision making concerning the functioning of the system.

The simulation of production processes is a technique used for solving problems occurring in the course of the manufacturing process. It is based on virtual models [7].

2. Simulation models in production engineering

Contemporary production is characterised by a wide selection of products, reduction of the product's life cycle, production costs and time span between designing and launching products [8]. Gathering operational data in the real time is essential for measuring the compatibility of results with the plan [9].

Simulation studies are applied to and are used in many scientific fields [10, 11]. The application of a simulation in production processes constitutes a form of experimenting on a computer model. Its objective is to provide an answer to the question on how the production system will react to various situations, according to arranged scenarios. Implementing computer solutions in production engineering allows for reducing costs that an enterprise incurs due to erroneous decisions while planning and modernising production lines. This is as well helpful in reducing the time required to devise plans for manufacturing new products. The application of simulation models allows for a more effective selection of manufacturing strategies by enterprises. Simulation models are typically used when it is impossible or very difficult to devise an analytical solution of a studied problem. This takes place in the case of analysing a dynamic behaviour of production systems and processes. An adequate selection of strategies and skillful management of chosen tools, including methods of computer simulation, allow for and facilitate solving problems occurring in the activity of an enterprise [12].

Simulation, as each method, has its pros and cons [13]. Benefits of a simulation:

- a simulation allows for arranging a form of a system with the use of experiments directly conducted on the studied model
- it may be applied for analysing large and complex decisional problems that cannot be solved with the use of other methods
- it allows for quick preparation of decisions thanks to analysing the effects of experiments conducted for many alternating periods

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