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UTILIZATION OF PROGRESSIVE SIMULATION SOFTWARE FOR OPTIMIZATION OF PRODUCTION SYSTEMS IN THE AREA OF SMALL AND MEDIUM COMPANIES

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Subject review
In current situation of fast transition of world economy to competition in efficiency, European production companies are forced to deal with painful transformation, while passing through often, in last decade impossible, changes of economical conditions. Intensive global contest makes industrial companies to focus more closely to reinforcements of marketing and to quick reactions to increasing requirements and expectations of customer. This article surveys the problems of bridging the technological gaps between small and big companies with the use of simulation technologies for creation of simulation models of concrete production systems, which means giving the CIM technologies access to the environment of small and medium companies in order to improve their competitiveness.

Keywords: *factor/AIM software, production, simulation*

Uporaba progresivnog simulacijskog softvera za optimiziranje proizvodnih sustava u području malih i srednjih poduzeća

Pregledni članak
U današnje vrijeme brze tranzicije svjetske ekonomije ka natjecanju u učinkovitosti, europska su proizvodna poduzeća prisiljena baviti se mukotrpnom transformacijom prolazeći, zadnjih desetak godina, kroz česte promjene ekonomskih uvjeta. Zbog tog intenzivnog globalnog natjecanja industrijska su poduzeća prisiljena više se usredotočiti na bolji marketing i brzo reagiranje na sve veće zahtjeve i očekivanja kupaca. Ovaj se rad bavi problemom smanjivanja tehnoloških razlika između malih i velikih poduzeća korištenjem simulacijskih tehnologija za izradu simulacijskih modela stvarnih proizvodnih sustava, a to znači pružanje mogućnosti da CIM tehnologije uđu u mala i srednja poduzeća kako bi se povećala njihova konkurentnost.

Ključne riječi: *faktor/AIM softver, proizvodnja, simulacija*

1 Introduction

Complexity of solutions that are needed in the field of current company tasks forces us to leave the area consisting of well known analytical methods and move to progressive concepts and solutions. One way to utilize simulation techniques is to use the simulation method with implementation of the principles of discrete simulation. Thanks to this method we are able to verify the correctness of the proposed solutions. It is possible to get an objective evaluation of achieved results and to compare individual alternatives. This method is based on the generation of a production system model which behaves as a real one [5, 6].

Development and availability of modern computing techniques bring the simulation into new areas such as logistics, transportation, particular fields of engineering sector, etc.

Simulation presents an experimental method where the studied object is substituted with its simulation model and all the experiments and tests are realized with that model in order to obtain the information and conclusions about the original system [7].

The principle of simulation lies in the fact that there is a simulation model of real system created in computer environment. Then it is possible to realize different experiments. On the basis of these experiments the results are achieved that can, after right interpretation, be used for improvements of the real system [3].

In this way we can in a relatively short time, compared to the realization time using the real system, test the behaviour of the model in different operational situations. Behaviour course can be observed on computer screen in the form of animation or statistical characteristics.

2 Steps for creation of possible alternative solutions with creation of simulation model

First step for the optimization of existing operation is a detailed analysis of existing workplace. Prior to the technological innovation itself it is necessary to find the answers to the following questions [10]:

- What has the greatest influence on the value of production time?
- What are the relations between stocks, course of time and reliability in connection with delivery schedules?
- Which are the so called "bottlenecks" and weaknesses of the system?
- Which investments are meaningful for the concrete orders structure?
- How can sale goals be achieved through suitable changes?

In technological innovation it is necessary to have the following in mind:

- Real cooperative inputs,
- Low operation costs,
- Bearable automation of production process.

At the same time the requested quality and low price of products need to be secured.

Another important step in the creation of simulation model and the realization of the simulation itself is the selection of suitable simulation software. Currently lots of simulation programs exist that are divided according to computer platform, performance and range of use. With

consideration of these facts the price of individual simulation program is different. It has to be said though, that even in the simulation software of the highest price, in most cases of the simulation processes, the cost highly exceeds the benefits achieved.

For the selection of suitable simulation software it is necessary to consider the following system attributes:

a) detailed but clear definition of the system and its environment, together with input and output variables of the system,
b) detailed identification of particular system elements and their connections,
c) detailed definition of functionality of particular components,
d) determination of all parameters that are necessary for monitoring the behaviour of the entire system, determination of variables in time frame of the given simulation experiment,
e) Possibilities to gather the information directly from the company information system.

While working with the simulation software several hours a day it is right to consider also the suitability of the user environment and the interactivity of communication with its user. Welcomed features present the support of quick searching and easy correction of mistakes. An important factor is also the ability of the software to run under most of the used operation systems.

One of the most used simulation software is simulation software tool Factor / AIM that was created by Pritsker Corporation from Indianapolis, USA. Worldwide this company has a number of installations higher than 6000 and is among the leading providers of simulation systems for production planning and management.

It was established in 1973 and deals exclusively with development and introduction of simulation systems. In the area of further development this company closely cooperates with the users of its products. This strong orientation to customers guarantees the solutions that meet the requirements for utilization in practice. In 1997 the company Pritsker Corp. associated with the firm Symix Systems Corp., Columbus, Ohio.

Simulation tool provides solutions for the following tasks:

- Bottleneck analysis
- Capacity planning
- Cost studies
- Gantt studies
- Materials handling studies
- Scheduling studies
- Summary studies
- Throughput studies
- Utilization studies
- User defined types of tasks.

3 Example of creation of simulation project for innovation of existing workplace

Through the analysis of existing workplace we dealt with production and assembly of constructional point displayed in Fig. 1 [4].

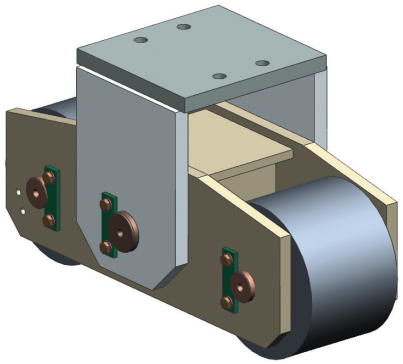
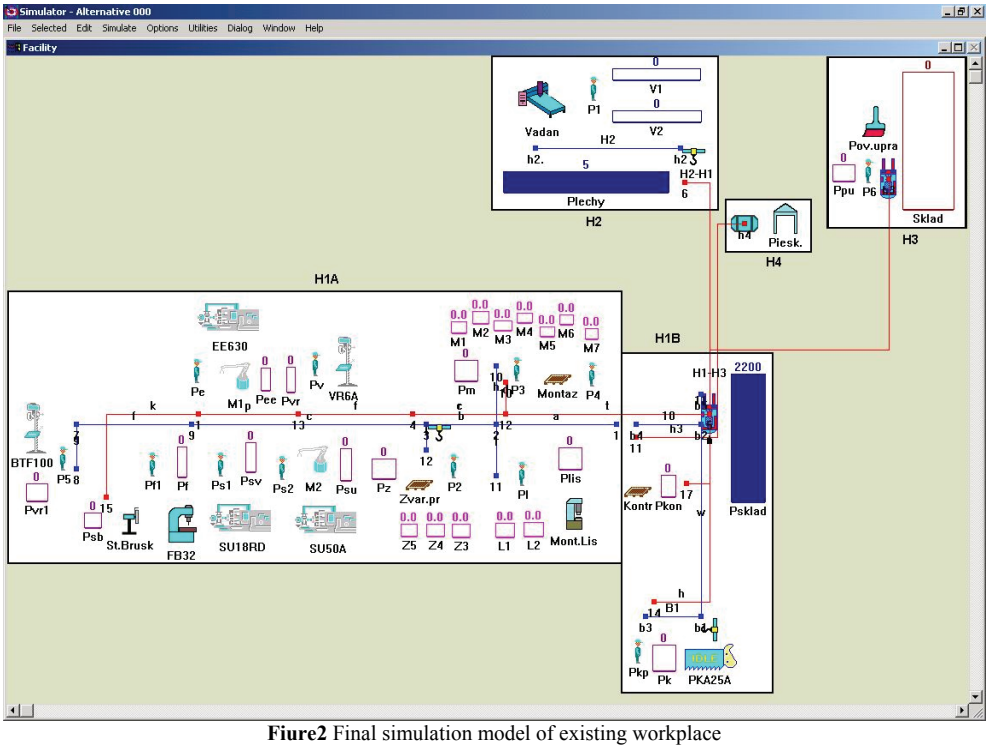


Figure1 Produced constructional point



Fiure2 Final simulation model of existing workplace

Technical parameters of product:
- weight: 720 kg,
- total number of parts in assembly: 59 pcs,
- number of types of parts: 17 pcs,
- dimensions ($l \times w \times h$): 1050 × 455 × 570 mm.

Before the simulation itself it is necessary to gather detailed information about proceeding of production and all the input parameters. On the basis of these parameters a complex simulation model of existing workplace can be created (Fig. 2).

In the next phase it is necessary to define the process plan. As the production technology used for different parts varies, more process plans need to be elaborated. A process plan presents the order of particular allocation rules that define the technological process of parts production.

Next step is the creation of innovated alternatives to simulation models where after realization of experiments we evaluated the benefits achieved with the changes in production system.

The simulation program output is usually presented in the form of graphs which can be used for evaluation of individual alternatives with the given input values. For quick and easy evaluation the simulation software offers a lot of graphical expressions:
- production efficiency,
- proportion of production and non-production time,
- usability of all devices and workers from the shift,
- idle times and downtimes of individual machines,
- Gantt chart.

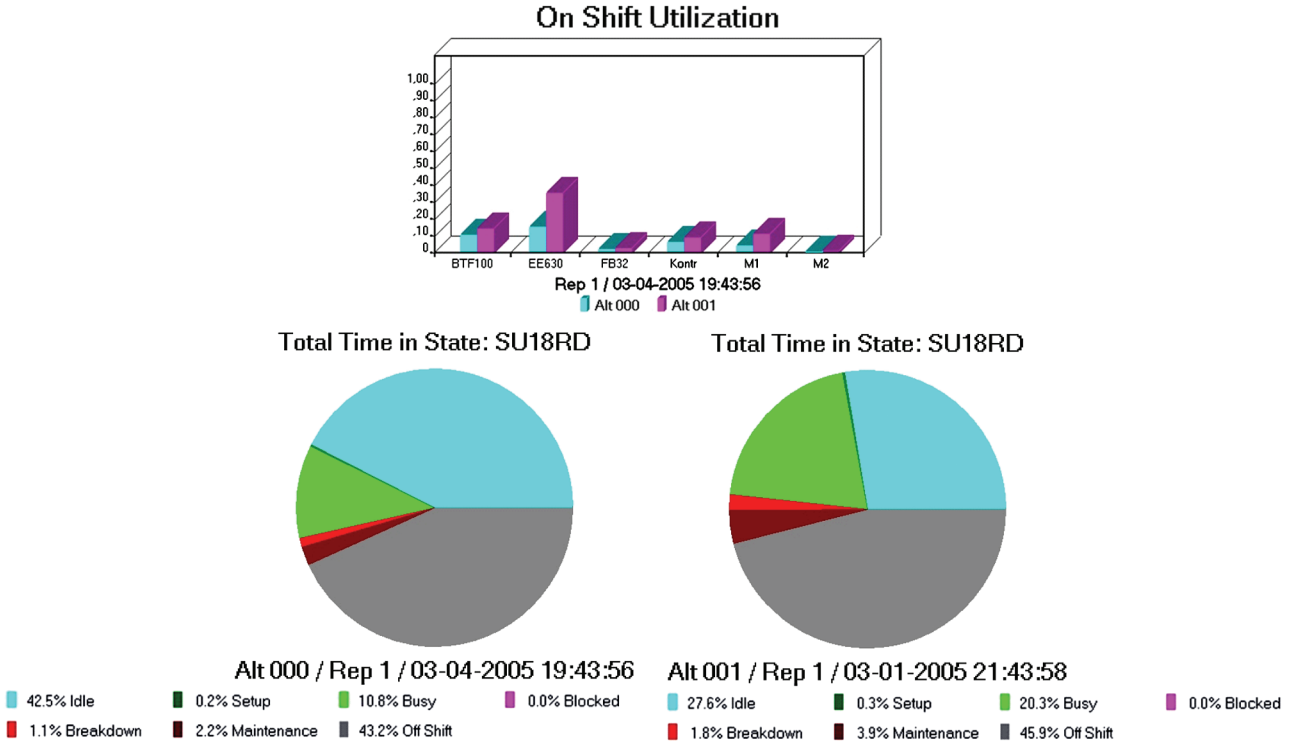


Figure 3 Example of graphical output from Factor/AIM software

4 Conclusion

Simplicity of the new used software and its availability brings simulation technologies closer to small and medium companies. Simulation indeed is meaningful also for this segment of production and offers the possibility of great savings together with reduction of mistaken investments. Simulation becomes a respectable supporting tool in technical and also in social and natural sciences. Thanks to its possibility to observe and monitor stochastic but also dynamic properties of individual processes and to predict the behaviour it presents the unique tool used in many areas of science and technology [8].

Variability of possible alternative solutions in the innovation process of existing workplaces is easy even for this company segment, mainly thanks to the focusing of these companies to production of pieces or small series. The simulation allows achieving most suitable allocation of production portions, production sequence, variability, production cycle, etc. [1].

Simulation results in shortening of production and also preparation and manipulation times, suitability of allocation of workplaces, stocking places and proposal of inter-operational transportation. With the use of simulation programs we can design production with higher efficiency which will lead to great savings in money, time or material. With a suitable choice of production portion a great change can be obtained in the value of production time. It allows the prevention of idle times of machines and increases the usability of individual devices and workers [2, 9].

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