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COMPUTER SIMULATION OF THE ASSEMBLY LINE – CASE STUDY

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Abstract: At raising productivity and improving logistics processes are increasingly using computer simulation. It plays an important role specially due to its ability to simulate the behavior of complex systems and take into account the dynamic and stochastic influences on the processes that operate. The present contribution presents a concrete example of the experience of using the computer simulation of discrete events. The article briefly introduced the assembly line project analysis, which is focused mainly to check the line's capacity - the emphasis was therefore placed particular verify the operation of the line in error conditions. Another important purpose of the simulation project was to determine the necessary number of pallet's carriers. Presented project was elaborated with the support of Siemens simulation program Tecnomatix Plant Simulation.

1 INTRODUCTION

Why exactly the simulation? Because every, even the merest mistake cost company money. And the discovery of mistakes still in the planning phase is much cheaper than fixing a mistake when the project is starting or the project is fully implemented.

By using computer simulation we can beforehand check whether the project was well designed and work properly. The simulation provides a comprehensive view on the issue, a dynamic multi-criteria analysis and examination of different options of resolution. An important property of this method is the possibility to test the proposed system behavior in error conditions, such as failure of the machine. Especially in nowadays tough market requirements is showing on that computer simulation is becoming an indispensable tool in supporting the design and improvement of business processes (see eg [2], [4], [5], [7]).

The above-mentioned issues will be outlined in the next chapter in the example simulation analysis of the assembly line.

2 CASE STUDY - SIMULATION OF THE ASSEMBLY LINE

Project was processed in a standard way gradually in 4 stages:

- Defining the project
- Create simulation model
- Experimentation
- Project completion

Generally, the processing procedure of the simulation project, see eg [6].

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2.1 Introduction of the project

This is an automated assembly line that produces the machine into the socket. The assembly line consists of one main assembly and two pre-assembly. Individual assembly operations following each other. On the main assembly are moving palette molds on the belt into which are assembled the individual pieces of machine. From the first pre-assembly is placing the form of tubes into the palette assembly and from the second pre-assembly is placing the form of stick with a belt into the palette assembly.

The simulation project was processed in the simulation of the Siemens Tecnomatix Plant Simulation. Its main objective was to verify the capacity of the line in error conditions. Another objective was to test the number of palette assemly.

2.2 Simulation Model

An important phase of entire analysis was collecting of input data. The most important data for the creation of the model was time of individual assembly units, all sizes of conveyors, the distance between the mounting unit and the speed of conveyors.

For creating of a simulation model of assembly lines were used as standard elements of the simulation system (eg SingleProc, Line, ..., and elements of the Method, which was defined by the control logic lines. Example of model structures and methods for counting on the box are shown in Figure 1st.

After assembling the model was its validation. To verify the validity of the model was simulated process without downtime.

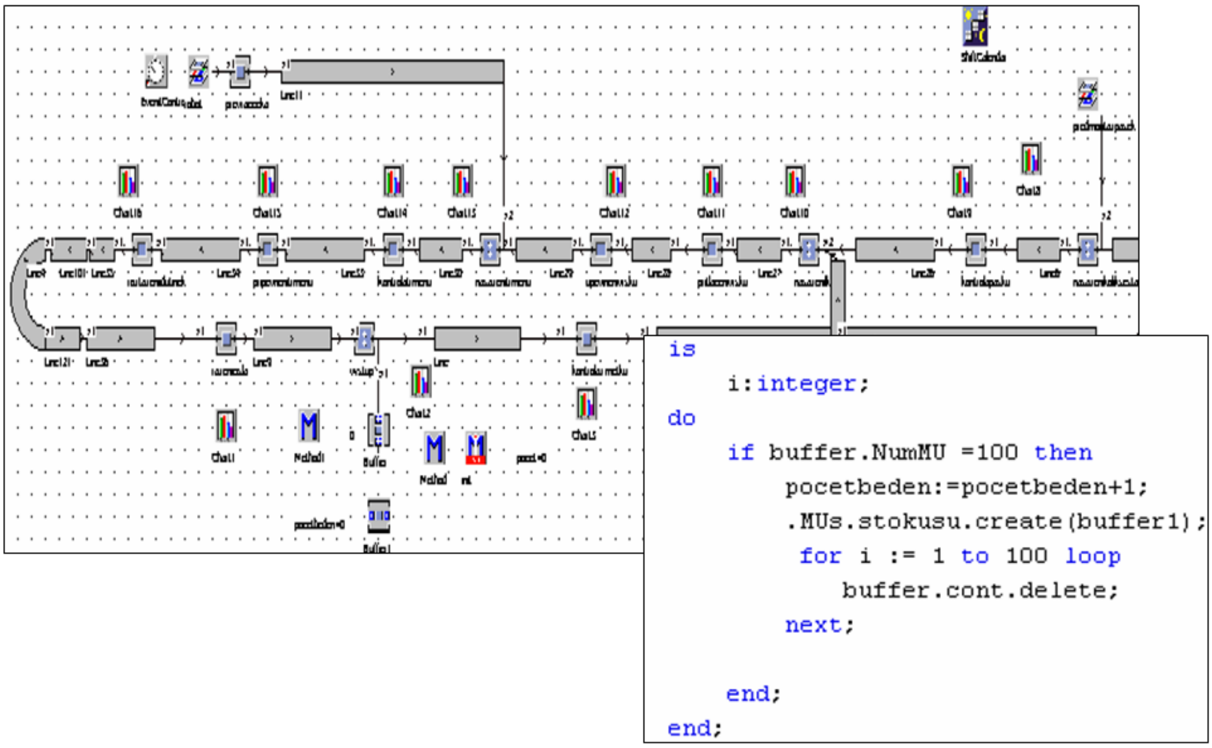

Figure 1: The sample of simulation model – the cut of the main assembly

The model was subsequently included disorders. Failures in the individual stations were in agreement with the company set at 5% (see Figure 2). Breakdowns were generated randomly.

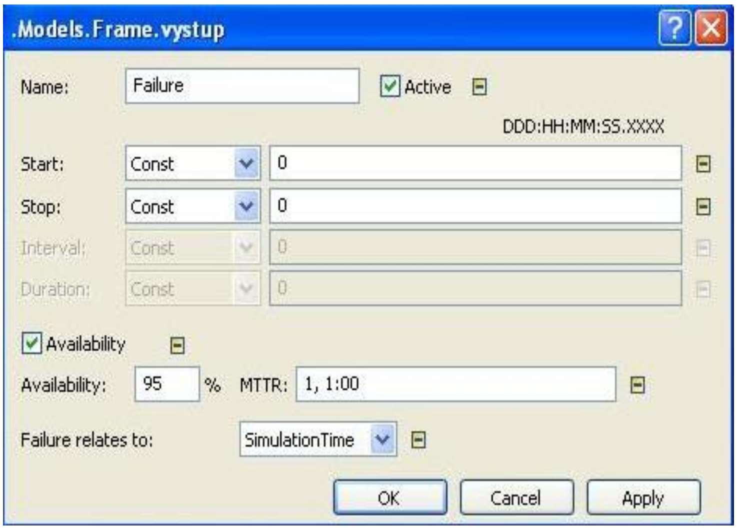

Figure 2: The sample of the assignment of failure

2.3 Experiment results and discussion

In experimental part was verified, how are disorders reflected in the various stations for a total of productivity and efficiency lines. Experiments were performed with both the original clock lines, as well as the increased clock lines, which would be achieved by reducing cycle time of a narrow spot. During the experimenting was observed number of manufactured items and the use of individual workplaces (see Figure 3).

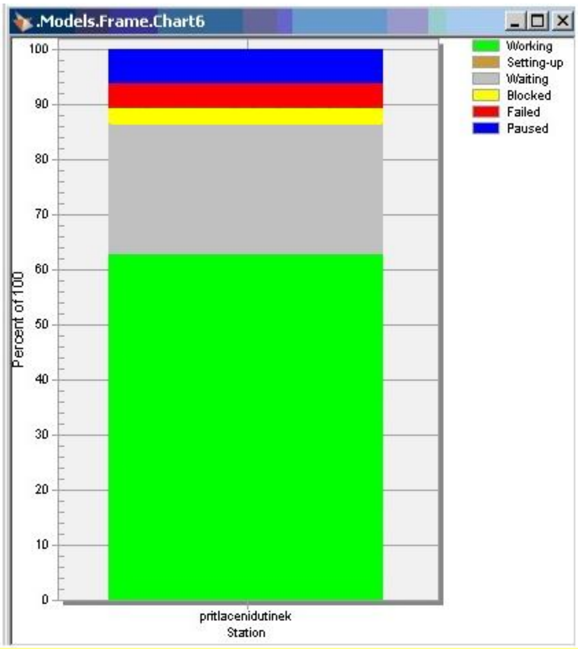

Figure 3: The example of output statistics – use of workplace

As seen from the results of experiments in the moment when there is a balancing full cycle time of a bottle neck (BN) with the next slowest station, begins to manifest itself significantly affect the interaction of failures. Although there is still an increase in the total number of units produced (see Table 1), this phenomenon has a significant negative impact on the efficiency of line (see Table 2).

Table 1: Comparison of results - an increase in the number of pieces from the original tact time of line (Model with failures - a 5-percent failure rate at each station)

Description	Original cycle time of BN	Cycle time of BN (original BN lower by 5%)	Cycle time of BN (original BN lower by 12% - equalization of cycles)
Number of pieces in %	100%	104,5%	104,9%

Table 2: Comparison of results - the influence of failures interaction on the efficiency of line

Description	Original cycle time of BN	Cycle time of BN (original BN lower by 5%)	Cycle time of BN (original BN lower by 12% - equalization of cycles)
Number of pieces in % (theoretical calculation given by cycle time of BN without failures)	100%	100%	100%
Number of pieces in % (model with failures - 5% failure rate on particular stations)	94,9%	94,4%	89,1%

An important experiment was also the experiment to determine the minimum number of palettes to ensure the maximum power of lines. The results of experiments in comparison with the current state are plotted in Figure 4. For it shows that the current state is the number of palettes on the line oversized. When increasing the number of rhythm time of lines is current number of palettes sufficient.

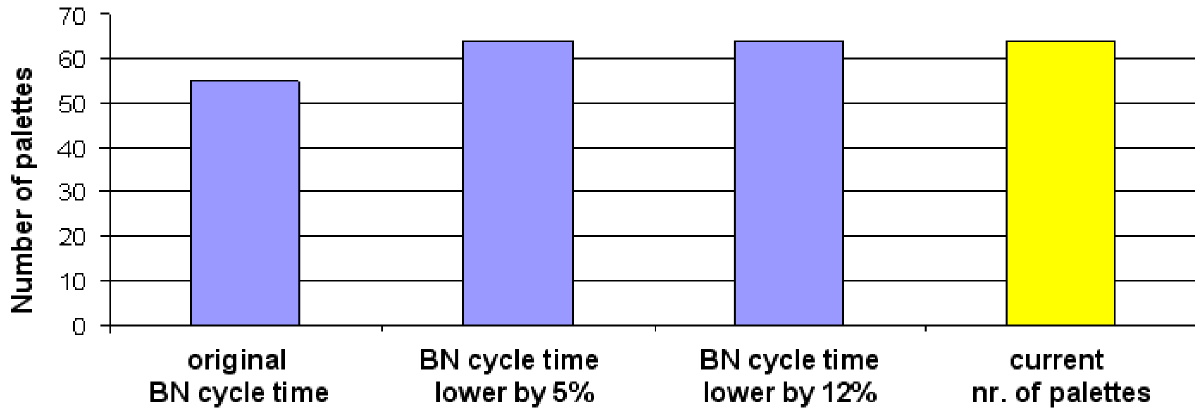

Figure 4: Minimum number of assembly palettes

3 CONCLUSIONS

Computer simulation is thanks to its ability to mimic the behavior of complex systems has become an important support tool that helps staffers at different levels to reflect today's tough business requirements for business processes.

This is also confirmed by the presented case study analysis, simulation assembly line. Using computer simulation was able to:

• verify the operation of the lines at the expected failure rate of each station for both the current status and potential for innovation line,

• determine the minimum number of palettes to ensure adequate power of lines for different situations.

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