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MODELLING AND SIMULATION IN THE TECNOMATIX PLANT SIMULATION ENVIRONMENT

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Abstract: Simulation technologies are nowadays an integral tool for planning, implementation and operation of technical systems. Simulation is used where more straightforward methods no longer provide useful results. The simulation aims to arrive at objective decisions using dynamic analysis. This allows managers to plan specific processes at optimal cost. If real-world verification is too expensive and restrictive to perform experiments and time consuming, then modelling and a simulation is an excellent tool for analysing and optimising dynamic processes. The article deals with the importance of modelling and simulation in industrial practice, which is demonstrated in the text's case studies.

1 Introduction

In the source [1] defines VDI (Verein Deutscher Ingenieure/Association of German Engineers) Directive 3633 simulation "as the emulation of a system, including its dynamic processes, in a model one can experiment with". It includes the preparation, implementation and evaluation of specifically oriented experiments within a simulation model.

The models below are output from the Tx Plant Simulation software. It is a discrete, event-controlled simulation program that only inspects those points in time. Events occur within the simulation model, i.e. Time-Oriented Simulation and Event-Controlled Simulation.

In reality, on the other hand, time elapses continually. That is why by watching a part that moves along a conveyor, it is impossible to detect leaps in time. The curve for the distance covered and the time it takes to cover it is continuous. It is a straight line, see Fig. 1.



Figure 1 Curve of continuous, real-time movement In simulation run [1]

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Tx Plant simulation as a discret event-controlled program takes points in time (events) into consideration that are of importance to the further course of the simulation. Such events may, for example, be a part entering a station or leaving it or of it moving on to another machine. Any movements in between are of little interest to the simulation as such. It is only important that the entrance and the exit (Out) events are displayed correctly.

The simulaton starts by a part enters to material flow. Tx Plant Simulation calculates the time until the object exits that flow. Simulation run is regulated by EventController. Thus, the simulation time that the EventController displays, leaps from event to event. This happens as soon as an event is processed.

In general, it can be said that simulation is a method in which we search, calculate the state, respectively. behavior of a real system using a model.

Simulation is a method in which we imitate a real system with its simulation model, on which we perform experiments, the results of which we apply back to the real system. In this sense, the simulation model is understood as a model on which we implement a set of experiments and process the results statistically, i. the model is created in a simulation tool, language, simulation system, which in addition to the model itself has equipment such as random number generators, statistical processing of results, timer for controlling the simulation time, system for identifying errors in creating the model, etc. Simulation models are mostly functional models that mimic the behavior and functions of the system and transform the real system into a formalised system of collective service.

If we experiment, resp. we calculate the results, e.g. on the analytical model once, then we do not need to create the simulation environment described above. In the limit case, the calculation on the analytical model can also be considered as an individual experiment, ie as a simulation.

Models, simulation models, analytical models, etc. are terms that often appear today in discussions and the work of experts in all areas of management. A model is a simplification of an object or process. It is created on some or some real process object. We understand modeling as creating models. Simulation as calculation and experimentation with a model.

2 Verification of analysis results on digital models in Tx Plant Simulation

The Tx Plant Simulation software module from Siemens was used to verify the results resulting from the analysis above. The application of simulation tools is important in terms of shortening planning cycles, which allows to increase the complexity and variability of production, increases the flexibility of the ability to respond to customer requirements, thereby increasing the competitiveness of the company. Modeling and simulation of the following case studies was processed in the software module Tx Plant Simulation, which is focused on objectoriented simulation of discrete processes. The aim of these case studies was to verify the potential of demand-driven supply logistics. The developed models are the output of the scientific work of the author of the habilitation thesis at the ÚMPaDI workplace:

- 1. Simulation model of procurement for demanddriven consumption.
- 2. Simulation model of material flow optimisation.
- 3. Simulation model of value stream mapping / e-VSM.
- 4. Simulation model of verification of production capacity of production plant and dimensioning of inter-operational stocks.

1. Simulation model of procurement - for demanddriven consumption. Specifically, it is the simulation model of procurement for demand driven consumption, i.e. customer orders simulation and consumption, which consume the inventory and initiates the supply process from the supplier when reach buffer minimum of inventory level. The way of representation of inventory consumption is viewed as a silo.



Figure 2 Simulation model – maximum inventory level



Figure 3 Simulation model – average inventory level



Figure 4 Simulation model – empty buffer

2. Simulation model of material flow optimisation. Analysed production line produces 5 kinds of shafts, 4 of which have several variations. The variety of components in this line and the lack of machinery cause supply problems for the assembly line itself. The goal of simulation was the verification of the model, an experiment was performed to verify system stability and production



stability. Collection of the necessary information and subsequent simulation of the process revealed a bottlenecks place in the production line, which reduced the production throughput at the production line of hard shafts.



Figure 5 Simulation model - material flow optimisation

3. Simulation model of value stream mapping / e-VSM. The main objective of the case study was to create a dynamic model of map of the value stream in the production of the reference product and to optimise the current state in the TX Plant simulation environment. The partial goal was to point out the possibilities that optimisation through computer simulation allows.



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4. Simulation model of verification of production capacity of production plant and dimensioning of interoperational stocks.

The simulation model concerned the production of products from the paper industry. Specifically, the production flow was processed for two types of products A and B, which are produced on the line. Production line from case study was created on principle hierarchical structure. Hierarchical model means inserting individual frames into the other frames. One of the reasons for this way of modelling and testing is a possibility the larger simulation model analyses independently. It is possible to create different parts of a simulation model by multiple users. Created sub-frames can be inserted into a main model (also more than once and can be reused in other models). Most important benefit is that the large model thus created is easier to understand and follow a structure reflecting the hierarchy in which it was constructed.



Figure 7 Simulation model – verification of production capacity

3 Conclusion

Current trends in the manufacturing industry include accelerating product development, starting production as soon as possible, increasing flexibility, quality and variability of production in conjunction with low costs. Achieving these goals is conditioned by the implementation of new technologies that are able to handle such demands. Verifying the functionality of products in a virtual environment will be a necessary standard in the near future.

However, achieving the optimal result is conditioned by the system solution. Globalisation affects the design requirements of companies, which must flexibly adapt to top performance and ensure high production variability if they want to maintain a high degree of resilience to competitors. This goal in terms of production can be achieved by focusing on the modularity of the system concept supported by functional integration, the introduction of standardisation, standardisation in product design.

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