Acta Simulatio - International Scientific Journal about Simulation
Volume: 7 2021 Issue: 1 Pages: 1-5 ISSN 1339-9640



*doi:10.22306/asim.v7i1.59*

*Received: 16 Dec. 2020*
*Revised: 05 Jan. 2021*
*Accepted: 28 Jan. 2021*

# MODELLING AND SIMULATION IN THE TECNOMATIX PLANT SIMULATION ENVIRONMENT

**Miriam Pekarčíková**
Technical University of Kosice, Faculty of Mechanical Engineering, Institute of Management, Industrial and Digital Engineering, Park Komenskeho 9, 042 00 Kosice, Slovakia, EU, miriam.pekarcikova@tuke.sk (corresponding author)
**Peter Trebuňa**
Technical University of Kosice, Faculty of Mechanical Engineering, Institute of Management, Industrial and Digital Engineering, Park Komenskeho 9, 042 00 Kosice, Slovakia, EU, peter.trebuna@tuke.sk
**Michal Dic**
Technical University of Kosice, Faculty of Mechanical Engineering, Institute of Management, Industrial and Digital Engineering, Park Komenskeho 9, 042 00 Kosice, Slovakia, EU, michal.dic@tuke.sk
**Štefan Král**
Technical University of Kosice, Faculty of Mechanical Engineering, Institute of Management, Industrial and Digital Engineering, Park Komenskeho 9, 042 00 Kosice, Slovakia, EU, kral@slm.sk

***Keywords:*** simulation, model, verification, production

***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.

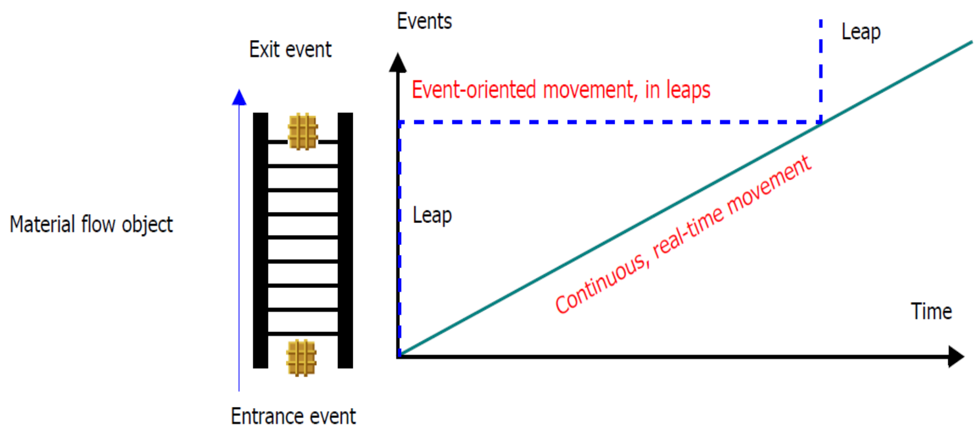


*Figure 1 Curve of continuous, real-time movement In simulation run [1]*

Acta Simulatio – International Scientific Journal about Simulation
Volume: 7 2021 Issue: 1 Pages: 1-5 ISSN 1339-9640



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 object-oriented 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 demand-driven 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 demand-driven 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.

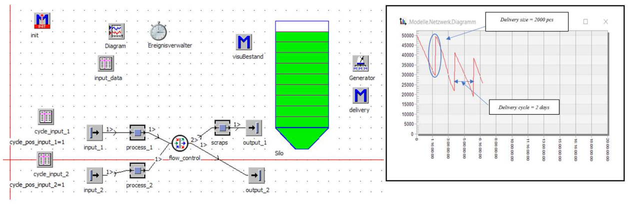

*Figure 2 Simulation model – maximum inventory level*

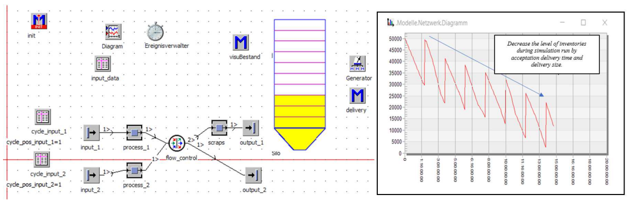

*Figure 3 Simulation model – average inventory level*

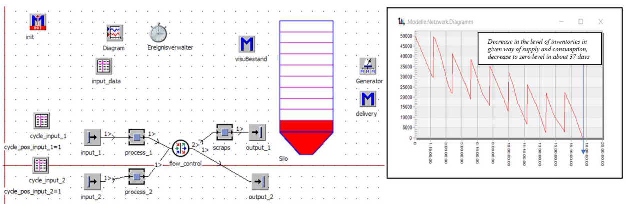

*Figure 4 Simulation model – empty buffer*

**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.

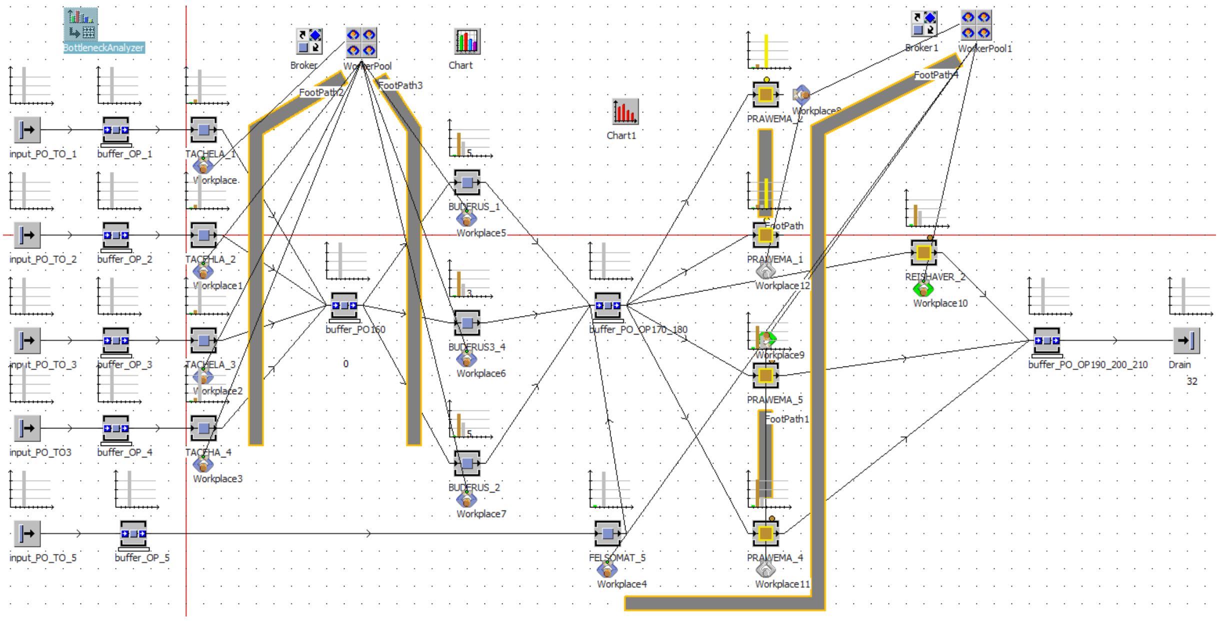


*Figure 5 Simulation model – material flow optimisation*

**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.

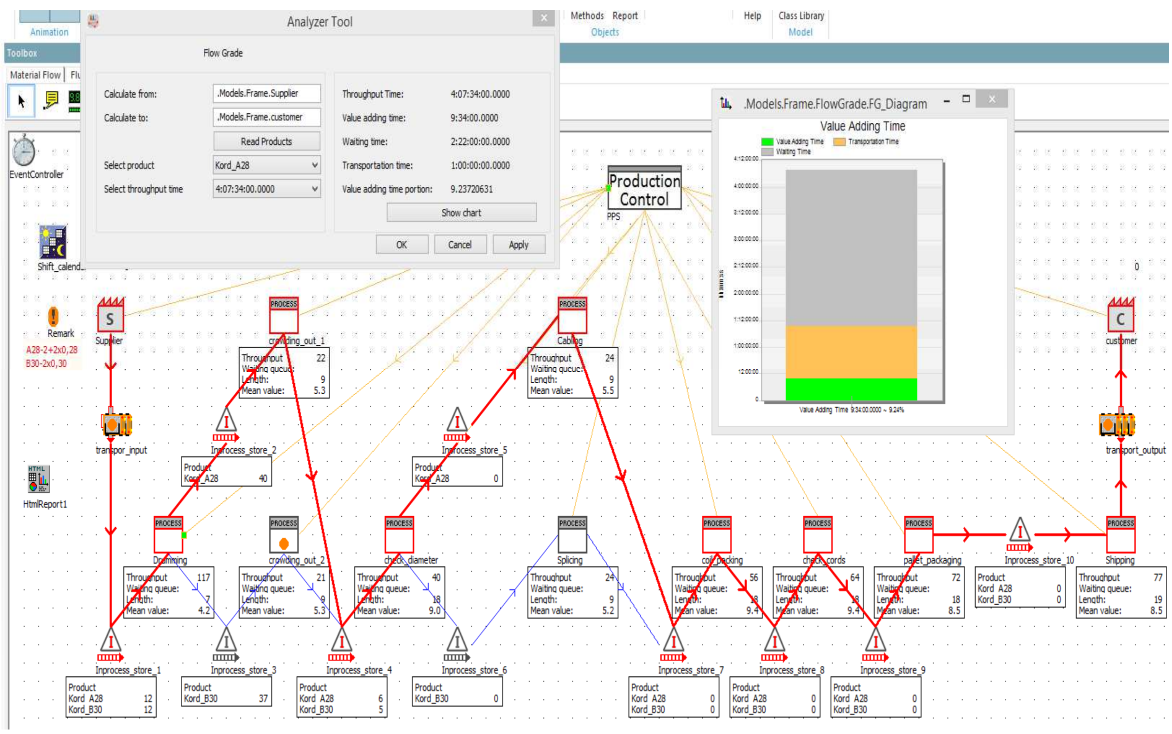


*Figure 6 Simulation model- VSM*

**4. Simulation model of verification of production capacity of production plant and dimensioning of inter-operational 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.

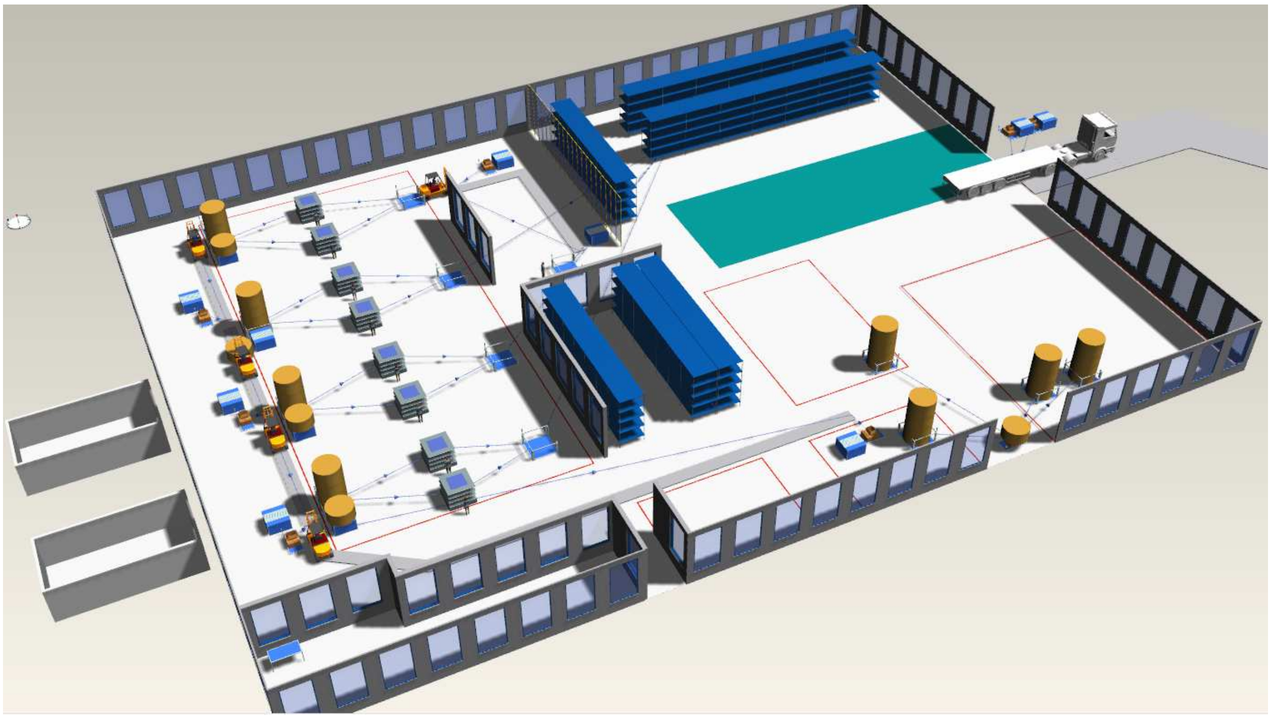

*Figure 7 Simulation model – verification of production capacity*

## 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.

**Acknowledgement**

This article was created by the implementation of the grant project APVV-17-0258 "Digital engineering elements application in innovation and optimisation of production flows", APVV-19-0418 "Intelligent solutions to enhance business innovation capability in the process of transforming them into smart businesses", VEGA 1/0438/20 "Interaction of digital technologies to support software and hardware communication of the advanced production system platform" and KEGA 001TUKE-4/2020 "Modernising Industrial Engineering education to Develop Existing Training Program Skills in a Specialized Laboratory" and University Science Park TECHNICOM for Inovation Application Supported by Knowledge Technology, ITMS: 26220220182, supported by the Research and Development Operational Program funded by the ERDF.

## References

[1] Tecnomatix Plant Simulation 10.1 Step-by-Step Help, 2011 Siemens Product Lifecycle Management Software, 2011.

[2] FURMANN, R., FURMANNOVÁ, B.: *Logistics and digital twin, InvEnt 2017: Industrial Engineering – Invention for Enterprise*, Wydawnictwo Fundacji Centrum Nowych Technologii, 2017.

[3] STRAKA, M., SADEROVA, J., BINDZAR, P., MALKUS, T., LIS, M.: Computer simulation as a means of efficiency of transport processes of raw materials in relation to a cargo rail terminal: A case study, *Acta Montanistica Slovaca*, Vol. 24, No. 4, pp. 307-317, 2019.

[4] STRAKA M., KHOURI S., ROSOVA A., CAGANOVA D., CULKOVA K.: Utilisation of computer simulation for waste separation design as a logistics system, *International Journal of Simulation Modelling*, Vol. 17, No. 4, pp. 583-596, 2018.

[5] BANGSOW, S.: *Tecnomatix Plant Simulation, Modeling and Programming by means of examples*, Springer, 2015.

[6] FEDORKO, G., VASIL, M., BARTOSOVA, M.: Use of simulation model for measurement of MilkRun system performance, *Open Engineering*, Vol. 9, No. 1, pp. 600-605, 2019. doi:10.1515/eng-2019-0067

[7] BUCKOVA, M., KRAJCOVIC, M., EDL, M.: Computer simulation and optimisation of transport distances of order picking processes: 12th International Scientific Conference Of Young Scientists On Sustainable, Modern And Safe Transport, Procedia Engineering, Vol. 192, pp. 69-74, 2017. doi:10.1016/j.proeng.2017.06.012

[8] GREGOR, M.; HERCKO, J.; GRZNAR, P.: The Factory of the Future Production System Research: 2015 21st International Conference on Automation and Computing (ICAC), pp. 254-259, 2015.

[9] *Tecnomatix Plant Simulation Basics, Methods and Strategies Student Guide*, 2012, Siemens PLM, 2012.

[10] FUSKO, M., BUCKOVA, M., GASO, M., KRAJCOVIC, M., DULINA, L., SKOKAN, R.: Concept of Long-Term Sustainable Intralogistics in Plastic Recycling Factory, *Sustainability*, Vol. 11, No. 23, 2019. doi:10.3390/su11236750