Acta Simulatio - International Scientific Journal about Simulation
Volume: 8 2022 Issue: 2 Pages: 9-15 ISSN 1339-9640

Optimization of processes using simulation software elements
Marek Kliment, Miriam Pekarcikova, Marek Mizerak, Peter Trebuna

doi:10.22306/asim.v6i1.57

Received: 04 May 2022
Revised: 26 May 2022
Accepted: 11 June 2022

Optimization of processes using simulation software elements

Marek Kliment
Technical university of Košice, Faculty of Mechanical Engineering, Department of Industrial and Digital engineering, Park Komenského 9, 042 00 Košice, Slovak Republic, EU, marek.kliment@tuke.sk
Miriam Pekarcikova
Technical university of Košice, Faculty of Mechanical Engineering, Department of Industrial and Digital engineering, Park Komenského 9, 042 00 Košice, Slovak Republic, EU, miriam.pekarcikova@tuke.sk (corresponding author)
Marek Mizerak
Technical university of Košice, Faculty of Mechanical Engineering, Department of Industrial and Digital engineering, Park Komenského 9, 042 00 Košice, Slovak Republic, EU, marek.mizerak@tuke.sk
Peter Trebuna
Technical university of Košice, Faculty of Mechanical Engineering, Department of Industrial and Digital engineering, Park Komenského 9, 042 00 Košice, Slovak Republic, EU, peter.trebuna@tuke.sk

Keywords: simulation, plant simulation, effecienty, optimalization.
Abstract: The aim of the article is to point out the advantages of simulation software, and the possibilities in solving process optimization, whether it is production processes or non-production processes. The essence of the entire improvement process is a thorough analysis and definition of the examined business processes and their parts in the entire volume. After identifying bottlenecks, it is optimal to set optimization criteria and goals. When using simulation software in the process, it is necessary to thoroughly redistribute and edit the data files for the needs of their application in the given software. This activity often represents a more demanding part of the process than the actual processing of simulation models and the subsequent testing of options for improving real processes in the digital environment.

1 Introduction

The contribution is a kind of cross-section of selected projects in which simulation used Tecnomatix Plant Simulation software module. This software module was used in different situations in the framework of evaluation, analysis, and improvement of different types and phases of business processes. It was used, for example, when expanding production with new equipment, or during verification of return on investment in the innovation of some parts of the production process. He also found his meaning when solving warehouse spaces and verifying the capacity of pallet places [1,2]. It was used effectively in optimizing the production process of the Cobas HIV-1 blood plasma separation card. Of the listed, it is obvious that its implementation is justified not only in the engineering industry and automotive, but its application is broad-spectrum wherever it is possible to analyze one transformation process, possibly stock movement and material flow.

2 Optimization in the production of the card for the separation of blood plasma Cobas HIV - 1

In this project, simulation software was used to solve the optimization of the card production line for the separation of blood plasma, which is used mainly in developing countries where there is a disease HIV is much more widespread than in today's modern world in more developed countries. During this process, it is necessary to observe strict hygiene regulations and also the standards according to which plasma samples are stored and then transported from the collection points to the places where they are used they perform additional tests that cannot be performed on-site [3,4]. Therefore, the plasma sample is stored and secured in the form of a Cobas HIV card - 1 (Figure 1).

During the analysis of the entire process, the workplace of the application of the final (Figure 2) layer was revealed and evaluated as the most critical and it is necessary to optimize production at this point [5-9].

Copyright © Acta Simulatio, www.actasimulatio.eu

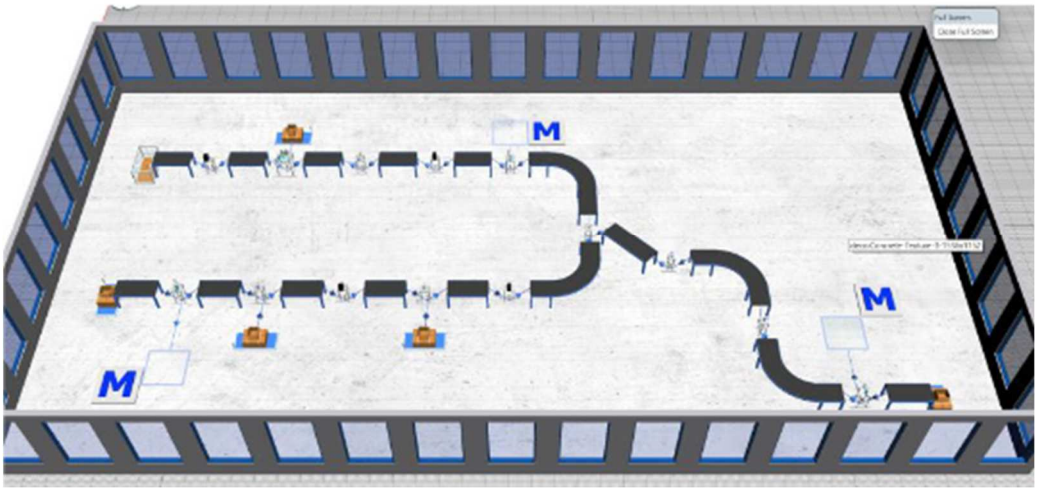

Figure 1 Simulation model of the initial state

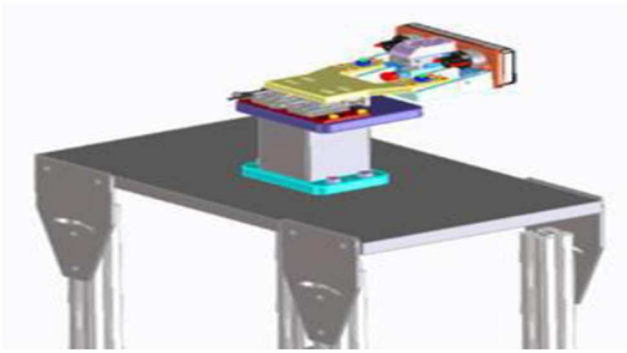

Figure 2 Final layer application workplace in the original production process

The aim of the optimization was to save time at this point of production and thereby increase production capacity. With several variants and suggestions for improvement, this operation was eventually improved and overall shorten the process (Figure 3). The production process has been shortened thanks to the fact that we have added several at these station operations that were previously done individually and between these workplaces the product in question moved with the help of conveyors, which were dismantled at this point in production.

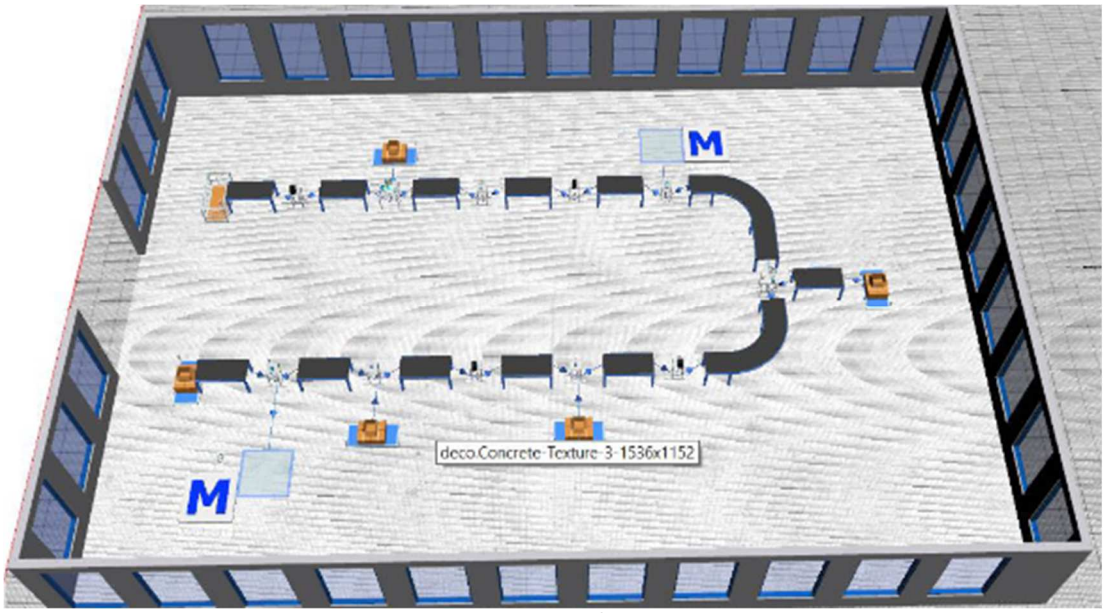

Figure 3 Simulation process after applying changes

Figure 4 shows the model of the final layer application production station after the changes that were made performed as part of optimization measures.

Copyright © Acta Simulatio, www.actasimulatio.eu

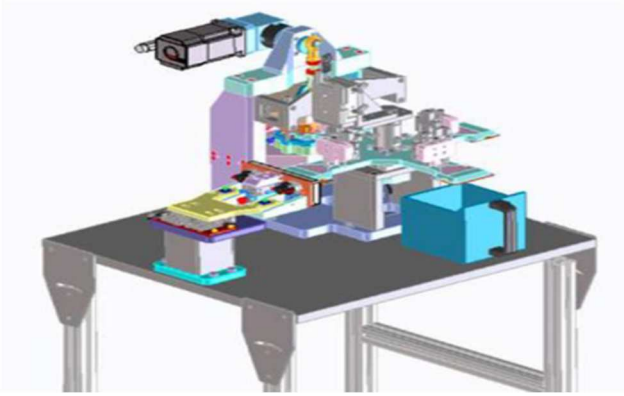

Figure 4 Final layer application workplace with the implementation of improvement proposals

A comparison of the results of the production process before and after optimization can be seen in the tables below (Table 1, Table 2).

Table 1 Results of the production process before optimization

Operation	Output name	TPH (pcs/hour)	Production	Transportation
Output	Cobas HIV-1	350	52.94%	47.06%

Table 2 Results of optimization of the final layer application process

Operation	Output name	TPH (pcs/hour)	Production	Transportation
Output	Cobas HIV-1	699	52.94%	47.06%

2.1 Expanding production with new equipment

Another project where Tecnomatix Plant Simulation simulation software was used was a project to verify the proposed capacity of the number of pallet places in the warehouse. The project in question concerned cold storage in the food industry. It is a warehouse that is currently in construction and the task of the project team was to verify the proposed capacity, set by the investor. During the analysis and the actual solution of this project, thanks to the results of the simulation, several times changes the planned distribution of pallet places, as well as the layout of the entire warehouse (Figure 5). This project was processed at a relatively high graphic level and its entire design was presented with the help of a virtual tour with the help of an Oculus virtual helmet.

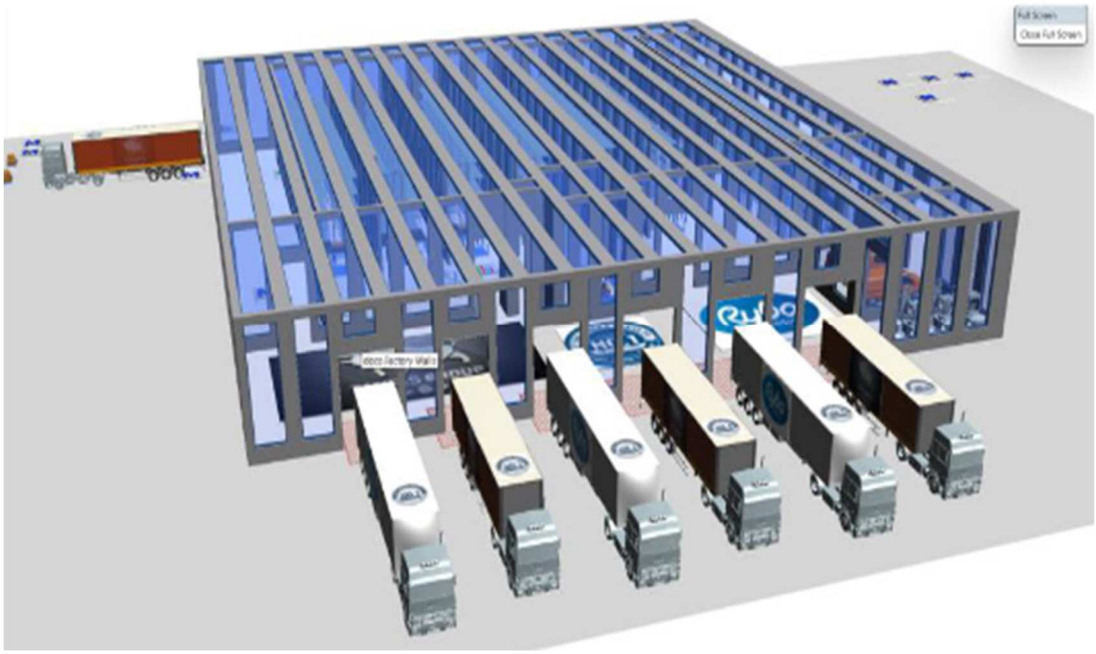

Figure 5 3D projection of the warehouse ready for a detailed and virtual tour

During the actual implementation of the project, the panel of functions for processing was used as part of the simulation automatic storage and retrieval system.

Figure 6 Panel for simulating HBW racks

The automatic rack stacker is shown in Figure 7.

Copyright © Acta Simulatio, www.actasimulatio.eu

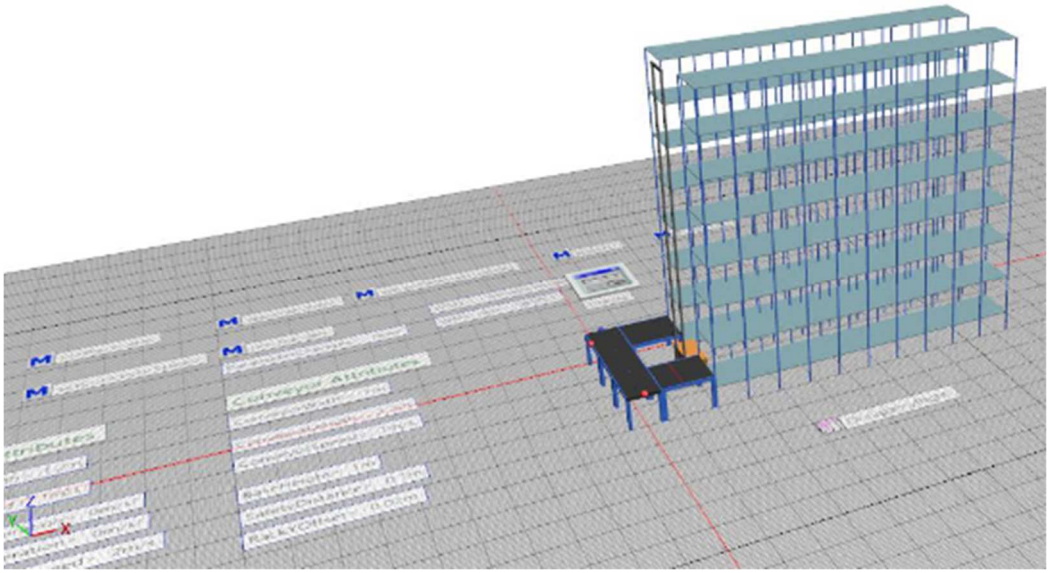

Figure 7 Automatic rack stacker in simulation software

2.2 Project to expand production with new machines and verify their utilization

Another project is expanding production and doubling the number of production facilities and verification of their utilization and production capacity. In the original state of production, there were 8 production lines that produced different types of products in different production batches (Figure 8). These products were then packed on one packaging machine and then stored in the warehouse, from where they were destined for export to customers.

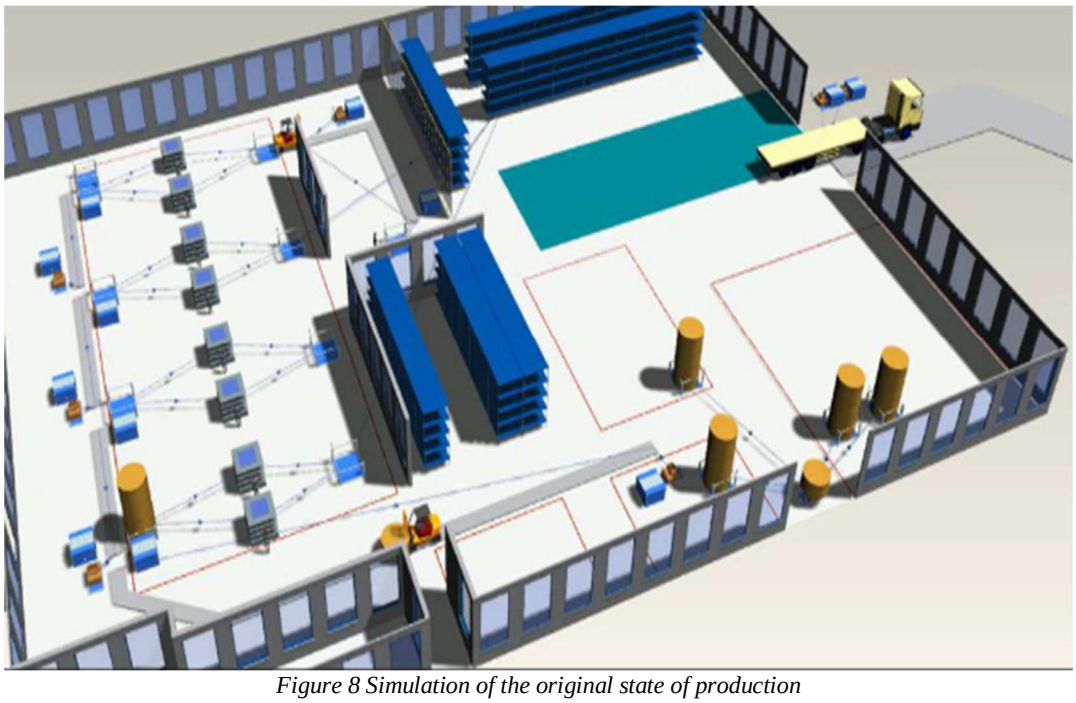

Figure 8 Simulation of the original state of production

The request of the company that commissioned this project was to double the number of production equipment in the main production hall from 8 production lines to 16 lines. At the same time, it was necessary to verify the necessary number of packaging machines that would ensure the smooth packaging of manufactured products. In its original state, there was one packaging machine, which had a considerable capacity reserve in its utilization. It was questionable whether it would be sufficient to double the number of packaging devices in production with twice the number of machines, given that 2 of the planned new machines were supposed to have twice the output in their

Copyright © Acta Simulatio, www.actasimulatio.eu

production, that is, production was expanding by 6 production devices with a production capacity equal to the team the current ones and 2 devices were supposed to have twice the output as well as the production capacity. The requirement was also to propose an efficient method of supplying production equipment from the incoming warehouse. When solving the project, several variants were processed with respect to the investigation of the best way of supply. The proposal of supplying with the help of conveyor belts was addressed (Figure 9).

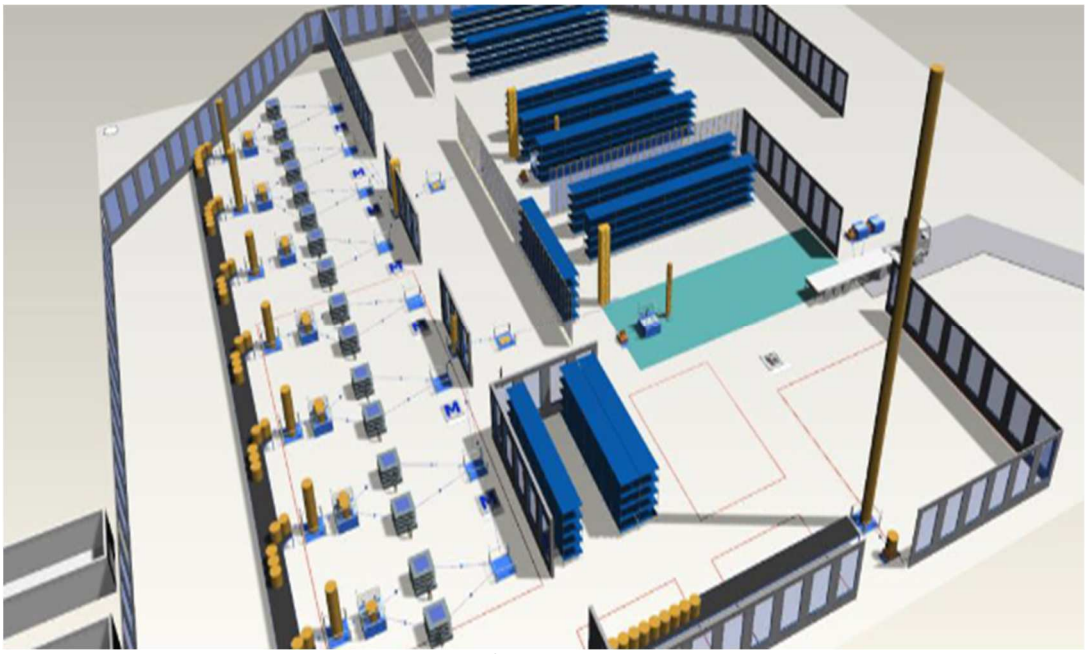

Figure 9 Design of storage using conveyor belts

The second variant was to implement a train with several wagons into production, which would supply the equipment with several runs of the train during the production shift throughout the entire production (Figure 10).

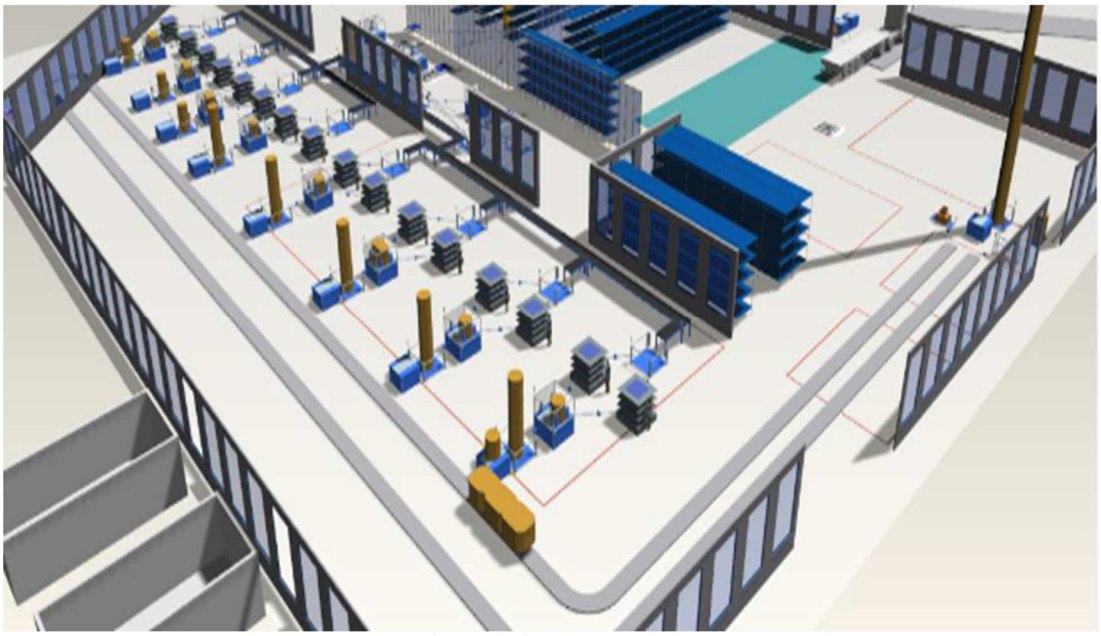

Figure 10 Verification of the supply train in production

The latest version of the supply method was the implementation of an AGV truck, which would drive around production as needed and supply individual production equipment (Figure 11).

Copyright © Acta Simulatio, www.actasimulatio.eu

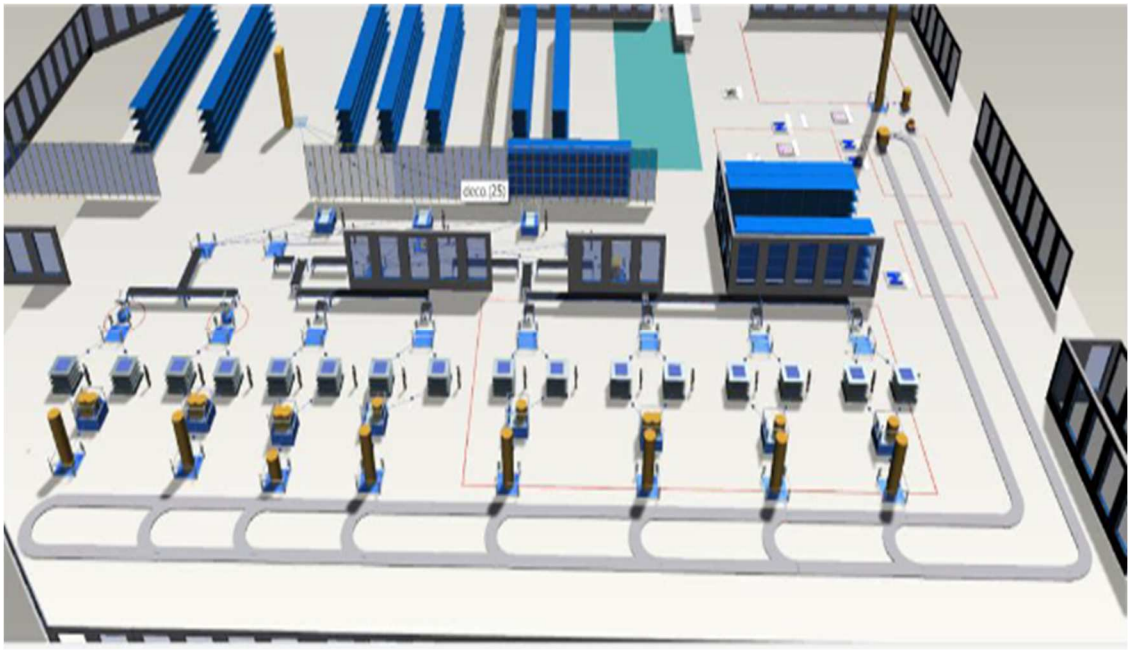

Figure 11 Application of AGV trucks in production supply

3 Conclusions

From the examples given in the article, the importance of using simulation software in various areas of industry is noticeable, not only in the field of mechanical engineering and automobile production but also, for example, in healthcare, stationery, etc. A simulation is a necessary tool when checking the possibilities of improving existing production processes, as well as when solving the feasibility of new operations, both production, and non-production, for example, storage. It is an effective way to cheaply verify proposals and variants of the solution to changes that are subsequently applied in the given area.

Acknowledgement

This article was created with the support of projects VEGA 1/0438/20 Interaction of digital technologies to support the software and hardware communication platform of advanced manufacturing system, KEGA 001TUKE-4/2020 Modernization of the teaching of industrial engineering to develop the skills of the existing educational program in specialized laboratory, APVV-17-0258 Application of elements of digital engineering in innovation and optimization of production flows, APVV-19-0418 Intelligent solutions to increase the innovation capacity of the company in the process of their transformation into intelligent companies. VEGA 1/0508/22 Innovative and digital technologies in production and logistics processes and systems.

References

[1] MARSCHALL, M., GREGOR, M., DURICA, L., VAVRIK, V., BIELIK, T., GRZNAR, P., MOZOL, S.: Defining the Number of Mobile Robotic Systems Needed for Reconfiguration of Modular Manufacturing Systems via Simulation, *Machines*, Vol. 10, No. 5, pp. 1-20, 2022. https://doi.org/10.3390/machines10050316

[2] GRZNAR, P., KRAJCOVIC, M., GOLA, A., DULINA, L., FURMANNOVA, B., MOZOL, S., PLINTA, D., BURGANOVA, N., DANILCZUK, W., SVITEK, R.: The Use of a Genetic Algorithm for Sorting Warehouse Optimisation, *Processes*, Vol. 9, No. 7, pp. 1-13, 2021. https://doi.org/10.3390/pr9071197

[3] BURGANOVA, N., GRZNÁR, P., MOZOL, Š.: *Challenges of factory of future in the context of adaptive manufacturing*, Conference Invention for Enterprise 2021, InvEnt 2021, Industrial Engineering – Invention for Enterprise, Proceedings, Wydawnictwo Akademii Techniczno-Humnistycznejw Bielsku-Białej, pp. 32-35, 2021.

[4] PLINTA, D., KRAJČOVIČ, M.: Production System Designing with the Use of Digital Factory and Augmented Reality Technologies, *Advances in Intelligent Systems and Computing*, Vol. 350, pp. 187-196, 2015.

[5] STRAKA, M., BINDZÁR, P., KADUKOVÁ, A.: Utilization of the multicriteria decision-making methods for the needs of mining industry, *Acta Montanistica Slovaca*, Vol. 19, No. 4, 2014.

[6] LERHER, T., EDL, M., ROSI, B.: Energy efficiency model for the mini-load automated storage and retrieval systems, *International Journal of Advanced Manufacturing Technology*, Vol. 70, pp. 97-115, 2014. https://doi.org/10.1007/s00170-013-5253-x

Copyright © Acta Simulatio, www.actasimulatio.eu

[7] SANIUK, S., SANIUK, A., LENORT, R., SAMOLEJOVA, A.: Formation and planning of virtual production networks in metallurgical clusters, *Metalurgija*, Vol. 53, pp. 725-727, 2014.
[8] BURGANOVA, N., GRZNÁR, P., MOZOL, Š., MATYS, M.: *Trends in the design of factories of the future*, Trends and Innovative Approaches in Business Processes 2021, October 19-20, pp. 72-76, 2021.
[9] STEFANIK, A., GRZNAR, P., MICIETA, B.: *Tools for Continual Process Improvement - Simulation and Benchmarking*, In: Annals of DAAAM for 2003 & Proceedings of the 14th International DAAAM Symposium: Intelligent manufacturing & automation: focus on reconstruction and development, Katalinic, B., ed., Daaam Int Vienna: Wien, 2003, pp 443-444, 2003.

Review process
Single-blind peer review process.

Copyright © Acta Simulatio, www.actasimulatio.eu