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INFLUENCE OF DISPLAY MODE ON DISTANCES IN SOFTWARE TECNOMATIX PLANT SIMULATION

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Abstract: The article presents the results of comparing the two principal display modes in the software Tecnomatix Plant Simulation. Currently, there is an increase in the application of modelling and simulation in industrial practice. Behind this are the new features of the simulation software and the growing number of users who control the simulations. The complexity of the simulation for the simulator is derived from the complexity of the system and the required degree of accuracy. The accuracy itself depends on the abstraction and reduction of the elements of the simulated system. Tecnomatix Plant Simulation software is a widely used tool that allows for multiple display modes, each with its specific purpose. The article aimed to determine the deviation between the individual display modes experimentally and outline their specific use based on abstraction and reduction level.

1 Introduction

Currently, modelling and simulation as part of the digital factory are experiencing a boom in use. This has to do with the increasing computing power of computers, the increasing simulation software functions, and the increasing number of trained staff. The use of simulation is in the frame of digital factory strategy where the company works with digital 3D models of real production, making changes and optimising them. Modelling and simulation are important areas of the digital factory that allow businesses to answer questions about modelled processes. Modelling is the process of creating a simulation model based on available information about the real system. Based on the layout of the real system and its abstraction, we are creating a model on which experiments will be carried out later [1,2]. The model is created based on a layout where the static and dynamic objects that make up this model are inserted. The model is a simplified version of the real system containing all its essential parameters. On this model, we conduct experiments in order to obtain information about the real system. Simulation is a representation of the real system and its dynamic processes in the model. As has already been said at the outset, the simulation aims to obtain information for the real system, with its subsequent optimisation [3,4]. Basically, it is about preparing, implementing and evaluating individual experiments through a simulation model and realised by simulation runs. Therefore, the simulation is used to support decision-making processes and verify the implications of individual decisions prior to their actual implementation. As the most common scenario analysis of the results from the simulation, the run is considered the what-if analysis. Operational managers can simply perform what-if analysis as a part of a decision-making process [5,6]. In general, the difficulty of modelling, which results in a model, depends on various indicators. Specifically, determining the model and the required degree of abstraction is one of them. If, for example, we take into account only a line for simulation, where only means of production and conveyors are installed, then a simple simulation is sufficient that neglects the dimensions of these devices. However, let's take into account workers who perform free movement and must avoid objects whose position changes over time. It is necessary to create a model that also takes this state into account in the simulation. Tecnomatix Plant Simulation is a dynamic simulation software that allows you to model at different levels of abstraction and reduction. In general, it allows display in both 2D-only and 3D-only, the usage of which is currently dependent on the required model properties. At its core, the article describes 2D only or 3D only modes for

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Lucia Mozolová; Štefan Mozol; Milan Gregor; Patrik Grznár

Tecnomatix Plant Simulation, their comparison and application with obtained achievements.

2 Tecnomatix Plant Simulation

It is a simulation tool from Siemens that allows simulation and optimisation of production and logistics systems and their processes. Through Tecnomatix Plant Simulation (TPS), it is possible to optimise material flow, resource utilisation and logistics at all levels of planning in the company. Tx Plant simulation as a discrete 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 moving on to another machine [7]. Hierarchical modelling allows us to optimise processes, flows and resources for selected parts of the system (individual devices) or the system as a whole (enterprise). The digital models make it possible to conduct experiments and incorporate the various required changes according to the question "What would happen if?". This tool allows increasing productivity, optimising the number of workers and their activities, verification of the new layout, removal of bottlenecks areas, optimisation of logistics, reducing the work in progress of production. By carrying out testing in the digital model without interference with the real system, the pressure resulting from the possible threat to the running of the production process is being exerted.

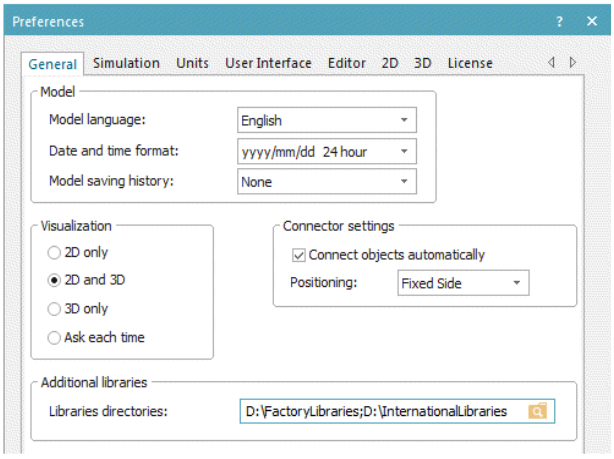
In general, these benefits can be obtained from employing simulation [8]:

- Enhance the productivity of existing production facilities.
- Reduce investment in planning new production facilities.
- Cut inventory and throughput time.
- Optimise system dimensions, including buffer sizes.
- Reduce investment risks by early proof of concept.
- Maximise use of manufacturing resources.
- Improve line design and schedule.

The simulation outputs will provide information on making quick and reliable decisions during the production and early stages of process planning. The program can be imported from other programs, such as MS Office formats (Layout in .pdf format or databases in xlsx format).

2.1 Description of display modes

Platform Tecnomatix Plant Simulation enables three types of display 2D-only, 3D-only, and combination (2D and 3D) views. Each of the views has its dominant application, which is defined by the degree of abstraction required. However, the post will only deal with the 2D-only or 3D-only display. The select and switch between views window are on (Figure 1).



(a)

(b)

Figure 1 Switch between modes
(a) using Preferences; (b) using Open 2D/3D

2.2 2D environment

Modelling in 2D introduces the most important tasks of the modeller's face when creating a simulation model. The display is designed for models with a higher degree of abstraction and reduction, especially where the object's size for the entity may be neglected. When working in 2D, you can navigate to 3D with those objects after inserting objects, but after changing the view, we find that the dimensions are the same for each object in that class. Precisely because of the recurrent activities of workers, it is necessary to create a so-called footpath in order to keep the distance of the worker's walking in the performance of activities.

2.3 3D environment

The view in 3D introduces the possibility to visualise the material flow and see differences between simulation objects, animable objects, graphic groups, state groups, state graphics, and graphics of the selected object. This type of display is suitable if we need to model objects with medium abstraction and reduction of elements. This means that the object behaves as one in the basic frame, even if it has a multi-part graphical structure, but the overall dimensions of the object are preserved. Based on [8], the dialogue Show 3D Graphic Structure shows the graphics in a tree structure that visualises the 3D simulation object but not the content of this simulation object. In this mode, when defining the free movement of workers, the worker bypasses the obstacles and behaves like when moving in a physical layout. In this mode, you

can also create an animation of objects using Graphic groups. Graphic groups define a possible visual representation of an animate object and have a unique name for this object. This is similar to the 2D icons of the simulation objects. A graphic group can be permanently shown or hidden to enable switching between alternative graphic groups. Each simulation object or animate object contains at least one external graphic group named default and optionally any number of alternative or additional graphic groups, which you can show or hide independent of each other. The visibility of the graphic groups is a 3D object property that can be inherited and the entire graphic structure. This type of display and modelling is especially suitable for visually satisfactory model display, especially when presenting to investors or senior management, where we want to subdue our simulation-obtained results. If necessary, the model with minimal abstraction and number of reductions uses different software, namely Tecnomatix Process Simulate.

2.4 Comparison of 2D-only and 3D-only views

Whether 2D-only or 3D-only in Tecnomatix Plant Simulation, each view has its specific features and functions. Individual functions, especially in 3D mode, allow modifying the size of an object, which in 2D, for example, is only possible directly in the object's parameters. The comparison of functions and modes is in (Table 1).

Table 1 Comparison of Tecnomatix Plant Simulation function and modes [8]

Function	3D Only	2D Only
Axes origin of the scene	objects can be inserted anywhere, the grid adjusts its size	upper left corner of the Frame window objects can only be inserted within the displayed grid, starting at the position 0.0
Standard Graphic of certain Information Flow Objects	small icon next to label	large icon next to label
Ribbon	Yes	Yes
File Menu	Yes	Yes
Ribbon > Start	Yes	Yes
Ribbon > Debugger	Yes	Yes
Ribbon > 3D > Edit	Yes	No
Ribbon > 3D > View	Yes	No
Ribbon > 3D > Video	Yes	No
Ribbon > Frame > General	No	Yes
Ribbon > Frame > Icons	No	Yes
Ribbon > Frame > Vector Graphics	No	Yes
Ribbon > Method > Edit	Yes	Yes
Ribbon > Method > Tools	Yes	Yes
Ribbon > DataTable > List	Yes	Yes
Context Menu of the Class Library	3D-related commands only general and 3D-related commands	no 3D-related commands general and 2D-related commands
Dialog Window of the Objects > Menus	3D-related commands only general and 3D-related commands	no 3D-related commands general and 2D-related commands
Ribbon > Icon Editor > Edit	No	Yes
Ribbon > Icon Editor > Animation	No	Yes
Ribbon > Icon Editor > General	No	Yes
Dialog of Length-oriented Objects > Tab Curve	No	Yes
Display Panel	No	Yes

3 Results

A simple simulation model has been created to verify the accuracy of previous claims, consisting of several objects of different sizes in real conditions. The first model is created in 2D graphics and neglects the dimensions of objects, while the worker can move freely. The second model is created in 3D graphics and takes into account the dimensions of objects. (Figure 2) depicts 2D-only a 3D-only models.

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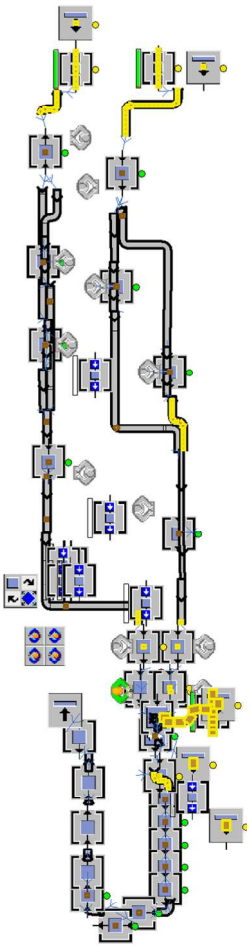
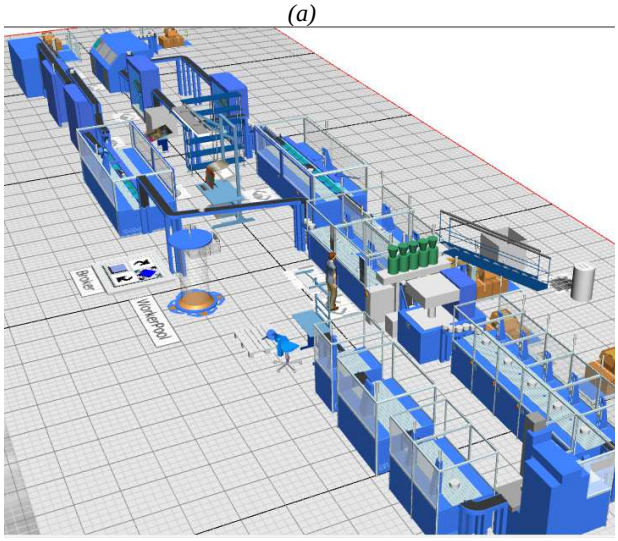
Lucia Mozolová; Štefan Mozol; Milan Gregor; Patrik Grznár



(a)



(b)

Figure 2 Display in (a) 2D-only; (b) 3D-only

The results of simulation runs are contained in (Table 2), where 100 simulation runs were conducted for each model for a period of one shift, i.e. 7.5 hours.

Table 2 Comparison of the 2D-only and 3D-only simulation model

View	Distance travelled (m)
2D-only	73225.33
3D-only	73708.61

The results show that 3D displays also consider objects' size more suitable for the worker's free movement in space without a defined footpath. The results obtained in this way are more accurate and reflect the actual situation. The difference in views is 0.66%.

4 Conclusion

Speed in verifying different solutions is most important if the processes are characterised by uncertainty about the final result. By applying simulation, we can get a really accurate picture of the outcome of these uncertain processes, and we can simulate the behaviour itself. The simulation application also solves the problems of estimating the results of large investment projects, which equally positively affects the costs that would arise in the future due to bad decisions. The costs and time requirements for implementing the simulation project themselves depend on the degree of abstraction and reduction of the model elements. The article describes an experiment conducted in Tecnomatix Plant Simulation software that was tasked with detecting results that can be achieved when using individual mods of the display, namely 2D-only and 3D-only, and the impact of the abstraction of elements on accuracy. The core of the article was to describe the views in software and compare these two views, assessing the accuracy that we can achieve with individual views on a model example. In this particular case was, the difference between example models 0.66%.

Acknowledgements

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