

USE OF PLANT SIMULATION IN AREA OF STORAGE

Andrea Krauszová

TU of Košice, Faculty of Mechanical Engineering, Institute of technology and management, Department of Industrial Engineering and Management, Němcovej 32, 04 200 Košice, andrea.krauszova@tuke.sk

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Abstract: Implementation and use of designing and simulation is currently becoming a standard practice in many undertakings. Simulation enables the company to detect bottlenecks in the production and forecast potential threats. Contribution shows the practical usage of the Tecnomatix Plant Simulation student version in the specific conditions of the industrial company. It deals with the problem of storage and dispatching of the finished products. Plant Simulation is a computer application developed by company Siemens PLM Software for modelling, simulation, analysis, visualisation and optimization of manufacturing systems and processes, flow of material and logistic operations. The application enables comparison of complex manufacturing production alternatives, including the internal processing logic, by help of simulation on computer.

1. Introduction

In the present time are available various information systems which are used by industrial enterprises for removal of problems in production, elimination of losses or decrease of costs.

Plant Simulation is a computer application developed by company Siemens PLM Software for modelling, simulation, analysis, visualisation and optimization of manufacturing systems and processes, flow of material and logistic operations. The application enables comparison of complex manufacturing production alternatives, including the internal processing logic, by help of simulation on computer. Plant Simulation is used by small and also bigger enterprises mainly for strategic planning of layout, check of logic of the process and extent of complex production investment.

2. Use of Tecnomatix Plant Simulation for process of storage

The simulation module Plant Simulation has a wide use mainly in the area of manufacturing and service processes [1]. Its relevant use requires knowledge of basic terms and also understanding of internal logic [5], [7], [8].

The theory of simulation systems usually works with the following terms: [6]

- *Entities* – items which pass through the system (components, documents, clients, statements, reports, etc.).
- *Activities* – activities which are carried out in the system – e.g. loading of truck, turning, check of components, repair of machine, etc.
- *Resources* – means which enable carrying out of activities – personnel, machines, area, tools, energy, financial means, etc.
- *Controls* – rules, which describe how, when and where are carried out the individual activities and

under which conditions the individual events may occur in the system.

Overview of basic elements of simulation model of manufacturing system is given in Table 1.

Table 1 Main elements of simulation manufacturing system [6]

Model element	Example		
Components of manufacturing system	static – immobile	machines, stores, ways, conveyors	
	mobile	temporary	products, material, tools, cutting fluids, waste, and others.
		permanent	trucks, pallets, workers, etc..
System variables	internal variables		manufacturing performance, number of necessary tools, preparations, etc.
	external variables		number of orders.. failure of machines, and others.
	parameters		number of machines, capacity of containers, number of trucks, and others.

The way of depicting these elements in the model and range of parameters and attributes by which they may be described, is usually given by a specific simulation system [3]. Besides the common objects such as input and output, typical elements for the area of storage are mainly objects existing in the menu of material flow, mobile elements and tools (Table 2) [6].

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Table 2 Basic elements for area of storage

	Store	The object serves for storage of components.
	PlaceBuffer	Temporary keeping of parts in row, one behind the other to maximal capacity.
	Buffer	Temporary keeping of parts in row, one behind the other with secured shift.
	Sorter	Temporary keeping of great number of parts and simultaneously their separation according to attributes.
	Line	Modelling of enterprise systems of transport.
	Turntable	Modelling of rotation platform which moves on one of several interconnected material flows or revolves.
	Turnplate	Modelling of rotation platform which revolves after loading of parts.
	Track	Modelling of store or way on which the transporter moves.
	FlowControl	Modelling of strategy of passing and providing total flow of material.
	Display	Presentation of current data and results of simulation process.
	Chart	Presentation of current data and results of simulation process.
	Report	Presentation of current data and results of simulation process.
	Entity	Mobile unit in process represents a component, assembly unit or assembly whole.
	Container	Mobile unit in process represents manipulation units of 1st row.
	Transporter	Mobile unit in process represents motorized and manipulation transport units.
	TransferStation	Control of unloading and loading of entity.

3. Analysis of current state of distribution of finished products

The main task of this part of enterprise is to ensure the put away of manufactured products and their subsequent planned export. The enterprise ensures production of selected models on the basis of orders which are arranged within the shortest time possible so that no overstocks may occur in the store [2].

In the enterprise there exist two inputs of finished products:

1. *TOP LOADER* - serves for separation of products of type T.
2. *FRONT LOADER* - serves for separation of products of type F.

The manufactured, wrapped and marked products are transported on conveyor to the section of physical distribution the main task of which is to distinguish individual models of products and subsequently separate them.

Before the use of simulation program itself it is necessary to analyse the current state of storage and distribution process of finished products. Fig. 1 [4] shows the solution of storage in the enterprise.

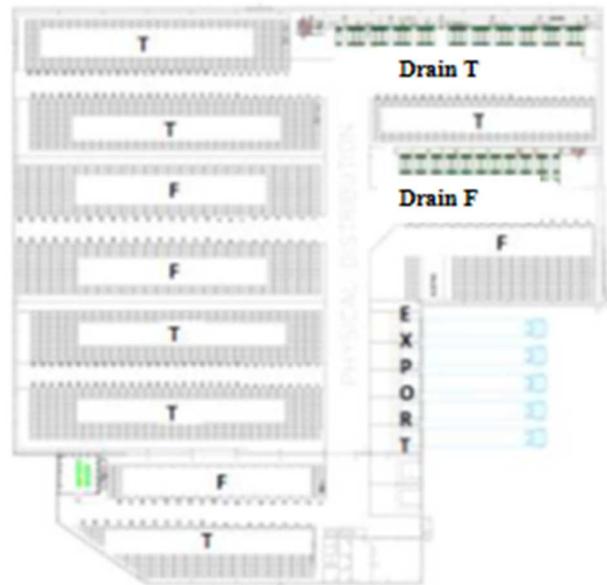


Figure 1 Solution of storage in the enterprise

The products are transported by an input belt to the elevator, which shifts two products into the sorter. In the sorter the operator of the conveyor sets the input requirements under which the device separates them into ten places connected by conveyors. Any such site has three conveyors with a capacity of five pieces per one conveyor. If the sorter requests output into a full destination, the entire belt system is blocked until the conveyors remove the products. For each input are

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available during the working shift two forklifts while one can transfer twelve pieces of products.

The last part of the followed process in the company is expedition. There are four port ramps for loading of finished products into tandem. For each ramp is provided a forklift and one operator who scans the products according to order and ensures their stability during transport. After preparation of tandem the forklift of respective expedition will start transporting of the required products to the appropriate place where the operator checks the order by scanning. After checking of the order he sequentially stacks the finished products and loads them into the parked tandem. The tandem is filled up until the entire space is filled, respectively until the order is completed.

4. Application of simulation module

For needs and realisation of simulation program Tecnomatix Plant Simulation (TPS) it was necessary to mark the individual types and also transform the real state into the TPS environment. Therefore the products were marked in the program as type A and type B. Their number was adjusted to daily production which represents 5270 pieces for A type and 3300 pieces for B type of products. The transformation into TPS environment itself was realised for input conveyor (Fig. 2), elevator and also sorter.

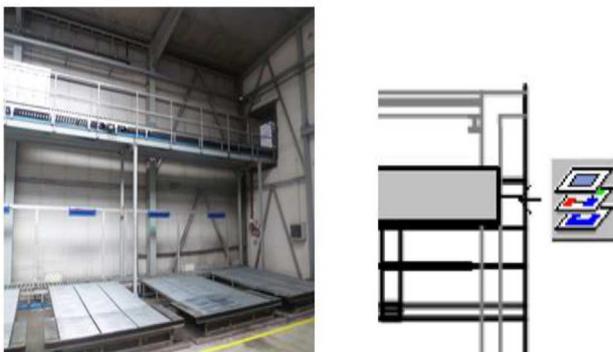


Figure 2 Transformation of real state into the TPS environment
- input conveyor

Products entering the conveyor belt individually with the interval of three seconds, due to the safety requirements with respect to the maximum conveyor capacity. The conveyor belt push them to the lift, which ensure transfer on the lower belt, where enters into the sorter. The main task of the sorter is to sort products by planned outputs on a conveyor belt, with a total capacity of 15 units.

Products on the belt are operated with forklift, which is managed by one worker. Overall, in the operation are on the one sorter available two trucks of full condition

throughout the work shift. The truck is in this object the moving unit whose main task is to move products from the sorter to the store for the selected product model.



Figure 3 Colour coding of forklifts in the program

At construction of transport in the enterprise the forklifts (Fig. 3) were marked as follows:

- truck A – forklift for put away of the products of type A with maximal capacity 12 pieces,
- truck B – forklift for put away of the products of type B with maximal capacity 12 pieces,
- truck C – forklift for export of products of type A and also B with maximal capacity 12 pieces.

At construction of infrastructure due to programming of crossroads it was necessary to show the movement of all types of trucks after operation. Due to object limitation it was necessary at realisation of the program to point at its versatile use. Therefore are in individual projects included the following basic characteristics of the enterprise's store:

➤ *Loader* – it includes elevator, sorter and conveyors which have a capacity 15 pieces of selected type of product. In figure 4 is shown the 2D and 3D simplified model of the sorter. Its main task is to separate the products according to the code so that separation according to the model may be ensured.

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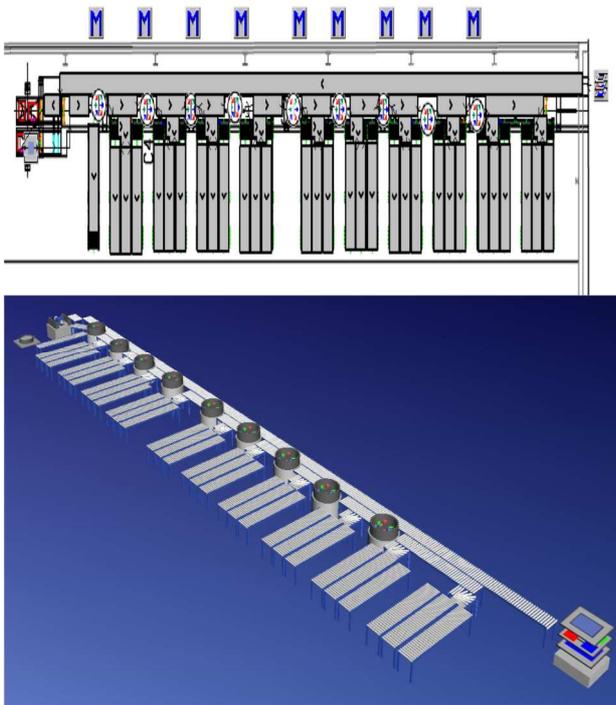


Figure 4 2D and 3D simplified model of the sorter [4]

In the project of simulation were used the following objects: frame, method, control of flow, simple process (serves as elevator) and angular conveyor of the belt.

➤ *Storage and dispatching* – it includes elements as receipt of components, expedition of components from the store, dispatching of components for export and individual ways. In figure 5 is shown the 3D simplified model of storage and dispatching. The main task is to load the finished products from conveyors and transport them into the closest free space designated for storage of selected type of product.

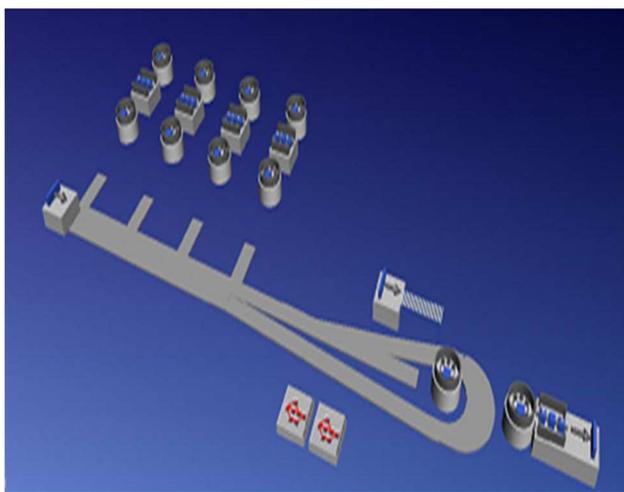


Figure 5 3D simplified model of storage and dispatching [4]

In project of simulation were used the following objects: input, output, letter, way, method, conveyor, display, transforming station and bumper (serves as store).

➤ *Simplified proposal of the process* – within the project was then created a simplified model of total process of storage, shown in figure 6. That includes elements which bear a simplified principled character of the current state. The following objects were used in it: input, output, way, method, simple process, display, Sankey diagram, transforming station, bumper, calendar of changes, work position, worker (operator), work forces, exporter.

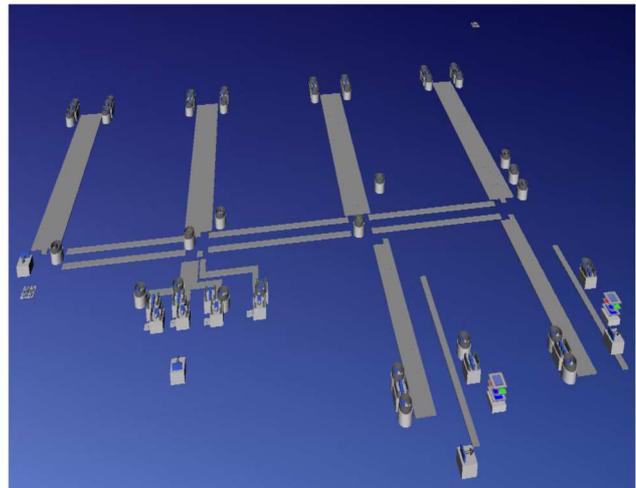


Figure 6 3D simplified model [4]

4.1 Outputs presented by simulation software

The report of the company during three day simulation is shown in figure 7.

From the report it is possible to read:

- average time of product from taking over by truck to its export;
- number of pieces which were exported;
- export per hour;
- manufacturing time;
- time of transport; time of storage;
- added value and also graph of total use of time.

Simulation time: 3:00:00.00.0000

Cumulated Statistics of the Parts which the Drain Deleted

Object Name	Mean Life Time	Throughput TPH	Production	Transport	Storage	Value added	Portion
export1.Entity	1:03:27:03.3656	3850	57	0.03%	1.19%	98.78%	0.01%

Figure 7 output of simulation [4]

A further output from the program are graphs of filling up which depict the state after three days of simulation (Fig. 8) and Sankey diagram which after simulation marks the frequency of material flow for selected types of trucks. The program thus provides

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comprehensible analytic tools for detection of obstacles and also for following the flow of material or products in the manufacturing process.

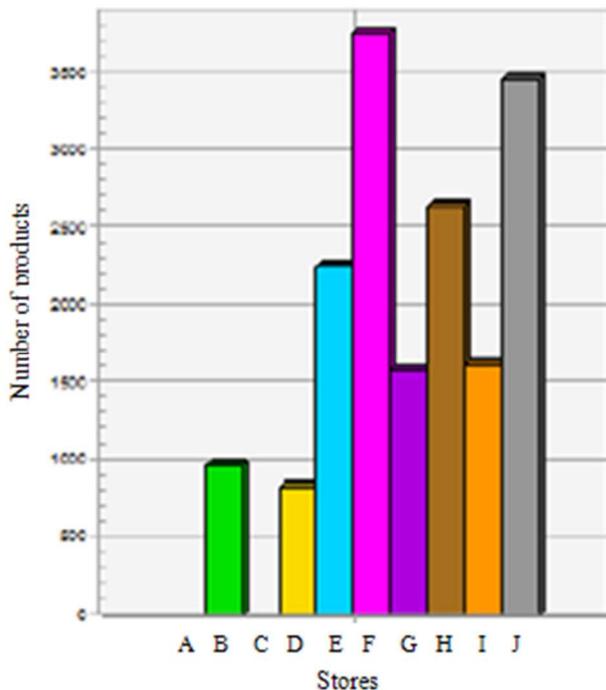


Figure 8 Graph of filling up the stores

At work with simulation program it was necessary to solve several problems and shortages where one of them was the limitation of objects. At full licence which the enterprise would have to buy the problem with limited number of objects would not exist. For work with TPS program it is also necessary to master the basic elements of programming language Simtalk without the knowledge of which the program would be used only to limited extent.

Conclusions

The present era disposes with the whole range of information systems which significantly differ by use in process of proposal, realisation of product and their applications. At use of these systems there is a trend of degradation of complex technological procedures, operational instructions, eliminations of losses and costs of manufacturing.

The use of modern simulation tools brings also a number of necessary analyses and results. With the arrival of newer and newer versions of the Tecnomatix simulation software, wider applications are assumed, which will be more efficient, due to their statistical outputs in the real time, compared to previous versions.

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Review process

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