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A PRACTICAL SOLUTION TO THE USABILITY OF TECNOMATIX PLANT SIMULATION SOFTWARE TO INCREASE PRODUCTION

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Abstract: *This article presents a practical solution to improve the usability of Tecnomatix Plant Simulation software to increase production. In today's dynamic industrial environment, optimizing manufacturing processes is crucial to achieving a competitive advantage. Tecnomatix Plant Simulation is a powerful tool for modelling and simulating manufacturing processes, making it easy to identify inefficiencies and opportunities for improvement. However, maximizing the utility of the software often presents challenges due to its complexity and the need for specialized expertise. We illustrate the implementation of our approach through case studies in a variety of industrial environments, demonstrating concrete improvements in production efficiency and performance. By bridging the gap between advanced simulation technology and practical application, our solution offers a path for manufacturers to unlock greater productivity and competitiveness in today's dynamic market environment.*

Keywords: *Tecnomatix Plant Simulation, simulation, production, analysis,*

1. INTRODUCTION

Industrial engineering is gaining increasing importance in various fields of economic activity, which underlines its multidisciplinary nature. Issues related to process modelling and simulation are becoming increasingly important as they relate to the needs of industrial practice. Verification and validation of designed manufacturing processes and systems are essential for cost savings. The implementation of PLM systems, such as the Tecnomatix Plant Simulation software module, is becoming an increasingly desirable alternative for manufacturing companies [1].

PLM is a set of product-focused software tools that cover the various phases from product design through construction, production, and process design to warehouse management and waste disposal. The information generated in these processes is used by a wide range of stakeholders such as designers, technologists, industrial engineers, product managers, manufacturers, customers, or disposers.

Modelling and simulation of production do not take place in a single phase. They are built incrementally as they consist of multiple components, and their integration is key to achieving an enterprise-wide solution. The use of PLM systems for modelling and simulation should primarily be for industrial manufacturing.

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1.1. Tecnomatix Plant Simulation

Tecnomatix Plant Simulation is a software tool for the modelling and simulation of production processes and systems. Its main objective is to help companies to optimize their production processes and improve efficiency [2].

Tecnomatix Plant Simulation software allows users to create virtual models of production equipment and processes. These models allow simulation testing of different scenarios and strategies without risk in the real world. Users can analyse the impact of various factors such as equipment capacity, work organization, shop floor layout, material flow, and more on the overall efficiency of the manufacturing process [3].

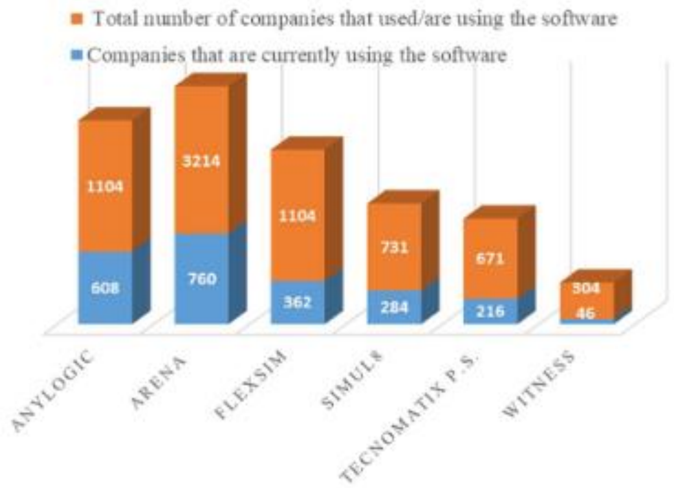


Figure 1. *Worldwide use of Tecnomatix Plant simulation in the enterprise [7].*

The percentage benefits that Tecnomatix Plant Simulation provides to businesses in optimization can vary depending on the specific conditions and application. However, in general, with this technology, companies can achieve significant savings in several areas:

- **Improve resource utilisation**: using simulations, companies can identify opportunities to increase the utilisation of their production facilities and workforce, leading to reduced inefficient downtime and waiting times.
- **Process optimisation**: By analysing different production process scenarios, companies can identify the most efficient ways to organise work, material flow and production processes.
- **Anticipating problems**: simulation testing allows companies to identify potential problems and pitfalls in production processes before they are implemented, enabling them to take measures to prevent or minimise them [4].
- **Improving lead times and quality**: Optimising production processes can lead to shorter lead times and improved product quality, leading to greater customer satisfaction.
- **Cost minimisation**: identifying cost-saving measures and optimising production processes can reduce operating costs, thereby improving the overall economic efficiency of the business.

- **Flexibility in response to change**: Tecnomatix Plant Simulation software allows different scenarios and strategies to be tested under different conditions, enabling businesses to be more flexible and efficient in the face of changes in the market, demand and technological innovation.
- **Layout optimization and production planning**: Tecnomatix Plant Simulation enables detailed analysis and optimization of these aspects, leading to improved performance of the production environment.
- **Decision support**: based on simulation results, managers and decision makers can make better informed decisions regarding investments, process optimization and production strategy [5, 6].

2. ANALYSIS OF THE CURRENT SITUATION

A company producing solid wood tables approached us with the possibility of cooperation, where they required a streamlined production process. The company provided us with all the necessary information and data we needed for the simulation. We created the simulation in Tecnomatix plant simulation software from Siemens. Figure 2 shows a simple representation of the production process [8].

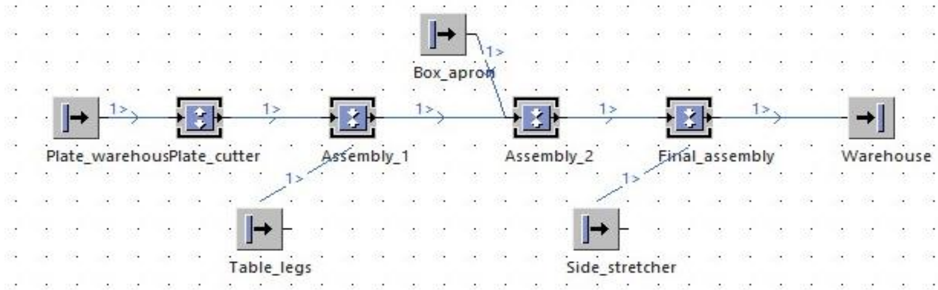


Figure 2. *2D model of solid wood table production*

After assigning the parts that either enter the manufacturing process and the units that are created on the workstations, the simulation can be run. Table I describes the components of the solid wood tables that the company manufactures.

Table I.
Components needed in joinery production

NAME	QUANTITY
Raw board	1
Tabletops	3
Table legs	4
Box apron	4
Side stretcher	2

The production takes place in 8-hour intervals. The company buys raw boards, dries them, and then moves them to the cutting room. Other parts such as legs, box apron, and side stretcher are sourced from a subcontractor due to space constraints. The company has 3 employees. Table II elaborates on the times required for assembly.

Table II.
Processed times that are needed during assembly

NAME OF OPERATION	TIME
Plate cutter	20:00
Assembly_1	10:00
Assembly_2	17:00
Final assembly	14:00

The movement of material is staffed, where we already see the first possibility of improvements. The second task will be to establish the utilization of the workplaces.

We can find out the utilization of a machine in two ways, either by assigning a counter to it or by assigning a graph that will show us graphically how the machine is utilized.

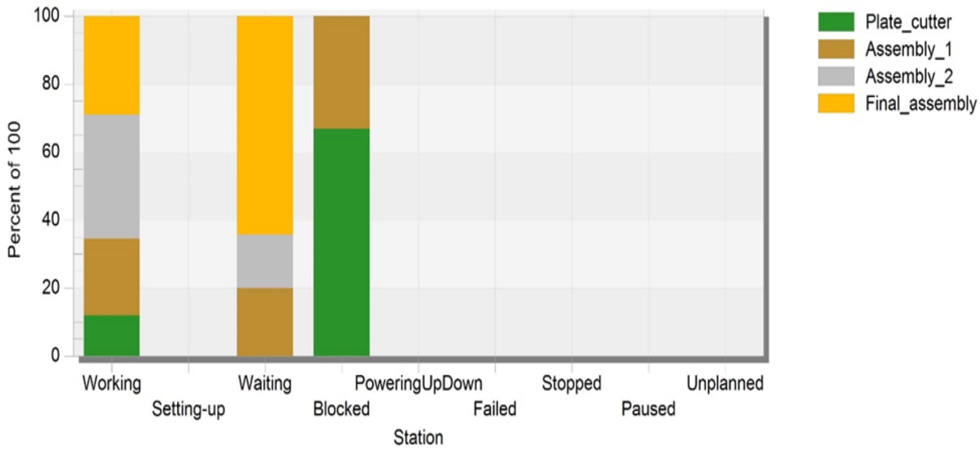
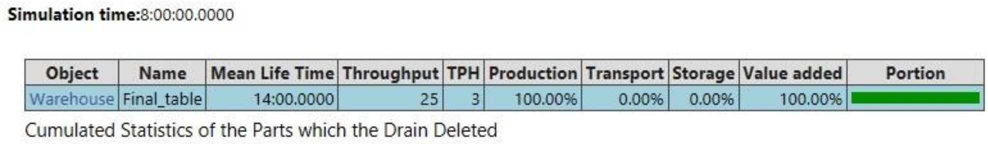


Figure 3. *Statistical data after production*

3. ANALYZE AND DESIGN OF PRODUCTION PROCESS IMPROVEMENTS

After simulating the production of wooden tables for one shift, the program generates a table (Figure 4). The result is the finished table, which is then transported to the warehouse.

Typically, Sankey diagrams consist of multiple columns (inputs and outputs) and the strips between them show the flow between these columns. These diagrams allow users to easily identify the major sources and destinations of flow, as well as their relative magnitude and relative to each other. In this way, Sankey diagrams can be very useful tools for visually displaying and analysing complex flows and processes in a system [9, 10].



Simulation time:8:00:00.0000

Object	Name	Mean Life Time	Throughput	TPH	Production	Transport	Storage	Value added	Portion
Warehouse	Final_table	14:00.0000	25	3	100.00%	0.00%	0.00%	100.00%	

Cumulated Statistics of the Parts which the Drain Deleted

Figure 4. *Number of tables produced per 8-hour operation*

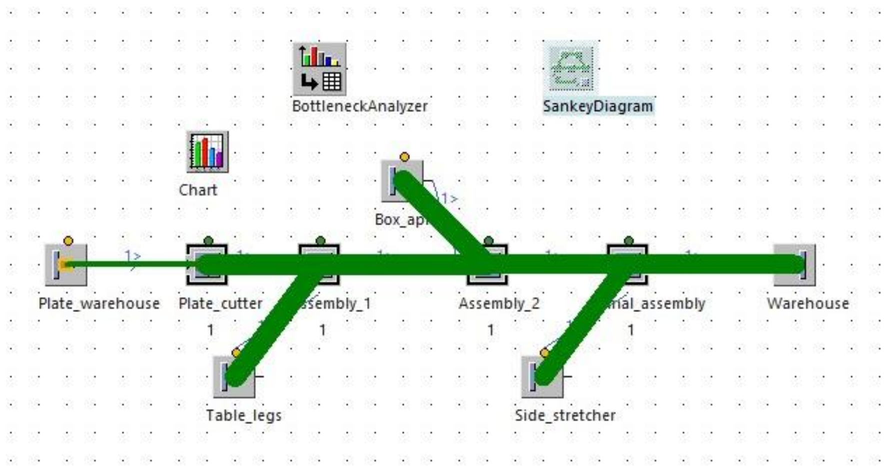


Figure 5. *Production tracking using the SankeyDiagram element*

The Sankey diagram revealed no inaccuracies, which is evoked by green. From this point of view, optimization is unnecessary.

Another element that could help and Tecnomatix plant simulation has it on offer is bottleneck analysis. In this case, it is necessary to select the parts to be monitored and graphically displayed [11].

BottleneckAnalyzer is a feature available in Tecnomatix Plant Simulation that is used to identify and analyze bottlenecks in a production process or material flow. This feature is useful for optimizing production processes and improving overall system performance [12].

The principle of the BottleneckAnalyzer is that it analyses the material flow or production process and identifies the parts that limit the maximum capacity or performance of the system. These bottlenecks are called "bottlenecks". Since bottlenecks restrict material flow or production, identifying them allows businesses to focus on these key areas and take action to improve efficiency and performance.

BottleneckAnalyzer characteristics include the following elements:

- **Bottleneck identification**: the BottleneckAnalyzer identifies specific parts of the process where material flow is congested or restricted. These parts are then considered bottlenecks.
- **Analytical Tools**: This allows users to understand the causes of bottlenecks and propose appropriate solutions [13].
- **Visual display**: This visual approach facilitates the understanding and interpretation of the analysis results.

- **Simulation testing**: users can use the simulation features of Tecnomatix Plant Simulation to test different scenarios and strategies to address the identified bottlenecks and their impact on overall system performance [14].

Figure 6 shows the use of the BottleneckAnalyzer element. The yellow colour indicates waiting and the green colour evokes that the workstation is working and to ensure a smooth transport already requires the previous workstation to deliver the material. If this is not possible a grey colour appears which means blocking [15].

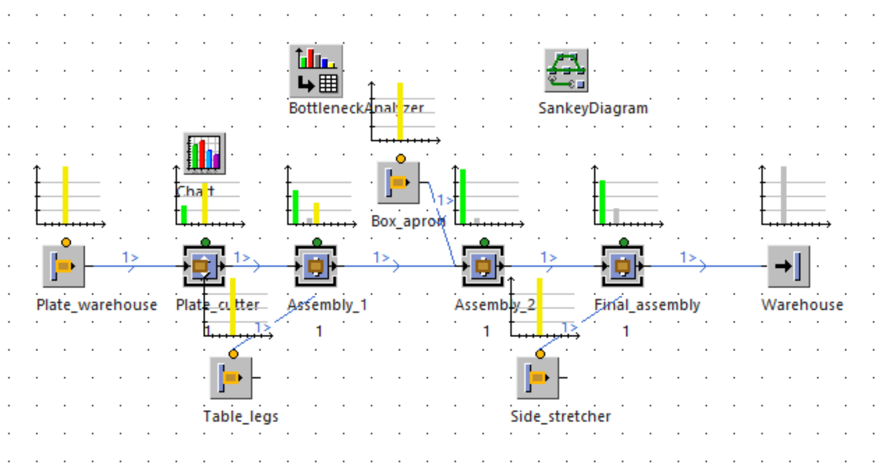


Figure 6. *Production monitoring with BottlenechAnalyzer*

The final evaluation of the collaboration with the solid wood table company is the discovery of more opportunities to streamline production and consequently increase the number of tables produced per shift.

The first, which emerges from Figure 3, is the elimination of waiting times for stations. A practical solution is the use of AGV trolleys between workstations. The company has space between workstations so these devices can be used.

Another improvement in terms of ergonomics is the elimination of the movement of raw boards from the stacking point to the sawmill. The transport of raw boards from the warehouse is provided by forklift trucks, but from the stacking point, they are manually carried by the workers to the sawmill. If the company had sufficient funds, it could use a sawmill superstructure where the machine would already take the boards themselves for cutting.

There is a similar problem between Plate_warehouse and Plate_cutter. Transportation is provided by staff. In this case, a conveyor belt can be used because the plates are identical, and this is a favourable optimization in terms of speeding up the transport between the workstations and the ergonomic load on the staff.

The last proposed improvement is the creation of separate workstations where the components will arrive, and the result will be a finished table. This would save the company space and allow it to expand production.

In terms of efficient use of resources, the business could upgrade the warehouse locations by adding tablets to the workstations and if a worker does not deliver enough components ahead of time send the request to the warehouse. Where another employee will receive his request and the necessary components will be delivered to him.

4. CONCLUSION

In the final part of the article, we presented a practical solution to improve the usability of Tecnomatix Plant Simulation software to increase production. Our work highlights the importance of the effective use of simulation tools in today's industrial environment and offers concrete recommendations to improve the usability of this specialized software. The implementation of the proposed solution can help manufacturers identify and solve bottlenecks in their production processes, leading to increased productivity and competitiveness. An important aspect is not only to provide technical expertise but also to provide adequate training and support materials so that users can successfully exploit the potential of the software. We believe that our solution will have a positive impact on manufacturing industries and bring tangible benefits in the form of improved efficiency, performance, and innovation in industrial operations.

At the time of writing, we as a collective have presented the improvements to the business and if any of the proposed solutions are applied, the article will continue with the final and accurate results.

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