

## Case study of using KEPServerEX software as a connection tool between Tecnomatix Plant Simulation and a real device

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**Abstract:** The article focuses on the processing of simulation models, covering their creation methods and exploring the possibilities of collaboration. The author utilized the Tecnomatix Plant Simulation program developed by Siemens to design a visual representation of a production line and provided a detailed description of the steps involved in its creation. To achieve the objectives of the thesis, the author employed KEPServerEX, a software solution enabling the connection and communication between the Tecnomatix Plant Simulation program and the Programmable Logic Controller (PLC). This integration allowed for the successful connection of a CNC device, establishing communication and collaboration with the Plant Simulation program. In summary, the thesis project employed the Tecnomatix Plant Simulation program to create a comprehensive visualization of a production line. The integration of KEPServerEX facilitated seamless communication between the simulation software and the PLC, enabling effective cooperation with a CNC device.

### 1 Introduction

The process of simulation in the production sphere is a method that allows you to model, analyze and test production processes in a virtual environment. In this way, it is possible to predict and optimize the behavior of real production systems and identify areas where efficiency, productivity, and economy can be improved.

The manufacturing simulation process includes the following steps (Figure 1):

- **Data collection:** At the beginning, it is necessary to collect relevant data about the production process, including data about equipment, workstations, material flow, cycle time, work procedures, and other relevant parameters.
- **Creation of a model:** Based on the collected data, it is necessary to create a model of the production system. This model can be created using a software simulation tool such as Tecnomatix Plant Simulation. The model includes various elements such as equipment, machines, workstations, conveyor belts, storage areas, and other relevant components [1].
- **Defining parameters and scenarios:** After creating the model, it is necessary to define the parameters and scenarios for the simulation. This includes setting equipment parameters, time constraints, material flow, work procedures, and other factors affecting the production process.
- **Simulation:** After defining the parameters, the simulation can be started. The simulation simulates the movement of material, work procedures, time constraints, and other aspects of the production process. During the simulation, it is possible to monitor system performance, identify bottlenecks, analyze material flow, and collect data on production results.
- **Analysis of results:** After the simulation is finished, the results are analyzed. In this way, it is possible to identify areas with insufficient efficiency, long cycles, equipment overload, or other problems. Based on the analysis, it is possible to propose improvements to the production process and optimize it.
- **Optimization:** Based on the analysis of the simulation results, it is possible to design and test different scenarios and improvements to the production process. These improvements may include process optimization, reallocation of equipment, changes in material flow, increased workstation capacity, and other adjustments that will help improve production efficiency, productivity, and profitability.
- **Verification and implementation:** After designing the optimal changes, it is necessary to verify their effectiveness and implement them in a real production

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environment. This may include testing new procedures, adapting equipment, training staff, and other steps necessary to implement the changes.

- **Monitoring and updating:** After implementing changes, it is important to monitor and evaluate the results of the new production process. If new challenges or opportunities for improvement emerge, the model needs to be updated and the simulation run again for verification and optimization [2].

The process of simulation in the manufacturing sphere allows manufacturing companies to gain a better understanding of their processes, identify areas for improvement, and test different scenarios without having to make expensive and time-consuming physical changes to manufacturing systems. In this way, more efficient production, better use of resources, and an increase in the overall competitiveness of the production company are achieved.

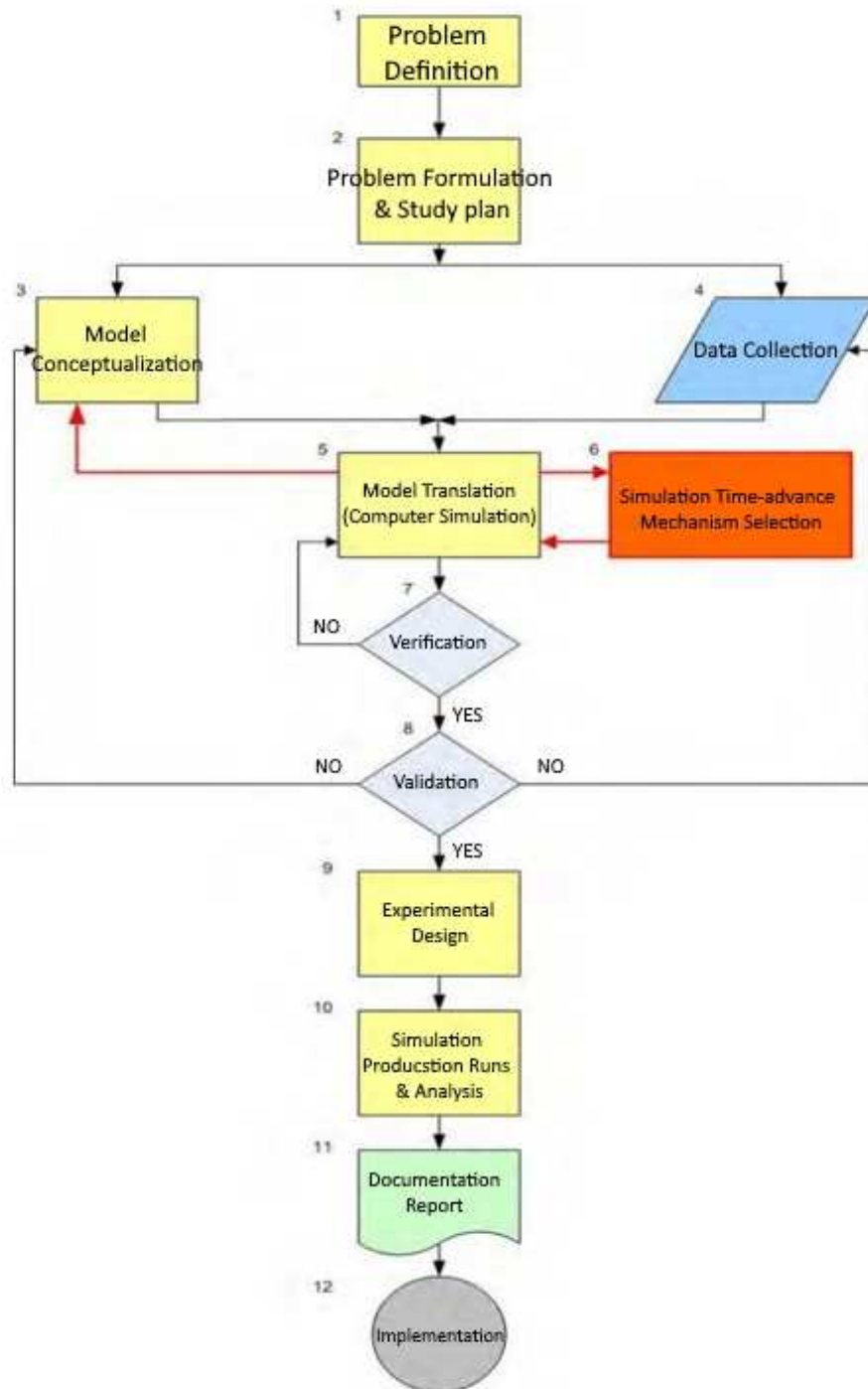


Figure 1 Steps in a simulation study [3]

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The Tecnomatix Plant Simulation program offers advanced capabilities for 3D modeling and visualization. It allows users to create and visualize models in 3D using built-in libraries or external CAD data. The program supports the JT data format for efficient 3D modeling and utilizes Siemens direct model technology, ensuring realistic visualization of large-scale simulation models without sacrificing simulation accuracy and analysis.

One of the architectural advantages of Tecnomatix Plant Simulation is its support for encapsulation, inheritance, and hierarchy. This enables users to effectively manage, comprehend, and maintain complex simulations that involve intricate details, surpassing the capabilities of traditional simulation tools.

The modeling approach in Tecnomatix Plant Simulation involves using objects within objects and models within models, structured in a hierarchical manner. By utilizing libraries, users can store and maintain various objects, and any changes made to these library items are automatically applied to all instances throughout the simulation. This ensures consistency and simplifies the configuration process, allowing users to easily adapt library items to meet the specific requirements of their simulations.

In times of increasing cost and time pressures in production along with ongoing globalization, logistics has become a key factor in the success of a company. The need to deliver on time and in sequence, introduce lean manufacturing principles, plan, and build new sustainable production facilities, and manage global production networks requires objective decision criteria to help management evaluate and compare alternative approaches. Plant Simulation helps to create digital models of logistics systems so companies can explore system characteristics and optimize their performance. The digital model not only enables users to run experiments and what-if scenarios without disturbing an existing production system but it can be used in the planning process long before the real system is installed. Extensive analysis tools, statistics, and charts let users evaluate different manufacturing scenarios and make fast, reliable decisions in the early stages of production planning [4].

KEPServerEX is a software solution developed by Kepware Technologies, which is now part of PTC. It functions as a communication server specifically designed for industrial automation systems. Its primary purpose is to facilitate seamless communication and data exchange between various devices and software applications within industrial environments.

One of the key features of KEPServerEX is its ability to establish communication with a wide range of devices and support multiple network protocols commonly used in industrial settings. It can interface with devices such as Programmable Logic Controllers (PLCs), Remote Terminal Units (RTUs), Distributed Control Systems (DCS), and Computer Numerical Control (CNC) machines. Furthermore, it supports protocols like OPC

(OLE for Process Control), MQTT (Message Queuing Telemetry Transport), Modbus, SNMP (Simple Network Management Protocol), Siemens S7, Allen-Bradley, and numerous others commonly employed in industrial automation (Figure 2).

KEPServerEX acts as a versatile communication server that enables efficient and reliable data exchange between different industrial devices and software applications. It supports a wide range of protocols and devices, making it a valuable tool in integrating and coordinating industrial automation systems [6].

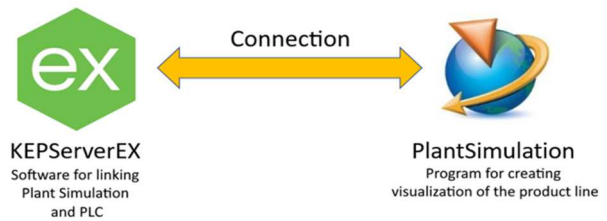


Figure 2 Communication medium (KEPServerEX) with Tecnomatix Plant Simulation

**2 Case study in the TestBed 4.0 laboratory**

First of all, after opening the KEPServerEX program, we click on "Project" in the menu on the left and create a "New Channel". After creating a "New Channel", the option "Select the type of channel to be created" will appear and we will select the option "Simulator" (Figure 3).

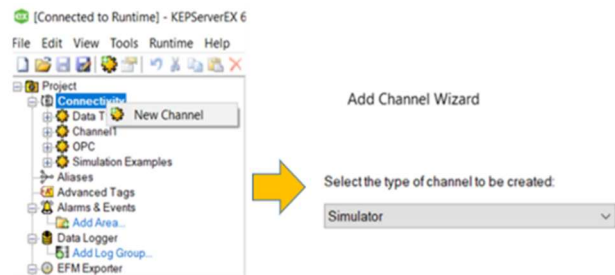


Figure 3 Creating a "New Channel"

The subsequent stage involves providing a name for the object and specifying its identity. This step requires entering the name of the object.

While configuring specific program options, it is crucial to determine the approach for handling invalid floating-point numbers when transmitting data to the client. The default setting is "Replace with Zero", which replaces any invalid floating-point numbers with zero [7].

Furthermore, the option for Item Persistence needs to be adjusted to "Disable". This setting disables the persistence feature for the item, indicating that the item's state will not be preserved between system restarts or power cycles.

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The final step in the settings options is defining the address where the information will be stored. This involves specifying the location or destination where the data will be stored for retrieval or further processing. A summary of the settings is shown in Figure 4.

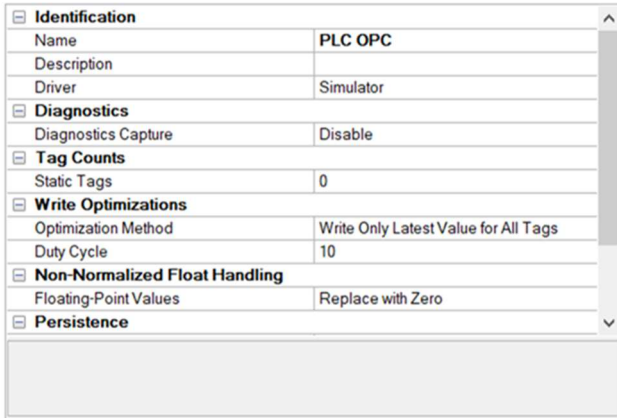


Figure 4 Summary of set values and names

After creating a "New Channel", to which we set the name PLC OPC, click on this "channel" and create a "Device". Subsequently, it is necessary to set the specific device type, input format, and method (Figure 5).

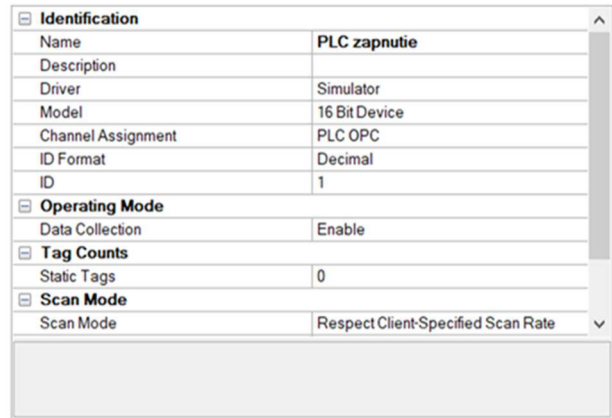


Figure 5 Summary of set values and names

In the next step, we opened the production line in the Tecnomatix PlantSimulation program and assigned one of the production processes from the "Toolbox" in the "Information Flow" section called "OPC UA".

The use of "OPC UA" allows us to connect the PlantSimulation program and KepServerEX, enabling communication between these programs. After adding "OPC UA" to the production program, we right-clicked on the KepServerEX program and selected the option "OPC UA Configuration" (Figure 6).

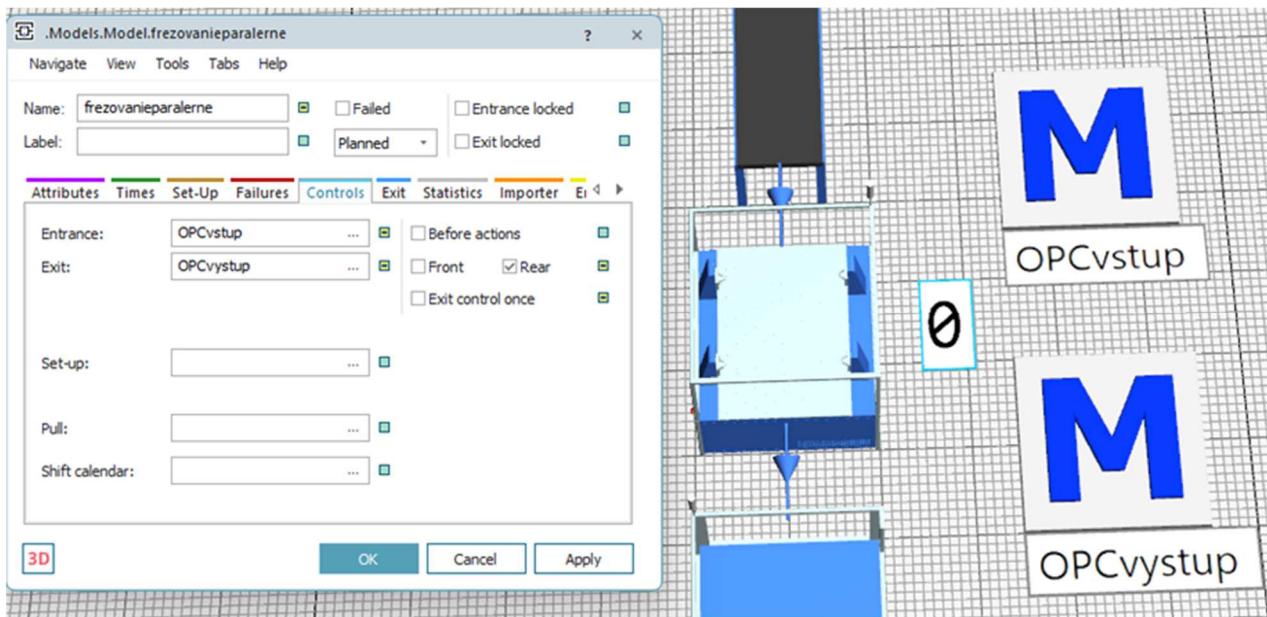


Figure 6 Allocation of methods

The "milling in parallel" process in the simulation will only be activated and the associated "CNC device" will be turned on if all four parts specified in the input arrive simultaneously. This condition ensures that the process starts only when all the necessary components are present [8].

Furthermore, the simulation involves a PLC (Programmable Logic Controller) that establishes a signal

connection between the Tecnomatix Plant Simulation program and the physical CNC model. This enables the simulation to interact with and control the real CNC machine based on the defined conditions and inputs (Figure 7).

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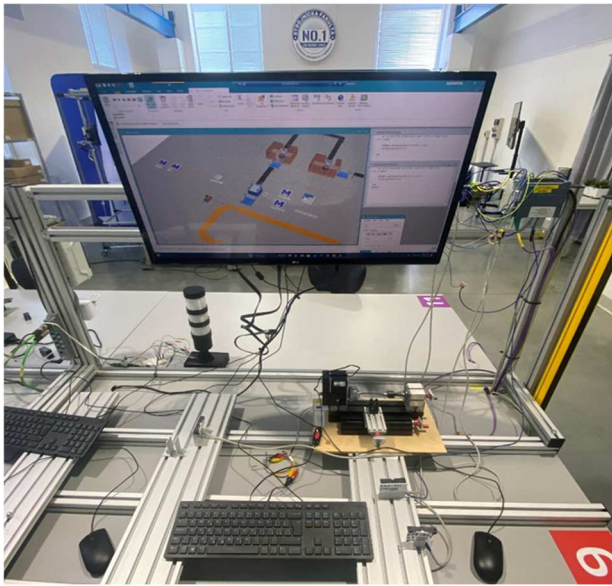


Figure 7 Means for the implementation and connection of the simulation with the real environment

### 3 Conclusions

The objective of the project was to model and simulate production processes in collaboration with TestBed 4.0 laboratory technologies. To achieve this, the Tecnomatix Plant Simulation program from Siemens was utilized to create a visual representation of a custom production line. The setup of the entire production line was then described in a step-by-step manner.

In the TestBed 4.0 laboratory, efforts were focused on establishing a connection between the Plant Simulation program and the Programmable Logic Controller (PLC) using KEPServerEX. This involved creating a server using KEPServerEX and establishing communication between it and the Tecnomatix Plant Simulation program to facilitate data transfer and communication. This integration allowed the project to achieve its goal of connecting Plant Simulation with the PLC, as well as integrating CNC equipment into the system.

The outcome of this work is a functional link between the simulation environment and the real-world production setting. This connection adds value to the simulation environment by showcasing its capabilities in a practical context, thereby bridging the gap between simulation and reality.

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#### Review process

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