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SIMULATION AS A PART OF BUSINESS PROCESS MODELING

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Abstract: Simulation, especially computer simulation has been in a rapid growth in recent years. Its deployment in practice generally improves production possibilities in many ways. Requirement for computer-simulated production system is to optimize production, where the resolution needs to be ultimately maximizing the savings in production costs and minimizing production time with respect to the quality of the final product. Resources of the computer simulations in the coming years will be increasingly powerful means of competitive producers. Knowledge of simulation and its application in a virtual environment in a connection with real production is already a key tool for the success of many companies nowadays.

1 Simulation of the production processes

Current computer program can imitate the real card game or chess. Process simulation offers computer models of real processes. The model is composed by entering critical operating parameters of real processes (eg. Operational inputs, process flow and resource usage) into the simulation program. By adding specific information on how to change these parameters, the resulting model is able to replace actual process.

Process model allows analysts to monitor the behavior of process from the comfort of the office or lecture rooms, with operations that can commonly take several days or weeks, they are completed within a few seconds. Such a quick process is able to collect and process large amounts of data that would be difficult to obtain during normal operation. Process simulation also helps collect and analyze data, perform with them a variety of experiments and changes without disrupting critical operations running.

Most commercially available simulation packages uses Assay using the "Monte Carlo" method. This method utilizes the principle whereby each successive simulation uses randomly selected combination of input variables from a set of pre-defined input parameters. By implementing simulations in multiple cycles may be using a computer to obtain a large amount of data in a few minutes. This allows analysts to track data for high-speed implementation of operations for greater periods of time instead of short-term data that would be obtained from the real process. Long-term collection of data offers a much more accurate picture of how performance may vary and importance of processes in terms of time.

An important simulation techniques is a visual computing and logical action. Visualization options allow designers to create high-performance presentation with live animation for the executive management and the owners, so they can watch how the information is transferred or any part of the process before implementing the change and after. The logical action allows users to select different routes and activities based on conditions that are programmatically defined in the model.

2 Simulation possibilities in the Tecnomatix Process Simulate

Simulation of the production processes can be done in many softwares. One of them, especially module of Siemens Tecnomatix software, has many possibilites how to simulate the process. Tecnomatix Process Simulate (Fig. 1) is designed for building new or modifying existing production processes. On the base of simulation you can imagine the future picture of the real production system. 3D Simulation can reflects the actual status and conditions on the running system and of course, after some improvements, it can show the possible figure of the production system. The question about creation of simulation is simple. Engineers need to know, if the

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created simulation will be managed by time sequence (time based) or controled by signals (event based).

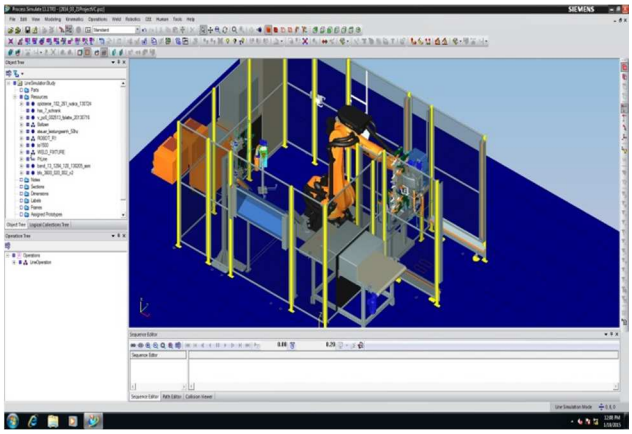

Fig.1 Process Simulate environment

3 Simulation methods

Main build stones of a time-based simulation are resources, products and operations. Time-based simulation is limited by its duration of operation and it is strictly defined to one scenario of a given simulation. Logic of time-based simulations is based on Gantt chart (Fig. 2). It describes a sequence of operations in simulations, so all relationships between operations and duration of each process defined in the operation tree. To build a time-based simulation it is necessary to define kinematics of functional elements (gripper,weld gun, etc.), modeling of all operations (human operations, robotic operations, material flow operations) and create relationships between those operation.

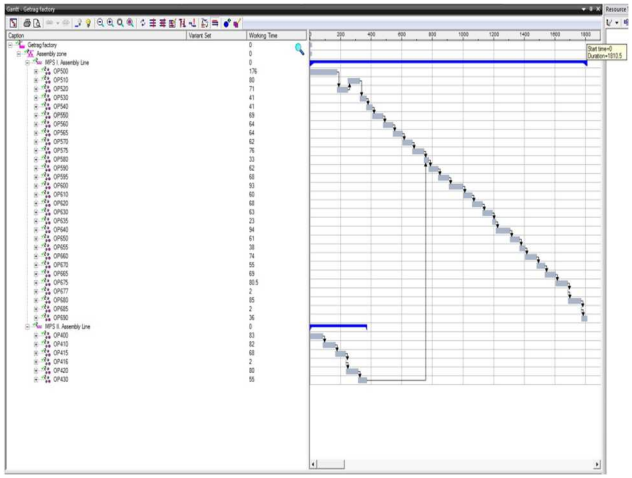

Fig.2 Time sequence – Gantt chart

The Event-Based Simulation module provides a simulation environment that supports the design and verification of sophisticated production stations. The module can simulate production stations where a variety of robots, manufacturing resources, and control devices must function in full synchronization. Process Simulate's Event-Based Simulation module offers an approach that is much more accurate than conventional time-based (sequence) simulations, creating programs off line and an event-based and flow control simulation that enables you to simulate multiple robots and the surrounding devices in the production station. Using the unique simulation capabilities of the Event-Based Simulation module, OEMs, line builders and system integrators can save time and costs by identifying synchronization and automation problems, long before they start the expensive process of deploying new production stations.

In a conventional time-based simulation, the predefined sequence of operations dictates the simulation of the process. In event-based simulation, the logic of the process and the events that occur during the simulation determine the course of the simulation. The sequence of the operations is only one element of the complete logic definition. Because the events that occur during a simulation can vary, each simulation of the same process can be unique. With a PLC as well as event driven simulation, the sequence of operations is controlled using signal based logic. Various devices are stopped and started through the simulation by setting a signal.

Process Simulate enables the verification of the various segments of the manufacturing process: assembly processes, human labor, welding, continuous processes such as laser welding and gluing a further quantity of robotic processes simulated in the same environment, enabling the simulation of virtual production zones. The simulation emulates realistic human behavior, robotic controllers and PLC logic.

The main functions Process Simulate software module are:

- 3D simulation,
- Static and dynamic collision detection,
- measurement in 3D dimension,
- mapping operations,
- robotic assembly and production planning of roads,
- resource modeling (3D and kinematics)
- simulation of the human tasks
- simulations of discrete and continuous manufacturing processes.
- virtual commissioning

4 Software modules

Siemens software package Tecnomatix has several modules for each area of usage.

Process Simulate Assembly module allows users to verify the feasibility of the assembly process. This technology allows to determine the most efficient sequence of installation, adjustment of supply for the elimination of unnecessary conflict situations and determining the shortest time production cycle. Submodul Assemby Process Simulate provides the ability to choose

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the most appropriate tool for the search process in the tool library, conducting virtual testing and analysis of the consequences of collisions with simulating the full assembly process of the product and tools together.

Module Process Simulate Human (Fig. 3) allows users to verify the design of work stations, verify the achievement of the required safety of the individual parts of a product.

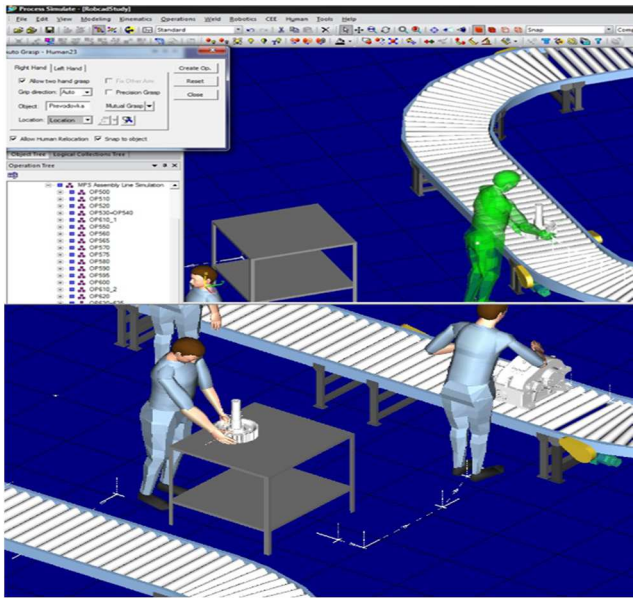

Fig.3 Process Simulate Human

The module offers powerful features for analyzing and optimizing the ergonomics of human activity, thereby providing an ergonomic and safe production process according to industry standards. Using simulation tool of human activity, the user can perform realistic simulation of the human tasks and optimize process times of the production cycle according to the standards of ergonomics.

Process Simulate Spot Weld allows users to design and verify spot welding process with 3D graphics and simulation environment from the beginning of the planning phase up to detailed engineering degrees. The module handles so-called offline programming. This module also enables the simulation of manufacturing of technical tasks such as the distribution of weld spots on individual stations, cycle welding tasks, selection of optimal hot melt guns from the library of existing guns and tools.

Process Simulate Rototics module (Fig. 4) allows users to design and simulate complex manufacturing zones, which are automated with robots. Synchronization of more robot zones with a very complex tasks provides facilitation processes using simulation tools such as assessing cyclical events and control emulator of a particular robot. Robotics simulation tools provide the ability to design without collision path for all robots and optimize their cycle times.

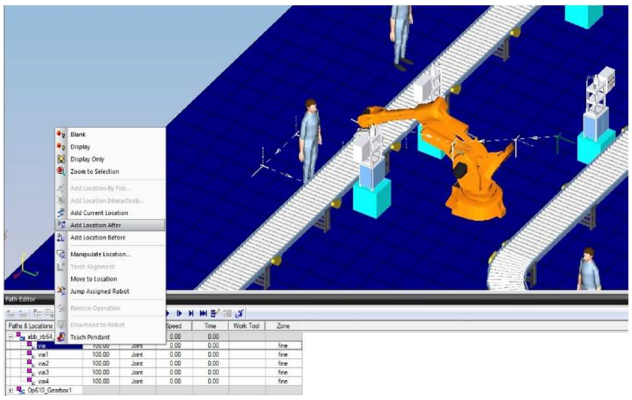

Fig.4 Process Simulate Robotics

Virtual Commisioning Module of Process Simulate allows users to simplify existing manufacturing and technical data from conceptual design to final product manufacture. The module supplies a common integration platform for various disciplines participating in real commissioning of production (mechanical and electrical). Using Process Simulate module Virtual Commisioning users can simulate real PLC code with the actual hardware through OPC and the real robot programs, allowing faithfully virtual commissioning of the production environment.

5 Benefits of using a simulation

Using special software for the virtualization of the production processes have a lot of positives:

- rapid design and deployment of creating a model,
- verify the installation,
- reduces the need for physical verification,
- verify the collisions of robots, automated equipment,
- suitable storage locations, the shelves,
- planning and layout improvements in production.

Most companies looking for savings in purchased materials, overheads, energy. Also focusing on the field of logistics optimization, optimizing material flow, layout of the workplace and human resources is important.
The benefits of optimization in Business processes are:

- reduce the cost of materials handling by up to 70%,
- reduce inventory by 20 to 60%,
- increase the capacity utilization of the space by 30%
- increase in productivity of the current system by 15 to 20%,
- reducing the cost of implementation the necessary changes for a new product to 5 to 20%.

Conclusions

The goal of simulation is to connect the 3D aspect of the process (resources, parts and operations) to the logic of the process. The Event-Based Simulation better approximates the shop floor process, taking into account many additional elements such as failure scenarios, mixed production, maintenance, and operational problems. In addition to creating a more realistic simulation, event-based simulation enables you to analyze aspects of the manufacturing process that are not possible to analyze in time-based simulations. Tecnomatix Process Simulate has a big offer how to manage production processes by innovative way. Choosing a particular module there is a possibility to design the workplace, design the process, calculating average cycle time, robot-added and non-added values, idle time, analyzing and optimizing a mixed production process in terms of collisions, flow of material, logistics, bottlenecks, time difference between different mixture ratios, analyzing and optimizing maintenance operations, reporting statistics of the process, such as the number of products produced after a given time, the number of times an alternative was applied, etc.

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