Acta Logistica - International Scientific Journal
Volume: 1 2014 Issue: 4 Pages: 17-21 ISSN 1339-5629

SIMULATION AS AN APPROPRIATE WAY OF VERIFYING THE EFFICIENCY OF PRODUCTION VARIANTS IN THE DESIGN OF PRODUCTION AND NON-PRODUCTION SYSTEMS

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Keywords: design, simulation, product lifecycle, simulation software
Abstract: The paper deals with simulation and her forms of use in designing of production and non-production systems. Points to the possibility of using software can help in planning and subsequently in other phase of the lifecycle production and products. Article informs about some of the advantages of this type of software and his options. Sets out some theoretical knowledge of simulation and in the practical part presents some frequently used simulation software.

1 Introduction

The trend of rapid shortening life cycle of products and innovation, which today is normal in almost every area, it is necessary to look for, means fast design of production and non-production systems. However is necessary pay attention also to the project to be well as effective and planned production or innovation of products entering in the physical parts of its optimum manner. Just for this purpose it is appropriate that simulation capabilities that enable us to verify several possible variations, as has given by production look and eliminate any narrow spots in advance.

1.1 Simulation of production processes

Simulation ranks among leading industrial engineering techniques (Fig.1). Large expansion began to experience at the end of the twentieth century and the development and application is significantly visible also in currently. This is due to the fact that the increased complexity of the problems, which the industrial engineering resolves.

When building a production system operates a variety of different factors which cannot be described by exact mathematical equations. Even before designers begin with the construction of the enterprise, it is necessary to focus on narrow spots in the enterprise, the main risks and crisis situations:

- From an economic point is of view necessary to focus on minimizing costs in general.
- From a management perspective, it is necessary to focus on the consequences project approval, meet the deadline and prices, causes of high stocks and intermediate times.

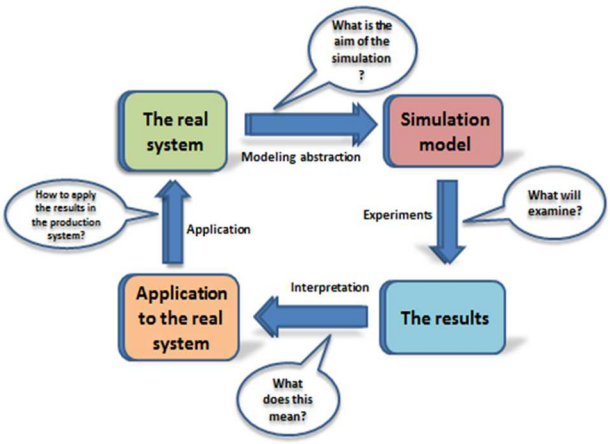

Figure 1 Principles of computer simulation

Simulation is able to remove all the shortcomings of analytical methods, but it is more demanding to time (the design model, model testing, planning and carrying out experiments) and the preparation of input data and by this it is also more expensive. This method overcomes many boundary conditions and limitations of analytical modeling procedures and its use is appropriate in particular in cases where other possible solutions have failed. The simulation is actually an experimental method, based on which the experiments with the model of the production system on the computer. Model production system typically consists of the following types of objects:

- Dynamic temporary objects (moving elements that enter the system, moving between the static parts of the system and at some point the system the leave the - parts and pallets).
- Static lasting objects (immobile parts of the system which are permanently active - machinery, warehouses, etc.).

- Elements of interconnection with the surroundings (the place where the input dynamic objects in the system and where the system leave the).

Simulation may rank among the statistical experimental methods because it works on the same basis as theoretical methods of mathematical statistics. When it is impossible to examine the whole extensive set, selects a sample that represents the characteristics of our sample set (statistical sampling). This sample is statistically analysed and the analysis result is then applied to the entire file. Similarly, in the simulation takes place as the real system simulation model. This model includes only those characteristics of the real the system, which is interesting in terms of analysis. From experiments with a model it can be concluded about the entire real system. Simulation can be divided into:

- Deterministic - simulation model does not use random variables,
- Stochastic - simulation model uses also random variables.

Based on the principle which is used in the preparation of simulation model distinguishes these types of simulations:

- A continuous simulation - the values of state variables are changing continuously in a given time interval. Value is determined variables are determined by solving differential equations that describe the behaviour of the simulated the system in a very short time steps (numerical solution, usually using the method RungeKutta).
- Discrete simulation - also called event-oriented simulation. From the perspective simulation in this case will simulate only the points in time (events), in which there is a change of state quantities the system. Examples of discrete systems are the majority of production and logistics systems.
- Combined Simulation - contains elements of discrete and continuous simulation. The basic types of simulation are shown in Fig. 2. Even in the simulation of production systems dominated discreetly processes are sometimes combine the principles of discrete and continuous simulation. Some chemical or thermal processes in the production are changing continuously, but in mass production are many discrete processes (e.g. conveyors, lines with plenty of continuously moving material).

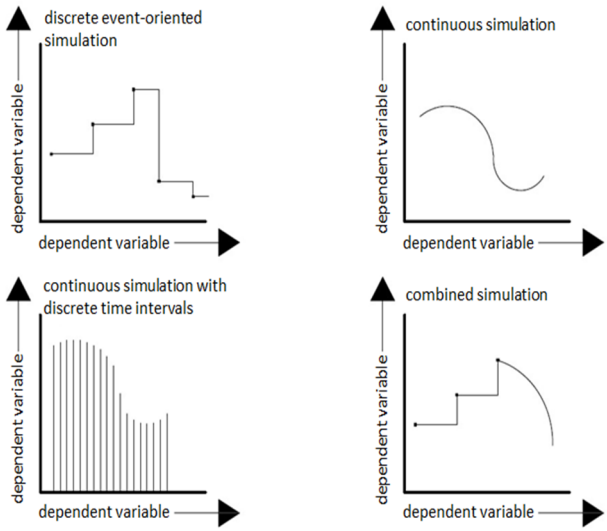

Figure 2 Basic types of Simulation

2 Some Simulation Software

The most used computer systems in area simulation include software modules from Siemens PLM Software and software package with Tecnomatix.

Tecnomatix Plant Simulation, characteristics and advantages

Plant Simulation is computer software developed by Siemens PLM Software for modeling, simulation, analysis, visualization and optimization of production systems and processes, material flow and logistics operations (Fig.3). Using Tecnomatix Plant Simulation enables users to optimize material flow, resources for all levels of planning. The software allows comparison of complex manufacturing production options, including immanent logic processing, using computer simulation. Plant Simulation is used for individual production plans as well as multinational enterprises, mainly as a strategic planning layout, process control logic and complex dimensions of productive investment. This is one of the main reasons for the dominance of this product on market.

Object-oriented programming uses the following three properties:

1. **Heritage** - Users create libraries with their own objects that can be re-used. Unlike copies, any change in the object class library is extended to some of the derived objects (children).
2. **Polymorphism** - Classes can be derived and derived method can be redefined. It allows users to create complex models faster, easier and more transparent in the structure.
3. **Hierarchy** - complex structures can be created very clear on several logical layers, allowing each layer to move between them by relevance.

The program can import data from other systems, such as: Program Access, Oracle databases, Excel or SAP.

Integration of Plant Simulation supports:

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- import data from PLM systems, or can be directly used,
- virtual enterprise putting into service,
- download data from AutoCAD.

Microstation, FactoryCAD etc. are directly into the simulation.

It provides a clear analytical tool for detecting obstacles for monitoring material flow (Sankey diagram) or to detect oversized batteries (Chart).

Provides integrated optimization tools:

- Experiment Manager automatically creates scenarios and evaluate the dependence of two input parameters.
- Genetic algorithms search large space solution.
- Neural networks show the connection between input and output parameters and can be used for forecasting.

The program can:

- Recognize and show problems that might otherwise result in high cost and time consuming remedial measures in the start-up phase.
- Offers mathematically calculated key performance indicators (KPI) instead of an expert,, feeling ".
- Reduce investment costs for production lines without jeopardizing the desired quantity.
- Optimize the performance of existing production lines.
- Incorporate machine failure, availability (MTTR, MTBF) when calculating the numbers throughput and usability.

Higher productivity planning, the program can be achieved by:

- Collection and management of knowledge within a single source of information will ensure the reuse of certified processes and cut costs for capital equipment.
- Ensuring and troubleshooting in production systems that would otherwise require time-consuming and costly remedial measures at the onset of production.
- By limiting tasks associated with planning assembly, shortening, planning and reducing related costs.
- By sharing and analysing information within the digital environment, offering a detailed overview of the various stages of the development process and the impact of these processes.
- Streamlining communications can quickly adapt to customer requirements, the decision is based on facts.

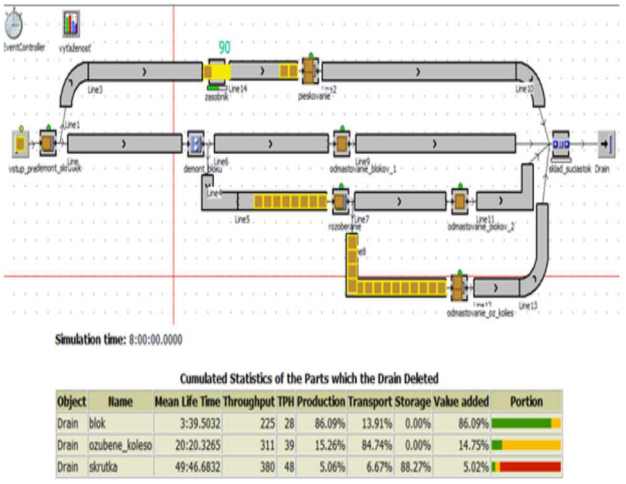

Figure 3 Output from the software Plant Simulation

Tecnomatix Process Designer

Process Designer (Fig.5) is a comprehensive instrument for designing (design) process. Analysis the 3D graphical environment, validation and optimization of production allow parallel planning of technological teams. Planner and technologist evaluate the production time, costs, resources, capacity, logistics and other important information with its help. The basic building block of work in the Process Designer is: what will be produced, whereby will be produced and what processes are used to produce.

Process Designer allows at an early stage planning concept:

- evaluate production alternatives,
- coordinate means,
- to plan a more alternatives,
- Implement changes,
- estimate the cost and duration of cycles,
- define and verify the assembling of products,
- create layout assembly lines,
- assign each operation necessary time,
- assign production functions,
- monitor the use of means,
- analyse the costs of products and production.

Process Designer provides the possibility of jointly to plan analyse and manage production processes for entire plants, lines and the individual operations. Using object-oriented technology corporate libraries means operations, manufacturing best procedures and proven experience, helping to create optimal processes and adapt to several alternative products.

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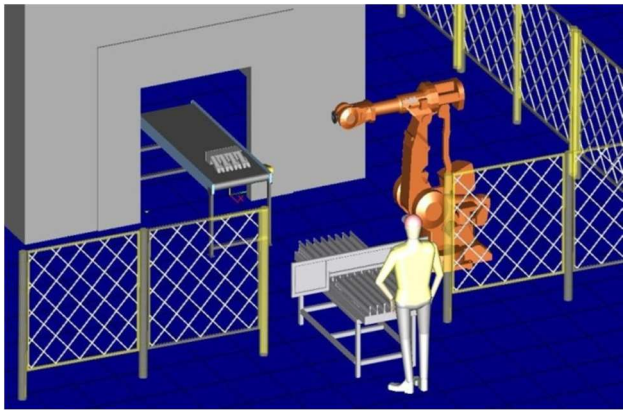

Figure 4 Tecnomatix Process Designer

Tecnomatix Process Simulate

Process Simulate is a digital tool for production solutions for the verification of the production process in a 3D environment. The ability to use 3D data of products and resources facilitates virtual validate, optimize and transfer complex manufacturing processes, leading to a faster onset of real production and the quality of products. Tecnomatix Process Simulate is a toolbox simulation and verification of production tools:

- is integrated with the Process Designer tool for,
- shortens planning helps to optimize production systems,
- uses the technology of smart devices with extensions for teaching robots.

Process Simulate enables the verification of the various segments of the production process: assembly processes, labour, welding, continuous processes such as laser welding and bonding, and an additional amount of robotic processes simulated in the same environment, enabling the simulation of virtual production zones. The simulation mimics the realistic human behaviour, robotic domain controllers and PLC logic.

The main functions of the software module Process Simulate are:

- 3D simulation, Static and dynamic collision detection,
- 2D and 3D cuts,
- measurement in 3D dimension,
- mapping operations,
- robotic assembly and production planning of roads,
- resource modeling (3D and kinematics)
- Design of the production lines and workstations,
- tools for creating documents,
- native support of visualization the standard JT,
- simulation of human tasks,
- simulation of discrete and continuous of production processes,
- simulation robotic automated processes,
- virtual commissioning.

The sub-modules software tool Process Simulate

As almost all the products from the portfolio of Siemens PLM Software and Process Simulate concentrated his work is divided into several functional software sub-modules (Fig.5).

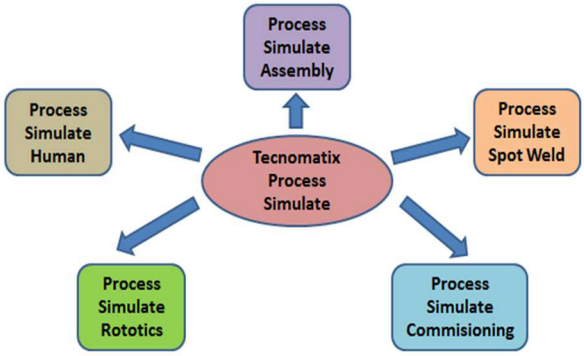

Figure 5 Sub-modules software tools Process Simulate

Tecnomatix Jack

Jack is a separate simulation tool comprising a biomechanically accurate digital model of man, has many of detailed ergonomic and time analysis permitting draft possible most comfortable, safest and a most productive workplace and product. Workplace, operations or product is by simulating possible maximum ergonomics and adapt to the needs of future users during the first stage of development 3D CAD model. Jack also fully supports virtual reality tools (Fig.6).

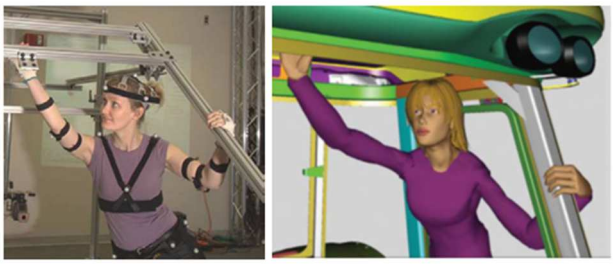

Figure 6 Environment in the Tecnomatix Jack

These and some other software for different types of simulation offers the provider Siemens PLM Software for management and elaboration data across the life cycle of products and their productions. Software similar character provide also offer other providers operating either in PLM systems, or be closely are specializing on simulation.

Conclusion

Simulations are after their introduction of a correct application for the enterprise a big competitive advantage. The advantage lies in several areas, in the planning of new products or product innovation, also in the field of marketing. Simulations are suitable for the presentation of products and processes for their preparation before customers or potential investors in companies. An

essential advantage of simulation is cost savings in many ways. This is a saving in production planning, which is in the preparatory phase can be verified several possible options, as well even at the stage of an existing production, which can detect problems and bottlenecks and with the help of the simulation can be removed and transferred into production in already optimized form.

Acknowledgement
This article was created by implementation of the grant project KEGA 004TUKE-4/2013 *"Intensification of modelling in teaching II. and III. degree in the field of study 5.2.52 Industrial Engineering"*.

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Review process
Single-blind peer reviewed process by two reviewers.