Simulation of Manufacturing Systems

Version 1. 2019

Tantárgy:

Machine Design and Production Technology
(BMEGEGEMW01, BMEGEGINWDT)

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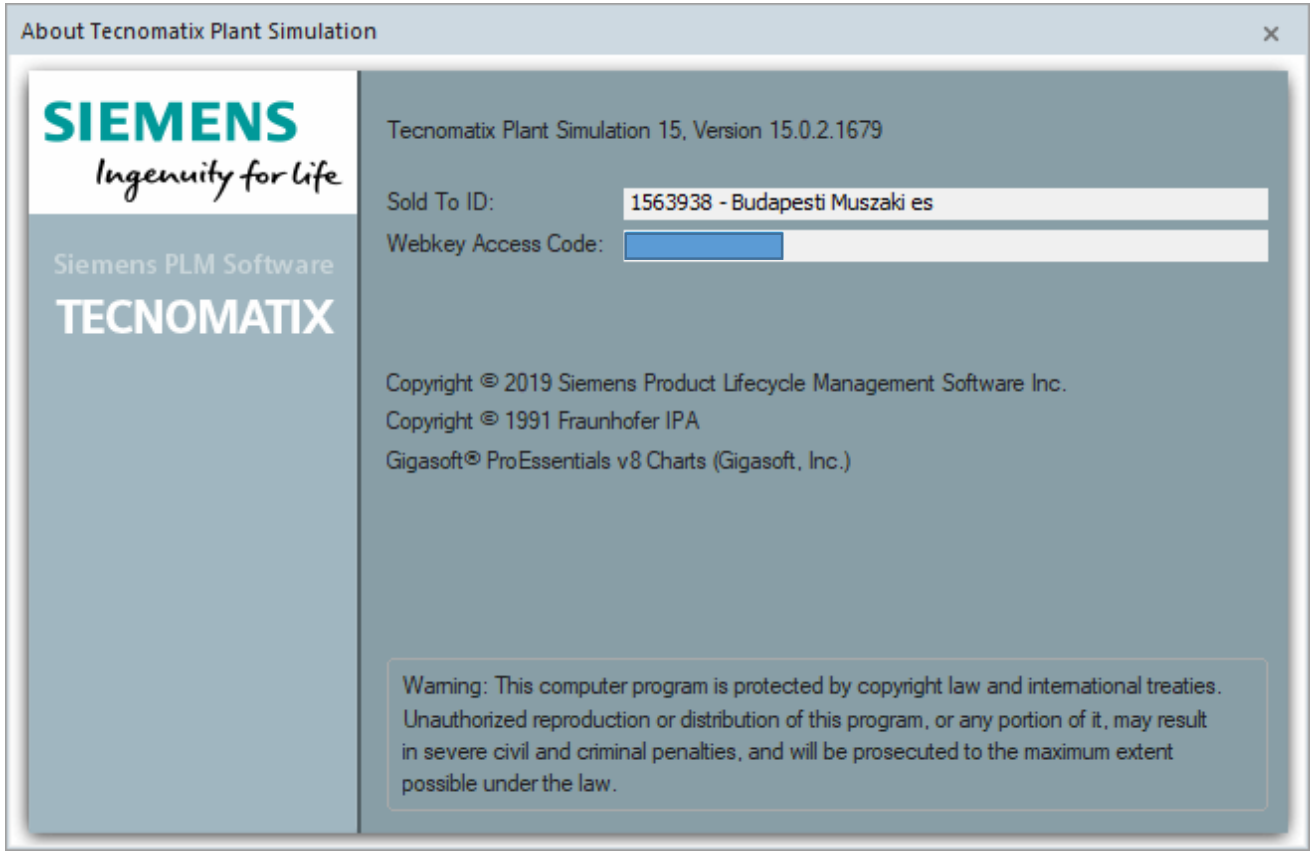
Applied software

Siemens Tecnomatix Plant Simulation 15, version 15.0.2



Simulation

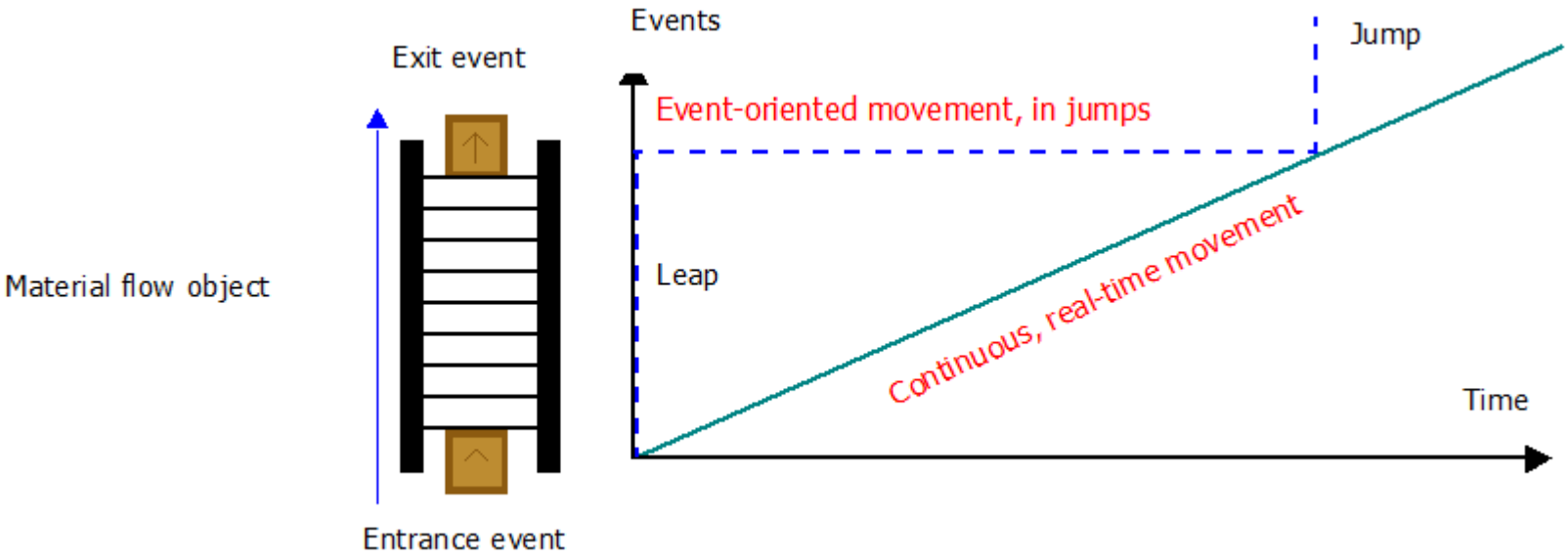
VDI (Verein Deutscher Ingenieure) 3633:

- Simulation is the emulation of a system, including its dynamic processes, in a model one can experiment with. It aims at achieving results that can be transferred to a real word installation. (VDI 3633)
- Simulation includes the
  - preparation,
  - execution and
  - evaluation

  of carefully directed experiments within a simulation model.

Discrete Event Simulation (DES)

Plant Simulation is a discrete, event-controlled simulation, i.e., it only inspects those points in time, at which events take place within the simulation. When an event occurs, the state of certain model components changes. Plant Simulation processes the events step by step and the simulation time leaps from event to event. The time between these events are not important for the simulation.



When Employ simulation?

A. Planning new a plant.
B. Optimising an existing plant.
C. Putting the formulated plan into practice.

A. Planning a new plant

- **Detect and eliminate problems** that otherwise would require cost- and time-consuming correction measures during production ramp-up.
- **Determine and/or optimise** the **times** (processing time, failure time, recovery time, etc.) and the **throughput** of the plant.
- Determine and/or optimise the **size of buffers** and the **number of machines** your intended throughput requires.
- Investigate **how failures affect** the throughput and the utilisation of the machines.
- Determine **how many workers** and staff members are required for the intended throughput.
- Determine suitable **control strategies** of the machines and of the way the machines interact.
- **Test different scenarios**.

B. Optimising an existing plant

- **Optimise the efficiency** of an existing plant.
- Optimise control strategies.
- **Scheduling** of products and jobs.
- **Buffer sizing**.
- Test **throughput**.

C. Applying plans to an existing plant

- Test different **changes in production** and investigate their effects.
- **Educate** machine operators (e. g. simulate various rare situations).

Steps of a Simulation Project

1. Define the problem and the goals.
2. Analyse the system.
3. Acquire data.
4. Build the simulation model.
5. Verify the simulation model and check its validity.
6. Execute simulation experiments and collect the results.
7. Analyse the results of the experiments.
8. Author the final documentation.

Steps of a Simulation Project

1. Define the problem and the goals.

- Define and decompose the problem.
- Is it worth making a simulation?
- Define the goals of the simulation.
  - Finding the capacity of the plant.
  - Buffer sizing.
  - Finding good control strategies.
  - Finding the quantity of required resources (humans, machines).

Steps of a Simulation Project

1. Define the problem and the goals.

2. Analyse the system.

- Describe the system to be simulated.
- Identify the structure of the system.
- Define the boundaries of the system to be simulated:
  - What will be included (e.g. manufacturing area)?
  - What will be neglected (e.g. inventory area)?
- Decompose the system into functional units (inside the boundaries).
  - What will be included (e.g. machine tools and buffers)?
  - What will be neglected (e.g. operators)?
- Define the parameters that need data acquisition.
  - e.g. processing time, set-up time, long-term data collection to determine deviations, etc.

Steps of a Simulation Project

1. Define the problem and the goals.
2. Analyse the system.
3. **Acquire data.**
    - It often requires a lot of time and effort!

Steps of a Simulation Project

1. Define the problem and the goals.
2. Analyse the system.
3. Acquire data.
4. **Build the simulation model.**
   - Top-down approach.
   - Bottom-up approach.

Steps of a Simulation Project

1. Define the problem and the goals.
2. Analyse the system.
3. Acquire data.
4. Build the simulation model.
5. **Verify the simulation model and check its validity.**
   - See if the results are plausible and credible.
   - Make an estimate of the most important results and compare them with the results of the simulation.
   - Compare the results with real measured values (if possible).

Steps of a Simulation Project

1. Define the problem and the goals.
2. Analyse the system.
3. Acquire data.
4. Build the simulation model.
5. Verify the simulation model and check its validity.
6. **Execute simulation experiments and collect the results.**
   - How to reach the goals? → How to arrive at the desired data?

Steps of a Simulation Project

1. Define the problem and the goals.
2. Analyse the system.
3. Acquire data.
4. Build the simulation model.
5. Verify the simulation model and check its validity.
6. Execute simulation experiments and collect the results.
7. **Analyse the results of the experiments.**
   - Analyze and interpret the results.
   - Conduct a sensitivity analysis in order to identify the most important parameters.

Steps of a Simulation Project

1. Define the problem and the goals.
2. Analyse the system.
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4. Build the simulation model.
5. Verify the simulation model and check its validity.
6. Execute simulation experiments and collect the results.
7. Analyse the results of the experiments.
8. **Author the final documentation.**
    - Leave time for documentation.

Steps of a Simulation Project

1. Define the problem and the goals.
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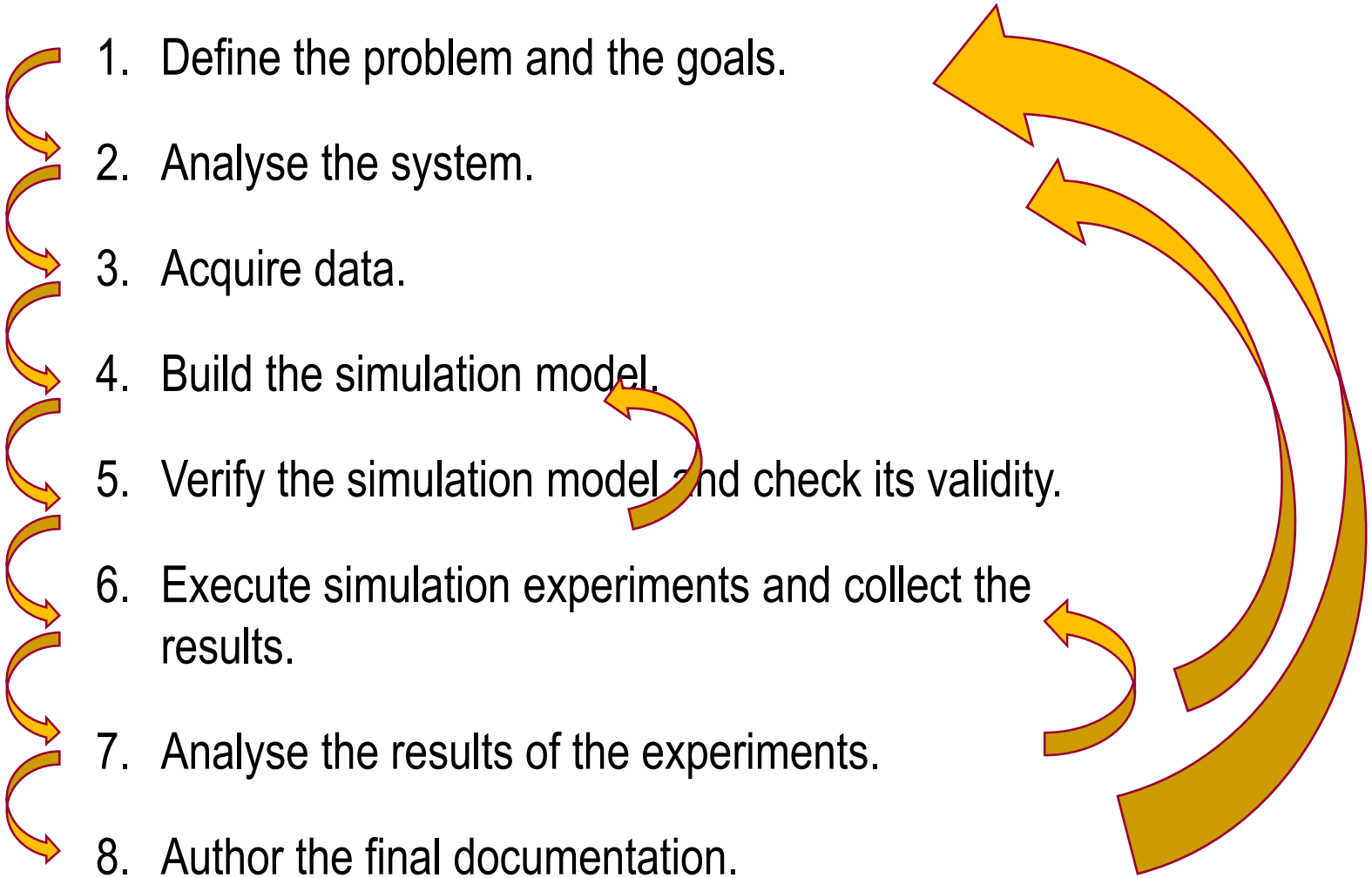

Sources

- Tecnomatics Plant Simulation Help, Version 13.0.5, Siemens Product Life Cycle Management Software Inc., 2016
- Plant Simulation Basic Course (in Hungarian), GraphIT Kft, 2010.