

LOGISTICS SIMULATION AND ARTIFICIAL INTELLIGENCE INTEGRATION OPPORTUNITIES – TEACHING MATERIAL

The teaching material comprises an integrated teaching module **consisting of a 2-hour lecture and a 2-hour practical session**, and aims to provide a comprehensive overview of simulation-based development of logistics processes and the potential applications of artificial intelligence. In response to the challenges of the modern industrial and logistics environment, the teaching material focuses on digitalisation, Industry 4.0 solutions and data-driven decision-making.

During the lecture, students will learn the basics of logistics simulation and its role in the analysis of complex systems, with particular emphasis on comparing alternatives, determining capacities and analysing operational disruptions. The theoretical section covers the fundamentals of process improvement, the identification of lean losses, as well as in-house and outsourcing-based development approaches and optimisation strategies. Another focus of the lecture is the logistics applications of digital technologies and artificial intelligence, including the concepts of digital models, shadow and twin, as well as BI, monitoring, VR and AR solutions. Particular emphasis is placed on the application of AI for decision support, optimisation and forecasting, as well as its integration with simulation.

The practical session builds on the theoretical foundations of the lecture and applies them in a simulation environment. Students create models using Plant Simulation software, learning about discrete event simulation, object structure and parameterisation. The tasks cover the modelling of logistics systems, the determination of buffer capacities, the analysis of the impact of failures, and performance analysis. A key element of the practical is experimental design and data generation, where training data is produced based on a large number of simulation runs. Using this data, a neural network is trained to predict lead times, whilst students also learn to interpret the results and analyse discrepancies.

During the course, students will learn the fundamental analytical and simulation approaches to logistics systems and gain an insight into the potential applications of AI. They will be able to create simple simulation models and carry out basic experiments. The course contributes to the development of a digital mindset and data-driven thinking in the examination of logistics problems.

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Course material prepared by:

Prof. Dr Péter Tamás
Director of the Institute, University Professor
Institute of Logistics, University of Miskolc