LOGISTICS SIMULATION AND ARTIFICIAL INTELLIGENCE INTEGRATION OPPORTUNITIES – A CASE STUDY

This material presents a case study-based teaching module which illustrates the integrated application of simulation and artificial intelligence through an analysis of the logistics system of a fictional automotive supplier. In the system under examination, production volume varies on a weekly basis, whilst the processes of forging, heat treatment, shot blasting and warehousing operate in close interaction. The central problem is determining the optimal number of heat treatment baskets, which affects both production lead time and costs, thus presenting a multi-objective optimisation problem.

The solution is based on the development of a simulation analysis system, which involves defining the processes under investigation, determining the level of detail of the model, and formalising the operational logic. The discrete event-driven model represents the main resources and material flow, whilst the structured handling of input data and parameters ensures that various test cases can be run. During the development of the model, particular attention is paid to the unified management of material and information flows, as well as the automated execution of experiments.

As a further development of the system, artificial intelligence is integrated, which is trained using synthetic data generated by simulation. The neural network is capable of estimating the optimal batch size and expected lead time based on input parameters, thereby supporting weekly planning decisions. During the verification and validation of the model, the simulation and AI results are compared with the simulation model data, ensuring the reliability of the decision support.

The result of the application is a functioning, validated decision-support tool capable of determining optimal resource allocation in line with the production plan. The approach presented also lays the groundwork for further development, particularly in the direction of digital shadow and digital twin solutions, where the connection between the model and the real system becomes closer, enabling continuous data updates and adaptive optimisation.

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