Chapter 10
Material Handling System

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Abstract A highly complex material handling system for pallets forms the interface and link between a warehouse, two production areas and an order-picking area of a company handling numerous crossing flows of palletised raw materials, products, packaging materials etc. Simulation-based analysis of the system aims at investigating its performance to determine the system’s load limit and derive conclusions regarding the system’s ability to cope with future loads. The case study presented in this chapter extracts key aspects from the respective real project to show how such a problem typical to logistics is approached and solved.

10.1 Objectives of the Project

The main objective of the project is to analyse the flows and system performance for:
• Estimating the maximum load the material handling system could cope with because of its design and technical parameters
• Analysing bottlenecks hindering system performance at load limit
• Deriving recommendations for improving system performance without changing its design or elements

The material handling system’s workload limit is estimated from the number of pallets per hour that are concurrently provided to and removed from each of the production and order-picking areas. The potential of conflicts resulting from this ‘competition’ for resources finally determines a performance limit below the sys-
tem’s technical capability. Therefore the project aims at proportionally balancing flows in such a way that this loss of performance is minimised.

10.2 Description of the Material Handling System

This section describes the material handling system to be analysed with its components, parameters and flows relevant for model building and simulation.

10.2.1 System Functionality

The material handling system interlinks a company’s warehouse (high-bay store), two production areas (manufacturing, packaging) and an order-picking area (via a depalletising robot). It is passed by several types of palletised goods (e.g. boxes, barrels) in crossing flows: the warehouse holds refilling stocks, work-in-progress stocks, raw material stocks, etc. necessary to provide the order-picking area with ready-made products to serve customer orders. The lifecycle of such products usually starts at the warehouse from where raw materials are moved to the manufacturing area. After manufacturing, products are stored in the warehouse until there is a respective demand for them. Exceptionally, certain products might also be forwarded to the depalletising robot directly. Then they are removed from the warehouse and provided to the packaging area. Packaging of products aims at making them ready for delivery to customers. Therefore pallets from packaging are usually forwarded directly to the depalletising robot. Alternatively, ready-made products might also be stored in the warehouse. Finally, empty pallets leaving the depalletising robot need to be returned to the warehouse for further use.

10.2.2 System Structure and Boundaries

The system is linked to its environment by a number of transfer points where pallets enter or leave the system. These transfer points form the sources and sinks of the system to be investigated (see Fig. 10.1). Whereas the links to the warehouse (IN/OUT_WH) work automatically and without any significant time delay, providing and receiving of pallets at transfer points of the two production areas (OUT/IN_PACK and OUT/IN_MAN) are operated manually with average handling times of 2 min per pallet. In contrast, the link to the order-picking area is not classified as system boundary because here only depalletising operations are carried out with the resulting empty pallets not leaving the system.

Pallets are of standard size (800 × 1,200 mm) and are moved by use of automated mechanical handling technology, i.e. non-accumulating chain conveyors (CC),