Synchronized lot sizing with capacity constraints

1. Problem description

In an inbound warehouse there are multiple materials stored in a variety of storage facilities. Among them continuous flow racks are used to store small and medium-sized parts. Let $i \in \mathcal{I}$ denote the set of parts considered in the following. Each flow racks consists of 4 levels and multiple runways per level. The parts are ordered and stored in boxes. There are different types of boxes, but each part is stored in one particular box type only. Thus, b_i denotes the capacity of a box for part i (given in pieces). In each runway only one part should be stored. Thereby, the width of a runway can be adapted to width of the box type which corresponds to the part assigned to the runway. Thus, the total number of runways per level depends on the assigned parts and is limited by the total width of the rack. Figure 1 illustrates a flow shelf.

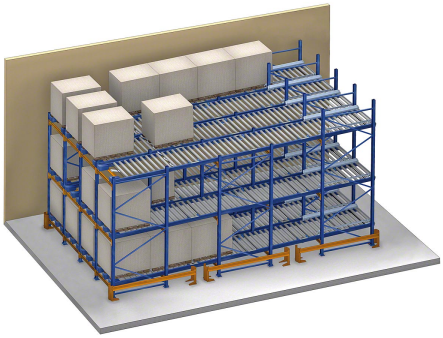

Figure 1: Schematic representation of a flow shelf (source: www.mecalux.de)

All parts are ordered from one supplier. Only complete boxes can be ordered. When placing an order for part i, ordering cost c_i^{or} have to be paid. Additionally, overall ordering cost $\bar{c}^{or}$ are charged every time at least one order is placed. Likewise, $c_i^{sh} = p_i \cdot h$ indicate the stock holding cost rate based on unit price p_i and interest rate h.

2. Task

Determine an lot sizing model that determines lot sizes for each part such that rack capacity constraints are adhered to and the total cost per period for stock holding and ordering are minimal. Assume an interest rate of $h = 10\%$ and overall ordering cost of $\bar{c}^{or} = 1500$ €. All other data are summarized in the file "Data_ordering.xlsx".