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Modelling ramp-up curves to reflect learning: improving capacity planning in secondary pharmaceutical production

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Abstract

The experience gained during production ramp-up leads to an increase of the effective production capacity over time. However, full utilisation of production capacity is not always possible during ramp-up. In such cases, the experience gained and hence the available effective capacity are overestimated. We develop a new method, which captures ramp-up as a function of the cumulative production volume to better reflect the experience gained while producing the new product. The use of the more accurate and computationally effective approach is demonstrated for the case of secondary pharmaceutical production. Due to its regulatory framework, this industry cannot fully exploit available capacities during ramp-up. We develop a capacity planning model for a new pharmaceutical drug, which determines the number and location of new production lines and the build-up of inventory such that product availability at market

launch is ensured. Our MILP model is applied to a real industry case study using three empirically observed ramp-up curves to demonstrate its value as decision support tool. We demonstrate the superiority of our volume-dependent method over the traditional time-dependent ramp-up functions and derive managerial insights into the selection of ramp-up function and the value of shortening ramp-ups.

Keywords:

ramp-up | learning | experience | time- vs. volume-dependent | empirically observed curves | mixed-integer planning model

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