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Influence of order acceptance policies on optimal capacity investment with stochastic customer required lead times

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Highlights

- Three order acceptance policies are developed for random customer required lead times.
- Capacity investment and order acceptance policy parameterization are optimized.
- Order acceptance possibility leads to lower capacity investment.
- High service level objectives for order acceptance lead to high costs.
- Information sharing in supply chains can lead to lower order rates.

Abstract

The influence of applying queue state dependent order acceptance policies, where either decision is with customer or with manufacturer, on optimal capacity investment is discussed. Therefore, three order acceptance policies are developed where either the customer has a certain service level threshold for each order or the manufacturer has an overall service level threshold. The third policy, modelling queue state independent order acceptance, is used to identify performance gains of including queue state knowledge into this decision. Equations for state probabilities, order acceptance rate, work-in-process, finished-goods-inventory, backorders and service level are developed for a system with stochastic customer-required lead times applying queuing methodology. An optimization problem minimizing capacity, work-in-process, finished-goods-inventory, backorder and lost sales cost (for rejected orders) in a single stage MTO production system is presented. The system is modelled as an M/M/1 queue with input rates depending on queue length and random customer required lead time. For the optimization problem, which cannot be solved explicitly, a solution heuristic is developed and a broad numerical study is conducted. The numerical study shows that allowing the customer to know the expected production lead time and - based on this knowledge - decide whether or not to place an order can have positive or negative influences on the overall costs, depending on the customer's service level target. Furthermore, the study shows that a high cost reduction potential exists for simultaneously optimizing capacity investment and order acceptance policy if the production system can decide whether or not to accept an order.

Keywords: order acceptance, stochastic customer-required lead time, queuing theory, service level, tardiness, operations management

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