

Impact of Due-Date Requirements on Capacity Management

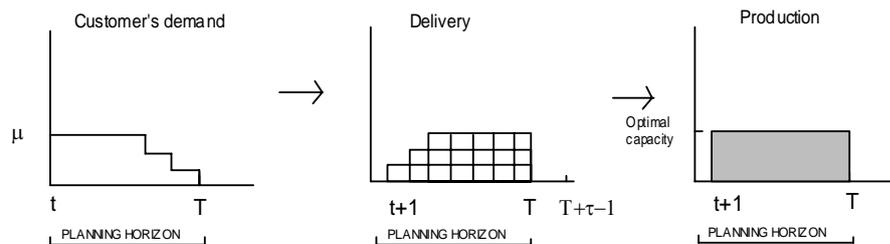
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EXECUTIVE SUMMARY

Nowadays, managers are well aware that supply chain decisions have a vital impact on the success or failure of a firm. This fact is due to the direct influence that supply chain decisions have to generate revenue as well as costs. This study seeks to help the supplier in making one of the main supply chain decisions, that is, to determine the optimal capacity level of production of a particular good or process. An excess of production would cause the supplier to deal with large inventory levels, while an underestimation of the production levels could represent the loss of future orders.

The study of the demand is a key factor for the supplier, who will try to fix his levels of supply accordingly. To support our analysis, we first develop a novel demand model which considers both the uncertainty in the overall demand and the uncertainty in when the customers will require the manufacturer to fulfill the order. Two specific demand structures are then utilized to determine the minimal capacity required to achieve a pre-define service level.

- **Result 1** determines the optimal production capacity, when the supplier's ending production policy does not allow to set up due dates beyond the planning horizon. Hence, at some point, the demand decreasingly staggers until disappearing.



- **Result 2** determines the optimal capacity when the supplier allows the placing of orders inside the planning horizon with delivery dates beyond the planning horizon.

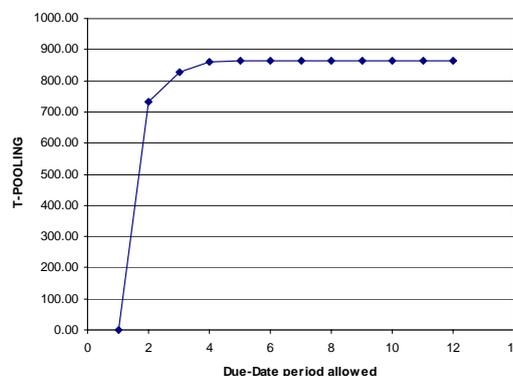


The corresponding optimal production capacities determined by Results 1 and 2 are analytical definitions very easy to implement for the supplier as they are exhaustively defined. At this point, our work investigates how the implementation of a particular optimal capacity is impacted by the required lead times of the customers. Simply speaking, we want to provide an answer to the following question:

If the supplier was able to increase or decrease the lead time he promises to his customers, how does this change affect the capacity he needs in order to achieve a certain customer service level?

We identify an interesting effect, called *t-pooling effect*, between the allowance of further due dates and the level of optimal capacity that needs to be produced in a particular period of time. The *t-pooling effect* quantifies the impact the optimal capacity has if customers due date preferences change. Our analysis shows that the impact of *t-pooling effect* may be significant, and so, capacity decisions made with conventional models (i.e. without accounting for this effect) may lead to excessive capacity levels, whereas the implementation of the optimal production capacity defined in this thesis will still achieve the desired service level requiring lower production quantities.

Result 3 proves the existence of the *t-pooling effect* under the second approach presented above and states that the *t-pooling* value increases as long as the due date interval expands. Hence, we demonstrate the existence of this effect, foreseeing that if the supplier takes the *t-pooling effect* into account, it can imply benefits for the company. Result 3 is illustrated below:



This thesis can be the starting point of some interesting applications and further research. For instance, the definition of the optimal reservation capacity for the high priority customers or high margins products in a multi-class or multi-product environment can be derived. Additionally, a cost analysis of the economical benefits of the *t-pooling* could be very interesting to develop.

Finally, we would like to highlight the main contribution of the present study. This work states that by taking into account the suppliers' partial knowledge of the behavior of future orders and the due date preferences of their customers, the optimal manufacturing level can be analytically determined. Furthermore, if this capacity is implemented, it will be below the one required if no information were used or no due date broader options were allowed.