The Impact of Safety Stock in a Supply Chain on Service Level, Schedule Instability, and Cost

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ABSTRACT

Generally, supply chain management systems keep safety stock to achieve satisfactory customer service in spite of uncertain demand. Because safety stock helps prevent stock-outages when demand is higher than expected, it may help improve customer service level. However in some systems safety stock may have undesirable side effects.

To study impacts of carrying safety stock in a supply chain we considered typical functions in material requirements planning (MRP) systems, because they are so common in supply chains. In material requirements planning systems, safety stock may have side effects on the stability of the master production schedule and on cost. These kinds of side effects have not been researched as much as the impact on service level. Therefore we conducted a simulation study of the impacts of carrying safety stock that included a study of side effects.

We analyzed impact of safety stock on MRP system performance in terms of service level, instability, and cost. In addition to studying these direct effects, we also examined how safety stock interacts with four other factors: frozen interval, re-planning interval, lot-sizing rules, and forecast accuracy, because in other studies these factors have influenced MRP system performance.

Our study confirmed earlier studies and intuition that safety stock improves service level, although its impact on service level abates as safety stock increases. Our main interest was investigating the impact of safety stock on instability and cost. Frequent changes to production schedules in a material requirements planning environment can lead to confusion at the shop floor level and reduced productivity. Some researchers have suggested instability may be reduced by introducing safety stock at the end item level to act as a buffer against differences in actual and forecast requirements.

We found that increasing safety stock reduces cost, mainly because the saving in setup cost outweighs the increase in holding cost. After safety stock exceeds a certain level, the situation reverses, and cost increases as safety stock inreases. However there is an interaction with choice of frozen interval, re-planning interval, and forecast accuracy. The interaction abates as safety stock increases.

Perhaps our most significant finding is that increasing safety stock does not necessarily improve system instability. In fact, increasing safety stock may worsen system instability. However, within a certain ranges of safety stock levels, there exists a locally optimal safety stock level. Interactions between safety stock and other MRP system factors are significant. Because forecast accuracy improves system performance, managers can increase investment in forecasting to improve system performance.