



MIT SCALE RESEARCH REPORT

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Reallocation of in-transit inventory in centralized replenishment systems with continuous review

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Reallocation of in-transit inventory in centralized replenishment systems with continuous review

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EXECUTIVE SUMMARY

Effective management of distribution systems has been one of the most challenging issues facing companies whose operations include the handling of physical goods. The length of the time period from the moment a product is acquired (either by purchase or production) till the moment the ownership is transferred to a third party (normally by selling) creates a set of costs for the organization that holds it. Raw materials, components, work-in-progress, and finished goods inventories build up in an effort to meet random demand expressed by the market. The holding and handling costs of these inventories add up to large percentages of the balance sheet and income statement of such companies.

This inventory replenishment and allocation problem stems from the fact that demand is highly random. Excess inventory can cause significant holding costs and write-offs if products can become rapidly obsolete, while too little inventory may cause lost sales. An effective way to face such uncertainties, used mainly in manufacturing, is the design of processes that permit postponement of customization of the product (i.e., localization attributes). In this way, better and more up-to-date information on demand characteristics can be used to produce final products that will follow the trends of the market. The effect of demand fluctuation on inventories can therefore be reduced, providing the capability of having the “right” product at the “right” time. World-known companies that use such techniques include HP and Dell.

In this study, we attempted to examine similar postponement possibilities in the replenishment policies of a supply chain. The use of a technique similar to production postponement logic could provide increased flexibility to the supply chain when introduced in a centralized replenishment system. In particular, we examined the reallocation proposal for a supply network of a single product that consists of a unique supplier, one distribution center (DC) that operates as a cross-docking warehouse (the DC is considered to perform idealized cross-docking activities; no inventory can be stored), and multiple retailers. To illustrate the pure impact of the postponement of allocation, and for the sake of simplicity, we assume identical retailers (in terms of

store characteristics and demand), whose stock replenishment is controlled by the supplier according to an (s,S,Q) policy with continuous review.

We are proposing a new policy that postpones the final allocation of the in-transit quantities at the distribution center. Postponement is achieved with a complete redistribution of the in-transit quantity according to the inventory levels of retailers at the moment the aggregate in-transit quantity reaches the distribution center. The aim of the reallocation is to balance the inventory levels of the retailers in order to protect retailers that experience high unexpected demand until adequate replenishment quantities arrive.

We conducted a numerical experiment by simulating the distribution network replenishment process using Rockwell Arena software and examined 27 scenarios that combine different network characteristics: number of retailers, duration of lead times, fixed ordering and backordering costs.

The results of the experiment revealed that the proposed policy of reallocation benefits the distribution system by decreasing the total cost of replenishment when the reallocation process takes place in the later stages of the total lead time – that is, when the lead time from the supplier to the distribution center is greater than the lead time from distribution center to retailers. Benefits are maximized when the fixed ordering cost is relatively small compared to the unit cost of product.