

Impact of RFID Technology on Replenishment Decisions for Multi-Echelon Supply Chains

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Abstract

Radio frequency identification (RFID) has long been regarded as an automated data collection technology that promises solutions to inefficiencies found in supply chains such as “just-in-case” inventory stock, inventory obsolescence, stockouts, and theft. However, the disappointingly slow return on RFID investment has forced companies to examine and redefine RFID initiatives.

In this research, a methodology to model different inventory replenishment scenarios in multi-stage, multi-player supply chains with and without the implementation of RFID technology were developed. The main objective of this methodology is to help organizations gain a better understanding of how RFID technology may enable more effective replenishment decisions in multi-echelon supply chain designs. To accomplish this objective, the main research tasks were divided into two stages.

In the first stage, an exploratory study was conducted to evaluate the impact of different supply chain performance (SCP) factors on two different multi-echelon supply chain designs. Twelve SCP factors were analyzed using a designed experiment, and a total of 3,200 experimental runs were conducted. The results of the exploratory study showed that five SCP factors had a significant effect on the performance of both supply chain designs with respect to the response variables total number of stockouts and fill rate. It was also revealed that even with the implementation of RFID technology, the fill rates observed at different echelons in both supply chain designs were not very high.

The results of the exploratory study motivated the implementation of a multi-echelon inventory optimization (MEIO) model. A MEIO model was selected because it relies on centrally located information to make replenishment decisions, and RFID can leverage the level of detailed information needed for the model. The objective of implementing a MEIO model was to evaluate the performance of both supply chain designs in terms of overall costs and fill rates for each player in the supply chains. Three SCP factors were analyzed using a designed experiment, and a total of 4,800 experimental runs were conducted to better understand under which scenarios RFID is cost-effective. The results of the second phase showed that all players in both supply chain designs experienced an increase in their fill rates and a decrease in the number of stockouts when RFID was implemented. However, the implementation of RFID was only profitable in scenarios where the unit cost was high.

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