

**CONDITION MONITORING AND  
SUPPLY CHAIN COORDINATION  
FOR SPARE PARTS INVENTORY MANAGEMENT**

By

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## ABSTRACT

After-sales service has received increasingly attention in manufacturing industry in recent years. A large portion of the service cost comes from the inventory cost for spare parts. In this research, we focus on two specific problems in reducing the cost and improving the efficiency of spare parts inventory system.

First, we develop a framework for incorporating real-time condition monitoring information into inventory decisions, which successfully links machinery fault diagnosis with the inventory management of spare parts and reduces unnecessary inventory cost through improving the demand estimation for spare parts. Two different reliability models, one degradation model and one Bayesian filtering based lifetime model, are investigated in incorporating condition monitoring information into demand estimation. Furthermore, under a Bayesian inventory framework, we study three different solution approaches to find the optimal inventory policy. We demonstrate that a myopic critical fractile policy can perform quite well relative to the optimal policy, and more importantly, the gap between these two policies decrease if we pool more demand sources together.

Second, we study a two-period distribution system of spare parts consisting of a single supplier and multiple retailers. We discover that a new type of incentive misalignment, called horizontal double marginalization, exists in and only in supply chains with multiple retailers, and examine coordination strategies through supplier-facilitated transshipments. In this two-period system, the supplier produces in each period to fill the orders from the retailers. Transshipments among the retailers occur at the start of the second period. These transshipments are implemented through a bi-directional adjustment contract, offered by the supplier to each individual retailer. Under this contract, in the second period, each retailer can either buy additional inventory from the supplier or sell back excess inventory to the supplier. We show that a properly designed adjustment contract, along with a wholesale contract with appropriately chosen wholesale price, can be used to achieve coordination in a system with a single supplier and multiple non-cooperative retailers.