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Dismantle or Remanufacture?

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Abstract: In this paper we study a firm's disposition decision for returned end-of-use products, which can either be remanufactured and sold, or dismantled into parts that can be reused. We formulate this problem as a multi-period stochastic dynamic program, and find the structure of the optimal policy, which consists of monotonic switching curves. Specifically, if it is optimal to remanufacture in a given period and for given inventory levels, then it is also optimal to remanufacture when the inventory of part(s) is higher or the inventory of remanufactured product is lower.

Keywords: Logistics; inventory; dynamic programming; remanufacturing; dismantling.

1 Introduction

In this paper we study a firm's disposition decision for returned end-of-use products, which can either be remanufactured and sold, or dismantled into parts that can be reused. As an example, consider product recovery activities at IBM. In its remanufacturing facility, IBM remanufactures or dismantles returned servers and storage systems. While remanufactured products are sold at a restricted price to meet demand for used products, parts obtained through dismantling can be used to meet internal or external demand for spare parts (Ferguson et al. 2011).

Broadly speaking, the problem we study belongs to the closed-loop supply chain (CLSC) literature; see Souza (2013) for a general review. In the CLSC literature, there is a significant stream of research on hybrid systems, where there are two supply sources (remanufacturing or buying new) for meeting a single demand stream for an item. In contrast to hybrid systems, our problem has a single supply source (returns) that can be used to meet multiple demand streams, specifically demands for remanufactured products, and for different parts. In other words, there are two disposition options for a return: remanufacturing, and dismantling. Several product disposition decisions are studied in the CLSC literature, including remanufacturing products that are perfect substitutes for new products, remanufacturing products that are imperfect substitutes for new products, dismantling for spare parts, and recycling for materials recovery (Thierry et al. 1995). Dismantling is different from other disposition options in that it yields multiple items, i.e. several distinct spare

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