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Dynamic product acquisition in closed loop supply chains

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Abstract

We consider a closed-loop supply chain where demand can either be satisfied by manufacturing new products or by buying back used products from customers and upgrading their functionality by remanufacturing. A joint buy-back pricing and manufacturing–remanufacturing decision model at the operations–marketing interface is presented that allows for dynamic parameters, e.g. product life cycles and seasonal aspects. The model allows the identification of beneficial opportunities for buying back and storing used products for immediate and future recovery. We present a new deterministic, dynamic, continuous-time optimisation model, derive necessary and sufficient optimality conditions, and develop a solution algorithm to find the cost-minimising manufacturing and remanufacturing policies as well as buy-back strategies for used products based on Pontryagin's Maximum Principle. It is shown that, in general, an optimal policy will include time intervals where returns are acquired so as

to synchronise demand and remanufacturing, where returns are acquired and stored for future remanufacturing, and intervals where demand is satisfied by a mix of manufactured and remanufactured products. Furthermore, we discuss several reactive and proactive acquisition and remanufacturing heuristics and show under which conditions they are optimal. The findings are illustrated by numerical examples.

Keywords:

reverse logistics

supply chain management

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