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When core sorting and quality grading is beneficial to remanufacturers: Insights from analytical models

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ABSTRACT

In this paper, we study the core acquisition and remanufacturing problem in which the remanufactured products are produced from acquired cores with uncertain quality condition, and are used to satisfy customer demand. Decision-making models are developed to examine the potential value of core sorting and quality grading in the remanufacturing system: a single-period model with deterministic demand, and a single-period model with stochastic demand (i.e., a newsvendor-type model). In each model, both the sorting strategy and the non-sorting strategy are discussed and compared. Our theoretical and numerical results show that: (1) In the deterministic demand case, core sorting is cost-effective only when the unit sorting cost is below a threshold value and the unit acquisition cost falls into a specific interval. Furthermore, in the case with two quality grades the adoption of sorting strategy with respect to the expected fraction of high-quality cores may be non-monotone: an initial increase in the expected fraction of high-quality cores may motivate a switch to core sorting, however, further increase in the expected fraction may motivate a reverse switch; (2) Similarly, in the stochastic demand case, the sorting strategy also becomes unattractive when the unit sorting cost is sufficiently high. In addition, the value of core sorting will be better off under more fluctuating demand for remanufactured products if the sorting strategy is the dominant strategy. Otherwise, it will be worse off.

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