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# Cooperation regarding technology development in a closed-loop supply chain

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## Abstract

Remanufacturing is the process by which used products are recovered and rebuilt to meet like-new quality conditions. The quality level of the original equipment manufacturer (OEM) affects not only OEM production costs but also the recovery costs of the independent remanufacturer (IR). Thus, many IRs aim to lower their costs by cooperating with OEMs through technology licensing or R&D joint venture mechanisms. In this study, we investigate competitive and cooperative interactions in a closed-loop supply chain that includes an OEM and an IR. First, the OEM determines its quality level; according to which the OEM and the IR then choose their respective production quantities. Thus, the OEM's choice of quality level is essential to the subsequent quantity competition between the OEM and the IR. Moreover, two cooperative mechanisms between the OEM and the IR are developed: technology licensing with a licensing royalty and an R&D joint venture for technology co-development. We also investigate firm equilibrium decisions and profits in different models; consider the endogenous settings of cooperation schemes; and compare performance between the cooperative models. Furthermore, we extend our models to a dynamic setting to examine the effects of period and planning horizons on

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