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Optimal Control of Production and Refurbishment Activities: A Markov Decision Process Model

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With the increased efforts to promote sustainability and with the spread of recovery technologies, many firms are seeking policies to effectively incorporate their recovery activities with their production decisions. Refurbishment is one of the effective recovery mechanisms that can greatly enhance sustainability. In this paper, we generate insights into policies that effectively coordinate production and refurbishment decisions. Using Markov Decision Processes (MDP's), we model the joint production and refurbishment control problem (facing a supplier of a serviceable product) in continuous time under the finite-horizon, infinite-horizon, and average cost settings. We then perform structural analyses on the jointly optimal production and refurbishment policy to support such a supplier with interconnected decisions regarding when to activate production, when to perform refurbishment, when to do both, and when to do neither. Using the operator based analyses of the MDP theory, we show that the jointly optimal control policy is of a two-level threshold type. We also perform sensitivity analyses on the optimal threshold levels and investigate the monotonicity of the optimal policy in the production and refurbishment costs.

Key words: Markov Decision Process; Production Control of Serviceable Items; Production/Refurbishment Decision
