Modeling Closed-Loop Supply Chain for End-of-Use Product

Abstract

The study on closed-loop supply chains (CLSC) has gained considerable attention from academia as well as industry in the recent times. They have realized the adverse impact of unsustainable environmental practices followed for the new and used product on the present and future quality of living standard. CLSC can effectively reuse the used products at the end of the supply-chain cycle. Creation of awareness among the customers to return their used product to minimize environmental hazards is an important issue. CLSC has an enormous potential to focus on economic, social and environmental aspects. Many CLSC literatures have given much attention on consumer's behavioral attitude towards remanufactured products. However, not much attention has been paid on consumers' intention towards returning the used products. Consumers return their products for a variety of reasons such as warranty, end-of-lease, end-of-use, and end-of-life over the product life cycle. In the literature, extensive studies have been made to understand the consumers' intention about purchasing the remanufactured products. Remanufacturing can be made successful only when sufficient quantity of used product is available in the market and for that customer must be aware about the benefit of returning the used product. This thesis at the beginning focuses to understand the return intention of consumers about the end-of-use products and developed a scale and methods to measure consumer intention towards returning their used products. The empirical study reveals that advertising is one of the key factors in motivating the consumers to return their used products. Taking this cue from the empirical study, in the next part of the thesis, first, a mathematical model has been developed to see the impact of advertisement on returned items. Apart from advertisement, product acquisition price along with incentive to the consumers also play an important role in collection of the used product for remanufacturing. (Re)Manufacturer can collect the used product by various means. But, determination of the optimal acquisition price, considering the availability of used product in the market is a major challenge for any collector. The thesis tries to capture this issue by developing another mathematical model. Further, when a manufacturer adopts remanufacturing practices, it is important for the manufacturer to adjust his sales strategies in response to remanufacturing. In that case, pricing is an important competitive tool, and the competing firms often play a price war to attract the customers. Apart from price, nowadays, customers are also equally interested on service and

quality of the products. Therefore, the task of remanufacturer before remanufacturing the products is to determine the optimal selling price, service level and whole sale price under the competitive and cooperative environment and the thesis develops a mathematical model to study this issue also. The motivation of the present research emanates from all these issues.

In this thesis, apart from the empirical study, different mathematical models are developed to study various aspects of CLSC considering end-of-use products. This study also captures the implementation of quantity discount contract, Shapley Value and bargaining method in a CLSC under competitive environment.

Keywords: closed-loop supply chain, acquisition price, service, availability, advertising, coordination, competition, cooperation, remanufacturing, co-option, consumer return intention, structural equation modeling, end-of-use product.