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A Multi-Criteria Decision Making Approach for Disassembly-To-Order Systems under Uncertainty

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Abstract : In order to minimize the negative impact on the environment, it is essential to manage the waste that generated from the premature disposal of end-of-life (EOL) products properly. Consequently, government and international organizations introduced new policies and regulations to minimize the amount of waste being sent to landfills. Moreover, the consumers' awareness regards environment has forced original equipment manufacturers to consider being more environmentally conscious. Therefore, manufacturers have thought of different ways to deal with waste generated from EOL products viz., remanufacturing, reusing, recycling, or disposing of EOL products. The rate of depletion of virgin natural resources and their dependency on the natural resources can be reduced by manufacturers when EOL products are treated as remanufactured, reused, or recycled, as well as this will cut on the amount of harmful waste sent to landfills. However, disposal of EOL products contributes to the problem and therefore is used as a last option. Number of EOL need to be estimated in order to fulfill the components demand. Then, disassembly process needs to be performed to extract individual components and subassemblies. Smart products, built with sensors embedded and network connectivity to enable the collection and exchange of data, utilize sensors that are implanted into products during production. These sensors are used for remanufacturers to predict an optimal warranty policy and time period that should be offered to customers who purchase remanufactured components and products. Sensor-provided data can help to evaluate the overall condition of a product, as well as the remaining lives of product components, prior to perform a disassembly process. In this paper, a multi-period disassembly-to-order (DTO) model is developed that takes into consideration the different system uncertainties. The DTO model is solved using Nonlinear Programming (NLP) in multiple periods. A DTO system is considered where a variety of EOL products are purchased for disassembly. The model's main objective is to determine the best combination of EOL products to be purchased from every supplier in each period which maximized the total profit of the system while satisfying the demand. This paper also addressed the impact of sensor embedded products on the cost of warranties. Lastly, this paper presented and analyzed a case study involving various simulation conditions to illustrate the applicability of the model.

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