A novel multiple criteria decision-making approach based on fuzzy DEMATEL, fuzzy ANP and fuzzy AHP for mapping collection and distribution centers in reverse logistics

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ABSTRACT

The strategic location of reverse logistics facilities enables organizations to obtain optimal performance to collect end-of-line (EOL) products and distribute remanufactured products effectively and efficiently. The planning of facility location entails consideration of multiple essential criteria rather than optimizing a single criterion. This paper develops a methodological framework based on an integrated multiple criteria decision-making (MCDM) approach that captures the complexity of location planning for collection and distribution centers under fuzzy conditions utilizing decision making trial and evaluation laboratory (DEMATEL), analytic network process (ANP), and analytic hierarchy process (AHP). This novel approach aids decision-makers to simultaneously select a separate location for collection and distribution through a holistic assessment of a location’s viability for both purposes. It advances the reverse logistics literature by considering multiple criteria and their interrelationships in the location selection process, along with uncertainty and vagueness in decision making. Additionally, the proposed approach allows flexibility for decision-makers as they retain the control in picking a site based on its priority on being a collection or distribution center. Results show that government policies and regulations play a vital role in the facility location decision as they interact mostly with other criteria. Moreover, results also suggest that quantity and quality uncertainties for remanufacturing are significant factors that must be taken into consideration in the collection function, while economic and market-oriented issues are major concerns for a distribution function. This finding was observed through the application of the proposed methodological framework in a case study of the furniture industry in the Philippines. The practical implications of this study focus on being an aid in organizing and improving the operations of the reverse logistics sector of the Philippines. Finally, the proposed approach can be used to address general facility location problems in other industrial applications where tradeoffs among stakeholders or entities are well pronounced and decision-makers find it imperative that such tradeoffs must be carefully considered.

Keywords: Reverse logistics; Collection; Distribution; Fuzzy environment; Remanufacturing; Multiple criteria decision-making (MCDM); Decision-making and trial evaluation laboratory (DEMATEL); Analytic network process (ANP); Analytic hierarchy process (AHP)

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