

# 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.

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# Nov pristop odločanja z več kriteriji, ki temelji na mehki metodi DEMATEL, mehkem ANP in mehkem AHP za lociranje zbirnih in distribucijskih centrov v vzratni logistiki

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## POVZETEK

Strateška lokacija objektov vzratne logistike omogoča organizacijam, da pridobijo optimalno zmogljivost za zbiranje odsluženih izdelkov (EOL) in učinkovito distribucijo obnovljenih izdelkov. Načrtovanje lokacije objekta vključuje upoštevanje več bistvenih meril in ne optimizacije enega samega merila. V tem prispevku je razvit metodološki okvir, ki temelji na integriranem pristopu odločanja z več kriteriji (MCDM), ki zajema kompleksnost izbire lokacije za zbirne in distribucijske centre pod mehki pogoji z uporabo metode DEMATEL, procesa analitične mreže (ANP) in analitičnega hierarhičnega procesa (AHP). Ta nov pristop pomaga odločevalcem, da hkrati izberejo ločeno lokacijo za zbiranje in distribucijo s celostno oceno sposobnosti preživetja lokacije za oba cilja. Nadgrajuje se znanje o vzratni logistiki z upoštevanjem več meril in medsebojne povezanosti v postopku izbire lokacije, skupaj z negotovostjo in nejasnostjo pri sprejemanju odločitev. Poleg tega predlagani pristop omogoča odločevalcem prilagodljivost, saj obdržijo nadzor pri izbiri mesta glede na prednostno nalogo zbiranja ali distribucije. Rezultati kažejo, da imajo vladne politike in predpisi ključno vlogo pri odločitvi o lokaciji objekta, saj večinoma vplivajo na druga merila. Poleg tega rezultati kažejo tudi na to, da so količinske in kakovostne negotovosti za obnovo izdelka pomembni dejavniki, ki jih je treba upoštevati pri zbiranju, medtem ko so ekonomska in tržno usmerjena vprašanja glavna skrb za distribucijsko funkcijo. To je bilo ugotovljeno z uporabo predlaganega metodološkega okvira v študiji primera pohištvene industrije na Filipinih. Praktične posledice te študije so usmerjene v pomoč pri organizaciji in izboljšanju poslovanja Filipinov z vzratno logistiko. Predlagani pristop je mogoče uporabiti za reševanje splošnih težav z lokacijo objektov tudi v drugih industrijskih aplikacijah, kjer so kompromisi med zainteresiranimi stranmi ali subjekti dobro izraženi in odločevalci menijo, da je treba takšne kompromise skrbno upoštevati.

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## PODATKI O ČLANKU

*Ključne besede:*

Vzratna logistika;

Zbiranje;

Distribucija;

Mehko okolje;

Predelava;

Odločanje z več kriteriji (MCDM);

Metoda DEMATEL;

Analitični mrežni proces (ANP);

Analitični hierarhični proces (AHP)

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