World Academy of Science, Engineering and Technology
International Journal of Industrial and Systems Engineering
Vol:20, No:07, 2026

Reverse Logistics Network Optimization for E-Commerce

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Abstract : This research consolidates a comprehensive array of publications from peer-reviewed journals, case studies, and seminar reports focused on reverse logistics and network design. By synthesizing this secondary knowledge, our objective is to identify and articulate key decision factors crucial to reverse logistics network design for e-commerce. Through this exploration, we aim to present a refined mathematical model that offers valuable insights for companies seeking to optimize their reverse logistics operations. The primary goal of this research endeavor is to develop a comprehensive framework tailored to advising organizations and companies on crafting effective networks for their reverse logistics operations, thereby facilitating the achievement of their organizational goals. This involves a thorough examination of various network configurations, weighing their advantages and disadvantages to ensure alignment with specific business objectives. The key objectives of this research include: (i) Identifying pivotal factors pertinent to network design decisions within the realm of reverse logistics across diverse supply chains. (ii) Formulating a structured framework designed to offer informed recommendations for sound network design decisions applicable to relevant industries and scenarios. (iii) Propose a mathematical model to optimize its reverse logistics network. A conceptual framework for designing a reverse logistics network has been developed through a combination of insights from the literature review and information gathered from company websites. This framework encompasses four key stages in the selection of reverse logistics operations modes: (1) Collection, (2) Sorting and testing, (3) Processing, and (4) Storage. Key factors to consider in reverse logistics network design: I) Centralized vs. decentralized processing: Centralized processing, a long-standing practice in reverse logistics, has recently gained greater attention from manufacturing companies. In this system, all products within the reverse logistics pipeline are brought to a central facility for sorting, processing, and subsequent shipment to their next destinations. Centralization offers the advantage of efficiently managing the reverse logistics flow, potentially leading to increased revenues from returned items. Moreover, it aids in determining the most appropriate reverse channel for handling returns. On the contrary, a decentralized system is more suitable when products are returned directly from consumers to retailers. In this scenario, individual sales outlets serve as gatekeepers for processing returns. Considerations encompass the product lifecycle, product value and cost, return volume, and the geographic distribution of returns. II) In-house vs. third-party logistics providers: The decision between insourcing and outsourcing in reverse logistics network design is pivotal. In insourcing, a company handles the entire reverse logistics process, including material reuse. In contrast, outsourcing involves third-party providers taking on various aspects of reverse logistics. Companies may choose outsourcing due to resource constraints or lack of expertise, with the extent of outsourcing varying based on factors such as personnel skills and cost considerations. Based on the conceptual framework, the authors have constructed a mathematical model that optimizes reverse logistics network design decisions. The model will consider key factors identified in the framework, such as transportation costs, facility capacities, and lead times. The authors have employed mixed LP to find the optimal solutions that minimize costs while meeting organizational objectives.

Keywords : reverse logistics, supply chain management, optimization, e-commerce
Conference Title : ICSCM 2026 : International Conference on Supply Chain Management
Conference Location : Bali, Indonesia
Conference Dates : July 15-16, 2026