

Chapter 4

Freight Transport and Logistics Evaluation Using Entropy Technique Integrated to TOPSIS Algorithm

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ABSTRACT

Freight transportation and logistics decisions such as modal choice decisions are strategically important for effective supply chain operation and economic benefits. The freight selection logistic is a multi-criteria multi-objective (MCMO) process, crucial for smooth sourcing of materials, cost-effective delivery of products to customers in the right time, at the right quantity. The study discusses the major transport logistics attributes and the order preference by similarity ideal solution (TOPSIS) algorithm as the preferred MCMO model to support comparative ranking among the alternative freights. The entropy weight coefficient method minimizes the subjectivity in the selection of weight of the attribute. This study integrates the entropy technique on TOPSIS platform to improve the freight selection decision. A numerical example illustrates the procedure of the proposed algorithm and ranks the choices among truck, rail, and several intermodal transport combinations (rail/truck and air/truck) in a transportation selection model.

INTRODUCTION

In today's economy, buyers and suppliers are closely linked in domestic and international supply chain for constant sourcing of materials and economic benefits. The buyer company's major decision regarding mode of transportation has a direct effect towards competitive analysis and increasing efficiencies and profits. In supply chain, the business application that connects a range of activities, starting with the

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procurement of materials from suppliers, followed by delivery of semi-finished or finished products to distributors or retailers and then to the consumers, requires freight transportation. Intermodal transportation has become a driving force in the current economy, in large part due to capacity and cost benefits. With advances in information technology and logistics innovations, the freight transportation process has improved extensively. Companies are now able to respond to customer demands swiftly, and deploy policies to adopt market changes efficiently in a short period of time. The freight carrier maintains the flow of products between facilities and marketplaces on a global scale in a safe, reliable and cost-effective way to meet any new challenges. Technological advances enable companies to implement cutting-edge logistics technologies, such as a cloud-based transportation management system, to obtain real-time data for quick analyzing and decision making, tracking and moving freights in many different locations. The freight transport costs, shipment characteristics, transportation mode, availability, route, and compliance to the buyer company policy and objective influence the choice of mode of transportation.

High-tech products, such as computer chips, are designed in one facility at a certain location. Meanwhile, pre-processing raw materials, intermediate production, final assembly, quality control and packaging are each completed in many locations, often at a distance, in a coordinated fashion. Likewise, daily consumable and functional products such as food, beverages, apparel, pharmaceutical products, sports items, packaged letters and goods continuously flow through a supply chain with increased collaboration to deliver products in the right quantity, at the right time and place. The freight selection is a complex and dynamic process that decision makers must solve with a multiple criteria decision problem (MCDP) using real-time market data, transport, and business attributes in order to find the best option of all feasible alternatives. Business sectors can use the MCDM analysis, as several new methods have been developed, and the methods are becoming considerably easier for the users.

A global supply chain is made up of a global network of suppliers, manufacturers, warehouses, distribution centers, and retailers through which raw materials are procured, transformed and delivered to customers (OECD, 2002). A transport chain focuses on a consignment and extends over movement, physical handling, and other activities directly related to transport such as dispatch, reception, planning, and control. As more customers enter the market, competition increases and prices inevitably fall. This results in higher product availability and the need to continuously improving transportation systems to keep up with the pace of growing customer demand (Coyle et al., 2006). There is tremendous growth on commercial implication of freight transport due to the globalization of the market. It is almost a requirement for success for companies entering today's market to take part in global sourcing (Zeng, 2005). Across the globe, hundreds of millions of shipping containers are moving through seaports, carrying product in different stages of production (raw material, sub-assembly, and finished goods). These goods contribute almost \$5.8 billion per year to the world economy. In the current economic system, the growing role of freight is a fundamental component that enables companies to meet the need for goods to circulate at the global, regional and local scales. Freight transportation costs in the United States amount to approximately 6% of the GDP. This indicates that a significant portion of a company's supply chain costs come from transportation (Robinson, 2015). Freight volumes are expected to increase in the foreign trade oriented countries. The value of freight shipments, imports and export, for the U.S. only has increased from \$16.651 trillion dollars in 2007 to \$17.983 in 2013 and is expected to reach almost \$40 trillion in 2040 (Federal et al., 2015).

The most critical activities in supply chain management are freight selection and understanding of the attributes related to the movement and delivery of products, as well as support services such as storing product and receiving customer orders. Supply chain's impact on facilities depends on seamless mate-

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