

# A fuzzy quantified SWOT procedure for environmental evaluation of an international distribution center

Lee Kuo-liang <sup>\*</sup>, Lin Shu-chen

*Overseas Chinese Institute of Technology, Department of Marketing and Distribution Management, No. 100,  
Chaio Kwang Road, Taichung 407, Taiwan*

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## Abstract

In this paper, a fuzzy quantitative SWOT method is proposed to evaluate the competitive environment of locations as transshipment type's international distribution centers (IDC) in Pacific-Asian region. The method can more precisely show competitive relations and degree among the locations than other environmental analysis methods. By positioning location in the four quadrants, strategies are proposed in accordance with the grand strategy matrix (GSM) in order to strengthen locations competitive advantage and avoid the threats as demonstrated in the case of Kaohsiung.

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*Keywords:* Fuzzy quantitative SWOT method; Transshipment type's IDC; Grand strategy matrix; Competitive relations

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## 1. Introduction

Modern commodities distribution emphasizes quick response to customer demand. Therefore, the decision of logistics service providers (LSPs) and multinational corporations (MNCs) to concentrate logistics functions in a few international distribution centers (IDCs) is of critical importance. Many locations have made an effort to establish IDCs to provide logistics services, which not only efficiently supports the distribution of input/output cargos but also attracts MNCs and LSPs to distribute international commodities through the IDC [38,27,30].

With strong economic development since the early 1980s and a shift in the global center of manufacturing to Asia, major ports in Pacific-Asia have expanded rapidly. The demand for cargos in Pacific-Asia will further increase in the future [8]. According to [12], Singapore (23,192 thousand twenty equilibrium unit, TEU), Hong Kong (22,602 thousand TEU), Shanghai (China, 18,084 thousand TEU), Shenzhen (China, 16,197 thousand TEU), Busan (Southern Korea, 11,843 thousand TEU) and Kaohsiung (Taiwan, 9471 thousand TEU) are the six major competitive locations in the region. In this study, these locations are selected to evaluate the environmental position of locations for developing IDCs using the quantitative SWOT analytical method.

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<sup>\*</sup> Corresponding author. Tel./fax: +886 4 27016855x7712.  
E-mail address: [lee.kl@msa.hinet.net](mailto:lee.kl@msa.hinet.net) (K.-I. Lee).

Several IDCs have been established at major Asian port cities, such as Busan Logistics Park (Busan), Shanghai Waigaoqiao Bond Logistics Park (Shanghai), Kaohsiung Yes Logistics Zone (Taiwan), Schwartz Logistics hub (Shenzhen), Hong Kong International Distribution center (Hong Kong), and Kepple Distripark (Singapore). Hence, the environmental evaluation of competitive relations, among IDCs in different locations, from the perspective of MNCs, is important for location governors in order to design and implement appropriate strategies for attracting MNCs [34,36]. The problem is a multiple criteria decision-making (MCDM) problem, as it considers several environmental criteria.

The criteria for evaluating IDCs, as well as the weight assigned to each criterion, differs according to the subject of the evaluation, circumstances, degree of knowledge, and other factors [41,42]. The desired criteria performance values and importance weighting are usually described in linguistic terms: “low”, “medium”, “high”, and “very high,” presenting an imprecise qualification of the rating of each alternative selection, not to mention that precision-based methods are inadequate to deal with the location evaluation problem [3,7]. Fuzzy set theory was developed based on the premise that key criteria in human thinking are not numbers, but linguistic terms or labels of fuzzy sets. Several fuzzy MCDM methods have been utilized to integrate various linguistic assessments to determine optimal alternatives [3,7,15,20,25,28,37,41].

The SWOT (Strength, Weakness, Opportunity, and Threaten) analytical method is commonly used in strategy formulation [6,7,14]. The traditional SWOT analysis method is able to help enterprises qualitatively and roughly evaluate their competitiveness and can be used as a foundation for the development of strategies [23]. Quantitative SWOT analysis methods such as external factor evaluation matrix (EFE), internal factor evaluation matrix (IFE) and competitive profile matrix (CPM) aim at analyzing data statistically, differing from the qualitative estimations that lie behind the traditional SWOT analysis [13,14]. However, these environmental analysis methods are unable to carry out a complete examination of the enterprise’s internal and external factors, and cannot easily compare the competitive relationships between several enterprises simultaneously.

In this paper, a fuzzy quantified SWOT analytical procedure that integrates the MCDM concept of multicriteria evaluation is proposed to evaluate the environmental relationships of IDCs in the Pacific-Asia region. Using this method, the environmental position of locations developing IDCs can be judged according to their environmental position and competitive degree in four quadrants, and competitive strategies further developed to strengthen competitive advantage in accordance with the grand strategy matrix (GSM) model.

## 2. Literature review

### 2.1. Environmental analysis methods

Several methods such as the resource-based view (RBV), traditional SWOT, and quantitative SWOT methods, including EFE, IFE and CPM, are used to support the decision issue of the competitive environment in a given facility [3,7,9,13,14]. RBV was first introduced by Penrose in the late 1950s, largely reintroduced by Wernerfelt [39] in the 1980s, and became a dominant framework in the 1990s [19]. The core concept of RBV emphasizes a facility’s internal strengths and weaknesses in contrast to industrial organization economics, which focuses on a firms’ external opportunities and threats (e.g. Porter [31,32], Grant [18]; Foss and Erikson [17]). When the external environment is dynamic, the firm’s own resources and capabilities may be easier to control [1,2,17,29].

The traditional, qualitative, SWOT analysis method is an environmental analysis method that integrates the internal strengths/weaknesses and external opportunities/threats. Analysis of internal strengths and weaknesses is based primarily on evaluation of how an enterprise carries out its internal work, such as management, work efficiency, and research and development. The EFE and IFE methods quantitatively evaluate a facility’s competitiveness in accordance with its successful factors of internal and external environment. The CPM method identifies business advantages and disadvantages using EFE and IFE. The analytical results are based on quantitative methodology, different from the qualitative estimation of the traditional SWOT analysis method.

A comparison of these environmental analysis methods based on the literature is given in Table 1. RBV qualitatively evaluates a facility’s internal resources to dynamically understand its advantages and disadvantages in responding to external environmental challenges. The traditional SWOT method qualitatively

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