



Application of axiomatic design and TOPSIS methodologies under fuzzy environment for proposing competitive strategies on Turkish container ports in maritime transportation network

Metin Celik^{a,*}, Selcuk Cebi^b, Cengiz Kahraman^b, I.Deha Er^c

^a Department of Maritime Transportation and Management Engineering, Istanbul Technical University, Tuzla 34940, Istanbul, Turkey

^b Department of Industrial Engineering, Istanbul Technical University, Macka 34367, Istanbul, Turkey

^c Department of Marine Engineering, Istanbul Technical University, Tuzla 34940, Istanbul, Turkey

ARTICLE INFO

Keywords:

Turkish container ports
Port competitiveness
FAD
Fuzzy TOPSIS
Multiple criteria evaluation
Quantified SWOT

ABSTRACT

The strategic positions and geographical advantages of the Turkish container ports in the world transportation network create an excessive demand which seek urgent development strategies for managing ongoing problems in operational and administrative level. This paper proposes a hybrid approach on ensuring the competitiveness requirements for major Turkish container ports by utilizing fuzzy axiomatic design (FAD) and fuzzy technique for order performance by similarity to ideal solution (TOPSIS) methodologies to manage strategic decision-making with incomplete information. The outcomes of the quantitative models are utilized as data input for SWOT analysis that provide additional contributions for identifying the development strategies on container ports. The proposed strategies on Turkish container ports can be originally recommended as guidelines both for port administrations and new enterprises in Turkish maritime industry.

© 2008 Elsevier Ltd. All rights reserved.

1. Introduction

Acceleration in containerization trends in maritime transportation industry has been monitored by maritime expertise and strategy analysts in recent years. Especially, the changes in cargo flows in major routes and lines within container transportation network (Hsu & Hsieh, 2007) such as trans-Pacific and Asia–Europe reach to extreme rates approximately to 12.1% and 11.2%, respectively, during 2005 (UNCTAD, 2006). Moreover, the estimations on maritime transport with container mode (Knowles, 2006) underline the potential tendencies of maritime enterprises and growing rate of container seaborne traffic (Guy, 2003; Ocean Shipping Consultants, 2003), the size and service speeds (Flynn, 2001; McLellan, 1997; O'Mahony & Porter, 2004; Wijnolst, 2000). Therefore, the rapid growths influence the demand for new building vessels, ports, terminals, and other service related infrastructures (Baird, 2006; O'Mahony, 1998). In this sense, several needs have been appeared about performing and executing continual improvement strategies on container ports which are recognized as the critical integral part of the maritime transportation network (Müller-Jentsch, 2002). The external pressures of shareholders in maritime community such as ship owners, cargo

owners, and governmental organizations enforce the port and terminal authorities to execute effective development strategies for managing the competitiveness and continual improvement together in the transportation market.

The ports, channels, and inland waters of Turkey can be recognized as critical nodes in world container transportation network due to its strategic and geographical position. The globalization and liberalization processes in the region and new enterprises on several sector increase the demand and expectations especially from port and terminal authorities (Celik & Er, 2007a). Hence, this paper proposes competitive strategies with strengths, weaknesses, opportunities, and threats (SWOT) analyses on major Turkish container ports by utilizing the outcomes of fuzzy axiomatic design (FAD) and technique for order performance by similarity to ideal solution (TOPSIS) in fuzzy environment correspondingly as multiple-criteria evaluation methodologies. Both of the models are suitable for the problem characteristics due to the several common properties and assumptions such as evaluating under multiple criteria, identifying the acceptable levels and expectations in terms of defining functional requirements (FRs) and ideal solutions, respectively. On the other hand, application of two different methodologies on focusing problem is expected to increase the consistency to a desired level. The initial outcomes of FAD and TOPSIS methodologies are planned to be utilized as input data for the SWOT analysis to support strategy-making process as well. The information flow in the phases of research methodology is illustrated in Fig. 1.

* Corresponding author. Tel.: +90 216 395 1064; fax: +90 216 395 4500.
E-mail address: celikmet@itu.edu.tr (M. Celik).

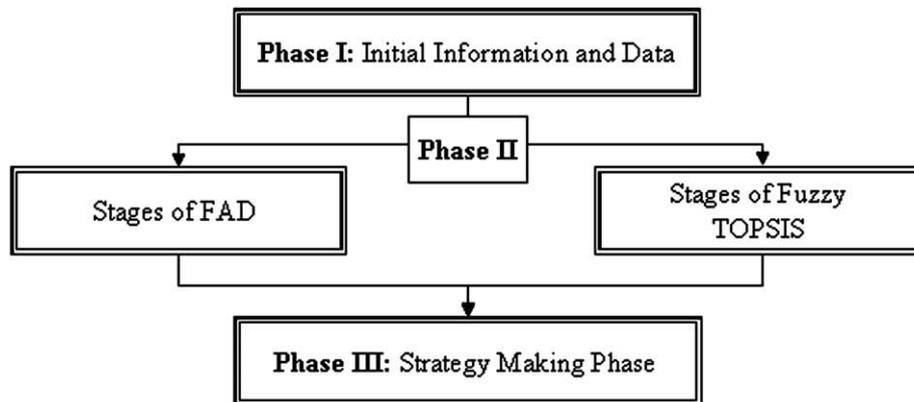


Fig. 1. Fundamental phases of research methodology.

Briefly, the remaining sections of the paper are organized as follows: Section 2 overviews the existing researches on port competitiveness and developments to identify the key assessment factors for this study. Section 3 explores the conditions of major container ports in Turkish maritime industry and structures the internal/external assessment scheme. The methodologies of FAD and fuzzy TOPSIS are performed in Sections 4 and 5, respectively. The outcomes of both models are utilized as input data for the quantified SWOT analysis in Section 6. The conclusion is drawn on expressing the utility and original contributions of this study for maritime society.

2. Literature survey on container port competitiveness in maritime industry

The external pressures of market players in regional and global perspective (Airriess, 2001) enforce the container terminal authorities to adopt new strategies (Chlomoudis & Pallis, 2002a; Chlomoudis & Pallis, 2002b; European Parliament, 1999; Juhel, 2001; Moglia & Sanguineri, 2003; Pallis, 1997, 2003) to satisfy the maritime industry expectations (Heaver, Meersman, & Van De Voorde, 2001). However, the proposed strategies within existing studies are not founded any of the analytical methodologies or strategy-making tools dramatically, instead, the industry-based reports and statistical data are utilized. The aim of this paper is to manage this shortfall by integrating the analytical methodology and strategy-making tool in fuzzy environment into the research methodology as well. As a more systematic approach, Perez-Labajos and Blanco (2004) outlined the links between the contents of future planning of port administrations and strategic actions of international logistics companies as a critical result of his research on commercial sea ports in European Union (EU). Hence, the significance of customer expectations is clearly appeared on development of ports and marine infrastructures. For managing this issue, the proposed approach in this paper takes the customer expectations into account by defining FRs and ideal solutions, respectively. On the other hand, it is one of the initial issues to identify the factors for structuring an evaluation model on port competitiveness. Generally, the existing studies on port competitiveness handle the problem as multiple criteria evaluation. According to Haezendonck and Notteboom (2002), hinterland accessibility, productivity, quality, cargo generating effect, reputation, and reliability are critical factors in enhancing a port's competitiveness while Malchow and Kanafani (2001) cited the oceanic and hinterland distances as the significant characteristics of ports. As other taxonomy, the influencing factors on port's competitiveness are categorized into six groups by Rugman and Verbe-

ke (1993) under extensive framework as follows: factor conditions such as production, labor, infrastructure, etc., demand conditions, related and supporting industries, firm structure and rivalry, chance, and government intervention. Yap and Jasmine (2006) outlined the key factors to identify the competitive dynamics between the major container ports in East Asia. Besides the additional contributions of existing studies on structuring evaluation scheme in this research, this paper also proposes additional items in advance to be able to outline the administrative, infrastructural, and operational factors on port competitiveness as internal and external aspects properly. Therefore, an original multiple-criteria evaluation scheme is proposed in the further sections of this paper.

The second part of the literature survey is based on investigation of the existing analytical model on container port development and performance analysis. The various proposals on investigation of port efficiency with methodological approaches (Roll & Hayuth, 1993; Talley, 1994; Tongzon, 2001; Valentine & Gray, 2001) have seemed in literature. However, it is necessary to develop more complicated approaches for modeling the port competitive requirements in dynamic maritime environment. In this sense, Koh (2001) described a mathematical model which incorporates linear programming and dynamic programming for identifying an optimal container port development plan and evaluating the alternative investments in Korea. As more advance approach, Wang, Song, and Cullinane (2003) developed hybrid model with DEA and free disposal hull (FDH) on measuring container port production efficiency. As another quantitative approach, Song and Yeo (2004) performed a competitive analysis on Chinese container ports by using the traditional analytic hierarchy process (AHP) methodology. The identifiable elements of port competitiveness were defined widely within this research. On the other hand, Min and Park (2005) proposed an inter-temporal data envelopment analysis (DEA) for measuring the operational efficiency of major container terminals in South Korea for satisfying the continuous improvement of container services. In recent years, extended discussions have been continued in maritime literature about specific themes of port competitiveness such as port privatization process, technology integration, efficiency improvement, safety aspects, security procedures, etc. (Clark, Dollar, & Micco, 2004; Cullinane, Ji, & Wang, 2005; Goodchild & Daganzo, 2007; Llacer, 2006; Murty, Liu, Wan, & Linn, 2005; Peris-Mora, Orejas, Subirats, Ibanez, & Alvarez, 2005; Tongzon & Heng, 2005).

The literature survey on existing studies regarding with the ports competitiveness provided invaluable support for structuring of assessment criteria scheme in the further sections of this paper. However, the numbers of considerable shortfalls on philosophy of existing methodological approaches were monitored during literature survey. First of all, managing the competitiveness in

متن کامل مقاله

دریافت فوری ←

ISIArticles

مرجع مقالات تخصصی ایران

- ✓ امکان دانلود نسخه تمام متن مقالات انگلیسی
- ✓ امکان دانلود نسخه ترجمه شده مقالات
- ✓ پذیرش سفارش ترجمه تخصصی
- ✓ امکان جستجو در آرشیو جامعی از صدها موضوع و هزاران مقاله
- ✓ امکان دانلود رایگان ۲ صفحه اول هر مقاله
- ✓ امکان پرداخت اینترنتی با کلیه کارت های عضو شتاب
- ✓ دانلود فوری مقاله پس از پرداخت آنلاین
- ✓ پشتیبانی کامل خرید با بهره مندی از سیستم هوشمند رهگیری سفارشات