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The Selection of Dry Port Location by a Hybrid CFA-MACBETH-PROMETHEE Method: A Case Study of Southern Thailand

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ABSTRACT

An intermodal transport could be the potential solution for reduction of logistics cost, including an acceleration of product flow, by way of dry port, where is regarded as a key component of combined transport. To promote a dry port in southern Thailand, the aim of this study is to propose an integrated method based on multi-criteria decision making (MCDM) for selecting its best location. Thus, a new hybrid CFA-MACBETH-PROMETHEE model is presented. Confirmatory factor analysis (CFA) is applied to determine loads for sorting out the importance of criteria and also investigate the relationship of logistic policy and geographical determination of dry port establishment. Later, measuring attractiveness by a categorical based evaluation technique (MACBETH) is utilized to build weights of those criteria. Eventually, preference ranking organization method for enrichment of evaluations (PROMETHEE) is engaged to rank from the most to least attractive alternatives of dry port. In this study, results indicate that Phthalung railway station is the most attractive location for being a new dry port.

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1. Introduction

Broadly recognized as one of the most important parts in the economic system, the international trade is the source to generate revenue of each country. Thailand is among of them where the nation has greatly driven economy through export. Currently, an export has been accounted for 65 of GDP (Tradingeconomics, 2016). To carry out this, Lamchabang seaport of Thailand, one of the world's busiest container ports with massive capacity more than six million twenty-foot equivalent units, is respected as the crucial terminal to support super-post-Panamax ship, gateway for Greater Mekong Subregion and logistics hub of Southeast Asia. With

goods carriage and storage along numerous supply chains, however, the overall logistics cost per GDP of Thailand is rather high, standing at 14.2 (i.e. transport: 7.4%; warehousing and inventory: 5.5%; administration: 1.3%) due to relying largely on the road transport, where its proportion is approximately 80% of all transport modes (National Economic and Social Development Board, 2014). The intermodal transport could be an alternative for decreasing that cost. In general, it uses at least two modes to convey container(s) without opening or repacking over the entire route. Reis et al. (2013) indicate that cost structure of mode combination is

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significantly lower than the one of road mode when holding a long distance. To extend this, an empirical work by Henttu and Multaharju (2011) point out that the break-even points in cost of intermodal transport (i.e. road and rail) against a single one (i.e. road) in transport network lie in 157 and 255 km. for one and two additional transshipment, respectively. Accordingly, a modal shift has appeared by utilizing a freight train on railway as the major path, while a truck on road is served as a feeder of rail transport. To connect between those two modes on purpose of goods transshipment, a dry port is needed. The southern region of Thailand is taken into consideration for establishment of dry port with the particular reasons of peninsula (holding deep seaports on both coasts) along with a long rail line, a possible increase of global trade in import/export and a large volume of cross-border trade with such neighboring country as Malaysia.

After all, a dry port may enhance the intermodal networks, which Thai government has promoted through national policy in order to strengthen the country's overall logistics performance, whereas determinants of transport node, transport link, production base and consumption point are determined as factors of dry port establishment. Consequently, this study will adopt CFA to examine the relationship between logistics policy and geographical determination of dry port establishment, particularly factor loadings of variables from the latter one for identifying their importance. Then, the location analysis of selecting the most appropriate dry port location is conducted by MCDM method. Commonly, each single method of it has displayed advantage(s) and disadvantage(s) for any problem of site selection. By heightening this, the integrated ones have continuously been issued in the previous research, for instance combined MCDM method, fuzzy set or others with MCDM one and so forth. Therefore, the objective of this paper is to propose a new hybrid SEM-MACBETH-PROMETHEE methodology for selecting the best dry port location in southern Thailand. The new combined one could help in enhancing the constraint of MACBETH and PROMETHEE. In order to sort out those variables of geographical determination of dry port establishment, CFA is firstly used to generate their loads. Subsequently, MACBETH is applied to build weights of criteria, altered from those variables, via the pairwise comparison computed by technique of linear programming. Eventually, PROMETHEE I and II are manipulated to rank from the most to least attractive sites.

2. Literature Review

2.1. Dry Port and Southern Thailand

With today's highly intense competition in the domestic and international markets, many firms have swiftly reacted to shift their capabilities for retaining business growth. To cope with it, logistics management is considerably viewed as a vital tool to succeed in cost reduction as well as response of customer satisfaction. Yet, transport sector has been widely regarded as the most essential part of logistics owing to having the greatest impact upon logistics cost structure. Alternatively, the combination of mode for goods movement from origin to destination is likely to be the imperative choice to lower that cost. An intermodal transport has consequently emerged, although some similar terms of mode combination, e.g. multimodal or combined transport, can be called interchangeably. Especially, it is defined as the movement of goods in one and the same loading unit or road vehicle, which uses successively two or more modes of transport without handling the goods themselves in changing modes (UN, 2001). Hanaoka and Regmi (2011)

make clear that development of intermodalism requires the consideration of three of its attributes: transport links (e.g. highway), transport nodes (e.g. seaport) and the provision of efficient services (e.g. quality of trade). As one of transport nodes, the dry port could play a major role in promoting intermodal transport (Hanaoka and Regmi, 2011). Or else, a dry port is a key component of intermodal transport (Hanaoka and Regmi, 2011; Henttu and Hilmola, 2011; Lättilä et al., 2013). In particular, a dry port is an inland intermodal terminal directly connected to seaport(s) with high capacity transport mean(s), where customers can leave/pick up their standardized units as if directly to a seaport (Leveque and Roso, 2002). As cited in Ng and Gujar (2009), CONCOR explains that a dry port supports various needs along the supply chain, namely: aggregation and unitization of cargoes, in-transit storage, custom clearance, issuance of bill of lading in advance, relieving congestion in gateway seaports, assistance in inventory management, as well as deference of duty payment for imports stored in bonded warehouse.

To establish a dry port, the policy is considered as a major role. According to ESCAP (Economic and Social Commission for Asia and the Pacific) as cited by Hanaoka and Regmi (2011), the existing government policies and regulations associated with dry ports influence their development. In reference to Thailand's policy of logistics aspect, the government has hugely realized that logistics cost is important for the country's competitiveness, so some parts of the eleventh national economic and social development plan (2012 – 2016) have concentrated on development of logistics, where a dry port may be involved.

In the light of dry port location, the surrounding accessible places tied up with a site of dry port on purpose of goods movement are required to take into consideration as referred by the previous studies. Usually located at strategic places near gateway seaports, industrial areas or along major transportation axes, a dry port plays significant roles in optimizing all activities to ensure cargoes can be delivered from one end to another in an efficient manner (Juhel, 1999). An inland port must be linked with a port terminal with a high capacity corridor where rail or barge dedicated links are the best options (Rodrigue et al., 2010). Also, several dry ports have an airport in proximity which can help support a variety of freight activities (Rodrigue and Notteboom, 2012). In Asia, both road- and rail-based intermodal dry ports are obviously nearing production, and industrial centers are being developed with the aim of effectively consolidating and distributing cargo (Hanaoka and Regmi, 2011). From view of Rodrigue et al. (2010), an intermodal rail or barge terminal enables to access from a port terminal to a regional production and consumption market. Moreover, access to a large population base is of importance since it will be linked to the level of import and export activities handled by the inland port (Rodrigue and Notteboom, 2012). Overall, the distance between possible sites of dry port and geographical determinants of dry port establishment (transport node, transport link, production base and consumption point) will be explored in order to rank from the most to least attractive locations of dry port.

2.2. The Location Problem in Multi-criteria Decision Making

Nowadays, a large number of decisions have become a regular basis of human life. However, with the radical change of development and advancement in several issues (e.g. society, environment and technology) it is even more complicated to make any decision correctly. For this reason, the MCDM method seems to be an alternative tool to solve the complex problem of those issues. In principle, it can be defined as the evaluation of the alternatives for the purpose of selection or ranking, using

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