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A Multi-Criteria Approach to Dry Port Location in Developing Economies with Application to Vietnam

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ABSTRACT

This paper presents a conceptual framework for the inclusion of multiple criteria in the evaluation of dry port location in developing countries from a multiple stakeholder perspective. We present the framework in four steps. The first step encompasses preliminary research to filter the alternative locations for dry port development. In the second step, the stakeholders are clustered in three groups: dry port users, dry port service providers and the wider community. Then, we present the sub-criteria related to dry port location including the associated measuring methods. The third step includes an explanation on the methods used for weighing these criteria and sub-criteria. A multi-criteria analysis is carried out in the final step. We apply the methodological framework to Vietnam. The location of a new dry port project in Vinh Phuc province will be evaluated against two existing inland clearance depots (ICD) in Lao Cai and Phu Tho province.

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1. Introduction

Dry ports are commonly defined as inland terminals that have strong connections to gateway seaports by high capacity and frequent transport services. Within a supply chain setting, dry ports might work as extensions of seaports or inland hubs to facilitate the movement of cargo between seaports and the hinterland. In advanced economies, such as North America or Europe, seaport authority and operators are the main drivers of dry port development with the purpose of solving the problems

of limited capacity, natural constraints and externalities at seaports or improving hinterland access particularly for import cargoes. In contrast, dry ports in developing economies are naturally land-driven, established for consolidating (export) cargoes from regional economic zones and forwarding them to gateway seaports. In developing economies, dry port development is accelerating to improve the inland logistics efficiency (Ng and Cetin, 2012). One of the imperative issues of dry port development in

developing economies is location planning. While the minimization of set up costs and total logistics costs are key factors in dry port location analysis, there are also other more qualitative location factors driven by multiple stakeholders involved like operators, users and the community.

This paper aims at building a conceptual framework for the inclusion of multiple criteria in dry port location for developing countries by taking into account the objectives of different stakeholders. Inspired by the LAMBIT model (Macharis and Verbeke, 2002), the paper provides a framework for proposing alternative locations, defining stakeholder groups, their criteria and sub-criteria in a hierarchical system as well as the methods to measure and weigh location factors.

The conceptual framework is applied to the developing country Vietnam. The location of a new dry port project in Vinh Phuc province will be evaluated against two existing inland clearance depots (ICDs) in Lao Cai and Phu Tho province. The results will take into account the relevant criteria for each stakeholder group and the specific setting in developing countries. Finally, a sensitivity analysis will be performed before turning to the conclusions.

2. The Characteristics of Dry Ports in Developing Countries

A variety of dry port terminologies is being used in the extant literature such as inland clearance depot (ICD) or inland custom depot (Beresford and Dubey, 1990, Economic Commission for Europe, 1998), inland terminals (UNCTAD, 1982), inland container depot (Roso, 2005), and inland port (Economic Commission for Europe, 2001). The term dry port is defined as: "an inland intermodal terminal that is 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" (Roso et al., 2009).

A full range-service dry port covers a wide range of functions including customs clearance; storage; cargo consolidation; cargo handling for different transport modes; depot function; container maintenance and repair and value added services. Roso et al. (2009) classified inland nodes as close, mid-range and distance dry ports, based on the distance to seaports and the position in the hinterland supply chain. This typology is similar to the concept of satellite terminals, transmodal centers and inland load centers (Notteboom and Rodrigue, 2009). Another way to classify dry ports is based on the directional development (Wilmsmeier et al., 2011). An outside-in or sea-driven dry port means that its development is driven by a seaport actor, such as a port authority or terminal operator. This is mainly the case in developed systems like Europe and North America where seaports have reached the phase of regionalization (Notteboom and Rodrigue, 2005) through a strong cooperation and coordination with inland logistics locations. In contrast, inside-out or land-driven inland terminals are developed by inland parties, such as a local government or transportation companies, mainly in view of serving the local market.

Most inland terminals in developing economies are land-driven as they have been established to serve the export-based industrial zones. Thus, inland locations in developing economies are dominated by land-based players' interests and generally lack a high level of intermodal integration with seaports through high capacity, reliable and flexible train or inland waterway shuttles.

Dry ports in developing economies differ from dry ports in developed systems also in other ways. First, they are likely to be situated close to production bases, or even inside economic zones, as illustrated in the case

studies of India (Ng and Gujar, 2009), Indochina region (UNESCAP, 2014) and South Africa (Cronje et al., 2009). According to Ng and Cetin (2012), the least-cost model for dry port positioning, which is working well in advanced economies, might therefore be insufficient for a developing system. They argue that inland nodes in developing countries might be more "cluster-oriented" than "supply chain-oriented". Next to a location at the end node of an inland supply chain, dry ports in developing countries could also be situated in the middle of the chain for transloading between two transportation networks. Such type of dry port is easily seen at border locations. Inland terminals in close proximity of seaports are rarely found in developing systems as such kind of dry ports are mostly sea-driven.

Second, production bases in developing nations are numerous but scattered across a large area. This supports the creation of numerous small ICDs which further complicates cargo bundling for intermodal services and results in a high reliance on road transport to transport cargo from/to seaports over mid-range or long distances.

Third, dry ports in developing countries have more chance of facing a lack of trained/experienced human resources and a poor information system support for inland transportation (see e.g. Garnwa et al., 2009 for a case on Nigeria).

Finally, dry ports in developing nations are frequently used by smaller shippers with less experience in global supply chain management. Using the transaction cost theory introduced by Williamson (1979), we argue that the problem of bounded rationality and bounded reliability lead to a higher transaction cost with distant dry ports. This makes local inland terminals more preferable for shippers to receive higher control and flexibility, therefore reducing uncertainty and lowering transaction costs.

We argue that the specific characteristics of dry ports in developing countries should in some way be reflected in dry port location analysis. Before introducing a conceptual framework on dry port location in developing countries, we briefly discuss existing approaches to dry port location.

3. Conceptual Framework to Evaluate Dry Port Location in Developing Countries

3.1. Methodological Considerations for Dry Port Location Planning in Developing Countries

Dry port location planning requires a thorough decision making process as it is too costly to relocate the facility in the short term. Many models used for facility location attach a substantial role to transport costs in view of finding the optimal location. Least transportation cost approaches as listed by Ng and Cetin (2012) include conditional logit model, mixed-integer programming, the dynamic programming model and the center of gravity model. We argue that dry port location analysis in developing countries can benefit from a methodological approach based on (a) the inclusion of multiple stakeholders' perspectives; (b) the inclusion of softer location factors and indicators; (c) an explicit consideration of the dry port environment in developing countries as outlined in the previous section.

First, location analysis should follow a multiple stakeholder perspective. Stakeholder theory has received increasing attention in transportation (De Brucker and Verbeke, 2008; Aerts et al., 2015). More specifically, the increasing integration between ports and their hinterland as captured by notions such as port regionalization and extended gates (Rodrigue and Notteboom, 2009; Veenstra et al., 2012) has led to a stronger involvement

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