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Location of logistics hubs at national and subnational level with consideration of the structure of the location choice

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Abstract: **The location of logistic hubs is a strategic decision made after multicriteria analysis. This requires first the definition of quantitative or qualitative criteria that can be independent or partially conflicting. The decision of location can be made at different geographical levels (countries or regions). In this paper, we suggest a generic structuration of criteria by geographical level and by family for choosing hubs location, taking into account the involved structure of location choice, which is rarely done in the literature: sequential assessment (choice of a country, then of a region of this country) or simultaneous assessment (direct choice of a location among several regions belonging to different countries)**.

Keywords: hub location, multicriteria analysis, structure, location choice, geographic level, sequential assessment, simultaneous assessment.

1. INTRODUCTION

In a globalisation context, firms are perpetually looking for new markets or new production resources. This implies to define efficient supply chains. In that purpose, the implementation of networks of logistic hubs usually allows to decrease the transportation costs in comparison with direct source/destination transportation (Alumur and Kara, 2008).
Implementing a hub requires a huge investment. The choice of a location is therefore a problem that has drawn a large attention from both practitioners and academics.
On the base of a literature survey, this communication suggests a hierarchical definition of families of criteria, then of criteria, that can be adapted to specific purposes. The main originality of the proposal is that it may allow to take into account the sequence of decisions resulting in the choice of a hub location, which is seldom done in the literature. Criteria are in that purpose defined either at the national or subnational level. The choice of a location can then be done by choosing first a country, then a region/city of the country, or by choosing directly a region/city among a set of areas located in different countries. Another originality is the reuse of indexes published by international entities (World Bank, World Economic Forum for instance) for assessing some of the considered criteria.

2. STATE OF THE ART

2.1 Problem statement

Logistic hubs allow to consolidate material flows coming from different origins, and to send them to their respective destination using unimodal (i.e. with a single type of transportation resources) or multimodal (i.e. with several types of resources) transport (Farhani et al., 2013; Campbell and O'Kelly, 2012).
Modern logistic hubs may play different roles according to the services they provide: standard functionalities (international/national transport, distribution, warehousing, inventory management...) or high added-value ones (orders assembly, co-packing, and post-manufacturing). Global Logistic Hubs (GLH) are usually located near ports or international airports. They may manage important flows of various types of goods (raw materials, semi-finished products, finished products...) at an international level but such hubs can also be used as transhipment resources only, linking national suppliers/producers to consuming areas. A Regional Distribution Centre (RDC) manages and gathers flows of goods, imported from international logistic centres or locally produced, in order to distribute them on a whole national territory using long distance transportation means. An Urban Distribution Centre (UDC) is a logistic platform located in the vicinity of an urban area, insuring the management and concentration of good flows coming from senders or RDC, for distributing them in the centre of the city. This includes the well-known "logistic of last kilometre" problem.

The location of logistic hubs is a specific case of the « facility location problem », intensively studied in the literature on transportation and logistics domain (see for instance (Owen and Daskin, 1998)). This decision is strategic and the comparison between several potential locations includes many

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aspects that can be either quantitatively or qualitatively assessed. In the last case, qualitative assessment based on expertise should be possible. Assessment criteria may be partially conflicting, which still increases the complexity of the decision-making.

The choice of implantation of a hub may be done according to various sequences of decision influencing the definition of the assessment criteria: choice of a country or region, with a sequential (country, then region of the chosen country) or simultaneous choice (choice among regions belonging to several countries). The sequence of decisions is chosen by the stakeholders (government, logistics operator, manufacturer...) according to their objectives. An assessment of possible locations at the national level requires to assess criteria denoting the global attraction of a country, which is often difficult in quantitative terms, especially for large and/or developing countries, that often have heterogeneous characteristics. The assessment at the regional level consists in comparing cities or regions of the same country. Most of the literature on hub location is either at the national or subnational level. Sequential (or hierarchical) assessment, consisting in comparing first countries, then regions/cities of these countries may nevertheless be found in (Daganzo, 1996; Mayer and al., 1999; Mataloni, 2011). A simultaneous assessment may also be relevant: this would mean to compare regions belonging to several countries, resulting in less biases than the sequential assessment. In that case, criteria allowing to choose a country should be added to the regional ones.

In that context, we shall analyse in the next section the location criteria often suggested in the literature. We shall also review some indexes published by economical entities that can be reused as location criteria. We shall finally suggest to group location criteria in categories and will show how they can be implemented on sequential and simultaneous assessment, which is seldom done in the literature.

2.2 *Survey of logistic hub location selection criteria in the academic literature*

In this survey, we have considered articles suggesting criteria for hub location but also for foreign investment, using keywords like: *hub location selection criteria, hub location decision, locational determinant, location criteria evaluation*. We have excluded many articles dedicated to comparisons of the competitiveness of existing ports or hubs, since they consider performance criteria of existing entities and not criteria related to the attractiveness of a potential location.
The selected papers involve either national evaluation based on national criteria (N), subnational assessment over regional criteria (R) or simultaneous assessment (SM) or sequential choice decision. Furthermore, in order to avoid giving too much consideration to very specific studies, we have finally only selected criteria cited at least by two different authors.

The criteria selected by the identified studies are summarized in Table 1 where the last column is related to this work.

Table 1. Main hub location selection criteria of analysed papers

	Paper	Ourn and Park 2004	Eskilsson and al 2010	El-rakib 2010	Yang and Chen 2016	Tongzon 2004	Muñoz and al 2010	Lipscomb and al. 2010	Lee 2007	Lu and Yang 2006	Kayikci 2010	Long and al. 2012	Uysal and yavuz 2014	Teng and al 2007	Botha and al 2008	Da Silva and al 2011	Skowron-Grabowska 2007	Rosa et al 2015	Żak and Węgliński 2014	Awasthi and al 2011	US
	Sequence of decisions	N	N	N	N	N	N	SM	SM	SM	SM	SM	R	R	R	R	R	R	R	R	Sequential /SM
	Location Object	RDC	RDC	RDC	GLH	GLH	GLH	GLH	GLH	GLH	RDC	GLH	GLH	GLH	GLH	UDC	RDC	GLH	GLH	UDC	GRULC
National Criteria	Availability and Quality of Infrastructure	X	X	X	X	X	X	X				X									X
	Connectivity										X										X
	Border administration Efficiency		X		X		X			X	X										X
	Openness to trade									X											X
	Geographic location	X		X			X			X											X
	Land Availability	X		X																	X
	Domestic Market size	X		X						X	X										X
	Foreign market size									X	X										X
	Availability of Skilled labour	X		X			X														X
	Labour market flexibility																				X
	Customs barriers				X						X										X
	Port/airport charges				X				X	X											X
	Labour cost			X	X																X
	Input Cost	X		X					X												X
	Transport & Distribution cost			X					X		X										
	Land price	X		X	X																
	Political stability	X		X	X	X	X		X	X	X										X
	Macro-economic stability						X		X		X										X
	Safety & Security								X	X	X										X
	Country Resilience								X												X
	Corruption control		X		X	X	X			X											X
	Property rights						X			X											X
	Reglementation transparency					X	X			X											X
	Burden of reglementation				X	X	X			X											X
	Incentives availability	X		X	X	X	X			X		X									X
Subnational criteria	Quality and availability of infrastructure							X				X	X		X		X		X	X	X
	Land Availability							X		X		X						X			X
	Location /land cost									X				X		X			X	X	X
	Avaialability of skilled labor							X	X	X		X	X		X			X	X		X
	Market size												X					X			
	Labor Cost																X		X		X
	Proximity to consumption market							X				X		X		X		X		X	X
	Proximity to Manufacturing Market							X				X		X	X	X		X		X	X
	Proximity to Port/Airport											X	X	X		X		X			X
	Availability of regional incentives							X					X						X		X
	Pollution				X								X						X	X	X
	Safety and Security				X						X		X			X			X	X	X
	Life Cost/economic development									X									X		X
	Extra services				X										X						X
	Transportation cost								X		X			X			X				
	Congestion level							X			X	X	X		X						

2.3 *Review of logistic hub location selection criteria on world organization indexes*

Several worldwide organizations, like the World Bank or the World Economic Forum, regularly publish indexes aiming at comparing the attractiveness of the countries for foreign