



Review (RE)

Dry Port Development: A Systematic Review

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Abstract

Studies on dry ports as nodes in multimodal transport have been expanded to decrease the mounting congestion on seaports. The principal objective of this study is to inspect how dry port researches have been conducted from different perspective. This paper tries to recap the existing researches that aimed to study dry port concept via a systematic review, to present a general overview of the researches on our relevant region and propose a classification for these researches. This paper present a systematic review of dry port that looks to illustrate the progress of researches on this area between 1986 and 2015, collecting researches on dry port concept and analyzing the main characteristics of the dry port development and their contribution to the multimodal transport. The results indicated that most dry port studies considerate the strategic level and concentrate in the Asian continent. Studies regarding other decision levels and continents have to be developed in further researches. Although the existing studies make a contribution in dry port concept, they allow gaps in terms of operational and tactical decision levels considering their limited geographical region.

Keywords: Dry port, Seaport, Multimodal transport, Systematic review.

Kara Limanı Gelişimi: SistematiK Bir İnceleme

Öz

Çok modlu taşımacılıktaki düğüm noktaları olan kara limanları üzerine çalışmalar, deniz limanlarındaki artan tıkanıklığı azaltacak şekilde genişletilmiştir. Bu çalışmanın ana amacı, kara limanı araştırmalarının farklı bakış açılarıyla nasıl yürütüldüğünü incelemektir. Bu makalede, kara limanı kavramını incelemeyi amaçlamış mevcut araştırmaların sistematiK bir inceleme ile yeniden özetlenmesine, genel bir bakış sunulmasına ve bir sınıflandırma önerilmesine çalışılmıştır. Bu makale, 1986 ile 2015 yılları arasında yapılmış olan kara limanları ile ilgili araştırmaları derleyerek, gelişimlerinin ana özelliklerini ve çok modlu taşımacılığa katkılarını analiz etmekle birlikte, yapılmış olan araştırmaların gelişimini göstermeye çalışan, sistematiK bir inceleme sunmaktadır. Sonuçlar, kara limanları ile ilgili çalışmaların çoğunun stratejik düzeyde olduğunu ve Asya kıtasında yoğunlaştığını göstermektedir. Diğer karar düzeyleri ve kıtalara ilişkin araştırmaların gelecek çalışmalarda geliştirilmesi gerekmektedir. Mevcut çalışmalar kara limanı kavramı ile ilgili katkıda bulunuyor olsalar da, sınırlı coğrafi bölgeler dikkate alındığında operasyonel ve taktik düzey açısından eksikliklere meydan vermektedir.

Anahtar kelimeler: Kara limanı, Deniz limanı, Çok modlu taşımacılık, SistematiK inceleme.

1. Introduction

Transport development is increasingly changing inland after a period that significant attention has been paid on the development of seaport terminals and maritime transport [1]. In the current literature a lot of attention has been given to multimodal transportation [2]. Multimodal transport transfers cargo from shipper to consignee using two or more different modes [3]. The objective is to transport goods in a permanent flow all the way through the whole transport chain, from shipper to consignee, with the most effective cost and time. Growth of economic movement conducts to the growth of maritime transport and as a result, a growth in the land transport. The growth flow of merchandise is fundamental to the development of international, regional and local economic systems [4]. Dry ports were founded in numerous regions around the world, particularly where the augmentation of inland freight distribution needed an intensification of flows. Congestion is usually viewed negatively and it is seen as a limiting element on economic efficiency as well as a source of pollution [5]. With the great augmentation of container flows and the development of international multimodal transport [6], Seaports are facing problems connected to need of space and the rising congestion on their access. Dry ports, as hubs in multimodal transport, have been created to decrease the mounting congestion. For this reason, dry port concept has received more consideration in literature. Many researchers have proposed the concept of dry port as a key to support multimodal transport development and seaport operations. This worldwide augmentation of container flow was modeled and simulated by Parola and Sciomachen [7]. Their results demonstrate that congestion rises proportionally with the increase in containers' flow. For some seaports, the feeblest link in the multimodal transport is the storage space. Notteboom and Rodrigue

[8] presented a seaport regionalization stage in seaport development and seaport system. The objectives of this paper are: (i) to collect existent researches on dry port concept via an interpretative organization of published literature on the involved area, and (ii) to classify existing dry ports from decisional and geographical perception. The following objectives were established via the following steps: (i) collect 'dry port concept' researches from 1986 to 2015; (ii) recognize the researches on dry port concept and (iii) classify these researches via a systematic review. The time period from 1986 to 2015 was chosen because no studies published before 1986 for dry port study. This paper is structured as follows. First, methodological procedures employed in the systematic literature review are discussed and results of the systematic literature review on dry port concept and their classification in Section 2. Section 3 results and discussion. Finally, conclusion is presented in Section 4.

2. Systematic Review of Dry Port Concept in Multimodal Transport

2.1. Methodology

This paper presents a methodological examination of the dry port concept in the literature. A literature review is an input part of any research mission. The researcher maps and assesses the pertinent intellectual area in order to indicate a research question [9]. We will use a systematic review in our review process. Traditional literature in management studies have not been substituted for any methodological criteria and too much subjectivity in the selection of studies were involved [10]. A systematic review based on recognizing, assessing and keeping all pertinent researches presently accessible for a definite research question [11]. Since the method allows relatively high practical and analytical objectivity and reproducibility. The description of a procedure is vital and essential because the procedure identifies the techniques employed to conduct the systematic

review. We will apply a systematic review methodology in our research project. In fact, the systematic review methodology is distinguished by a planned and structured approach to study university researches published using organized and reproducible techniques to recognize, choose and vitally assess researches [9]; [12]. Systematic review methodology is increasingly used to recognize, present and discuss the most important contributions in a particular domain of study [10]. The benefits of this review are diminution mistakes and to raise authenticity of the evidence. Hence reliable results are generated [10]. A systematic review provides consistent data from a collection of data dispersed across a large variety of researches [9]. The systematic review of the literature methodology follows five-steps which includes: (i) problem definition; (ii) selection of journals; (iii) selection of studies; (iv) critical evaluation; and (v) synthesis ([15]; [9]; [12] and [16]). First, problem definition, it is a delimitation of the subject area or topic. The aim of the systematic review in our project is to understand development of dry port concept. We performed this systematic review evaluations three times by two researches. We have assessed the differences detected in the results of the two researches, and the final list of chosen articles was created. Figure 1 presents the varied phases assumed to get the finishing list.

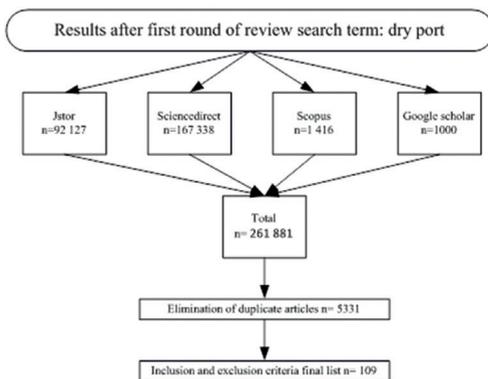


Figure 1. The Systematic Review Steps in Dry Port Research

The keyword was used as selection criteria for the 'title', 'keywords', and 'abstract' fields in each paper. Types of documents included in the search were 'articles' and 'reviews', as results we have found a total of 261 881 articles and reviews. After duplicates were removed, the abstracts and metadata of all papers were independently analyzed by two researchers oriented to select only papers whose research questions and results were directly related to our aim, as results we have found a total of 5331 articles. Then, an analysis of the articles was performed according to inclusion and exclusion criteria. The following inclusion criteria were utilized: (i) the identification of the term 'dry port' in the title, abstract or article body; (ii) the existence of a comprehensive view, i.e. studies which considered dry ports as an infrastructure, addressing aspects such as congestion in seaports and multimodal transport infrastructure and (iii) studies that directly considered, or were indirectly applied, to maritime transport of containerized cargo in multimodal transport networks. The exclusion criteria were studies focusing exclusively on air transport, tramp shipping, break bulk cargo, passenger terminals, road transport, fishing and roll-on/roll-off cargo and those aimed specifically at operations in seaports (berth allocation and quay crane scheduling problems), as results we have found a total of 109 articles. Once grouping the studies, it was feasible to recognize the involvement of every paper to this area under discussion with recognizing the papers which illustrated dry port development. These articles were examined in additional aspect, intending to illustrate the problem studied, express their decision level and identify their geographical location. At this stage, the aim was to present the different problems studied in this area at decision level and identify location of each study. Finally, for the data synthesis stage, an aggregative approach was employed in order to summarize findings of the reviewed

studies. Such aggregative approach relies heavily on the researcher's subjective interpretation about the reviewed papers [17]. We have used journals in Maritime Economics and Logistics; in Transportation Economics; in Transport Geography and in Maritime Policy and Management (Table 1).

performance and development. The necessity to deal with colossal volumes of containers traffic and the insufficiency of land in the seaport area pose serious challenges for operators to provide effective services. Seaports should be reviewed through the domestic cargo

Table 1. *Presents The Major Journals Used in Our Study*

Journals	Number of articles
Maritime Economics and Logistics	9
Research in Transportation Economics	6
Journal of Transport Geography	5
Maritime Policy and Management	4
World Review of Intermodal Transportation Research	3
Logistics Technology	3
Transportation Research Part E: Logistics and Transportation Review	2
Other journals (one article each)	45
Conferences	32
Total	109

The results of this aggregative approach include decision levels and geographical location perspective all over the years.

2.2. Overview of Research on Dry Port Concept

In this section, results from the systematic literature review are presented. In particular, this section provides a general summary of the researches on dry port concept and suggests a classification for dry port studies based in decision level treated chronological and geographical location of each study. Therefore in the following, we present studies on dry ports in the containerized goods transportation process presented in the literature on this theme.

2.2.1. Dry Port Concept and Role in Multimodal Transport

This Section starts by recalling the relevant role and evolution of the dry port in multimodal transport. In particular, the dry port concept is presented, highlighted the particular advantages for seaport

transport networks [18]. It is quite natural to master the seaport development which becomes more and more interesting and more complex to manage [19]. Increase in the flow of containers subsequently increases congestion in seaports. For some seaports, the feeblest link in the multimodal transport is the storage space. In addition, delays and transportation costs increase proportionally with increase of congested roads and inadequate rail links [7]. In recent years, suggestions for new ports and terminals to offer solutions to the seaport space problems have become a well-known element of the maritime context [20]. Dry ports should become new client for seaports, which will assist to reduce costs and capitalize on the added value of the whole multimodal transport [21]. Dry ports are predictable to progress the performance of seaports. Hence, the idea of creating dry port is to mitigate seaport congestion [22]. Cullinane and Wilmsmeier [23] stated that it is required to distinguish between "growth" and "structural transformation". The authors founded that we necessitate

a way to enlarge the seaport life cycle, in order to meet the rising demand for ship-owners based on Vermon [24] theory of product life cycle and following Schaeztl [25] arguments. The concept of dry port becomes a new solution to solve the problem of space in seaport areas [26]. We were able to find different nominations employed for inland port, as "Inland Port Advanced Port, Inland Freight Terminal, Intermodal Freight Station, and Inland Clearance Depot". Sometimes different terms are used for the same facilities or the same term is used for different infrastructures [27]. Earlier research by Slack [28] on the interior centers demonstrates the value of their improvement for multimodal transport. Later in his research, Slack [29] highlights the role of the inland part in reducing the environmental effects of multimodal transport. Notteboom and Rodrigue [1] examine how the inland ports participate in organizing the regional freight distribution. They referred to mention the number of services participated by the inland ports. They studied the inland port as regional parts of distribution of goods. For Rodrigue et al. [30], there is no perfect agreement on how these inland ports must be labeled with terms such as dry ports. Regarding the dry port concept, a numerous studies in relation to this concept have been published. The first mentioning of dry ports in academic literature goes back to 1986 [31]. Beresford and Dubey [32] employed a definition that corresponds to the definition of an Inland Clearance Depot. The definition of authors [32] is very close to the property and specific services, including customs, but no refers to any link to a seaport. For, the same authors [32] stated that dry ports in the beginning discussion were commonly developed from land to sea. An interesting study by [33]: A dry port have to be element of a multiparty system where the essential infrastructure (roads, railways) is present, maintenance is guaranteed and the legislative system, the regulatory institutional are considered to optimize the contribution of both the

public and private sector. Leveque and Roso [34], Based on proceeding investigate on seaports using the concept of dry port, the following definition was produced by Leveque and Roso [34] a dry port is an interior multimodal terminal directly linked to the seaport for different transport capacity, where clients be able to pick up their containers leave as if it was in a seaport. Roso [35] examined the dry port concept from an environmental perspective. A model of a transportation system, with or without a dry port is produced and the simulation results evaluated. Roso [36] has analyzed prior studies on the concept of the dry port. She evaluated the existing dry ports in the world which include the term "dry port" in their name. She tried to clarify the concept by showing irregularities or probable conformities between theory and practice. Also, Roso and Lumsden [37] analyzed the concept by comparing the physical flows and administrative activities at the seaport regarding transport time with and without a dry port. Basically, four functions should be in cargo terminal: (1) the cargo transport; (2) the storage of goods; (3) delivery and (4) manage logistics flow [29]. In addition to all the services cited above, functions such as maintenance of containers, clearance and other added value services should be in a dry port according to client's requests [38]. Therefore, the concept of dry port can assist to recognize less destructive means of transfer for the environment, mitigate congestion in seaports cities, handle goods in efficient manner as in seaports and provide developed logistics solutions for shippers in the hinterland [38]. Also, Roso and Lumsden [39] presented a number of qualitative criteria for the variety of services in the dry ports. Cullinane et al. [40] highlight the varied range of possible dry port scenarios, with the 'extended gate' form emerging as the vital appearance of the dry port concept. There are diverse types of dry ports depending on their location. Woxenius et al. [27] and Roso

et al. [38] classified the diverse dry ports following to their services and their location from the seaport. There are three different definitions for different types of dry ports (Figure 2): (1) distant dry port: its located 500 kilometers or more from the seaport [41]. The major gain of this dry port is the aptitude to transport over long distances. In this case, rail is cheaper than road transport mode. Some profits relate to the modal transfer from road to rail is reduce congestion and environmental impacts. (2) Close dry port: it's located near the seaport at less than 100 km distance [41]. This dry port presents a larger storage space to seaports. It proposes a consolidation for road transportation to and from the seaport. (3) midrange dry port: it's located between the close and distant dry ports. The distance from the seaport is about 100-500 km [41]. All other benefits are similar to distant dry port.

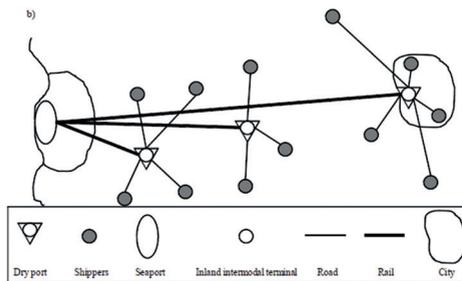


Figure 2. Dry ports types (Roso et al., 2009)

2.2.2. Classification Results of Dry Port Studies

Regarding the content of the articles, the first dimension corresponds to studies whose main goal was decision level in dry port concept and which can be classified in accordance with different planning and decision levels: long term or strategic level, midterm or tactical level, and short-term or operational level. A first main example of strategic level issue for the multimodal transport is represented by the location of one or more dry ports. For tactical level an example is related of infrastructure development in dry port. Finally, regarding operational level an example is operations

optimization. The second dimension includes studies that investigate the development of dry port in different countries and continents. Therefore, different types of dry ports were developed in different regions. We treat papers concerning different dry port types from a geographical perspective. Indeed, we have classified these papers by continent and by country. We present contributions in the literature (Table 2) dealing with the purpose of our systematic review.

We consider different planning and decision levels: long term or strategic decisions, midterm or tactical planning, and short-term or operational level, different geographic regions in chronological perspective. We will analyze and discuss the distribution of collected research regarding developing decisional level; developing geographical level and development dry ports research over the years.

3. Results and Discussion

The development of multimodal transport and developing logistics performance are key questions for countries that desire to become more competitive in the international geo-economic level. Good infrastructure, capable to rationalize trade and represent added guarantee of success for international trade. However, the lack of space within the seaport area, which is essential both for the transfer of containers and for the creation of high value added integrated logistics operations, obliges the seaport authority to search away beyond the seaport limit to find new areas at the service of the seaport logistical requirements [65]. Dry port concept has got more attention in the last decade regarding this important role in multimodal transport. It can be considered as the most important factor in maritime transport performance. We can clearly see the quantitative evolution of researches in the last years as shown in Figure 3.

3.1. Decision Level Used in Dry Port Researches

The strategic level takes action to a long-term approach (10 years and over). At this

Table 2. Presents Dry Port Concept with Different Geographic Region and Decision Level

Authors	Years	Country	Continent	Level	Problems
Ambrosino and Sciomachen [2]	2014	Italy	Europe	Strategic	Dry ports location problem
Andersson and Roso [42]	2016	-	-	Tactical	Dry ports: value-added services
Bask et al. [43]	2014	Finland-Sweden	Europe	Strategic	Development of seaport-dry port dyads
Benabbou et al. [44]	2012	Morocco	Africa	Operational	Handling equipment assignment in dry port
Beresford et al. [45]	2012	China	Asia	Strategic	Dry port development.
Black et al. [46]	2013	Myanmar	Asia	Strategic	Dry port evaluation
Caballini and Gattorna [47]	2009	Italy	Europe	Strategic	Dry port development
Cezar-Gabriel and Sebastian [48]	2012	-	-	Operational	Dry port operations risks
Chang and Notteboom [49]	2012	China	Asia	Strategic	Dry ports location
Chang et al. [50]	2015	China	Asia	Strategic	Dry port location
Chang-zheng [51]	2011	-	-	Tactical	Dry port International collaboration
Chen and Wang [52]	2012	China	Asia	Strategic	Dry port SWOT-PEST Analysis
Cronje et al. [53]	2009	South Africa	Africa	Tactical	Dry port infrastructure
Crainic et al. [54]	2013	Italy	Europe	Operational	Dry port optimization
Crainic et al. [55]	2015	Italy	Europe	Operational	Dry port based freight distribution planning
Cullinane and [23] Wilmsmeier	2011	-	-	Strategic	Dry port contribution to the extension of seaport
Cullinane et al. [40]	2012	-	-	Strategic	Dry port concept
Do et al. [56]	2011	Indochina	Asia	Strategic	Dry port development
Dungore and Joshi [57]	2014	India	Asia	Tactical	Dry port infrastructure
Fang et al. [58]	2012	-	-	Strategic	Dry Port location
Fechner [59]	2012	Poland	Europe	Strategic	Dry Port Development
Feng et al. [60]	2013	Taiwan	Asia	Operational	Dry Port optimization
Fengshan [61]	2013	China	Asia	Strategic	Dry Port development in Zhejiang
Flamig and Hesse [62]	2011	Germany	Europe	Strategic	Dry port in the context of seaports regionalization
Frost [63]	2010	Canada	America	Strategic	Dry port in sustainable development
Gancheva [64]	2012	Bulgaria	Europe	Strategic	Dry ports development
Garnwa et al. [65]	2009	Great Britain-Nigeria	Europe-Africa	Strategic	Dry ports development
Gonzalez Sanchez et al. [66]	2015	Spain	Europe	Strategic	Dry Port location

Table 2. Presents Dry Port Concept with Different Geographic Region and Decision Level (Cont')

Authors	Years	Country	Continent	Level	Problems
Hamalainen [67]	2007	Finland	Europe	Tactical	Dry port concept
Haralambides and Gujar [68]	2012	India	Asia	Strategic	Dry port sector of India
Haralambides and Gujar [69]	2011	India	Asia	Strategic	Dry ports development
Henttu [70]	2010	Finland	Europe	Strategic	Dry Port financial and environmental Impacts
Henttu and Hilmola [71]	2011	Finland	Europe	Strategic	Dry Port financial and environmental Impacts
Henttu et al. [72]	2011	Finland	Europe	Strategic	Dry port Optimization transport costs
Huseynli and Hamidov [73]	2014	Azerbaijan	Asia	Strategic	Dry port location
Iannone [74]	2013	-	-	Strategic	Dry ports concept
Jarzemskis and Vasiliauskas [26]	2007	-	-	Strategic	Dry port concept
Jeevan et al. [75]	2015	Malaysia	Asia	Strategic	Dry ports development
Jing-wen [76]	2013	China	Asia	Strategic	Dry Port role
Juan [77]	2010	China	Asia	Strategic	Dry port development
Ka [78]	2011	China	Asia	Strategic	Dry port location
Korovyakovskiy and Panova [79]	2011	Russia	Europe	Strategic	Dry port concept
Lattila et al. [80]	2013	Finland	Europe	Tactical	Dry port effects in transportation costs and CO 2 emissions.
Leveque and Roso [34]	2002	-	-	Strategic	Dry port concept
Li and Jiang [81]	2014	China	Asia	Strategic	Dry Port Performance
Li et al. [82]	2011	China	Asia	Strategic	Dry port location
Li et al. [83]	2013	Taiwan	Asia	Strategic	Dry port Location
Li et al. [84]	2015	China	Asia	Strategic	Dry port development
Lovric et al. [85]	2013	Croatia	Europe	Strategic	Dry port development
Lv and Li [86]	2009	China	Asia	Strategic	Dry port location
Makkhongkaew et al. [87]	2015	Thailand	Asia	Tactical	Dry port performance
Mingjian [88]	2011	China	Asia	Strategic	Dry port development
Mlinaric et al. [89]	2011	Croatia	Europe	Strategic	Dry port system transport network
Monios and Wilmsmeier [90]	2012	Scotland	Europe	Strategic	Dry port and offshore logistics hubs
Myagmarsure and Deng [91]	2015	Mongolia	Asia	Strategic	Dry port development
Ng and Gujar [92]	2008	India	Asia	Strategic	Dry ports in export of cargo
Ng and Gujar [93]	2009	India	Asia	Tactical	Dry ports competitive structure of the industry
Ng et al. [94]	2013	Brazil	America	Tactical	Dry port role
Nunez et al. [95]	2014	Spain	Europe	Strategic	Dry port location

Table 2. Presents Dry Port Concept with Different Geographic Region and Decision Level (Cont')

Authors	Years	Country	Continent	Level	Problems
Onwuegbuchunam and Ekwenna [96]	2008	Nigeria	Africa	Strategic	Dry port selection
Padilha and Ng [97]	2012	Brazil	America	Strategic	dry ports spatial evolution
Peng [98]	2010	China	Asia	Strategic	Dry Port construction
Qiu et al. [99]	2014	-	-	Operational	Dry port Optimal storage pricing
Qiu et al. [100]	2015	-	-	Tactical	Dry port operations
Rahimi et al. [101]	2008	USA	America	Strategic	Dry port location
Regmi [102]	2012	Laos	Asia	Strategic	Dry port development
Regmi and Hanaoka [103]	2012	China, Korea	Asia	Operational	Dry port infrastructure
Rezer and Hamalainen [104]	2007	Russia	Europe	Tactical	dry ports logistics railway
Rodrigue and notteboom [105]	2012	Europe-North America	Europe-America	Tactical	dry ports development
Rosa and Roscelli [106]	2009	Italy	Europe	Strategic	Dry port development
Roso [107]	2006	-	-	Strategic	dry port inland access
Roso [108]	2007	-	-	Strategic	Dry port concept
Roso [109]	2008	Australia	Australia	Strategic	Dry port location
Roso [110]	2009	Sweden	Europe	Strategic	dry port concept
Roso [111]	2009	Australia	Australia	Strategic	Dry port location
Roso [112]	2011	-	-	Strategic	Dry port concept
Roso [113]	2013	Australia	Australia	Strategic	Dry port development
Roso and Lumsden [37]	2009	Sweden-USA	Europe-America	Strategic	Dry port concept
Roso and Lumsden [114]	2009	Sweden	Europe	Strategic	Dry port concept
Roso et al. [38]	2009	Tanzania-USA-Australia	Africa-America-Australia	Strategic	Dry port concept
Roso et al. [115]	2015	USA-Australia-Sweden	America-Australia-Europe	Operational	Dry port operational and logistical dynamics
Rostom et al. [116]	2015	Syria	Asia	Strategic	Dry port location
Rozic and Rogic [117]	2013	Croatia	Europe	Tactical	Dry port functionality of distribution logistics centers
Rozic et al. [118]	2011	Croatia	Europe	Strategic	Dry port transport network
Saeed [119]	2009	Pakistan	Asia	Strategic	Dry port empirical study
Sanchez et al. [120]	2006	Spain	Europe	Operational	dry port capacity assessment
Soehodho et al. [121]	2009	Indonesia	Asia	Tactical	Dry port development
Tan [122]	2007	Singapore	Asia	Strategic	Dry port development
Timukhina et al. [123]	2008	Finland-Russia	Europe	Operational	Dry Port Services

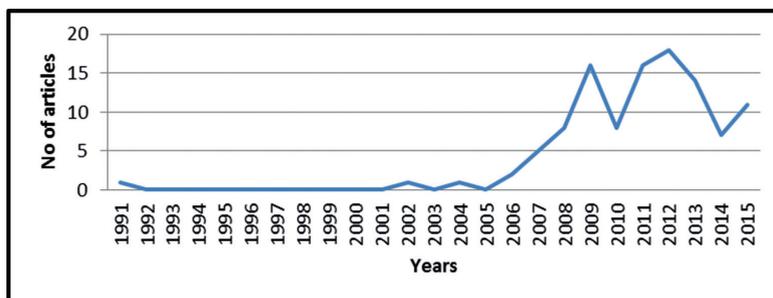
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Table 2. Presents Dry Port Concept with Different Geographic Region and Decision Level (Cont')

Authors	Years	Country	Continent	Level	Problems
Ting-jun [124]	2009	China	Asia	Strategic	Dry port development
UNCTAD [125]	1991	-	-	Strategic	Dry Port Management
Van den Berg and De Langen [126]	2011	Spain	Europe	Tactical	Dry port Implementation strategy
Van der Horst and De Langen [127]	2008	Netherlands	Europe	Tactical	Dry port coordination with seaports
Veenstraa et al. [128]	2012	Netherlands	Europe	Strategic	Dry port concept
Wang and Wang [129]	2010	China	Asia	Strategic	Dry port development
Wang and Wang [130]	2010	Taiwan	Asia	Strategic	Dry port location
Wang and Wei [131]	2008	China	Asia	Strategic	Dry port location
Wang et al. [132]	2009	China	Asia	Strategic	Dry port location
Wei et al. [133]	2010	-	-	Strategic	Dry port location
Werikhe and Jin [134]	2015	Kenya-Tanzania-China	Africa-Asia	Strategic	Dry Port development
Woxenius et al. [27]	2004	-	-	Strategic	Dry port concept
Yan-ping and Zheng [135]	2012	-	-	Strategic	Dry port construction
Zeng et al. [136]	2013	China	Asia	Strategic	Dry port development
Zhang et al. [137]	2011	China	Asia	Strategic	dry port harbor cooperation
Zhaomin [138]	2008	China	Asia	Strategic	Dry port location
Zhen [139]	2012	China	Asia	Strategic	Dry port construction
Zhifang [140]	2010	China	Asia	Operational	Dry port customs clearance
Zhi-ping [141]	2011	China	Asia	Strategic	Dry port development
Zhong et al. [142]	2009	China	Asia	Strategic	Dry port location
Zuo et al. [143]	2013	-	-	Strategic	Dry port operation management

level, political leaders describe transport policy, area served, resources available, etc. The tactical level is element instead in a medium term vision (5 to 10 years). This is to

define the role of the dry port. At this level, it details the modes of transport, type of services offered, etc. The operational level is intended to develop all the appropriate operational

**Figure 3.** Chronologic Development of Dry Port Researches

equipments. At this level, it is important to execute dry port services in the most efficient way possible.

3.2. Geographic Location in Dry Port Researches

This section includes studies that investigate the development of dry port in

Table 3. Dry Port Researches Used Decision Level

Decision level	1986-1990	1991-1995	1996-2000	2001-2005	2006-2010	2011-2015	Total
Strategic level	1	1	0	2	30	49	83
Tactical level	0	0	0	0	6	10	16
Operational level	0	0	0	0	3	8	11

Compared to the major number of papers in this study, the number of papers in which tactical and operational decision level were identified as insignificant (Table 3). They were accounted for only 12% of papers for tactical level and 10% of papers for operational level. However, papers on strategic level were accounted for 78% (Figure 4).

different countries and continents. There is not a dry port solution that suits all needs in all geographic regions. Therefore, different dry ports types were developed in different regions and countries. We collected papers concerning different dry ports types from a geographic perspective. Indeed, we have classified these papers by continent and by country. Table 4 shows the results of the



Figure 4. Decision level in Dry Port Researches

We can notice that dry port studies were in the beginning phase at the present time. Hence, the importance accrued in our study for this potential topic. The main goal of this paper is to discuss the strategic role of the dry port like promoting the development of a sub regional corridor through the storage, handling containers and customs clearance, etc. Increase the economic dynamics and competitiveness of the central regions. Also, promote rail transport of containers and set up a major logistics platform to reduce distances and to save money in trade with the countries of the sub region. In future, we can develop more researches regarding tactical and operational decision level to contribute in maturity of this research field.

investigation into geographic data used in dry port research. Papers included used a specific geographical region to deal with dry port researches and others grouped alone without geographic specification.

The investigation on dry port development across the world provides, overall, important evidences about the lack of studies in Africa (3%), America (4%) and Australia (3%). Regarding studies in Asia (42%) and Europe (29%), as per our analyze Asia and Europe have a considerable containers flow which intensify the congestion problems in their seaports. In a strategically point of view, Logistics agglomerations are often set up close to one another, because they are

attracted by the similar location aspects such as the proximity of markets and the accessibility of multimodal transport and support infrastructures. The geographical focus of logistics agglomerations in turn, generates interactions and economies of scale, which make the selected location even extra important and support focus of distribution businesses in an exacting

global supply chains and tactic organization focusing on the export have been great powers determining current dry ports distribution. Once maritime transport networks and seaport operations were better integrated, especially through the relationship between maritime transport and seaport operations, inland transport became the evident focal point and the dry

Table 4. Geographic Location Studied in Dry Port Research

Continent	1986-1990	1991-1995	1996-2000	2001-2005	2006-2010	2011-2015	Total
Europe	0	0	0	0	10	22	32
Asia	0	0	0	0	16	29	45
Africa	0	0	0	0	3	2	5
America	0	0	0	0	3	3	6
Australia	0	0	0	0	5	1	6
Studies without geographic specification	1	1	0	2	4	12	20

region [65]. Hinterland progress improves the location of logistics agglomerations in seaports and dry ports and along the regions between seaports and dry ports. We suggest producing more researches with tactical and operational aspect in order to develop dry ports services in these regions. We can notice that the most percentage of dry port

port became a basic element of this policy in Asia.

We analyze also Asian and European dry port development in countries of these continents. First, Asian country opted for its own projects of dry port development. Figure 5 reflect percentage of studies in each country. China has investigated with

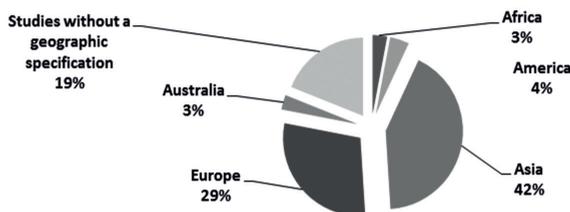


Figure 5. Geographic Location in Dry Port Researches

researches include a geographic aspect in their studies as we found just 19% of studies without a geographic specification. We can justify this geographic focus by the fact that this field is in its starting phase and we consider the geographic aspect as a strategic problem. Furthermore, Asian

a large number of studies (58%) in dry port development, followed by India with 9%, Taiwan with 7% and other countries with 3% or 2%. This high consideration of this potential field comes from the competitive environment and the huge containers exchange with international

seaports. China is a very large country and has an important intra-regional seaport competition. Creating dry port became a decisive solution in logistics management as a consequence.

a transport geography relating to modal accessibility and competence, market role and strength, the regulatory framework and governance [65].

There are many factors that manipulate

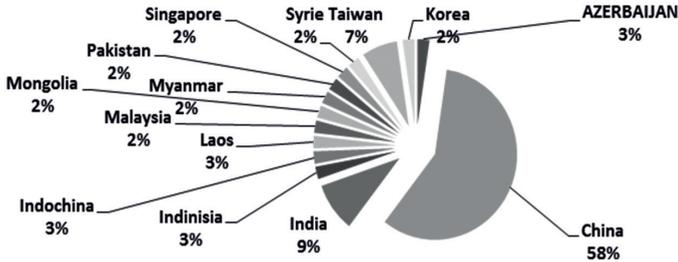


Figure 6. Dry Port Studies in Asian Countries

Regarding European countries opted for its own projects of dry port development. Figure 6 reflects percentage of studies in each country. Finland has investigated with a large number of studies (23%), followed by Italy with 16%, Croatia with 13%, Sweden, Russia, Spain with 10% and other countries with 6% or 3%.

The development of dry ports can be seen as a cycle in the ongoing development of containerization and multimodal transport. The geographical characteristics related to modal accessibility and the ability of regional inland access is essential in determining this development. Therefore, there is no unique strategy in terms of modal choices, as the regional consequence is basic in Europe countries. Every dry port is the result of the considerations of

the realization of a dry port. In the first position, the capacity problems in the seaport and appropriate infrastructure connectivity ([38]; [109] and [105]), appropriate location for the dry port that offer environmental values ([109] and [23]) and this will be partially stated by geographical properties of the country. Finally, there must be the finance existing to construct the dry port.

As per our study and from a closer look at the distribution of dry port studies at the decision, geographic and chronologic level provides interesting analyze about the detailed trends of studies. The evolution of the dry port concept reveals that fields is in the beginning phase and needs more qualitative and quantitative researches in order to reach the maturity phase. As

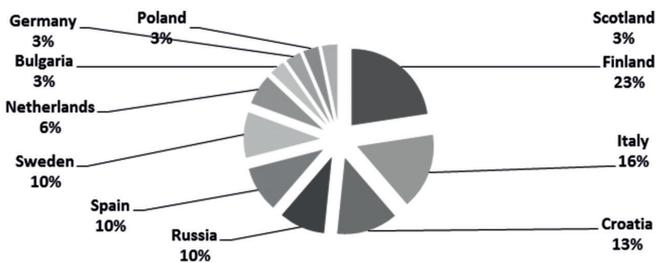


Figure 7. Dry Port Studies in European Countries

presented by previous dry port studies had been strongest after the year 2005 with a focus on the strategic level and a concentration in Asia.

4. Conclusion

The rising spotlight on dry ports is indicative of multimodal transport progress. Dry ports are progressively changing inland side to deal with capacity and efficiency issues in the seaports. The major causes of dry ports construction are density of freight distribution, the augmented focus on multimodal transport infrastructures and capacity problems. The massive volumes of containers in networks, through a focus of cargo on a limited space in seaports, have also generated conditions for dry ports. The construction of huge logistics infrastructures creates novel defy in the relations between seaports and dry ports. The performance of seaports is powerfully interlinked with the progress and performance of related inland infrastructures that provide quick access to containers in the hinterland. This study has an added value to a better understanding of dry port concept through a detailed description of its evolution stages in the literature. We presented previous researches on dry ports. Then we analyzed the results. A systematic review was proposed for analyzing dry port development from decision, geographical and chronological level. We conclude that studies had been strongest after the year 2005 with a focus on the strategic level and a concentration in Asia. For future research, we would focus on the operational and tactical level, and provide more studies in different regions of the world.

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