International Joint Conference on Industrial Engineering and Operations Management- ABEPRO-ADINGOR-IISE-AIM-ASEM (IJCIEOM 2020)

Identifying the factors engaged in customers' choice to operate through dry port or seaport

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Abstract The network of goods in the hinterland has changed since dry ports emerged as an option to fix efficiency problems in seaports. More than ever, shippers and consignees are looking to reduce the total logistic cost, besides to require a high service level in their operations. Despite the relevance of dry ports as a service provider option, there is a lack in the literature comparing both logistic operators. In this way, this article looks to answer the question: What 'cost factors' and 'service level factors' are commonly engaged in shippers and consignees' choice to operate through dry port or seaport? To fulfill this question, data were obtained through an analysis of 72 papers from Scopus and Web of Science data bases. As practical contribution, a set of 11 cost factors and 25 service level factors were found. Working as a first step for future researches, this article helps to fulfill the literature gap, offering theoretical and managerial contributions.

Keywords: Dry Port, Seaport, Cost Factor, Service Level;

1 Introduction

Seaports are well known as playing an important role in multimodal transport systems and international supply chains (Yeo, Thai and Roh, 2015). However, the outstanding increase of 74,6% in dry cargo volume loaded since the year 2000 (UNCTAD, 2019) has putting pressure on seaports, that are facing challenges related to terminal capacity, fairway drafts, equipment to handle those vessels, and, in particular, the hinterland access (Khaslavskaya and Roso, 2020). Despite the relevance of maritime transport, shippers and carriers are recently focusing on the entire logistics chain, looking for minimize the total logistic cost and maximize the efficiency of the whole chain (Bhattacharya et al., 2014).

Considering that the portion of inland costs in the total costs of container shipping would range from 40% to 80%, and it could be reduced by one third with appropriate regionalization strategies, the interest of shippers and consignees about the hinterland transport chain has been increasing (Notteboom and Rodrigue, 2005). In this context, dry ports emerge as an option that could bring significant benefits to stakeholders involved in hinterland transport operations by improving distribution systems, reducing direct and indirect logistics costs, stimulating regional development, and lowering the level of transportation emissions (Khaslavskaya and Roso 2020). The most widely used definition is that 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 (Roso, Woxenius and Lumsden, 2009). More than that, dry ports extends the gates of the seaport inland, offering services such as storage, consolidation, depot, maintenance of containers, track and trace, customs clearance, and others should be available at the dry port (Roso, 2007).

As dry port works as a seaport in the hinterland (Bentaleb, Mabrouki and Semma, 2015), one of the most important decisions of shippers and consignees that should be fulfilled in the literature concern in

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choice to operate through a dry port or a seaport. As mentioned by (Lättilä, Henttu and Hilmola, 2013), in order to a dry port to be successful, customers need to be able to operate with lower (or at least equal) costs compared to a seaport. Despite the relevance of this decision, this topic still remains a literature gap requiring more clarification, as evidenced in two recent systematic reviews covering dry port's researches (Khaslavskaya and Roso 2020), (Rodrigues, Mota and Santos, 2020). In this way, the main purpose of the paper is answer the following question: What 'cost factors' and 'service level factors' are commonly engaged in shippers and consignees' choice to operate through dry port or seaport? To answer this question, an analysis of 72 articles from Scopus and Web of Science databases was carried on.

The article is organized as follows: Section 2 brings the theoretical background that supported this research; Section 3 describes the methodology applied; Section 4 brings the results and discussions; at least, Section 5 presents the conclusions and suggestions for future researches.

2 Theoretical Background

The traditional flow of goods, where shippers and consignees could leave and pick their products from and to a seaport directly by road transportation is changing. The advent of dry ports in the last 40 years modified the traditional network to a new structure, as presents the Fig. 1. A generic description of the different stages of cargo flow considering dry ports is based on (Bentaleb, Mabrouki and Semma, 2015), (Tsao and Linh, 2018), (Fazi and Roodbergen, 2018) and (Sarmadi et al., 2020) as follows: (i) inland leg: in export and import, the shippers and consignees has the option to deliver or pick their containers to/from a dry port or directly to a seaport by road transportation; using a dry port, this container could be deliver/pick to/from seaport by rail or road transportation; in this step, the inland transportation, cargo storage, customs clearance process and additional services take place. (ii) Vessel operation: this step begins when the container is planned and loaded/discharged to/from a vessel, depending only of the seaport operator and shipping line. (iii) Sea leg: this step portrays the deep-sea transport, connecting the international trade of goods. As dry ports only act in 'inland leg', this article will focus only in step (i) inland leg.

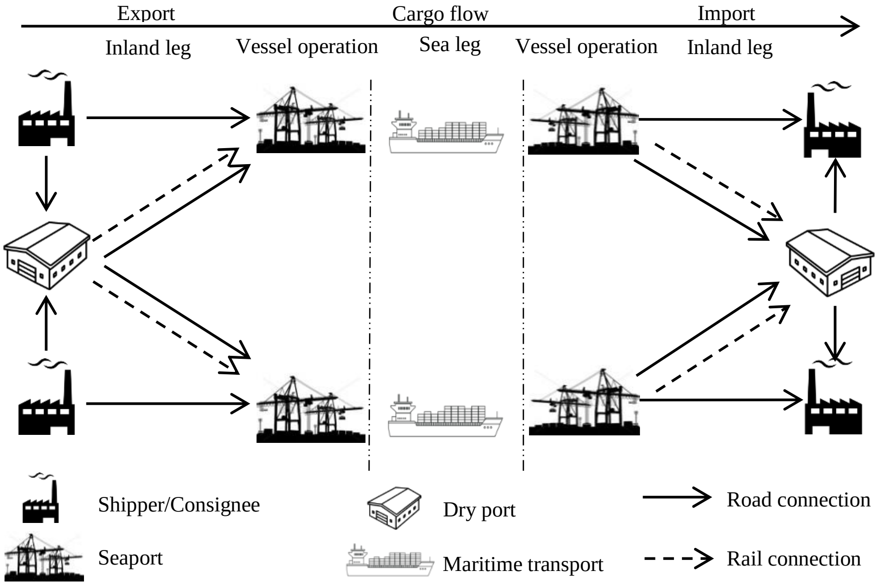


Fig. 1. Export/import cargo network

Taking into account the new transportation network, customers and freight forwarders are looking for supply chain effectiveness, reducing the total logistic cost with a high service level (Notteboom and Rodrigue, 2005). Despite the relevance of the choice to operate through a dry port or a seaport, the literature presents a disproportional volume of researches covering seaports compared to dry ports. Many authors have discussed about seaport choice from the perspective of shipping-lines (Talley and Ng, 2013), (Yeo et al., 2014); other research considered the perspective of customers, seaport operators, and inland actors (Tongzon, 2009), (Rezaei et al., 2019), (Castelein, Geerlings and Duin, 2019).

On the other hand, research about dry port have not focused on the choice among dry ports or between dry port and seaport; instead, some studies have focused mainly on intermodal connection decision and network optimization (Iannone, 2012), (Caris, Macharis and Janssens, 2013), (Tran, Haasis and Buer, 2016). Some exception were the study of (Onwuegbuchunam and Ekwenna, 2008), founding that the service level, security, efficiency, infrastructure and proximity to market are the most important factors influencing choice of dry ports by shippers; (Lättilä, Henttu and Hilmola, 2013) that calculates whether the cargo should go to the dry port or directly to the sea port; and (Jiang et al., 2020) that formulated a model to describe the joint choice of shippers on seaport, transport mode and dry port.

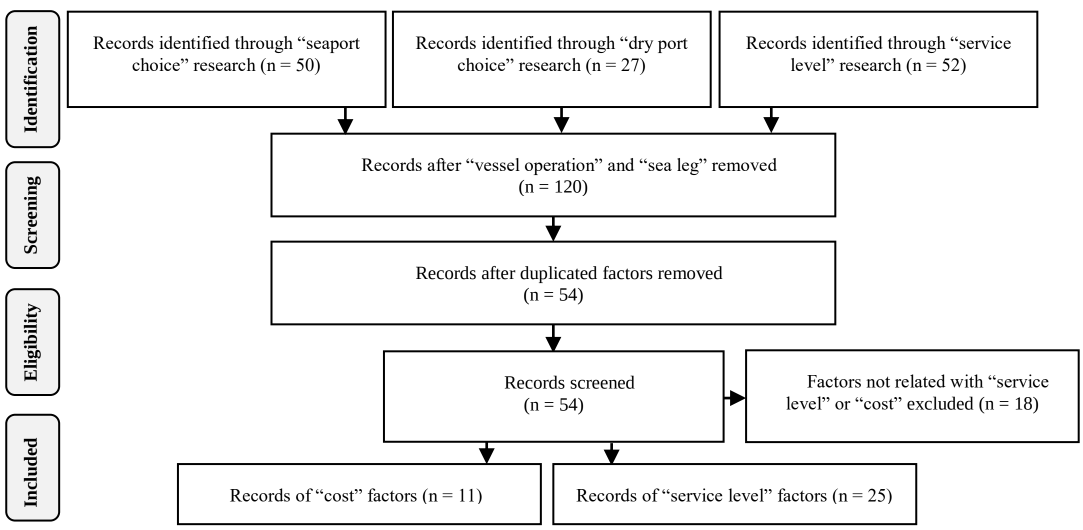
Related to service level, one of the first studies covering seaport choice was carried out by (Slack, 1985), where he found that exporters and freight forwarders are influenced more by price and service considerations of inland leg and sea leg. Since then, many authors contributed to the literature about service level, mainly considering the 5 dimensions of the SERVQUAL model: Reliability, responsiveness, assurance, empathy and tangibles factors (Ugboma, Ibe and Ogwude, 2004), (Yeo, Thai and Roh, 2015), (Hemalatha, Dumpala and Balakrishna, 2018).

3 Methodology

The methodology applied was a literature review based on the steps described by (Tranfield, Denyer and Smart, 2003), building a research protocol. The data collection and analysis period was from July to September, 2020. The databases used in this review were Scopus and Web of Science, in surveys published in English. For a wide coverage towards the paper goal, the main terms searched were: (i) seaport choice; (ii) dry port choice; (iii) seaport service level; (iv) dry port service level. The search for keywords was limited to the title of the paper, using only articles and reviews of the databases defined. The papers' selection was carried on by the author, selecting the papers by consensus considering an inclusion/exclusion dichotomous criterion: if the paper had discussed or had considered any factor related to dry port/seaport choice or service level, it should be included in the database. As result, 72 papers were selected, 34 related to seaport choice and service level, and 38 related to dry port operations.

To identify the main costs and service level factors for inland leg operation, this paper applied the PRISMA statement information flow as follows in Fig. 2 (Moher et al., 2009). In 'identification step', 129 factors were found, including all steps of export/import network detailed in Section 2. In the 'screening step' only 54 factors remained after remove duplicated factors and the ones related to 'vessel operation' and 'sea leg'. After review all factors, other 18 were removed for not comply with cost or service level factors in 'eligibility step'. As final result in 'included step' 36 factors were selected, 11 of them as cost factors and 25 as service level factors.

Fig. 2. Factors selection information flow



4 Results and Discussion

The 11 cost factors related to the inland leg follow in Table 1. These factors influences the inland leg operation, making possible to customers compares seaports and dry ports from cost perspective. Despite the list of factors, a cost analysis could become complex. Summarizing some costs factors, Thore and Iannone (2010) defined two types of costs: direct costs, which includes terminal handling costs, storage costs, and customs operation costs in the case of physical inspection and X- ray scanner control; and indirect costs, consisting of opportunity costs and economic-technical depreciation costs for the containerized goods during the time needed for the releasing operations (inventory in-transit holding costs at nodes). Assuming that shippers have no control over carrier and service providers' prices, it is thus reasonable to assume that shippers will seek to minimize their chain logistics costs in choosing the service operator (Talley and Ng, 2013).

Table 1 Set of 'cost factors'

Cost factors	Authors
Congestion cost	(Slack, 1985); (Tongzon, 2009); (Tang, Low and Lam, 2011); (Steven and Corsi, 2012); (Lee and Hu, 2012); (Brooks and Schellinck, 2013); (Yeo et al., 2014); (Moya and Valero, 2016); (Tsao and Linh, 2018); (Baert and Reynaerts, 2020); (Valls et al., 2020).
Cost of handling containers	(Janic, 2007); (Iannone, 2012); (Crainic et al., 2015); (Tran, Haasis and Buer, 2016); (Tsao and Linh, 2018); (Vaggelas, 2019).
Custom clearance cost	(Iannone, 2012); (Crainic et al., 2015).
Demurrage and detention cost	(Tongzon, 2009); (Yeo et al., 2014); (Crainic et al., 2015); (Oey and Setiawan, 2017); (Rezaei et al., 2019); (Hsu, Lian and Huang, 2020).
Dry port and seaport inland charge cost	(Brooks and Schellinck, 2013); (Crainic et al., 2015); (Button, Chin and Kramberger, 2015); (Tran, Haasis and Buer, 2016).
Emissions cost	(Lättilä, Henttu and Hilmola, 2013); (Tran, Haasis and Buer, 2016); (Tsao and Linh, 2018).
Import and export charges in inland	(Castelein, Geerlings and van Duin, 2019); (Baert and Reynaerts, 2020).
Inventory holding cost	(Janic, 2007); (Iannone, 2012); (Tran, Haasis and Buer, 2016); (Kapetanis, Psaraftis and Spyrou, 2016); (Oey and Setiawan, 2017); (Tsao and Linh, 2018).
Storage cost	(Iannone, 2012); (Brooks and Schellinck, 2013); (Qiu, Lam and Huang, 2015); (Crainic et al., 2015); (Oey and Setiawan, 2017); (Qiu and Lam, 2018); (Tsao and Linh, 2018); (Vaggelas, 2019).
Transportation cost	(Slack, 1985); (Janic, 2007); (Tongzon, 2009); (Iannone and Thore, 2010); (Iannone, 2012); (Brooks and Schellinck, 2013); (Yeo et al., 2014); (Crainic et al., 2015); (Qiu, Lam and Huang, 2015); (Larranaga, Arellana and Senna, 2016); (Nugroho, Whiteing and de Jong, 2016); (Tran, Haasis and Buer, 2016); (Oey and Setiawan, 2017); (Qiu and Lam, 2018); (Tsao and Linh, 2018); (Moya and Valero, 2016); (Rezaei et al., 2019); (Hsu, Lian and Huang, 2020); (Jiang et al., 2020).
Value-added services cost	(Janic, 2007); (Monios, 2011); (Bask et al., 2014); (Crainic et al., 2015); (Jeevan, Chen and Cahoon, 2018).

A key component of a logistics chain is the transportation system network. The costs associated with transportation amount to around one third of the total logistics costs, which necessitates effective and cost efficient transport coordination mechanisms (Bhattacharya et al., 2014). In general, transport costs include the price of transport plus opportunity costs and economic-technical depreciation (Thore and Iannone, 2010). Furthermore, Baert and Reynaerts (2020) found evidence that dry ports and seaports port charges and congestion are key factors in the decision making process of customers. In this context, dry ports usually charges a lower storage price than that in the seaport, hence, the dry port is more attractive for relatively long-term storage, affecting also the demurrage and detention costs (Tongzon, 2009), (Qiu, Lam and Huang, 2015). At least, all 11 cost factors should be aggregated, making possible to compare the total inland leg cost.

As dry ports provide a large set of services typical of seaports (Bask et al., 2014), customers can compare both service providers through service level perception, following the set of factors in Table 2.

The competitive position of a seaport and a dry port is decided mainly by the level of service quality (Cho, Kim and Hyun, 2010). Some findings indicates that logistics service quality is positively determined by five factors including responsiveness, assurance, reliability, tangibles and empathy (Le, Nguyen and Hoang, 2020). From the perspective of (Ugboma et al., 2007) the efficiency is the most important aspect of service level. One of the differences between both service providers is that dry ports benefits of the close relationships with customers, resulting in smooth transport processes and fast customs clearance (Bask et al., 2014). Besides, the influence of dry port service range and quality, custom clearance time, transport mode reliability, freight shipment size, ship call frequency on shippers' hinterland transport chain choice can't be neglected (Jiang et al. 2020).

More complex than cost factors, assess the service level depends on the subjective perspective of each customer, dealing with different unit of measures (Rezaei et al. 2018). Depending on their preferences, shippers choose supply chain partners and service providers that best suit their time, service, and cost preferences (Castelein, Geerlings and Duin, 2019). The 'service level' issue has got more attention from dry port operators, which are looking to fulfill seaports' service gaps (Rodrigues et al., 2020). Aggregating those factors in a common scale could benefit customers, aiding to compare service providers.

Table 2 Set of 'service level factors'

Service level factors	Authors
Customs clearance efficiency	(Lee and Hu, 2012); (Button, Chin and Kramberger, 2015); (Moya and Valero, 2016); (Rezaei et al., 2019); (Vaggelas, 2019); (Hsu, Lian and Huang, 2020); (Jiang et al., 2020).
Environmentally impact (CO2 emission)	(Janic, 2007); (Thai, 2008); (Thai, 2015); (Yeo, Thai and Roh, 2015); (Kapetanis, Psaraftis and Spyrou, 2016); (Hemalatha, Dumpala and Balakrishna, 2018).
Equipment and facility availability and condition	(Slack, 1985); (Ugboma, Ibe and Ogwude, 2004); (Ugboma et al., 2007); (Thai, 2008); (Onwuegbuchunam and Ekwenna, 2008); (Tongzon, 2009); (Lee and Hu, 2012); (Steven and Corsi, 2012); (Yeo, Thai and Roh, 2015); (Hemalatha, Dumpala and Balakrishna, 2018); (Sakyi, 2020); (Le, Nguyen and Hoang, 2020).
Financial stability of dry port and seaport	(Thai, 2008); (Yeo, Thai and Roh, 2015); (Hemalatha, Dumpala and Balakrishna, 2018).
Free dwell-time	(Yeo et al., 2014).
Good relationship with other ports and land transport service providers	(Yeo, Thai and Roh, 2015); (Ha and Ahn, 2017); (Hemalatha, Dumpala and Balakrishna, 2018).
Efficiency in operations, management and documentary process	(Thai, 2008); (Onwuegbuchunam and Ekwenna, 2008); (Brooks and Schellinck, 2013); (Thai, 2015); (Yeo, Thai and Roh, 2015); (Ha and Ahn, 2017); (Hemalatha, Dumpala and Balakrishna, 2018); (Sakyi, 2020); (Le, Nguyen and Hoang, 2020).
Hinterland connections	(Onwuegbuchunam and Ekwenna, 2008); (Brooks and Schellinck, 2013); (Talley and Ng, 2013); (Yeo et al., 2014); (Moya and Valero, 2016); (Castelein, Geerlings and Duin, 2019); (Vaggelas, 2019).
Knowledge and competent human resource	(Ugboma, Ibe and Ogwude, 2004); (Ugboma et al., 2007); (Thai, 2008); (Lee and Hu, 2012); (Brooks and Schellinck, 2013); (Thai, 2015); (Hemalatha, Dumpala and Balakrishna, 2018); (Le, Nguyen and Hoang, 2020).
Labor disputes and strikes	(Yeo et al., 2014); (Hsu, Lian and Huang, 2020).
Meeting customers' requirements	(Thai, 2008); (Brooks, Schellinck and Pallis, 2011); (Thai, 2015); (Yeo, Thai and Roh, 2015); (Nugroho, Whiteing and de Jong, 2016); (Ha and Ahn, 2017); (Hemalatha, Dumpala and Balakrishna, 2018); (Sakyi, 2020); (Le, Nguyen and Hoang, 2020).
Multimodal connectivity	(Slack, 1985); (Tongzon, 2009); (Tang, Low and Lam, 2011); (Brooks, Schellinck and Pallis, 2011); (Brooks and Schellinck, 2013); (Talley and Ng, 2013); (Moya and Valero, 2016); (Castelein, Geerlings and Duin, 2019); (Rezaei et al., 2019); (Vaggelas, 2019); (Valls et al., 2020); (Hsu, Lian and Huang, 2020).
Provision of on-time and accurate information	(Ugboma, Ibe and Ogwude, 2004); (Ugboma et al., 2007); (Thai, 2008); (Tongzon, 2009); (Brooks, Schellinck and Pallis, 2011); (Lee and Hu, 2012); (Brooks and Schellinck, 2013); (Yeo et al., 2014); (Thai, 2015); (Yeo, Thai and Roh, 2015); (Ha and Ahn, 2017); (Hemalatha, Dumpala and Balakrishna, 2018); (Vaggelas, 2019); (Le, Nguyen and Hoang, 2020); (Sakyi, 2020).

Table 2 (continued).

Quality of service provided	(Ugboma, Ibe and Ogwude, 2004); (Brooks, Schellinck and Pallis, 2011); (Lee and Hu, 2012); (Talley and Ng, 2013); (Button, Chin and Kramberger, 2015); (Moya and Valero, 2016); (Vaggelas, 2019).
Quick response to customers' needs (responsiveness)	(Ugboma, Ibe and Ogwude, 2004); (Thai, 2008); (Tongzon, 2009); (Lee and Hu, 2012); (Brooks and Schellinck, 2013); (Yeo et al., 2014); (Thai, 2015); (Yeo, Thai and Roh, 2015); (Button, Chin and Kramberger, 2015); (Moya and Valero, 2016); (Ha and Ahn, 2017); (Hemalatha, Dumpala and Balakrishna, 2018); (Vaggelas, 2019); (Sakyi, 2020).
Range of services	(Slack, 1985); (Ugboma, Ibe and Ogwude, 2004); (Ugboma et al., 2007); (Lee and Hu, 2012); (Brooks and Schellinck, 2013); (Talley and Ng, 2013); (Moya and Valero, 2016); (Ha and Ahn, 2017); (Vaggelas, 2019); (Jiang et al., 2020).
Reliability of the services provided	(Ugboma, Ibe and Ogwude, 2004); (Ugboma et al., 2007); (Brooks, Schellinck and Pallis, 2011); (Lee and Hu, 2012); (Brooks and Schellinck, 2013); (Yeo, Thai and Roh, 2015); (Thai, 2015); (Larranaga, Arellana and Senna, 2016); (Nugroho, Whiteing and de Jong, 2016); (Hemalatha, Dumpala and Balakrishna, 2018); (Sakyi, 2020); (Le, Nguyen and Hoang, 2020).
Reputation of dry port and seaport	(Thai, 2008); (Tongzon, 2009); (Brooks, Schellinck and Pallis, 2011); (Thai, 2015); (Moya and Valero, 2016); (Rezaei et al., 2019); (Sakyi, 2020).
Response to regulation and innovations changes	(Vaggelas, 2019)
Safety and security in operation and transportation	(Onwuegbuchunam and Ekwenna, 2008); (Tongzon, 2009); (Brooks, Schellinck and Pallis, 2011); (Lee and Hu, 2012); (Brooks and Schellinck, 2013); (Talley and Ng, 2013); (Button, Chin and Kramberger, 2015); (Thai, 2015); (Yeo, Thai and Roh, 2015); (Moya and Valero, 2016); (Nugroho, Whiteing and de Jong, 2016); (Ha and Ahn, 2017); (Hemalatha, Dumpala and Balakrishna, 2018); (Vaggelas, 2019); (Castelein, Geerlings and Duin, 2019); (Rezaei et al., 2019); (Jiang et al., 2020); (Le, Nguyen and Hoang, 2020).
Socially responsible behavior and concerns for human safety	(Thai, 2008); (Hemalatha, Dumpala and Balakrishna, 2018).
Storage capacity for containers and special cargo	(Brooks and Schellinck, 2013); (Vaggelas, 2019).
Transit time	(Ugboma, Ibe and Ogwude, 2004); (Ugboma et al., 2007); (Steven and Corsi, 2012); (Moya and Valero, 2016); (Larranaga, Arellana and Senna, 2016); (Nugroho, Whiteing and de Jong, 2016); (Fitri Abdul Rahman et al., 2019); (Castelein, Geerlings and Duin, 2019); (Rezaei et al., 2019); (Jiang et al., 2020).
Transparency of port charges	(Lee and Hu, 2012); (Vaggelas, 2019).
Waiting time	(Ugboma, Ibe and Ogwude, 2004); (Ugboma et al., 2007); (Tongzon, 2009); (Brooks and Schellinck, 2013); (Yeo et al., 2014); (Ha and Ahn, 2017).

5 Conclusion

Dry ports have emerged as an option to fix seaport congestion, optimizing the network of goods through the hinterland, reducing costs, and offering additional services. Despite the relevance of dry ports to the international trade of goods, researches comparing operations through dry ports and seaports remains a gap. Working as a first step of research in this context, this article carried on a literature review to identify the main costs and service level factors engaged in customers' choice to operate through dry port or seaport.

As practical contribution, 11 cost factors and 25 service level factors were presented as relevant in shippers and consignees decision-maker. Those factors brings theoretical contributions, enriching the discussion about the supply-chain network, as well managerial contributions, showing to customers a set of important factors engaged in customers' logistic service provider choice. As recommendation for future researches, the authors suggest to build a model to measure the costs mentioned above, finding the break-even point between dry port and seaport. Moreover, a multicriteria method could create a scale to measure the service level, making possible a trade-off analysis between cost and service-level.

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