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Commercial relations in global value chains: Potentials and limitations of ports

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Abstract— *The competitiveness of seaports is affected predominantly by several dimensions and variables present in areas outside the limits themselves. However, decisions made in these areas directly reflect port objectives and strategies. Due to the commercial relations linked to globalization, hinterlands have emerged, others have changed location, and there are also infrastructure changes, due to port congestion and scarcity of land use, as well as the development and emergence of intermodal corridors, among others, causes pointed out in the literature. However, this issue has been addressed relatively moderately in the literature on port operations. In particular, there are gaps to be studied to answer the question of how to know and understand port hinterlands and optimize supply chains. For this reason, this work describes a methodological approach to diagnose, map and define hinterlands of brazilian container seaports. The proposed approach allows researchers, managers and institutions (public and private) to have a resource to assist them in mapping, planning and managing current situations, as well as in analyzing port opportunities, potential and limitations.*

Keywords— ***Strategic Resource Management, Hinterland connections, Sea transport chains, Relationship management, Importance-performance analysis.***

I. INTRODUCTION

The world economy has advanced significantly in recent decades, especially in the areas of international trade and industrial organization (Gereffi, Humphrey & Sturgeon, 2005, Reuber *et al*., 2018). And, within this context, in the course and operational unfolding of activities in these areas, there has been a growing demand for better performance in the global logistics chain (Rodrigue, 2020).

As an alternative to meet the demands of productivity in cargo handling, Bird (1963) and Shintani *et al*. (2020), mention that the ports have stood out over time, as it is one of the oldest forms of interaction between businesses and, that up to the present day they have proved to be efficient in the transportation of bulk cargo.

According to Chen, Jeevan and Cahoon (2016), after decades of adaptation in the ways in which this type of transportation is operationalized and, based on an increasing demand for unitization of cargo, there was a need to create a compartment that met this expectation, appearing from there the containerization. For these authors, as a consequence of this emergence, there has been a growth in new relationships between countries, regions and port cities, supported among other dimensions, to a large extent, in the dimensions related to transport costs and commercial alliances.

As a result, cargo distribution on the continent (inland or hinterland) has become an important dimension of the globalization / maritime transport / goods distribution paradigm (Notteboom & Rodrigue, 2005, Behdani *et al*., 2020). For this reason, according to these authors, the transport of goods in contêiner (brazilian portuguese), contentor (european portuguese), container (english), has grown excessively, due to the mobility of handling and, differentiated total logistical cost in relation to other options on the market. And, according to Talley and Ng (2017), this growth implies demands for efficiency improvements in logistics - each product has a different logistics chain -, mainly, in the handling and transport of containers, something that, essentially, is largely derived

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part of cargo distribution inland and between port hinterlands, within the economic impact zone.

In this context, this work analyzes the connectivity of brazilian container seaports from the perspective of their hinterlands, with the objective of diagnosing, mapping and delimiting them.

II. THEORETICAL REFERENCE

The movement of containerized cargo is related to the maritime transport chain through shipowners, ports and transporters, so that the choice of operation and use of this chain needs to be joint, say Talley and Ng (2017). According to these authors, shipowners seek to maximize the profits of this chain, as well as, ports seek productivity and, carriers seek ways to minimize logistical costs.

In the opinion of Notteboom and Rodrigue (2005), knowing the geometric and operating characteristics of a port are preponderant for the performance of port cargo handling, intermodal, and its relationship with the hinterlands. Within this context, Talley and Ng (2017) highlight that in order to choose a port, attributes such as geographic location, oceanic distance between origin and destination, availability of berths, volumetric cargo capacity, value of fees, available services are considered, efficiency, physical and technical infrastructure and availability of transport links between ports and hinterlands. For these authors, these attributes are decisive for selecting a port and, from different users analyze their profitability with the possible capacity of handling containers.

For Kramberger *et al*. (2015) the choice of a port is related to the performance of its operating capacity. According to these authors, this performance is directly influenced by shippers, dispatchers, shipping companies and terminal operators.

In the opinion of Gamassa and Chen (2017), the transport system between a port and its hinterland plays an essential role in connectivity with inland regions. Expanding this view, Nasanjargal, Gamassa and Chen (2018) assure that in order to guarantee an additional cargo flow, the optimization and expansion of connections with inland regions (dry ports) has become preponderant, and as important as the port facilities themselves.

For this reason, Gereffi and Lee (2016) believe that the global value chain is fundamental in helping the management and operation of the industrial sector, allowing, in some cases, to maximize revenues and reduce negative impacts on corporate business. For these authors, another important characteristic of the global value chain is the opportunity for the chain to link leading companies in the market, with small and medium businesses and suppliers in different local contexts.

Due to the multiplicity of data, information and different operational contexts contained in a value chain, Backer and Miroudot (2014) emphasize that from this view it is possible to plan and manage projects, production, marketing, unitary distribution of products and, also, perform support to the final consumer. However, these activities can be carried out within the same company or divided between companies from different countries and continents, these authors point out.

The rise of global value chains in recent decades - in part, according to Amador and Cabral (2014), is linked to the expansion and development of international trade. These authors point out that this development leads to an increase in investment patterns in cargo transportation, affecting business competitiveness and also in regional macroeconomic developments.

For this reason, Notteboom and Rodrigue (2008) point out that the hinterland is an essential component in strategic and operational planning of a port and for its economic impact on land, due to commercial considerations. This perception of these authors is justified by the contributions that come from reflections related to these plans, such as, for example, in enabling optimized interconnections to stakeholders and supply chain components, which can help reduce costs, improve operational availability and decrease load distribution time.

Thus, as the economy and handling operations become increasingly specialized and globalized, according to Bergqvist and Egels-Zandén (2012), the importance of logistics activities in the interior also increases. However, these authors emphasize that this importance goes beyond regional limits, and it is important to consider port hinterlands in global transport systems. This consideration is based on seaports, which play a key role as transhipment hubs. Because of this, cargo movement flows must be diagnosed, monitored and managed, with measurement in hinterlands that reconciles transport demand and supply (Notteboom & Rodrigue, 2008).

According to Rodrigue and Notteboom (2010), the delimitation of hinterlands allows the understanding of the market, of specific niches and of potential situations to be explored by a port or by the authorities, which allows the development of port development plans (Pizzolato, Scavarda, & Paiva, 2010). Highlighting this argument, Degrassi (2001) suggests that, for a port to remain competitive, it is necessary to constantly review its cargo handling network, having in the hinterlands an important

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contribution of knowledge, which allows to understand the current situation, of expansion and, of possible investments outside the administrative boundaries of the geographical limits. In this author's view, this contribution of knowledge can be acquired at different levels of flows, such as primary hinterland - intense cargo handling (from 50,000 tons); secondary hinterland - median movement (between 15,000 and 50,000 tons); and marginal hinterland - small movement (below 15,000 tons).

III. METHODOLOGICAL APPROACH

As a research unit, the main brazilian public maritime port complexes were used. These units were selected due to their operational efficiency presented in the reports of ports that operate containers between the years 2010 to 2019 of the National Waterway Transport Agency (ANTAQ, 2020). Thus, the analysis carried out was composed of the five selected brazilian ports (Santos, Paranaguá, Rio Grande, Itajaí and Rio de Janeiro) that showed high efficiency and availability of data in the analyzed period (Rodrigue, 2020).

The methodological approach was established through three steps (Fig. 1), based on the principles: diagnose, map and delimit port hinterlands (Rodrigue & Notteboom, 2010). In addition, a survey was used using secondary data obtained from the waterway statistical yearbook, prepared by the National Waterway Transportation Agency (ANTAQ, 2020), for the time period from 2010 to 2019.

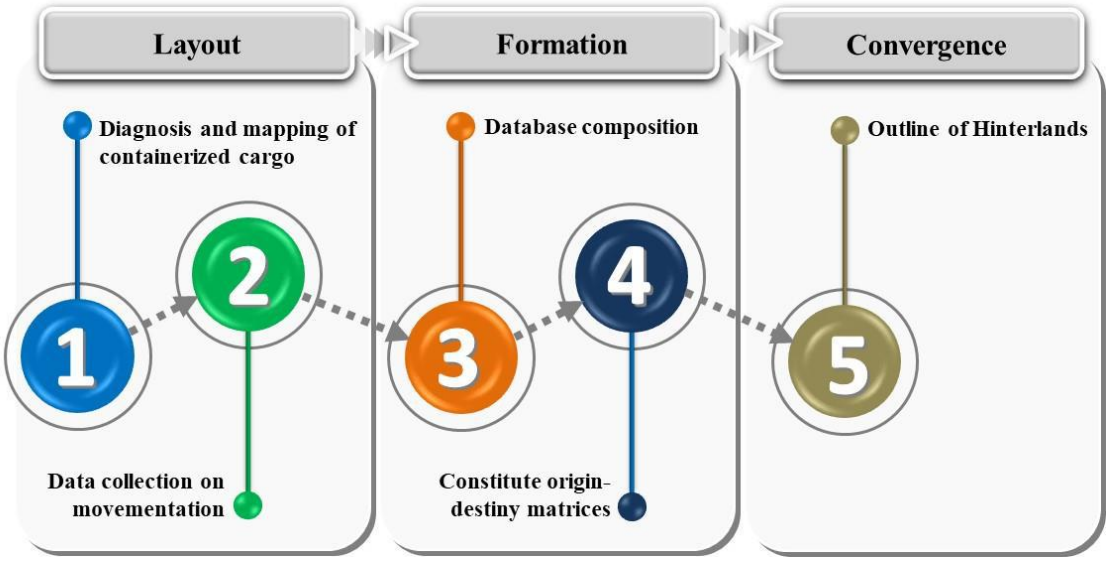

Fig. 1: Summary of the methodological approach used.

In the Scheme (Step 1) a diagnosis and mapping of the containerized cargo handled in brazilian ports was carried out, taking into account the ANTAQ database (2020). Then, container movement data were collected from all selected brazilian ports, completing Step 1.

Subsequently, Stage 2 (Formation), started with a composition of the Database (DB). However, for this selection the efficiency and availability of data were verified and, also, according to Bird (1963) and Guerrero (2019), a minimum representation of 3 ports was considered for the mapping of the interior. Then, considering the selection made, it was composed of DB, based on the categorization of hinterlands proposed by Degrassi (2001). From the port movements, these were categorized and classified in order of decreasing efficiency and, later, source-destination matrices were structured.

Finally, Step 3 (Convergence) delimited the primary hinterlands of the selected ports (Degrassi, 2001), with the preparation of thematic maps of containerized cargo (Notteboom & Rodrigue, 2005, Notteboom & Yang, 2017, Guerrero, 2019). The establishment of thematization considered a centrality of primary cargo in the country of origin and, also, for the destination of the cargo. It is important to mention that to assist the processing, mining, intelligence and data analysis activities, electronic spreadsheets and also Tableau software Trial version were used.

IV. RESULTS

In the Scheme (Step 1) a diagnosis and mapping of the containerized cargo handled in brazilian ports was carried out, taking into account the ANTAQ database (2020).

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Then, container movement data were collected from all selected brazilian ports, completing Step 1.

Based on data from ANTAQ (2020), shipment and disembarkation data were collected from the defined federal ports, analyzing and classifying them according to cargo occurrences by country (second phase). This procedure was necessary due to the consolidation of data in the Waterway Statistical Yearbook (ANTAQ, 2020).

From the classification of cargo occurrences by country, the data analyzed were synthesized, and with this, the origins and destinations of cargo were structured (third phase). For example, when preparing Table 1 below, it was possible to rank the 2010 commercial partners in the port of Santos, located in the State of São Paulo. This port in 2019 corresponded to 48.3% of all container shipments in the country and in previous years it has always remained the main port.

Table. 1: Loading of containerized cargo in 2010.

Destiny	Spain	United States	Singapore	Not identified	Germany	Hong Kong	China	Belgium	Italy
Qnt. (ton)	1.522.380	1.484.438	1.103.659	960.351	877.488	828.881	729.568	725.223	623.260
%	10,43	10,17	7,56	6,58	6,01	5,68	5,00	4,97	4,27
Accum. %	10,43	20,60	28,17	34,75	40,76	46,44	51,44	56,41	60,68
Destiny	Colombia	Netherlands	Maroccos	Argentina	Dominican Republic	South Africa	Mexico	Venezuela	Panama
Qnt. (ton)	556.266	535.480	427.561	410.177	361.947	359.694	355.405	346.370	242.477
%	3,81	3,67	2,93	2,81	2,48	2,46	2,44	2,37	1,66
Accum. %	64,49	68,16	71,09	73,90	76,38	78,85	81,29	83,66	85,32
Destiny	United Kingdom and Ireland	Chile	Peru	Angola	Jamaica	South Korea	France	Bermuda	Senegal
Qnt. (ton)	209.374	197.018	186.428	167.625	147.070	140.073	111.569	105.858	93.519
%	1,43	1,35	1,28	1,15	1,01	0,96	0,76	0,73	0,64
Accum. %	86,76	88,11	89,38	90,53	91,54	92,50	93,26	93,99	94,63
Destiny	Iran	Congo	Malasya	Trinidad and Tobago	Japan	United Arab Emirates	Uruguay	Ecuador	Oman
Qnt. (ton)	91.009	79.011	77.590	71.689	63.258	57.487	48.895	44.289	35.009
%	0,62	0,54	0,53	0,49	0,43	0,39	0,34	0,30	0,24
Accum. %	95,25	95,80	96,33	96,82	97,25	97,65	97,98	98,28	98,52
Destiny	Sri Lanka	Pakistan	Nigeria	Malta	Russia	India	Portugal	Taiwan	Zimbabwe
Qnt. (ton)	30.055	28.429	28.150	27.145	23.070	18.944	10.062	9.125	8.178
%	0,21	0,19	0,19	0,19	0,16	0,13	0,07	0,06	0,06
Accum. %	98,73	98,92	99,12	99,30	99,46	99,59	99,66	99,72	99,78
Destiny	Bahamas	Cuba	Equatorial Guinea	Cape Verde	Ivory Coast	Egypt	Saudi Arabia	Qatar	Israel

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Qnt. (ton)	7.946	7.570	7.105	4.858	1.859	1.702	562	441	78
%	0,05	0,05	0,05	0,03	0,01	0,01	0,004	0,003	0,0005
Accum. %	99,83	99,89	99,93	99,97	99,98	99,99	99,9955	99,9986	99,9991
Destiny	Lebanon	Greece	Dominica	Philippines	---	---	---	---	Total
Qnt. (ton)	58	34	31	9	---	---	---	---	14.592.804
%	0,0004	0,0002	0,0002	0,00006	---	---	---	---	---
Accum. %	99,9995	99,9997	99,9999	100	---	---	---	---	---

Source: ANTAQ (2020).

It is observed that the composition of the hinterlands for landing in 2010, according to Degrassi (2001) indicates: primary hinterland: Spain, United States, Singapore, Germany, Hong Kong, China, Belgium, Italy, Colombia, Holland, Morocco, Argentina , Dominican Republic, South Africa, Mexico, Venezuela, Panama, United Kingdom, Great Britain and Ireland, Chile, Peru, Angola, Jamaica, South Korea, France, Bermuda, Senegal, Iran, Congo, Malaysia, Trinidad and Tobago, Japan and the United Arab Emirates; secondary hinterland: Uruguay, Ecuador, Oman, Sri Lanka, Pakistan, Nigeria, Malta, Russia and India; and marginal hinterland: Portugal, Taiwan, Zimbabwe, Bahamas, Cuba, Equatorial Guinea, Cape Verde, Ivory Coast, Egypt, Saudi Arabia, Qatar, Israel, Lebanon, Greece, Dominica and the Philippines.

Based on the data collected, when comparing the years 2010 and 2019, it is possible to note that there was an increase of 117.24% in the number of commercial partners, as well as an increase of 20.84% in the amount of tons shipped.

There is a decrease from 33 (thirty-three) to 29 (twenty-nine) in the number of primary partners, with only 25 (twenty-five) countries repeated in the two years, such as the United Arab Emirates and the United Kingdom of Great Britain. Brittany and Ireland, which became secondary hinterlands. While Japan, Venezuela and Trinidad and Tobago, they became marginal hinterlands. Iran has no cargo transportation records for Santos after 2018, and Bermuda has not received containerized cargo after 2017 from the port. Also, four countries entered as primary hinterland, with Uruguay, Ecuador and Malta moving from secondary hinterlands to primary and Bahamas from marginal hinterland.

Between the years 2010 and 2019, it is observed that the port of Santos has three shipment sequences (Fig. 2), with important fluctuations in productivity. The first oscillation consists of a reduction in 2013, when compared to the previous year, there was a decrease of 3.68%. However, compared to 2010, there was an increase of 2.31%. The second reduction occurred in 2016, when compared to 2017 there was a reduction of 3.1%. However, when compared to the first reduction, there was an increase of 11.95%. The next reduction occurred in 2019, when compared to the previous year, its decrease was 1.66%, and in 2016 the increase was 5.09%.

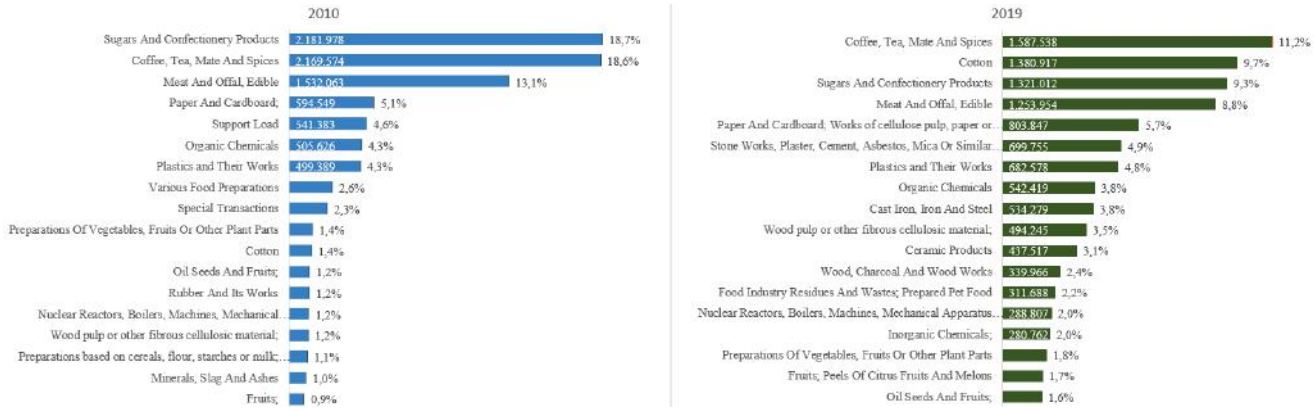

Fig. 2: Analysis of the variation between products shipped (2010 and 2019). Source: ANTAQ (2020).

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Thus, from Fig. 2 there is a decrease in sugar, coffee and meat transported, as well as its percentage of participation in the loading of containerized cargo, highlighting materials such as cotton, which now represents 9.7% of the products transported and stone works with 4.9% participation.

Concluding the analysis of the main port observed, there are four other remaining ports (Fig. 3), for which the shipping data will be discussed and analyzed, based on the data collected in ANTAQ (2020).

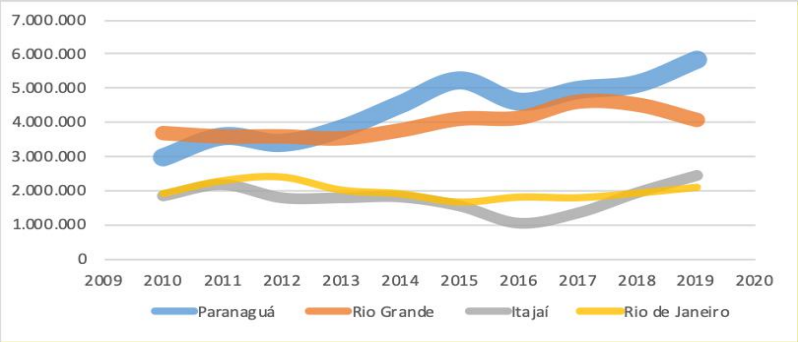

Fig. 3: Shipment history of the chosen ports related to the quantity transported (2010 and 2019). Source: ANTAQ (2020).

Seaport Paranaguá

The seaport Paranaguá, is located in the state of Paraná and in 2019 corresponded to 16% of the containers shipped in the country and in previous years it has always been among the three main ports. When comparing the years 2010 and 2019, a decrease in the number of partners is observed, from fifty-one to thirty-three, which is equivalent to a loss of 35.3%. However, there is a 96.34% increase in the amount of tons transported and a considerable increase in transport to countries that were already part of the primary hinterlands. An increase of 87.96%, in addition to the inclusion of six countries as primaries, of which only Jamaica became a new partner, and there was a change in hinterlands in five other countries. Of these, the United Kingdom, United States, Mexico and Morocco were marginal hinterlands and Angola was a secondary hinterland.

Based on Fig. 3, it can be seen that in the period from 2012 to 2015, there was a growth of about 54%, with this increase becoming a 5.36% drop in containerized transport in the years 2015 and 2016. The decrease in the transport of meat and offal (-8.42%), paper and cardboard (-19.68%), waste and waste (-44.97%), among others, is attributed. As a consequence, an increase of three consecutive years ended. In 2019, there was a significant increase in transport, recovering losses definitively and becoming the year with the highest quantity in tons of shipments in the last ten years.

Seaport Rio Grande

Located in the state of Rio Grande do Sul (RS) and in 2019 it accounted for 11.2% of all container shipment movements in the country and in previous years it has always been among the top three. It is also observed that there was an increase of thirteen commercial partners, adding to this an increase of 10.8% in the cargo transported during the analyzed period. Even with the decrease of seven primary partners, there was an increase of 16.81% in transport within the primary partners. For example, the United Kingdom and Ireland, the Dominican Republic, Germany and Italy became secondary hinterlands, Argentina and Venezuela became marginal hinterlands, and Jamaica began to export less over the years, with a hiatus in the years 2018 and 2019, returning to export in 2020 (ANTAQ, 2020).

It is also observed that there were slight drops in exports during the years 2010 to 2013, and from 2013 onwards the port had increasing exports until the year 2017 (31.28%). Subsequently, there were two falls, the largest in 2019, where the fall compared to the previous year was 10.14%. Products such as plastics, meat and tobacco, increased compared to 2018, however, the drop in cargo handling can be evidenced by chemicals (-66.76%), wood pastes (-51.32%), fish and crustaceans (-75.8%), while the other products had small falls or, remained proportionally with the same amount of cargo transported.

Seaport Itajaí

Located in the state of Santa Catarina, this port in 2019 corresponded to 6.7% of all container movements in the country and in previous years it has always remained among the main ports. It is observed that there was a reduction in the number of partner countries, however, there was an increase of 32.8% in the transport of

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containerized cargo. Involving the primary hinterland, this increase was much greater, as in addition to increasing the number of partners, the amount of cargo transported increased by 42.32%. Regarding the primary trading partners, Germany, the United Arab Emirates and Venezuela ended the commercial partnerships in the years 2017, 2014 and 2012, respectively, while Holland became a secondary hinterland and Panama became a marginal hinterland. While in 2019 the countries Malta, Angola and Mexico, which in 2010 were not trade partners, became in 2017, 2012 and 2013, respectively.

It can also be noted a fall between the years 2014 to 2016 (43.22%), reaching the worst year of cargo transportation in the last ten years. The main item was wood transportation (74.5%), which recovered in 2019; meats remained even in the drop in transport, increasing in 2019 by 69.6%. However, after the event, there was a rise for three years, reaching its peak in 2019 and reaching the highest amount transported in the last ten years (138.6%).

Seaport Rio de Janeiro

Located in the state of Rio de Janeiro, in 2019 it accounted for 5.8% of all container movement in the country and in previous years it has always remained among the main ports. There was an increase of 9.74% in shipments, despite the decrease in four commercial partners between the years studied. It is worth mentioning the exchange of four primary partners: Hong Kong, China, Singapore and the Dominican Republic. Of these, only the last mentioned became secondary, and the others became marginal and the new partners entered: Italy, Morocco, Panama and Chile, the first two coming from secondary hinterlands and the last two from marginal hinterlands.

The seaport of Rio de Janeiro grew for two years, in the years 2010 and 2012, after which three consecutive falls occurred, which represented 31%, when comparing the years 2012 to 2015. Subsequently, there were four consecutive increases, which demonstrated a gain of 26.5% in cargo transportation. In 2012, the main cargo was miscellaneous cargo, with a reduction of 71.9%, not being included among the main products of the subsequent cargo. Based on data obtained by ANTAQ (2020), there is a diversification in cargo transportation over the years.

The Fig. 2 below shows the analysis of landings from the selected ports, first illustrating the hinterlands of the port of Santos for the year 2010, to rank its commercial partners. In 2019, this port accounted for 48.3% of all container landings in the country and in previous years it has always remained the main port.

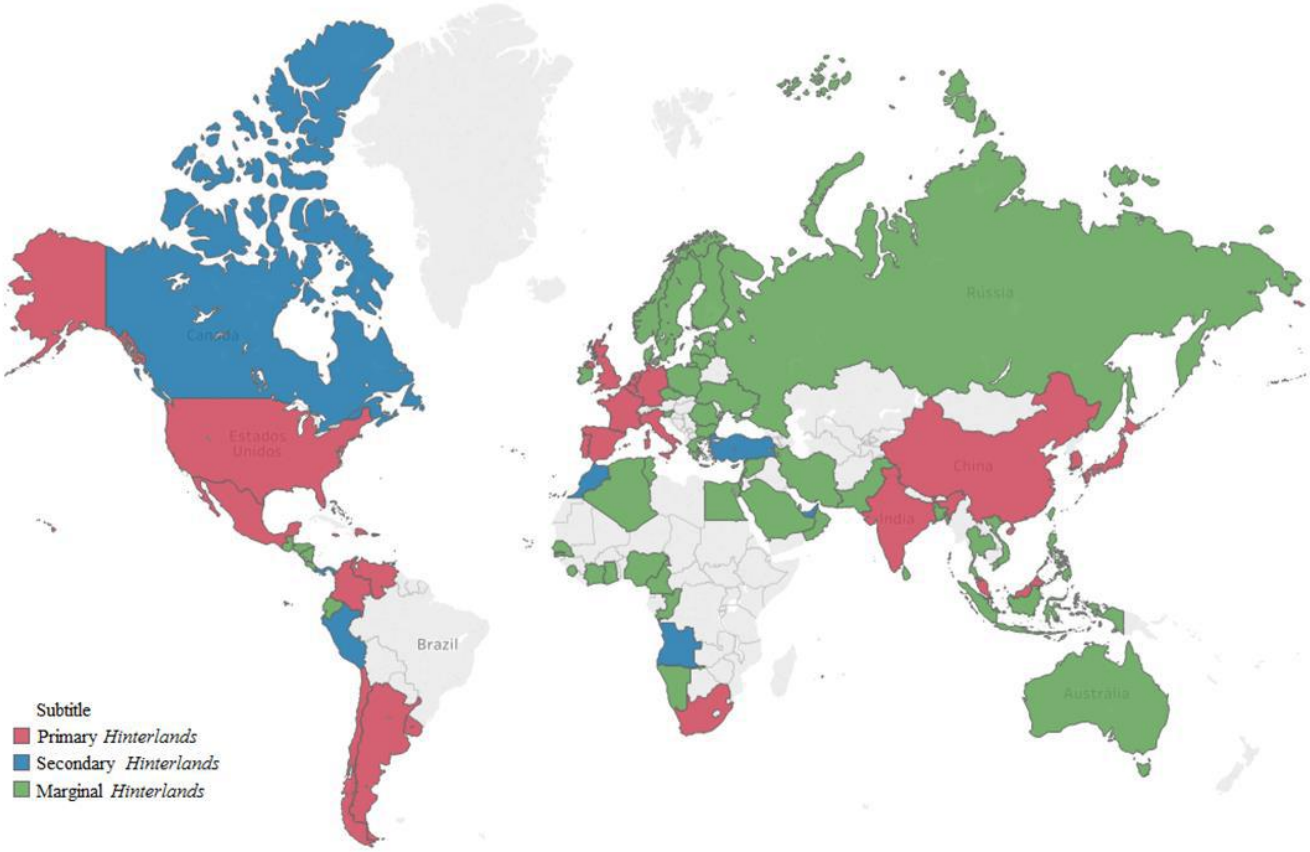

Fig. 4: Landing of containerized cargo in 2010. Source: ANTAQ (2020).

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The composition of the hinterlands of the year 2010, as established by Degrassi (2001) were: primary hinterland: United States, China, Belgium, Germany, Singapore, Spain, Hong Kong, Italy, Mexico, South Korea, Malaysia, Argentina, Netherlands , Colombia, Dominican Republic, Jamaica, South Africa, United Kingdom and Ireland, France, Chile, India, Venezuela, Uruguay, Portugal and Japan; secondary hinterland: Panama, Morocco, Angola, Cape Verde, Turkey, Bermuda, Mauritius, Peru, United Arab Emirates, Canada, Malta and Trinidad and Tobago; and marginal hinterland: Finland, Taiwan, Russia, Sweden, Ecuador, Iran, Senegal, Bahamas, Indonesia, Ukraine, Israel, Congo, Poland, Saudi Arabia, Thailand, Ivory Coast, Norway, Oman, Egypt, Guatemala, Algeria, Romania , Saint Lucia, Estonia, Pakistan, Greece, Qatar, Nicaragua, Latvia, Ireland, Ghana, Denmark, Honduras, Gambia, Vietnam, Puerto Rico, Sierra Leone, Bangladesh, Bulgaria, Cameroon, Nigeria, Syria, Tunisia, Lithuania, Costa Rica, Sri Lanka, Slovenia, Australia, Philippines, Lebanon, Namibia, Cyprus and the Czech Republic.

Based on the ANTAQ (2020) document, time data were compared and there was an increase of 33.3% in the number of commercial partners in the port of Santos. However, the increase in cargo landed did not match the proportion of the increase in the number of commercial partners (2.59%). It is also important to comment that there was an increase in the number of primary hinterlands, which increased from twenty five to thirty five countries. Among them, only Jamaica, the Dominican Republic and Venezuela are no longer part of the primary hinterland, with the Dominican Republic becoming a secondary hinterland, while the other two countries are now classified as marginal hinterlands.

Regarding the countries that entered the primary hinterland, the three that came from the secondary hinterland were Morocco, Turkey and Peru, while the countries that came from the marginal hinterland were Finland, Taiwan, Russia, Sweden, Indonesia, Israel, Saudi Arabia, Thailand, Norway and Vietnam.

Between the years 2010 and 2019, regarding the volume of disembarkation from the Port of Santos, it was observed that in 2012 there was a decrease in relation to the previous year. This fall was 10.68%, showing a recovery in 2013, however there have been drops in landing in the following three, coming to decrease by 26.6%, when comparing the years 2013 to 2016, with recovery of falls in the years 2017 to 2019, in the order of 25.8% (Fig. 5).

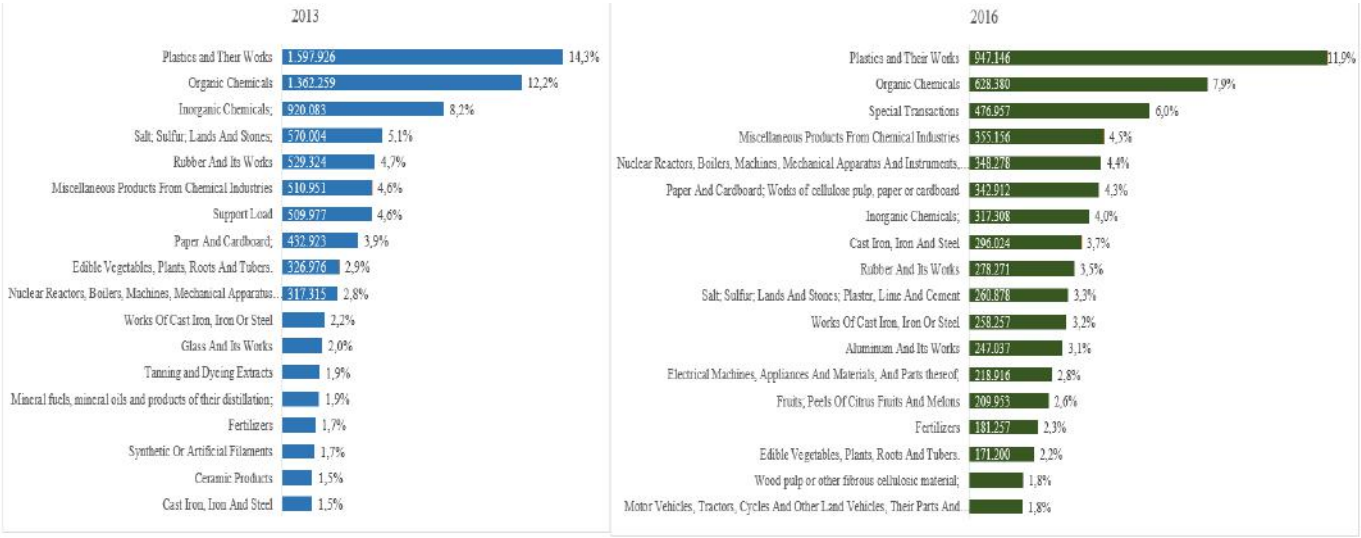

Fig. 5: Landed products. Source: ANTAQ (2020).

There is a drop in the almost unloading of practically all products, with the only product showing growth Special Transactions, which in 2013 represented 0.03% and in 2016 started to represent 6% of the entire volume of cargo landed. With regard to products that suffered falls, it is noteworthy that for plastic with 40.72%, organic chemicals with 53.87% and inorganic chemicals with 65.51%. This behavior can be seen from the movement history of the other ports (Fig. 6).

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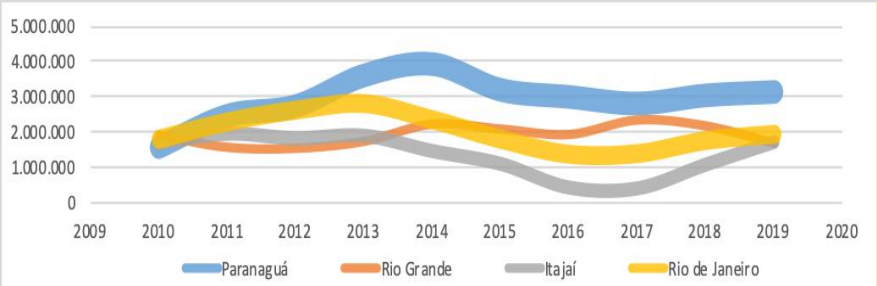

Fig. 6: Landing history of the chosen ports. Source: ANTAQ (2020).

Seaport Paranaguá

Paranaguá seaport in 2019 corresponded to 12.5% of the containers landed in the country, and in previous years it was always among the three main ports. When comparing the years 2010 and 2019, it can be reported that there was a decrease in the number of partners, which were 70 (seventy) and became 35 (thirty-five), which is equivalent to a loss of 50% in number of partners. However, there was an increase of 101.2% in the quantity of tons landed, showing productivity. There is also a considerable increase in transport to countries that were already part of the primary hinterlands (82.7%), in addition to the insertion of eight countries as primary ones, with emphasis on Italy that became a new partner, and the occurrence of a change in hinterlands from seven other countries. Of these Colombia, Singapore, Morocco and Malta were marginal hinterlands and Germany, Hong Kong and France were secondary hinterlands.

Still based on Fig. 6, there is a drop of 28.7% in container transport between the years 2014 and 2017, ending an increase of four consecutive years. According to ANTAQ (2020), it was found that a large part of the economic sectors had drops in transport in 2015 compared to 2014, in the order of 18.78% in the volume of shipment.

Comparatively, in the years 2010 and 2014, the port of Paranaguá grew approximately 152.5%. Subsequently, there was a continuous fall, and only in 2017, after three consecutive falls, there was a slight increase of 3.26%, represented by products such as meat, wood and paper that had not fallen between 2014 and 2015.

Seaport Rio Grande

This seaport in 2019 corresponded to 6.8% of all container movement in the country, a position maintained comparing the previous years and the five main brazilian ports. There was an increase in the number of seven trading partners, however, there was a decrease of 11.38% in the quantity of tons shipped. It can also be observed that there was a decrease in the number of primary trading partners, decreasing from ten to seven, of which, Germany became a secondary hinterland, while Hong Kong and Jamaica became marginal hinterlands.

Another consequence of this decrease in the number of commercial partners was a fall in imports within the primary hinterland (26.57%). It can be seen, based on Fig. 6, that the port has a characteristic of oscillation over the years, however it is worth noting the fall from 2017 to 2019 (27.37%). It can be concluded that, even with the growth of cargo shipped from plastics (14.63%), the other products transported presented significant falls, with emphasis on chemical products (81.01%) and cereal transportation (40.24 %).

Seaport Itajaí

This seaport in 2019 corresponded to 7% of all container movements in the country, a position maintained in relation to previous years among the main brazilian ports. It is possible to state, according to ANTAQ (2020), that there was a reduction of 58.44% in the number of partners, however, there was an increase of 2.65% in the amount of cargo transported. Another important factor was the increase in the number of primary hinterlands, with four in 2010 and ten in 2019. Only China and South Korea remained primary hinterlands.

Based on Fig. 6, it can be seen that the port of Itajaí suffered a reduction in the volume of transport for four consecutive years (2013 to 2017), reaching a decrease of up to 79.1% in the volume transported, and recovering in the years of 2018 and 2019, with a recovery of 334.5%.

When analyzing the last two years, based on ANTAQ (2020), there is a decrease in most of the products transported, with emphasis on plastic, which had been showing leadership in 2013 and suffered a decrease of 78.6% with respect to the year 2017, pulled by cast iron with a fall of 86.96%, contrasted with fish and crustaceans with an increase of 12.9%.

Seaport Rio de Janeiro

In 2019 it corresponded to 7.8% of all container movements in the country, a position maintained in relation

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to previous years among the main brazilian seaports. Even with a 7.7% increase in the volume of cargo transportation, there was a 13.6% decrease in the number of commercial partners (2019).

The increase in primary partners stands out, rising from six to eleven. As a consequence, there was an increase in landings made from these countries (33.16%). Comparing the period from 2010 to 2019, five new countries that were secondary hinterlands were registered: Argentina, Spain and France, and countries that were of marginal hinterlands: Chile and Singapore.

In 2010, 11.77% of the cargo landed had no record of the countries of origin, and in 2019 all had the record. Fig. 6 shows that growth in the years 2010 to 2013 of 54.1%, followed by three years of decrease, resulting in a drop of 49.8% in the volume of cargo unloading, until 2016. From 2016 there was a growth of 39.2%, remaining below the main peak of the last ten years.

Similar to the volume shipped, the main landing product was general cargo. This product in the years 2013 to 2016 decreased by 75.1%, and in 2019, there are no data among the main products of the port of Rio de Janeiro. Increases are noted in landings of plastics, other products and miscellaneous cargo, in the years 2016 to 2019.

Construction of Origin-Destination Matrices (Fourth Phase - Stage 2)

Therefore, based on the data for mapping the hinterlands of the chosen ports, considering the mapping and structuring of the origins and destinations of cargo (fourth phase), a correlation of data was made when analyzing the countries with which the ports related. For this, the electronic spreadsheet and the georeferenced database were used, made available by the Tableau software, with the aid of a tool available in the Gallery Alteryx.

From the elaboration of this database, matrices of origin and destination were designed to support the creation of thematic maps "Destinations" (Fig. 7) and "Origins" (Fig. 8). From these elaborations, the five ports, their cargo and countries joined, to identify the concentration of cargo flows from primary hinterlands (fifth phase - Stage 3).

Thus, in addition to the current commercial partners, the main brazilian ports studied have the capacity to prospect opportunities, as well as to propose commercial relations with countries that present possibilities to operate transactions, thus increasing their market share. For example, to provide better conditions with commercial partners for the consolidation of cargo flows, depending on the type of logistics (inbound or outbound). All of this should be done based on strategic planning with integration of information between the origins and destinations of the cargo.

Rodrigue (2020) reports that regionalization is a process that can take place both in the vicinity and around the hinterlands of a port. Thus, it was found that this statement may have practical application for the chosen ports, which, based on the knowledge of higher cargo movements, such as China, can offer conditions for planning operational continuity between intermodals and maritime transport systems and terrestrial.

The relationship between ports, their trade flows and trade policies is increasingly complex, given that trade flows change, not only through their own reforms, but also through the reforms of their trading partners (Rodrigue & Notteboom, 2010). It is noted, when comparing the results of the research carried out based on the years 2010 to 2019 that the ports, allowed to obtain information that presents possibilities of commercial expansion. Many secondary hinterland countries have the ability to switch from secondary and marginal hinterlands to be part of the primary hinterland group.

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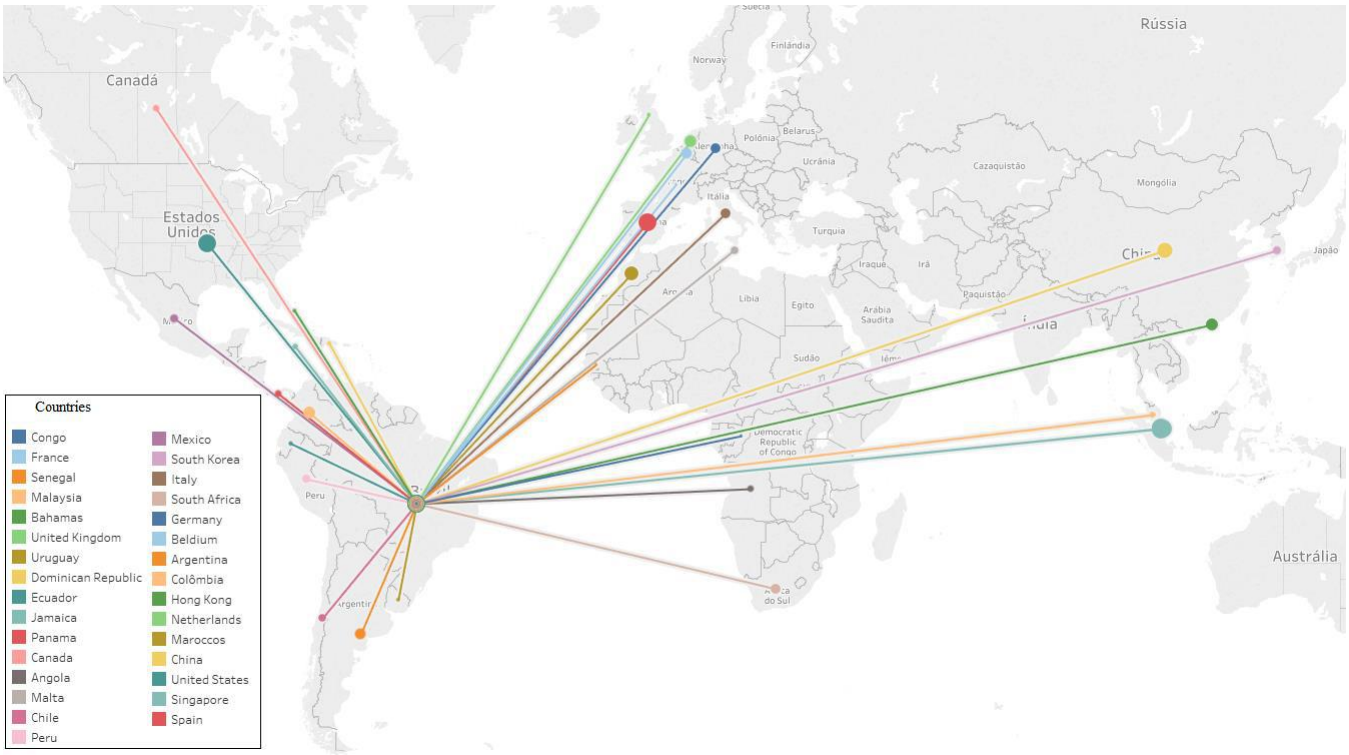

Fig. 7: Destination Map of Containerized Cargo. Source: Authors (2020).

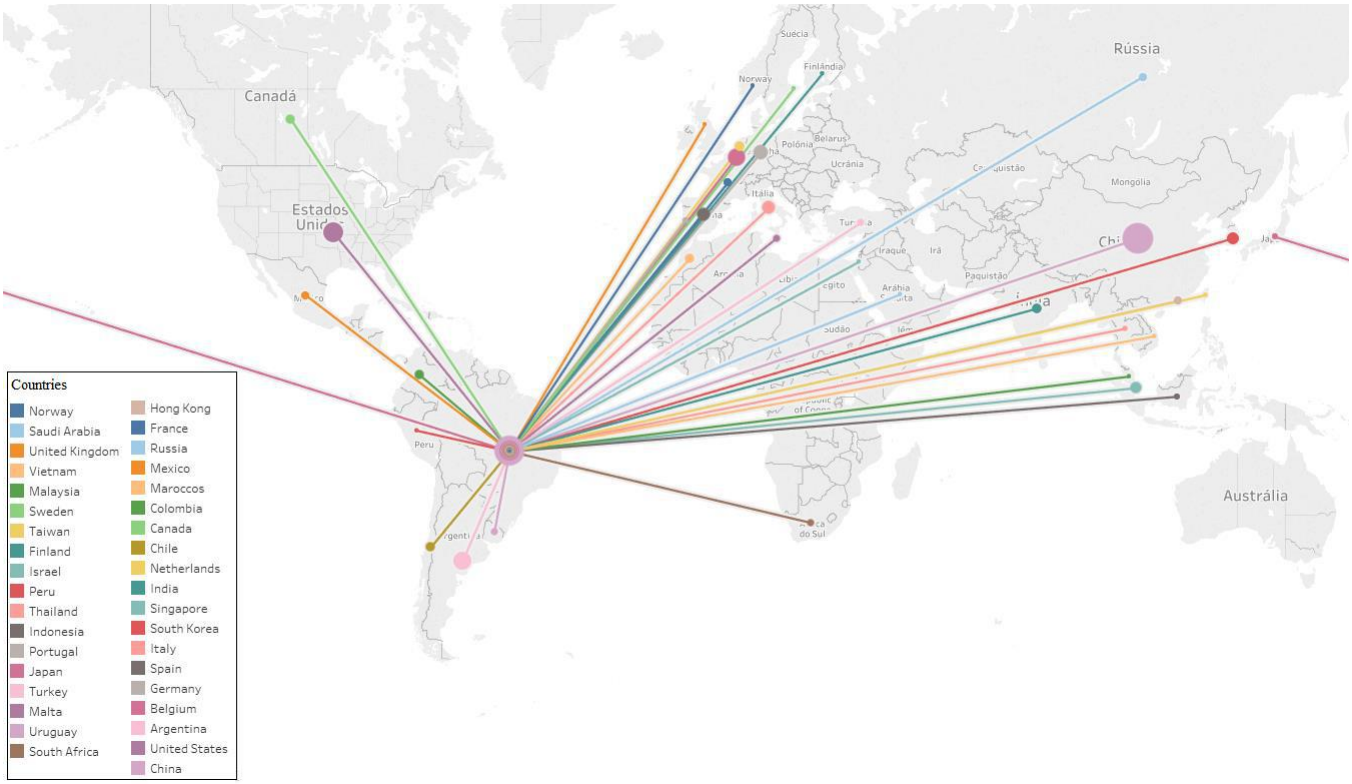

Fig. 8: Map of Origin of containerized cargo. Source: Authors (2020).

Thus, from the methodology proposed in this work, port administration, government agencies and the private sector, among other actors, can simulate market scenarios, as well as, throughout the supply chain and in the value

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chain, global value chain to interconnect market-leading companies, with small, medium and large businesses and suppliers in different local contexts, in order to plan and evaluate the implementation of possible improvements in the logistics infrastructure of the main brazilian ports, which may result in an increase in the volume of movement containerized cargo.

V. FINAL CONSIDERATIONS

Brazilian container seaport terminals have been experimenting in recent years with a new concept of performance in handling the unit volume of transported cargo, including shipments and landings. Consequently, there is a demand for planning, strategies and actions on the part of government officials, port authorities, intervening and consenting bodies and, other stakeholders. Within this context, this work, after diagnosing, mapping and delimiting brazilian containerized cargo movements, in five brazilian ports, found the existence of several hinterlands, which lead to the elaboration of foreign trade agreements and strategies, at national and / or regional level to encourage port cooperation, or even the formation of clusters.

The delimitation by categorization of the hinterlands allowed the visualization of commercial and potential partners, as well as countries that have become a reference in cargo handling, thus indicating markets and possibilities for action or expansion.

By analyzing the research units (port of Santos, Paranaguá, Rio Grande, Itajaí and Rio de Janeiro) that showed high efficiency and availability of data in the analyzed period, it was possible to carry out the analysis in relation to current and potential commercial partners, and so, underline decision-making processes. With this, it is possible to verify which factors and sub-factors that support to influence the choice of a port. Thus, for a port to be competitive within the logistics corridors, it must first be able to identify and know its hinterlands, and from there, increase its own level of connectivity for specific logistics networks (shipping companies, logistics service providers and end customers), and potential users.

In the studied regions, the main users of the ports showed a regularity in terms of cargo handling, in the analyzed period, leading to the conclusion that their commercial partners are being served efficiently. On the other hand, issues of inefficiencies, expected performance or under expected infrastructure and the quality of transport services along with cultural and behavioral reasons can be some limitations of the work.

The cargo handling market requires constant review of plans, in addition to intense monitoring of port market share. And, based on an efficient management of these issues, the level of specialization in the port tends to increase.

The findings verified from the results show movement relationships (ports and hinterlands) between brazilian origins and global destinations, and also in the opposite direction. These connections allow important reflections on commercial relations, shipping lines, supply chains, among other elements, dimensions and variables that influence the daily handling of inland and foreland containers.

From the methodological approach of this work, maritime stakeholders have one more tool to understand the brazilian handling of containerized cargo and, with this, expanded conditions and parameters to carry out reflections, projections, plans and actions in dry ports, and can even carry out integrated activities, between ports that are interconnected. Thus, if a port or terminal has congestion, and can rely on tools such as the approach of this work, it becomes possible to plan and manage cooperation with a dry port located nearby.

The results still provide the visualization of scenarios, as well as the possibility of simulations, from that, and countermeasures can be carried out, avoiding waste and optimizing efforts and resources.

In this study, the issue of cargo migration between ports and terminals was not considered. Thus, as a continuity, it is suggested the use of tools and / or techniques that contribute to the understanding or indication of ways to balance the benefits of each port / terminal involved in handling containerized cargo. For example, the use of multivariate data analysis to understand occurrences of interrelationships between dimensions and variables that act in one or in the hinterlands.

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