OUTLINING MARITIME CABOTAGE PUBLIC POLICIES FOR THE BRAZILIAN TRANSPORT SYSTEM

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ABSTRACT: Cabotage in Brazil has not been sufficiently addressed, despite the fact that its national importance requires that it be thoroughly understood. The purpose of this research revolves around analyzing and discussing the strategic role and usefulness of cabotage in order to base the development of public policies within the scope of the Brazilian transport matrix. The study is both exploratory and descriptive. Its aim is to inductively retrieve empirical data patterns from unstructured interviews guided by a general initial script; primary data collection was grounded on the problematic contextualisation set from relevant secondary data treated with content analysis software. The ex-post literature review played a central role in the discussion of the emerging patterns of behaviour that supported the development of preliminary correlations between the proposed recommendations and the identified obstacles. The three main types of obstacles that were found could be divided and linked to recommendations to facilitate the development of cabotage based on the research findings. The resulting policy proposals are classified, as follows: i) Looking holistically at cabotage and, as a strategic domain for both development and sovereignty; ii) Monitoring the fuel price as a core cost; iii) Eliminating and simplifying useless bureaucracy; iv) Establishing a fruitful relationship with shipbuilding; v) Regulating taxation; vi) Reviewing the state’s funding requirements and, vii) Improving Port Infra- and Superstructures. Finally, it is argued that credible public policies have emerged by following a scientific method to process and organise data.

Keywords: Shipping; maritime cabotage; Brazil; policy; logistics.

1 INTRODUCTION

The motivation for this current research are the challenges that developing cabotage in Brazil might encounter, despite the fact that leading world organisations such as the US Department of Transportation and the European Commission have actively supported maritime cabotage as an alternative, environmentally friendly mode of transportation. Although studies in the European Union and North America offer valuable insights into the obstacles to cabotage, seldom are the «policy issues… analysed from a broad perspective; [they] sometimes focus on a particular aspect such as labour and flagging out, and… the identified policy instruments target
the shipping industry as a whole and not specifically the cabotage market» (Casaca and Lyridis, 2018, p. 213).

So, they do not explicitly support the development of effective policies. Moreover, the contexts of these studies are quite different from those of many developing countries that have observed stronger economic growth (Raza et al., 2020).

This exposes a relevant gap in the literature as previous research does not sufficiently analyse the obstacles to cabotage development, especially in the context of developing countries (Venkatesh et al., 2017) i.e. African, Asian and Latin American countries; nor does it satisfactorily update existing information on the subject (Casaca and Lyridis, 2018), despite increasing interest in the topic (e.g. Soares, 2019; Brasil, 2019) and latterly, efforts to improve understanding (e.g. ANTAQ, 2021).

Furthermore, some economic and political changes might need to be performed at industrial and governmental levels (Casaca et al., 2017b) to improve regional economy competitiveness and economic growth (Sánchez and Wilmsmeier, 2005). To address these issues, studies have been arguing for a more integrated planning of transport infrastructure services that adopt modal shift strategies, real-time information systems, shorter transit times and freight offered on a door-to-door basis (Bendall and Brooks, 2011; Casaca et al., 2017a).

Brazil has the tenth largest maritime area in the world, extending to 3.5 million square kilometres (Castro et al., 2017). The Brazilian sea and coastal areas offer enormous potential for economic development. Approximately 91% of the oil and 73% of the national natural gas are extracted from under the sea, and 95% of foreign trade circulates on the sea, which is also a source of other activities such as fishing and tourism. Furthermore, in Brazil, 80% of the population is located within a range of two hundred kilometres from the coast, which highlights the potential for cabotage navigation in the country (Fonseca, 2015).

So, a new and even more promising Brazilian economic frontier may be in its maritime territory if it incorporates and executes the concept of the so-called "Blue Economy" (EC, 2018) more broadly. The success of the Blue Economy relies on a vision of the sea and coast as a large area of economic growth that gives rise to job creation and investment through the intelligent,
efficient and sustainable use of a broad spectrum of marine resources in various sectors. However, despite some progress of late, many activities related to the sea economy in Brazil are underused, with one such being cabotage navigation. Moreover, Brazilian cabotage presents numerous weaknesses, the resolution for which requires heavy investment and considerable regulatory changes in the medium-long-term (Casaca et al., 2017b).

Nevertheless, given the historical context, the use of cabotage navigation for cargo purposes in Brazil would appear to be relevant. However, cabotage navigation has been overlooked due to several factors, such as the imbalance in the transport matrix that is still very much focused on roads (Catela and Seabra, 2017).

In general, the excessive use of road transport over long distances has led to higher freight costs, lower productivity in freight (Konstantinus et al., 2019), energy inefficiency, a high accident rate and, cargo thefts (ILOS, 2019). Therefore, to encourage its further development in Brazil and because the Brazilian imbalance between the various transport modes deserves careful attention, cabotage might require a specific set of actions and policies.

Besides the aforementioned problems, the imbalance may lead to other risks. For example, the problematic truckers’ strike, which took place in May 2018, made clear the consequences of relying too heavily on just one mode of cargo transportation for a country like Brazil. Cabotage would also appear to provide significant potential for Brazil’s development and for the maintenance of its sovereignty, in addition to such aspects as national logistics and the economy (ILOS, 2019).

The above-mentioned challenges to the Brazilian transport system were addressed by three main research questions (RQ), as follows:

RQ1 - What are the advantages that the promotion of cabotage can bring to a country like Brazil? This is to know whether cabotage and its development would be beneficial in the Brazilian context.

RQ2 - What are the main obstacles that prevent the growth of cabotage navigation in Brazil? If cabotage is economically, environmentally and socially attractive, its constraints should be
identified and addressed.

RQ3 - What actions can bring further development to cabotage navigation in Brazil? One might expect that a systematic, empirically supported relevant set of recommendations could emerge by cross-checking the literature to outline future public policy regarding cabotage.

In summary, the purpose of this research revolves around analyzing and discussing the strategic role and usefulness of cabotage within the scope of the Brazilian transport matrix. The paper also coherently consolidates the available information that is currently scattered among many public documents. Secondary data provided both by credible national Brazilian institutions and Brazilian researchers helped to set the scene (section 2) to position, ground and conduct the primary data collection from interviews with highly respected experts in top job positions. The outcomes concern the grounded recommendations for cabotage development that have emerged based on the ex-post discussion (section 4) of the results coming from a formal content analysis of the interview data (section 3).

In accordance with the recommendations of Mir et al., (2018), content analysis measures variables in their natural state without any manipulation. Moreover, following research trends that address the modal shift, as recommended by Raza et al. (2020), mixed methods i.e. both qualitative and quantitative will be used. As stated in the conclusions (section 5), these recommendations should be consolidated and further developed into propositions to promote a supported public policy for cabotage in Brazil. This paper lays the ground for building theory concerning a topic recognized as significant to both researchers and policymakers.

2 CABOTAGE CONTEXT IN BRAZIL

2.1 Definitions, regulations and cabotage activity

The chosen definition of maritime cabotage concerns the Brazilian national scope despite there are different understandings. Thus, cabotage corresponds to the type of navigation carried out between ports or points of the national territory, using the sea or inland waterways, as defined in Law Nº. 9.432, January 8, 1997. Moreover, Law Nº. 10.233 of June 5, 2001 establishes that
only a vessel built in Brazil, flying the Brazilian flag, can operate in the country. Some exceptions to this rule are set out in Law Nº. 9.432 of January 8, 1997.

The cargo transported by cabotage steadily increased from 2010 to 2021, which provides evidence of the current higher importance of cabotage, i.e. 207 million tonnes of transported cargo in 2021. An increase in the slope during the period 2019-21 should also be noted. Oil and its derivatives are by far the most transported products in cabotage, i.e. 161 million ton in 2021. On average, for the depicted period, oil and derivatives represent around 77.24% of the total transported cabotage cargo (Figure 1). In 2021, cabotage represented 17.1% of the total movement of cargo at Brazilian ports, i.e. of 1,210 million ton (ANTAQ, 2021).

Despite its potential, cabotage shipping in Brazil is still far too restricted to the movement of a few products, especially the transportation of oil between offshore platforms and the continent.

Figure 1: Cargo transported by cabotage

In July 2017, the Brazilian cabotage fleet consisted of 197 vessels, classified into 15 types. These include 139 vessels of interest for this research, with a total carrying capacity of 2.61 million tonnes, or 99.5% of the total carrying capacity of the cabotage fleet (ANTAQ, 2017).

On the other hand, Cargo transported by cabotage increased by 61.7% between 2010 and 2021, while cargo handled by ports rose only 44.1%. In the same period, the ratio of transported cabotage cargo handled by ports increased from 15.2% to 17.1%, i.e. by almost 2%. Currently, there are 194 ports in Brazil, which handled a total amount of 1210486993 tonnes of cargo in 2021. Of these, 162 are private, handling 66.22% of the cargo, i.e. 801611887 tonnes, and 32 are public, handling 33.78% of the cargo, i.e. 408875106 tonnes. Moreover, the biggest 39 ports representing 20% of the total number of ports handle 1058084766 tonnes, which corresponds to 87.41% of the total cargo. The following 58 ports, i.e. 30% of the total number of ports handle 136 838 419 tonnes, which corresponds to 11.30% of the total cargo. The remaining 97 ports, i.e. 50% of the total number of ports handle just 15563808 tonnes, which corresponds to 1.29% of the total amount of cargo handled by Brazilian ports (ANTAQ, 2021).

2.2 Advantages, relevance, and state of the art

Compared to other carriage modes, cabotage is more advantageous for moving large quantities over long distances, due to its higher loading capacity and the lower operating cost per unit of cargo (Konstantinus et al., 2019). In general, other advantages of cabotage transport that might apply to Brazil are, as follows: i) longer service life of the infrastructure, equipment and vehicles; ii) lower fuel consumption per tonne-kilometre; iii) reduction in the rate of accidents and breakdowns; and, iv) less environmental impact (Perakis and Denisis, 2008).

The vast majority of Brazilian cabotage research addresses the low use of waterways in the transportation matrix, which contradicts the geographical distribution of natural resources in Brazil and the distribution of the population and economic activities (Coelho e Morales, 2012; Leal Júnior, 2010; Pacheco et al., 2008). Some authors provide diagnoses, highlighting the obstacles and challenges to the sector (e.g. Campos Neto and Santos, 2005; Lanchmann and Castro Junior, 2009; Botter et al., 2012;), which are consolidated further in the results discussion.
of this study. Other works have discussed cabotage policy and shipbuilding, or evaluated existing regulations compared to other countries (e.g. Nascimento, 2012; Pires Junior and Souza, 2012; Casaca and Lyridis, 2020). Lacerda (2004) and Pinto et al. (2007) discussed the relationship between cabotage and both the industrial policy and shipping industry given the growing demand for container traffic. Other research has been conducted on case studies (Silva, 2004; Souza et al., 2007; Ervilha et al., 2008; Fachinello and Nascimento, 2008; Oliveira, 2010) dealing with industrial cabotage, in search of possible alternative cabotage services to meet the specific demands of many different supply chains.

Recently, the literature on cabotage has advanced to discussing multimodality, in which Brazilian cabotage, due to its nature and current legal situation, could play a prominent role in reducing transportation costs and enabling specific flows of goods. Robles and Carvalho (2012) assumed that shipowners providing cabotage services had made changes to their service portfolio by adopting door-to-door rather than port-to-port transportation services to expand their deliveries and business opportunities. They confirmed the existence of fierce competition between cargo carriers and cabotage operators serving the port of Santos. Valois et al. (2011) discussed the feasibility of Motorways of the Sea (MoS) along the Brazilian coast where different combinations, road/sea, rail/sea, and road/rail/sea are possible. However, the imbalance of the transport matrix has prevented this concept from being applied in Brazil.

Although limited in number, it is also essential to mention quantitative cabotage studies. Ono (2001) developed a two-part methodology to generate all possible trade routes to minimize the overall costs of cabotage services and to support the decision-making process. Using a linear programming model based on gross contribution margin, Chebat (2006) studied the consequences of national and international combined cargo transportation and emphasised the vital role that cabotage plays in the distribution of goods by sea. Novaes et al. (2006) used the preference technique stated to evaluate transport users’ views before using another mode of transport and confirmed that variables such as rate and reliability were determinant in the choice of transportation mode.
2.3 Cabotage potential: volumes and growth opportunities

The following brief review shows not only the importance of Brazilian cabotage but also its vast potential for growth, fully justifying its relevance to the transport system. An ILOS (2019) report identified a volume of more than 44 million tonnes of truckloads that could be moved to cabotage. This potential volume is almost ten times the amount of national cargo currently handled by vessels (except feeder cargo). Thus, it is estimated that 50% of the potential cargo could be transported by shipping companies (ILOS, 2019), i.e., for every national container carried in cabotage (without feeder), there are 4.8 potential containers on the highways. This would increase the percentage of national cabotage representation from 11 to 15%.

Finally, cabotage is still currently predominant in the transport of crude oil between offshore platforms and the continent as ANTAQ (2017) had stressed. The latter point also shows the great potential that cabotage has to expand in the transport of containers, general cargo and solid bulk (vide Figure 1), which would make the Brazilian cargo transport system more efficient, safe and balanced, especially from both an environmental and economic point of view. In fact, a potential change in the Brazilian transport matrix is expected to generate higher productivity for the economy, higher, broader and more reliable transport capacity, besides generating social and environmental benefits (Perakis and Denisis, 2008; Casaca et al., 2017b).

3 METHODOLOGY

While, the purpose of this research is exploratory because the nature of the theme cabotage is not very commonly addressed, it also deserves investigation due to its importance and potential. Furthermore, it is descriptive because it also provides a detailed description of the Brazilian state of the art related to cabotage that is supported by credible national sources. Above all, the aim is to shed light on any patterns in the empirical data from the comments of important interviewees in the Brazilian cabotage context; the co-occurrences that were found support the development and preliminary discussion of the relationships between recommendations to improve cabotage and the obstacles to it in Brazil. This step, which follows a scientific method to process and organise the data collected, is essential to advance credible public policies based on
the data obtained from the unstructured interviews of experts.

A qualitative inductive research approach was taken, primarily based on conducting unstructured interviews guided by a general script of ideas coming from the contextualization of the problem (section 2). Semi-structured or structured interviews were excluded because they are not a good fit with the exploratory requirements of the inductive approach. Moreover, the ex-post review of the literature had a core role in the discussion of the emergent patterns of behaviour inductively found from the unstructured interviews. The approach taken follows the recommendation of Raza et al. (2020) that researchers should use rich, real-world, and numerical data to identify the relative importance of individual drivers and barriers for a modal shift from road haulage to short sea shipping.

For this initial exploratory study, seven respondents were selected. Each, as far as cabotage is concerned, is a top reference, is positioned at the highest national level and is well known among the Brazilian maritime community. They represent the following entities: the Brazilian waterway transport regulatory agency (interview on 2nd May 2019, 1h, Rio de Janeiro); the Brazilian maritime community (interview on 17th April 2019, 1h, Rio de Janeiro); the Captains of the Brazilian merchant navy (interview on 19th April 2019, 1h, Rio de Janeiro); the Brazilian maritime authority (interview on 1st June 2019, 1h, Rio de Janeiro); the Brazilian shipping companies with foreign capital (interview on 1st February 2019, 3 pm, 1h, São Paulo); the Brazilian Academy (interview on 25th January 2019, 1h, Rio de Janeiro); and the Brazilian shipping companies with national capital (interview on 14th March 2019, 1h, Rio de Janeiro). For reasons of confidentiality, the experts cannot be named.

These face-to-face interviews were expected to contribute to the comprehensive identification of factors influencing the use of cabotage. Even though the number of interviewees appears to be relatively small, other studies may be found with an even smaller number of interviewees (e.g., Tseng and Pilcher, 2019; Yang et al., 2014). The objective is to uncover in-depth customised insights into the subject, which will have more variables of interest than data points (Yin, 1994). Moreover, one of the authors does have extensive experience as a ship’s captain with 4,000 sea days sailing to 15 countries over a 20-year shipboard career.
The data obtained were transcribed into digital format and then analysed in an exploratory, descriptive and inferential way with the R 3.5 / IRAMUTEQ software, using techniques like Word Cloud, Similarity Analysis, Descending Hierarchical Classification (DHC) and Correspondence Factor Analysis (CFA). The interviews were carried out in Portuguese, recorded, transcribed to text and the contents analysed in that language. However, a translation of the main words will be provided in Figure 3.

**4 ANALYSES OF RESULTS**

IRAMUTEQ treats every interview as “a text” (*.txt file) to be included in the “text corpus”, which will be analysed statistically in its original language. The meanings and assumptions concerning some of the techniques used in the analysis will be explained in each relevant section of this article. The first step of the data treatment and analysis concerns text segmentation and identification of single words that appear just once in the whole corpus. Then, text segments are regrouped, and classes will be formed. Interpretation of these classes and their relationships follows.

In summary, an analysis of the textual content was performed to discover all the general and applicable themes, as well as the narratives present during the interviews, using the IRAMUTEQ techniques that are described in the following sections. The IRAMUTEQ 0.7 alpha 2 (Camargo and Justo, 2013, 2016), supported by software R 3.5.2 version performed the analyses.

**4.1 Word Cloud**

The *Lemmatized Word Cloud* is a technique that shows a set of words arranged in a cloud form produced by a stemmer. The words are presented in different sizes. The bigger sized words are those that have more importance in the textual corpus. The focus and heterogeneity of the interview can be verified by a *Lemmatized Word Cloud* where an analysis of the individual frequency of each word, and its derivatives, is associated with the word cloud grouped by its lemmas. Moreover, the word cloud identifies the frequency of each word in the textual set and
organizes the words from the full corpus scan graphically (vide Figure 2).

Figure 2: Lemmatized word cloud (analysis carried out in Portuguese)

In this way, a visual analysis enables a quick identification of the keywords in the corpus text of the interviews. It is noteworthy that the word cabotage ("cabotagem") is positioned at the centre of the diagram and shows up larger than the others because it was the word most used. This is representative of convergence and of a relevant focus on the research topic (vide Figure 2).
4.2 Similarity Analysis

The Similarity Analysis enables the operationalisation of the cluster analysis, which is a taxonomy that classifies the words of the text corpus into groups of homogeneous items, i.e. classes. In addition, the level of similarity establishes a hierarchy of the classes based on a matrix of distances among the words. The related interpretation depends on the distance measure that is adopted, as well as on the chosen aggregation strategy. One possible aggregation strategy is maximum distance, whereby a figure that is representative of the maximum distance is allocated to each pair \((p=\text{word}_i), (q=\text{the furthest word related to word}_i)\) (Oliveira and Amâncio, 2005).

A Similarity Analysis, therefore, makes it possible to visualize and infer the text structure and the central themes based on Euclidean distance (Equation 1). Furthermore, the derived distance matrix allows us to identify the most distant neighbours \(q_i\) of each word \(p_i\) by the Complete Linkage Technique (Rieck et al. 2011), showing the connections between words.

\[
D(p,q) = \sqrt{(q_1 - p_1)^2 + (q_2 - p_2)^2 + \cdots + (q_n - p_n)^2}
\]  
(Equation 1)

In addition, the similarity analysis performed identifies co-occurrences between words. So, the results show the connection between words, which helps to identify the structure of the content of the corpus text of the interviews. The commonalities and specificities are inferred from significant values.

The software produced a Full Tree of Similarity. As expected, the word cabotage ("cabotagem") is at its centre and pushes words that have distanced themselves from the narratives during the interviews, such as January ("Janeiro"), opinion ("opinião") or airplane ("avião") to the periphery, which confirms the focus of the study. Portuguese words such as isn’t it ("nê") and so ("então") are located away from the central axis, since they perform a merely complementary role in the syntax construction with a meaning irrelevant to this study.

Finally, in order to verify the similarity of the main words, a few conditions for the analysis were specified. Thus, a filter was applied using the Chi-square value to set the word frequency of occurrence; so, only those words with a frequency of occurrence equal to or greater
than 10 were considered. In brief, this model calculates the distances between words from the corpus dataset to a significance level of 0.05.

Finally, a Descending Hierarchical Classification (DHC) should be performed since the analysis of the contents of the interview was coherent, robust and satisfied the necessary condition of minimum frequency. DHC is one of the most critical analyses in qualitative research, as its results allow one to understand the groups of discourses and ideas. In other words, classes represent the meaningful space of words, and they may suggest elements belonging to social representations (Silva et al., 2013).

4.3 Descending Hierarchical Classification

The Reinert Method taxonomy supports an analysis based on a DHC (IRAMUTEQ Manual, 2014). This analysis enables us to group the closest text segments of the corpus into classes. The classes generated represent the context for the meaning of the words, and they may identify the social elements or representations referring to the social object studied (Camargo, 2005). Therefore, the DHC grouped the text segments by correlating their contents into a hierarchical scheme, i.e. the dendrogram shown in Figure 3. A Chi-square test is performed to verify the strength of the association that a specific text segment or word has within the class to a specific level of confidence.

When running a hypothesis test, the null hypothesis establishes that the frequency of occurrence of a word in one class or in another is not significantly different. Considering a significance level p<0.05, it was possible to reject the null hypothesis. Then, it was considered that the frequency a word occurred in a class would be significantly higher than the frequency of occurrence in another class (alternative hypothesis).
Figure 3: Descending Hierarchical Classification (DHC) technique with main words

<table>
<thead>
<tr>
<th>Class 3</th>
<th>Class 1</th>
<th>Class 4</th>
<th>Class 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>24.7%</td>
<td>29.6%</td>
<td>25.2%</td>
<td>20.4%</td>
</tr>
</tbody>
</table>

- **Transporte (Transport)**
- **Combustível (Fuel)**
- **Rodoviário (Road)**
- **Modal (Modal)**
- **Emissão (Emission)**
- **Diesel (Diesel)**
- **Percurso (Route)**
- **Motor (Motor)**
- **Teor (Content)**
- **Enxofre (Sulfur)**
- **CO₂**
- **Ferroviário (Railway)**
- **Ambiental (Environmental)**
- **Refino (Refining)**
- **Compenśação (Compensation)**
- **Menor (Smaller)**
- **Pensar (Think)**
- **Refinaria (Refinery)**
- **Petróleo (Petroleum)**
- **Baixo (Low)**
- **Utilizar (Use)**
- **Valor (Value)**

- **Cliente (Customer)**
- **Porto (Port)**
- **Rio (River)**
- **So (Only)**
- **Tudo (All)**
- **Hora (Hour)**
- **Sair (Leave)**
- **Chegar / Arrive**
- **Container (Container)**
- **Exemplo (Example)**
- **Porta (Door)**
- **Sul (South)**
- **Começo (Start)**
- **Operar (Operate)**
- **Estrutura (Structure)**
- **Conhecimento (Knowledge)**
- **Coleta (Tax)**
- **Entregar (Deliver)**
- **Conversa (Talk, Chat)**
- **Cabeça (Head)**
- **Belen**
- **Produtividade (Productivity)**
- **São Paulo**
- **Procurar (Search)**
- **Coletar (Collect)**

- **Brasileiro (Brazilian)**
- **Bandeira (Flag)**
- **Porque (Why)**
- **Mercante (Merchant Navy)**
- **Estrangeiro (Foreigner)**
- **Construção (Construction)**
- **Marinho (Marine)**
- **Caro (Expensive)**
- **Cabotagem (Cabotage)**
- **Lei (Law)**
- **Empresa (Company)**
- **Lado (Side)**
- **Mar (Sea)**
- **Não (No)**
- **Estado (State)**
- **Docagem (Dock)**
- **Certo (Right)**
- **Naval (Naval)**
- **PETROBRAS**
- **Dinheiro (Money)**
- **Estimular (Encourage)**
- **Compra (Purchase)**
- **Nacionalizar (Nationalize)**
- **Modo (Mode)**
- **Preço (Price)**
- **Políticas (Politics)**

- **Né (Isn’t it )**
- **Aí (There)**
- **Achar (Think)**
- **Muito (Much)**
- **Questão (Question)**
- **Público (Public)**
- **Falar (Speak)**
- **Regulação (Regulation)**
- **Caminho (Way)**
- **Agência (Agency)**
- **Funcionar (Run)**
- **Saber (To know)**
- **Agradecer (To thank)**
- **Conhecer (To know)**
- **Quantitativo (Quantitative)**
- **Banco (Bank)**
- **Nível (Level)**
- **Crescer (Grow)**
- **Geral (General)**
- **Enfim (Anyway)**
- **Pauta (Customs Tariff)**
- **Lucro (Profit)**
- **Contar (Tell)**
- **Declarar (Declare)**
- **Bem (Good)**
- **Inclusivo (Including)**
The DHC used 971 text segments, representing approximately 78% of the total contents analysed. The previous dendrogram (Figure 3) summarises the four different classes that were found: i) Class 2 (20.4%) and Class 4 (25.2%) are put together to form one component; ii) Class 1 (29.6%) is associated with that component to form another one; finally, iii) Class 3 (24.7%) is put together with the last component. A Correspondence Factor Analysis helps us to understand these associations further. Class 1 includes words such as customer (“cliente”), river (“rio”), port (“porto”), hour (“hora”) and productivity (“produtividade”), while Class 2 used an informal language such as isn’t it (“né”) and think (“achar”). Moreover, Class 3 includes words such as transport (“transporte”), fuel (“combustível”) and road (“rodoviário”); Class 4 adds Brazilian (“Brasileiro”), flag (“bandeira”), foreigner (“estrangeiro”) and merchant navy (“mercante”).

The naming of the classes considered the interactions between the words and their narrative contexts, as follows: i) Class 1 is related to cabotage latency, i.e. the ability to develop at an unknown time from existing preconditions; ii) Class 2 is closely associated with the residual expressions of the interviews less associated with the central topics of the assignment; iii) Class 3 is linked to the structuring conditions of the transport market, which are the ones that provide strength or sufficient competency for the purpose; and, iv) Class 4 puts together a social/legal representation of cabotage.

4.4 Correspondence Factor Analysis

The Correspondence Factor Analysis (CFA) generates the distribution of the four classes on a Cartesian plane as a graphical outcome. This factorial plane provides another way to visualize the contents and relationships among the classes. It complements the definition of classes by identifying significant themes of discussion. Moreover, CFA is a graphical representation of the data that helps to visualize the proximity of words and, consequently, to define the classes (Figure 4). It belongs to the multivariate techniques that examine the geometric relationships of categorical variables, by analysing the mass distribution of a set of observations; it has geometric closeness as a basic principle. The latter analysis complements the DHC since it allows verification of the relationships between classes graphically, indicating the location of these classes and their interactions.
Figure 4: Correspondence Factor Analysis technique showing the two main axes.

The results from the qualitative analysis uncover interesting aspects concerning the theme of cabotage in Brazil. The application of the CFA revealed two main axes, which are the Transport System Structure (Axis 2, depicted in blue) and the Potential (Axis 1, depicted in red). Axis 2 separated Class 3 from the others, and Axis 1 separated Class 1 from Classes 2 and 4. The Transport System Structure factor (Axis 2) retained 33.77% of the data variance, while the Potential factor (Axis 1) retained 40.35%. Thus, this two-factor model represents about 75% of
the variability of the results, indicating that these two themes - Transport System Structure and Potential - were found to be significantly relevant.

5 DISCUSSION OF THE RESULTS

The global outline of the interviews clearly indicated two central themes that help to answer the initial research questions concerning cabotage in Brazil.

5.1 Cabotage development potential

The potential is the first significant theme shown on the CFA vertical axis (Axis 1), where words such as customer ("cliente"), river ("rio"), port ("porto"), hour ("hora"), productivity ("produtividade") (Class 1) appeared more often in the interviews. Thus, a grouping of conditions related to business development expectations involving cabotage transport is present. Moreover, potential cabotage customers in Brazil are looking for logistics responses that provide systems able to transport their products more competitively from the point of view of energy and environmental efficiency, as well as economic aspects, as suggested by Catela and Seabra (2017), Botter et al. (2012) and CNT (2012). At the same time, the words flag ("bandeira"), Brazilian ("Brasileiro"), and merchant navy ("mercante") (Class 4), indicated an understanding of aspects related to issues of sovereignty of the country that employ cabotage, which were mentioned in Araújo (2014) and Castro (2007) but are not at the centre of the CFA analysis.

To sum up, the predominant class 1 is distinct from class 4, showing the separation between the potential customers and their national merchant navy, which corroborates the findings of Dias (2009). It also indicates, for example, that the flexibility and competitiveness of road transports, conferred by a better door-to-door delivery capacity inhibit the development of cabotage in Brazil, in the view of potential customers, as CNT (2013) also suggests. Therefore, this central theme extracted from interviews with informed respondents is aligned with several authors (e.g., Botter et al., 2012; Campos Neto and Santos, 2005), who suggest the great potential that cabotage might bring if it was more developed in Brazil.
The analysis of the primary data patterns coming from the interviews also provides insights into the main reasons why Brazil should use more cabotage navigation. These are supported by the *ex-post* literature survey as required in the inductive approach, as follows.

5.1.1 Sustaining economic growth with cabotage and rebalancing the transport matrix

Cabotage has the highest return on investment among all types of transport. Cabotage only requires a few specific investments, and by sharing existing port infrastructures with international shipping, no large direct government disbursements are needed (CNT, 2018). In addition, official growth forecasts for 2019 estimate that cabotage could represent up to 34% of the 319 billion TKU (TKU - Tonnage Carried by distance travelled), i.e. 109 billion TKU. This figure is equivalent to about 60% of the cargo handled by cabotage nowadays, which corroborates the findings of ILOS (2019).

Taking advantage of this potential demand would lead to a significant diversification in the national modal matrix, which is currently very focused on transport that is not geared to the movement of large volumes over long distances. So, to achieve lower logistics costs and thus make the country’s economy more competitive, a rebalancing of the Brazilian transport matrix is essential for companies operating in Brazil as stated by Leal Júnior (2010) and Martins *et al.* (2011). Changing transportation patterns and/or switching from road transportation to greener modes, such as the water mode would operationally reduce the negative effects of freight transportation (Perakis and Denisis, 2008). Moreover, switching from land modes, like truck or rail, to coastal shipping would also revitalize the domestic industry and/or improve GHG-efficiency in the transport sector (Bendall and Brooks, 2011).

5.1.2 Sustainability, safety and efficiency

Compared to other modes of transport, cabotage navigation has significant operational, economic and environmental advantages. This is also confirmed by Soares and Ribeiro (2014) who agree that cabotage has a large operating capacity for handling cargo which, together with a high loading capacity per vehicle, produces gains of scale that result in economic advantages, such as: lower fuel consumption per tonne transported; lower cost per tonne-kilometre.
transported; and fewer accidents which, in turn, results in lower insurance policy costs for both cargo and vessels. The transportation sector utilizes about 30% of all the energy used and freight transportation consumes about 43% of that. With lower fuel consumption resulting in lower air pollution, e.g. gaseous emissions and particulate matter, there is an obviously smaller negative impact on human health and the environment (Perakis and Denisis, 2008). So, from the environmental point of view, any effort to expand transport by sea in the Brazilian transport matrix would be welcome. Moreover, in economic terms, where there are benefits concerning both volumes and distances, cabotage has a low transport cost compared to rail, road, and air (Konstantinus et al., 2019). Nevertheless, cabotage vessels still need to reduce their operational costs (Casaca et al., 2017b). Thus, adequate funds and investment in human and shipping infrastructural development are imperative (Kingsley and Anele, 2018). For example, there is a need for new financing schemes to import cabotage vessels from abroad and reducing the existing import taxes should also be considered (Casaca et al., 2017b). Thus, by focusing on cabotage in particular, it is possible and desirable to improve the balance of the transport modes. These findings are cross-checked by CNT (2018), which strongly suggests that considering the total cost of cargo transportation, including capital costs and variable costs such as fuel, cabotage waterway transport has the lowest average cost when compared to rail and road transport.

5.1.3 National sovereignty

The presence on the coast of merchant navy ships flying the Brazilian flag contributes to the control of national waters. They could be used by the government to respond to disasters and conflicts, to promote the development of human resources, to enhance industrial capacity and to install an infrastructure, as stated in the Brazilian National Defence Policy Plan (Brazil, 2012).

An example from another country supports this idea, as follows: «the USA cannot rely upon foreign carriers to support its military in wartime» (Brooks and Frost, 2004). In the US, the Merchant Marine Act of 1920 (the Jones Act) requires that any vessel operating between two US ports must be US-built, US-owned, and manned by US citizens, which increases the capital and the operating costs for any cabotage operation (Perakis and Denisis, 2008). However, research
performed on maritime cabotage in a worldwide context shows that most countries have favoured protectionist cabotage policies with different degrees of freedom, with few countries having adopted either purely protectionist or liberalised cabotage policies (Casaca and Lyridis, 2020). Finally, Wong et al. (2019) suggest that different governments should be required to review their cabotage policies together, which introduces a concern regarding the regional balance in the MERCOSUL community.

5.1.4 Transport mode with low investment requirements compared to the others

In Brazil, only R$ 10 (Brazilian currency, i.e. the Real) per 1,000 TKUs are needed to maintain infrastructures for cabotage transportation. CNT (2018) reached this calculation by taking into account the volumes transported in 2017, the maintenance requirements in the three modes of the transport matrix and the fact that the port areas and waterways are shared between cabotage and international shipping. Thus, the cost of maintaining cabotage is about seven times lower than what would be necessary to maintain the road system in Brazil, and almost 15 times lower than keeping the national railways running, according to CNT (2018). Perakis and Denisis (2008) confirm that the capital costs of the infrastructure needed for the short-sea shipping terminal are significantly lower than the cost of infrastructure for the expansion and maintenance of highways. Expensive infrastructure costs associated with road operations include road surface maintenance, reconstruction and restoration of bridges, improvement costs, and other miscellaneous items. Moreover, Sánchez and Wilmsmeier (2005) argue for the potential of short-sea shipping, i.e. cabotage, to cover the infrastructure deficit.

5.2 Transport system structure and obstacles related to cabotage development

5.2.1 Structuring the transport system

The horizontal axis (Axis 2) was named the Transport System Structure, and concerns the intrinsic nature of the transport operations. Words such as fuel ("combustível"), transport ("transporte"), and road ("rodoviário"), present a higher intensity. They are related to several obstacles to the development of cabotage. For example, it emphasises the current Brazilian
transport system, mostly done by road, which is inappropriate for the continental characteristics of Brazil. The current Transport System Structure as it stands does not allow the development of cabotage, which represents a significant loss for companies dealing with agricultural products, livestock and minerals such as ornamental stones. The lack of alternative modes of transport that are more appropriate to the characteristics of the country prevents full advantage being taken of the existing natural conditions (Pacheco et al., 2008). So, the final price of Brazilian production is more expensive due to the inefficiency generated by the current transport set up, i.e. its underlying structure.

The class separation shown in the CFA along the horizontal axis (Axis 2) suggests that, at present, potential cabotage customers do not associate this mode of transport with their business or their merchant navy. They know it exists but, due to the lack of adequate conditions or cultural aspects such as a poor maritime mentality, they do not appear to seek out cabotage. Additionally, CFA’s horizontal thematic axis and its words indicate several other obstacles that might hinder the possible development of cabotage; one of the main ones appears to be the price of fuel for cabotage vessels. This input is one of the most critical components of the cost structure of shipping companies (Notteboom and Vernimmen, 2008). The situation is aggravated because the cost of fuel has increased by approximately 12 to 17%, due to the incidence of ICMS (tax on operations concerning the movement of goods and the provision of interstate and inter-municipal transport and communication services).

What is more, under the Brazilian State administration there is also a state tax on cabotage fuel, which does not include the fuel used by international shipping. On the other hand, although there is already a legal provision stating that the price should be the same as for international shipping (Fialho and Roberto, 2010), market prices are different for foreign ships. Also, the lack of a public policy for fuel prices in the national distribution chain makes it very heterogeneous; for example, prices are higher in the northern ports of the country (Brasil, 2019). Cabotage also competes directly with long-distance road transport, which has subsidised diesel.

Moreover, from Figure 4, it seems that a potential Brazilian cabotage customer does not also associate productivity with port, flag and the national merchant navy, which suggests a lack
of knowledge of this possibility on the part of future cabotage clients. This conclusion is based on the distance between the words of the Transport System Structure, such as fuel ("combustível"), transport ("transporte"), and other parts of the CFA chart, where words like flag ("bandeira"), Brazilian ("Brasileiro"), merchant navy ("marinha mercante"), and customer ("cliente"), appear.

A possible future approach is related to increasing customers’ awareness of the use of cabotage as a factor of gain in competitiveness and effectiveness for Brazilian businesses. In other words, the CFA chart indicates that part of Brazilian society and its business class is unaware of the beneficial role that cabotage could represent for their businesses.

5.2.2 Obstacles to cabotage development

The results of the interviews, when combined with data from the literature review, allow us to explain the relationships resulting from the data processing. Thus, the ex-post literature survey that is characteristic of the inductive approach confirms the expected existence of obstacles to cabotage in Brazil (vide section 5.2 a) and helps to classify them into three major types, as follows.

5.2.2.1 Economic Business Environment for cabotage

According to CNT (2018), both bureaucracy and the reduced availability of ships for cabotage are obstacles to the growth of the sector. Favarin et al. (2009), shows that shipbuilding in Brazil is still an uncertain activity, mainly because the shipyards cannot meet the requirements of the financial institutions. Monteiro (2012) emphasised the strategic role that the merchant navy plays in the cabotage market, via the requirements regarding the supply of ships (Fialho and Roberto, 2010; Ono, 2001), the protection granted the national flag and its connection with the Brazilian naval industry policy.

In addition to problems with shipbuilding in Brazil, the following issues have been also mentioned as part of a less favourable economic business environment:

- Fuel prices (Fialho and Roberto, 2010);
• Vast bureaucracy and lack of specific cabotage processes (Lanchmann and Castro Junior, 2009);
• Lack of a positive maritime mentality in Brazil (ILOS, 2013); for example, to overcome a dearth of officers and programs to attract the young generation to a sea career in Brazil (Casaca et al., 2017b).

To counter this, cabotage should develop customized and technologically advanced solutions to further integrate it into the intermodal transportation chain and to improve its image among shippers as a mode that can provide reliable door-to-door transportation (Perakis and Denisis, 2008). This would enhance the integration of logistics between transport modes and provide better services, which would include a real-time information system, shorter transit times and freight offered on a door-to-door basis (Casaca et al., 2017a). According to Kingsley and Anele (2018) the inclusion of technology transfer and other improvement safeguards is also an imperative aim to be pursued in Nigeria. Thus, service enhancements in time, sustainability, scale and scope should be expected from the IT push.

5.2.2.2 Port issues

Each port authority customises some of the main aspects related to the port sector, such as port infrastructures and superstructures, and port tariffs (e.g. Costa, 2009; Fialho and Roberto, 2010), which are already high. There is no single generalised system. The topics most often mentioned are, as follows:

• Lack of modernization and maintenance of port infrastructures;
• High port costs;
• Culture of benefiting international shipping in ports over cabotage;
• Low port productivity.

Venkatesh et al. (2017) confirmed that the infrastructure and procedures at ports and the underdevelopment of small ports are also barriers to be addressed. They also introduced a topic
not usually mentioned but of the utmost importance, which is the lack of a collaborative culture among the various service providers involved in the logistics supply chain. Christodoulou and Kappelin (2020) suggest the need for a different management culture on carriers-shippers’ relationships to help break down the barriers that prevent the further employment of cabotage and efficient port operations.

5.2.2.3 Legislation / tax / policy issues

For Lanchmann and Castro Junior (2009), the tax burden is one of the main barriers to the development of cabotage, especially concerning the difficulties in reimbursing the tax for renewal of the Brazilian Merchant Navy ("Adicional de frete para renovação da marinha mercante - AFRMM") (also Casaca et al., 2017b). They contend that additional taxes should be revised to reduce existing freight rates and to further promote the use of cabotage services (Casaca et al., 2017b). Otherwise, a national cabotage bunker becomes more expensive than an international one, which goes against Brazilian law. Besides this, the most frequent topics in this subsection are, as follows:

- Lack of tax incentives for cabotage;
- Customs and other port authorities’ systems do not differentiate positively between cabotage and international shipping;
- High import tax on new ships;
- Tax burden on cabotage;
- Hindrances to multimodality affecting cabotage;
- Lack of specific public policies for cabotage.

These situations concerning unfair and inadequate taxation are also found around the world e.g. in the United States (Perakis and Denisis, 2008) or in Australia (Bendall and Brooks, 2011).
5.2.2.4 Findings concerning obstacles hindering cabotage

So far, this study has demonstrated that the crucial factors influencing the adoption of cabotage, not only in Brazil but in the international landscape, are: the economic business environment; aspects concerning ports; and legislation/tax/policy issues. The Brazilian Shipping Companies (BSC) generically corroborate these findings by mentioning simplified customs’ procedures, using a specific terminal, transhipment time, a favourable port cost and taxation system and efficient terminal operations as cornerstone factors influencing the adoption of cabotage shipping services. These findings are consistent with those reported in previous international studies (Brooks and Trifits, 2008; Lee et al., 2010; Medda and Trujillo, 2010).

5.3 Public policy recommendations for cabotage development

Several topics have helped us to analyse and discuss how cabotage could be important to increase business performance in Brazil, for example: i) by providing a more efficient type of transportation, i.e. by decreasing energy consumption; ii) by being environmentally friendly and safer and, iii) by requiring less investment for its operation and maintenance than other modes (e.g. Botter et al., 2012; CNT, 2018). Moreover, a number of obstacles that hinder further development of this type of transport in the Brazilian context were also discussed, helping to answer the first two research questions that address both the potential (RQ1) of cabotage and its obstacles (RQ2). Finally, to address RQ3 - which concerns actions to further develop cabotage - a list of policy implications that could help to develop cabotage navigation in Brazil are proposed and discussed.

It is necessary to stimulate shipping companies to increase the supply of ships, and to leverage cabotage growth in order for it to reach its full transport potential. However, the risk inherent in indiscriminately opening up the market should be avoided, as this practice is incompatible with the need for gains of scale and, as well, is uncommon internationally as it generates uncertainty about the regularity of the services offered (Casaca and Lyridis, 2018). It is expected that increasing the offer of a Brazilian cabotage service might come from a regulatory stability that gives Brazilian Shipping Companies the security to operate and invest in the long
term, as they are capital-intensive companies (Notteboom and Vernimmen, 2008). Additionally, it is necessary to leverage the investment mechanisms to enable cabotage operations in the country. Based on the findings of this research, the three main types of obstacles might be divided and linked to the recommendations to facilitate the development of cabotage (*vide* Figure 5). In Figure 5, seven recommendations are presented.

**Figure 5**: Links between obstacles and recommendations for the development of cabotage navigation.

Table A1 (*vide* Appendix 1) illustrates a few examples of the recommendations, which might be further transformed into propositions or hypotheses for a future study to confirm the exploratory findings of this research.
In summary, it might be added that the empirical findings are pretty much aligned with a generic trend for developing countries (e.g. Kingsley and Anele, 2018), where the role of the State is central. This concerns such issues as shipbuilding investment e.g. shipyards and dry dockyards, protection of the national interest, e.g. national shipping companies, infrastructural development, e.g. ports, training and educating human resources, e.g. shipbuilding engineers, naval architects, technicians, and competent seafarers and, legislation.

Moreover, shipping companies are still coming to the fore as major decision-making players in the proposed recommendations. In fact, shipping companies are part of the most active maritime interest groups that represent the core components of the maritime transport system, i.e. ship-owners, shipbuilders, shippers, port authorities, and shipbrokers (Pallis, 2007). So, an effort towards inclusiveness should be made to consider the interests of all the groups of the Maritime Industry Sector, in general, and, specifically, of all the cabotage stakeholders both private and public.

6 CONCLUSIONS

This investigation concerns the analysis and discussion of the role cabotage plays in the scope of the Brazilian transport matrix. The challenges for its potential growth in the Brazilian transport system have been presented by answering three main questions, as follows: RQ1) What are the advantages that the promotion of cabotage can bring to a country like Brazil? RQ2) What are the main obstacles that prevent the growth of cabotage navigation in Brazil? And RQ3) What actions can bring further development to cabotage navigation in Brazil? These three research questions originated from a preliminary literature search. An in-depth analysis of the context of cabotage confirmed both the academic and social interests of the topic. Then, an inductive empirical study was conducted, following a content analysis of the data resulting from unstructured interviews with purposefully chosen, highly positioned officials. Specialised software was used to implement techniques such as Word Cloud, Similarity Analysis, Descending Hierarchical Classification and Correspondence Factor Analysis. These techniques identified data patterns emerging from the interviews. This methodological approach enables the extension of the SCM methodological toolkit (e.g. Mir et al, 2018). Furthermore, in line with
what is required of an exploratory study pursuing the best scientific traditions, an alternative tool, i.e. the IRAMUTEQ software was used. Thus, the methodological approach followed the dominant mixed method trend in this domain, as recommended by Raza et al. (2020).

Concerning RQ1, it was found that the country would benefit from an increase in cabotage in the Brazilian transport matrix. There appear to be numerous advantages that would result from a greater use of this type of transport, based on economic, efficiency and environmental factors, including: lower pollutant emissions, lower fuel consumption per tonne transported, lower cost per tonne-kilometre transported and reduced accident rates. This would also result in lower insurance policy costs for both cargo and vessels and an increase in the operational capacity for cargo handling. Furthermore, the presence of merchant ships under the Brazilian flag would contribute to the control of national waters and could be used by the Brazilian State to respond to disasters and conflicts in extreme cases.

With regard to RQ2, the main obstacles to Brazilian cabotage are those related to the following aspects: business environment, port issues, and political, legal and tax issues with a specific emphasis on the price of fuel for cabotage vessels and on the lack of a positive maritime mentality. The lack of information decreases the number of clients because Brazilian society and its businessmen are still unaware of, or are mistaken about what cabotage could represent for them. A vast bureaucracy, lack of specific cabotage procedures; inadequate public policies and problems related to ports are other relevant obstacles.

Finally, seven public policy recommendations resulted from the discussion on the obstacles identified, as addressed by RQ3 (vide Figure 5). Other complementary actions might also be discussed in the future that are aligned with the concerns introduced in the last part of the discussion. It is argued that these recommendations might be a necessary but are not sufficient foundation for a public policy of cabotage in Brazil that is robust and supported.

The research done in this study has addressed the research gap between public policy and SCM (Pagell et al., 2018), especially in developing countries (Casaca and Lyridis, 2018). Thus, it enables insights into the challenges facing Brazilian cabotage in the XXI century. Furthermore, it provides relevant information for decision makers in both the public and private sectors.
However, this investigation is not without limitations, one of which concerns the small number of Brazilian cabotage shipping companies that were studied. Another concerns the limitations of the data sources for the interviews, although these contemplated some of the most active stakeholders in the maritime community. In general, the literature review has shown that there is scope for further research on cabotage. Other topics to be considered in future studies are, as follows: i) the attributes of the cabotage service; ii) Brazilian cabotage policy benchmarked against other countries’ policies; iii) the role of Brazilian cabotage in the Mercosul agreement, taking into consideration the conclusion of the Bilateral Agreement between Brazil and the European Union on 28th June 2019; and, iv) the reviewing, completing and upgrading of the recommendations into propositions to conduct a more robust and explanatory study. A very important first step concerns the further development of a list of priority recommendations and the addition of complementary ones.

To sum up, Brazilian cabotage could represent a significant contribution to society by improving the competitiveness of Brazilian Industry through a more balanced and diversified transport system.

6 REFERENCES


ILOS (2019), *Cabotagem de contêineres no Brasil*, Instituto de Logística e Supply Chain, Rio de Janeiro.


