v. 1, n. 2, 2021

Journal of
Engineering
Research

PERSPECTIVES IN BRAZILIAN SHIPBUILDING: AN INVESTIGATIVE STUDY OF FUTURE DEMANDS

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Abstract: The naval industry is based on highly complex, engineering-intensive, high-cost structures based on custom-made projects and its main challenge is to gain competitiveness. In general, as it is considered an industry with a complex production process due to the size and number of stages, it is characterized by low volumes and production focused on orders, that is, demands are produced by projects. These characteristics make demand forecasting difficult, but they are not an impediment to the development of a demand forecasting study. The objective of this article was to present a forecast of demand for Brazilian shipbuilding based on economic levers, the main drivers of waterway movement in Brazil. In this article, the quantitative model of time series analysis was chosen, more specifically the regression analysis and trend projection, justified by the secondary and historical data base, which allowed the realization of inferences and analyses. The qualitative model was also used, based on the opinion of several executives in the area, serving to ratify the quantitative model. The results point to the existence of future demand reaching 264 container ships in a scenario of strong economic growth. Although the results are satisfactory, the topic must be continuously discussed with all those involved, as economic variables can generate significant distortions. The results also indicate the need for a joint effort of actions to feed these demands and activate the Brazilian industrial park.
Keywords: Naval Demand, Cabotage, Brazilian shipbuilding.

INTRODUCTION

The naval industry is based on highly complex, engineering-intensive, high-cost structures based on custom-made projects, and its main challenge is to achieve gains in competitiveness.

The last ships in the Brazilian fleet renewal program will be delivered later this year and knowledge of demand possibilities is essential for defining strategies in this segment. But determining demand for some segments depends on the market, for others it depends on the need for consumption. In the case of the shipbuilding industry, it is important to understand that this market must not be considered homogeneous and standardized. The demands are associated with the various types of navigation, classified in Brazil according to Law No. 9,432 of January 8, 1997, namely: port support, maritime support, cabotage, inland navigation and long-haul navigation.

Port support navigation is carried out exclusively in ports and waterway terminals, to service ships and port facilities. Maritime support navigation is that carried out for the logistical support to ships and installations in national territorial waters and in the Economic Zone, which operate in the activities of research and mining of minerals and hydrocarbons. Cabotage navigation is that carried out between ports or points in Brazilian territory, using the sea or this and inland waterways. Inland navigation is carried out on inland waterways, on a national or international route. Long-haul navigation is that carried out between Brazilian and foreign ports.

In general - as it is considered an industry with a complex production process due to the size and number of stages - it is characterized by low volumes and production focused on orders, that is, demands are produced by projects. These characteristics make it difficult to forecast demand, but they are not an impediment to the development of a study that makes it possible to forecast demand.

Therefore, **this study aims to present a demand forecast for Brazilian shipbuilding based on economic levers, the main drivers of waterway movement in Brazil.**

DEMAND FORECAST

The demand for a product is defined as the total volume of customer needs by geographic area, period, environment and marketing program. The highlight of demand is, above all, in its forecast, as it plays an important role in planning activities such as cash flow, production planning, being used more frequently in companies that deal with consumer goods (KOTLER, 1991).

Demand for products or services can be divided into average demand, by period, trend, seasonal influence, cyclical elements and random variation. Cyclic factors are more difficult to determine because both the period and the cause of the cycle may be unknown. Random variations are caused by random elements, which often have an influence and then disappear (DAVIS; AQUILANO; CHASE, 2007).

Demand forecasting can give the company a competitive advantage, reducing costs and waste. Although the uses of management models are beneficial, as they are projections, their result is not exact, and it is up to the manager to aggregate as much information as possible to support decision-making based on the organization's past performance, the socioeconomic and political environment of the country and the international scenario, bringing the forecast closer to the real scenario (VEIGA; DUCLÓS, 2010; CARVALHO, 2011).

Several studies on demand forecasting have been published in recent years, with a consensus on the existence of quantitative and qualitative methods in almost all authors, and there may also be hybrid models combining the two methods, indicated when you want to achieve greater flexibility and adjustment to the series temporal (BOX; JENKINS; REINSEL, 2011).

QUALITATIVE METHOD

The qualitative model or method, as well as any qualitative technique, is based on aspects that are more difficult to quantify, factors such as opinions and experiences, and its use is indicated when the acquisition of specific data is considered more difficult, using the opinion of experts or consumers to perform subjective estimations (LEMOS, 2006; DAVIS; AQUILANO; CHASE, 2007).

If, on the one hand, models based on qualitative data can be considered only as an approximation of reality and that the exclusive use of this model can generate forecast problems, creating the false belief that information from the past will not be useful for the future, for on the other hand, some aspects may be repeated in the future (DIAS, 1999; MAKRIDAKIS, WHEELWRIGH; HYNDMAN, 1998).

Qualitative methods are indicated for medium and long-term forecasts, presenting a subjective, opinionated character, based on intuition, estimates and opinions. The most common methods used are the Delphi method, market research, historical analogy and executive opinion (DAVIS; AQUILANO; CHASE, 2007).

The **Delphi method** can be defined as a method for structuring a group communication process with the objective of solving complex problems, seeking to learn from the exchange of opinions between the participants, in order to minimize the inconveniences and highlight the positive points of the group, showing the convergence of opinions. The application is indicated when purely mathematical techniques are not possible or applicable and when personal judgment is relevant (LINSTONE; TUROFF, 2002; RIBEIRO, 2009)

Market research demonstrates how to collect data in a variety of ways to test hypotheses about the market. Its typical use

is evident in the realization of long-term forecasts and for the sale of new products (DAVIS; AQUILANO; CHASE, 2007).

The **historical analogy** is related to forecasting demand for a similar product. It is important in new product planning, in which a forecast is derived from the trajectory of an existing similar product (DAVIS; AQUILANO; CHASE, 2007).

Executive opinion is the method in which a group of executives from the same company come together to estimate demand. The group is usually made up of executives from different areas, with the objective of long-term forecasting, involving strategic aspects of the company, such as the development of new products. The advantage of this method is the meeting of different views on the subject, which can generate quality in the consensus that is obtained (MOREIRA, 1998).

QUANTITATIVE METHOD

These are methods that use mathematical models to arrive at predicted values. They allow greater control of errors, but require information from past data in an objective way in order to carry out a future projection. There are several methods of quantitatively predicting demand, and simple techniques are used in these methods, such as the simple average, and also complex methods that require the user to have statistical knowledge and computational mathematics, such as the neural network method (GARCIA, 2011).

The main quantitative methods are classified into: **time series analysis** and **causal analysis**. Time series analysis is based on the idea that the history of events over time can be used to predict the future (moving average, weighted average, regression analysis, trend projection). The **causal analysis** seeks to understand the item system that must be predicted (linear and non-linear regression, input and output models, main indicators) (DAVIS; AQUILANO; CHASE, 2007).

The **moving average method** states that they are important to remove influences from random variations of historical data, combining extremely low and high values generating a forecast with less variability, however, the author indicates that, for the moving average, they are used data from a set of periods, usually more recent and with a number previously defined to generate a forecast, in addition, for each new period included in this set, an older period is removed (TUBINO, 2009).

Regression analysis fits a sequential row of past data, often relating the value of the data over time. The most common adjustment technique is that of least squares, which relates a dependent variable and other independent ones, being used by the researcher to establish future values of the dependent variable, based on this relationship (GAITHER; FRAIZER, 2002).

Trend projection adjusts the mathematical trendline of the point data and projects it into the future. Entry and exit models focus on selling each industry to other companies and governments. Indicates the changes in sales that a manufacturing industry can expect due to changing demand from another industry.

The **leading indicator model** corresponds to statistics that move in the same direction as a predicted series but change after the series, such as when an increase in the price of gasoline indicates a future decline in large car sales.

In this work, the quantitative model of time series analysis was chosen, more specifically the regression analysis and the trend projection, justified by the secondary and historical data base, which allowed the realization of inferences and analyses.

The qualitative model was also used, based on the opinion of several executives in the area, serving to ratify the quantitative model.

Demand forecasting in an unstable environment is quite complex, but it is critical to the managerial decision-making process. The demand of Brazilian shipbuilding depends on several variables such as the quantity, diversification and age of the fleet, in addition to the global and local economy.

From the ship fleet data, understanding the statistical behavior and making inferences of possible demands represents a simplistic view of the naval industry. For that reason it can be riddled with criticism. But if, on the one hand, there is a simplification for understanding trends, on the other hand, the lack of knowledge about forecasts is a much more nebulous environment than simplification. Thus, based on inferences made with the Brazilian fleet, from the statistical behavior, an analysis of the averages, LSC (Upper Control Limit), LIC (Lower Control Limit) and the economic forecasts of the GDP (Domestic Product) was carried out. Gross), for 2019 and 2020. The pessimistic scenario was attributed to the values found for the LIC, the realistic scenario was attributed to the expectations of economic growth and finally the optimistic scenario was attributed to the values achieved in the LSC of the curve.

The analysis was carried out according to the types of navigation. A detailing was not carried out to specify the type of ship, but it was possible to analyze the behaviors and thus it was possible to identify an order of magnitude to forecast the demands according to the assumptions of each scenario.

The first database analyzed was coastal and long-haul navigation. The trend line in the graph below shows an expected growth with a confidence level of 98.31%. This way, long-haul navigation and coastal shipping present, in the realistic scenario, an increase in the fleet of around 12 ships, in an optimistic scenario these data reach 21 ships and only in the pessimistic scenario, the fleet must have a downward trend, approaching the LIC. The fleet curve, when compared to the growth percentages, shows a shift, indicating that in 2015 and 2016 there would be a portion of the fleet idle in the domestic market. This behavior can be understood as a result of the country's economic problems, which from 2017 onwards stabilized again. The parallelism between data on fleet growth and economic growth is explained by the increase in exports in the country, demanding greater port handling, implying an increase in long-haul navigation.

World economic data, in comparison with Brazilian GDP data, indicate a shift in global behavior, from 2014, remaining in 2015 and 2016. Only in 2017, there was a recovery, returning to a behavior almost parallel to the world economy, as can be seen in the graph below.

The second database analyzed was maritime support navigation. The trendline in the graph below shows an expected growth with a confidence level of 99.28%. Thus, maritime support navigation in a realistic scenario shows an increase in the fleet of around **15 ships,** in an optimistic scenario these data reach **30 ships** and only in the pessimistic scenario, the fleet must have a downward trend, approaching of the LIC. The fleet curve, similar to the behavior of the previous curve, when compared to the growth percentages, shows a shift, indicating that in 2015 and 2016 there would be a portion of the fleet idle in the domestic market, a situation that - as of 2017 - returned to have a more predictable behavior.

The third database analyzed was the port support navigation. The trend line in the graph below shows an expected growth with a confidence level of 98.37%. This way, port support navigation in a realistic scenario would have an expectation of increasing the fleet by around 48 ships, in an optimistic

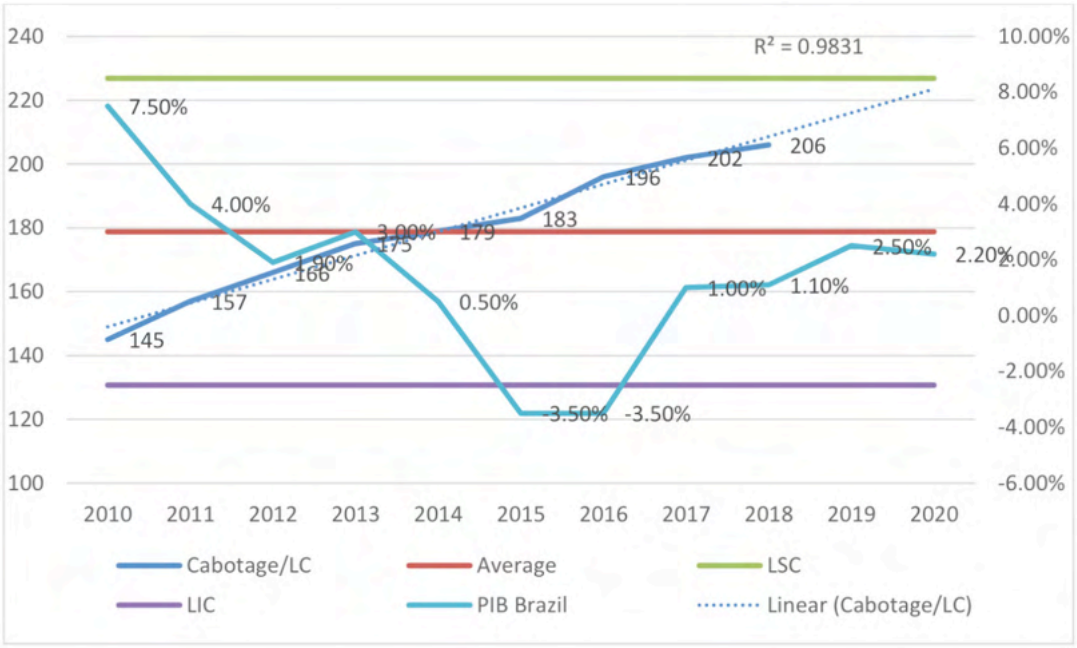

Figure 1 - Cabotage and long haul

Source: Adapted from ANTAQ data(2019)

Figure 2 – World economy compared to the Brazilian GDP.

Source: IMF (2019) and IBGE data (2019).

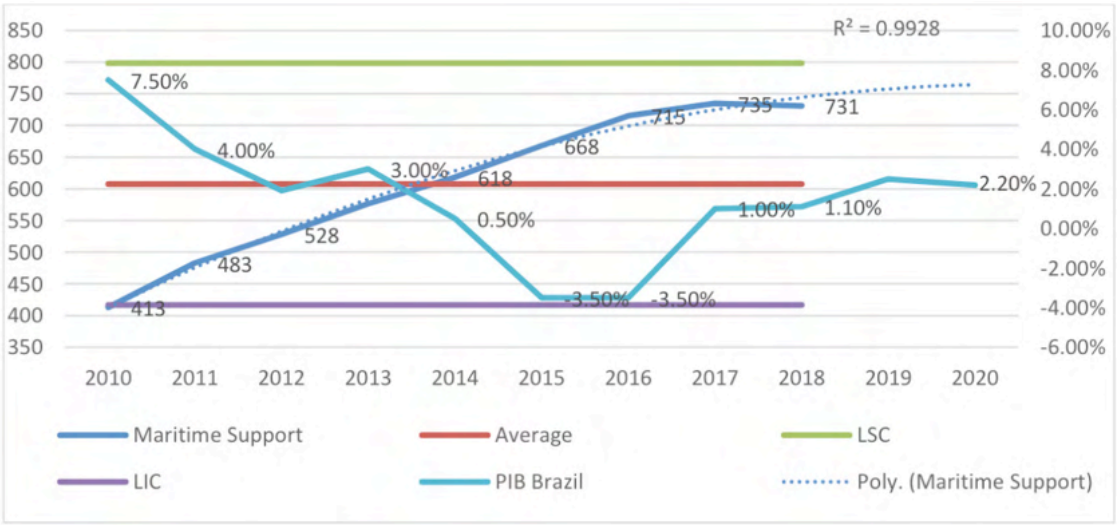

Figure 3 - Maritime support

Source: Adapted from ANTAQ data(2019)

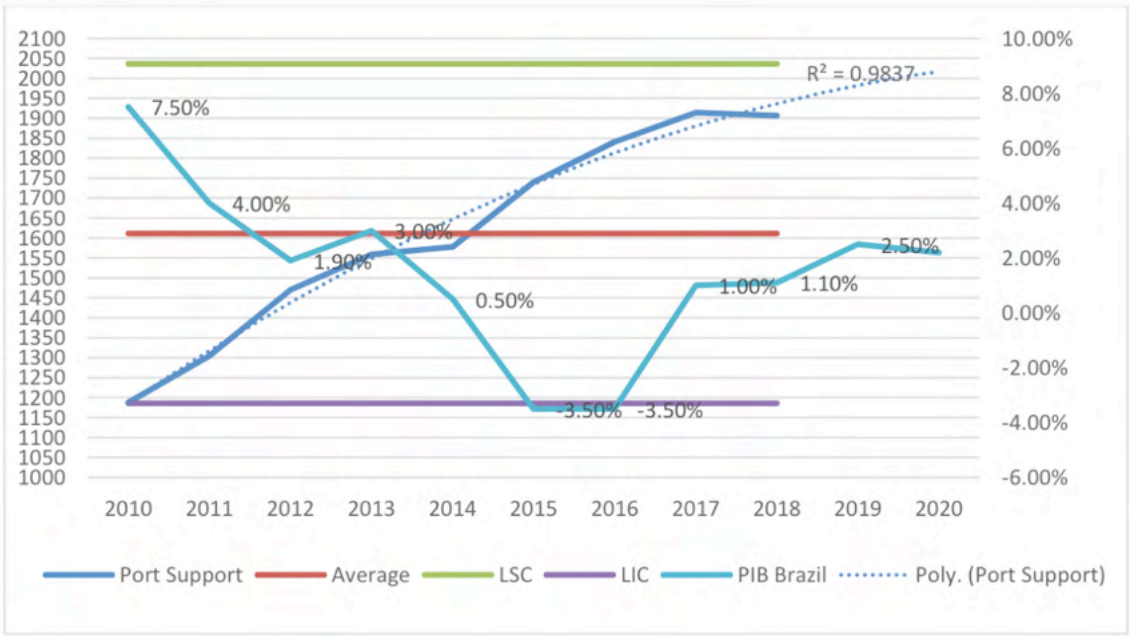

Figure 4 - Port support

Source: Adapted from data from ANTAQ (2019)

scenario these data would reach 93 ships and only in the pessimistic scenario, the fleet must have a downward trend, approaching the LIC. The fleet curve, similar to the behavior of the previous curve, when compared to the growth percentages, shows a shift, indicating that in 2015 and 2016 there would be a portion of the fleet idle in the domestic market, which from 2017 onwards more predictable behavior.

The fourth and last database analyzed was inland navigation. The trend line in the graph below shows an expected growth with a confidence level of 99.31%. Thus, port support navigation in the realistic scenario would have an expectation of increasing the fleet by around 77 ships, in the optimistic scenario these data reach 120 ships and only in the pessimistic scenario, the fleet must have a downward trend, approaching of the LIC. The fleet curve, similar to the behavior of the previous curve, when compared to the growth percentages, shows a shift, indicating that in 2015 and 2016, there was a portion of the fleet idle in the domestic market, which from 2017 onwards returned to have more predictable behavior.

All types of navigation show a growth trend in their fleet, ratified by the expectation of economic growth of 2.5%. With a reliability level above 98%, it is possible to affirm that the Brazilian shipbuilding market demands several ships. These findings may include variables related to chartering and fleet age, which further enhances the optimistic demand scenario to meet the various types of navigation. The table below summarizes the data presented, with a significant demand being feasible in most scenarios, where inland navigation appears with most of the demand (51% or 45%), followed by port navigation (32% or 35%), maritime support (10% or 11%) and cabotage (8%).

MARKET SIGNS

From various sources, lectures and presentations from various entities, there are signs of optimistic demand when compared to previous studies, thus confirming a necessary and poignant future demand for the Brazilian shipbuilding industry.

According to data from EAS (Estaleiro Atlântico Sul), there is great prospecting of demand due to the association of critical factors, such as: investments already made, a structured industrial environment, qualified labor and a repressed demand. He considers the demand for **160 oil tankers to be reasonable; 80 platforms and 50 cabotage ships of the bulk and container type**, presenting a production capable of moving the entire naval industry in the country for two decades at full capacity.

In a similar way, ABAC (Brazilian Association of Cabotage Shipowners) converges with the previous perspective of increasing the container fleet, indicating the need to increase the offer, to increase the attractiveness of cabotage, being necessary to guarantee regulatory stability to EBNS (Brazilian Companies of Navigation) to allow for competitive costs in cabotage and this way leverage investments in fleet formation. There is an expectation of an increase in demand in terms of 4.4% per year in cargo handling, thus generating a very favorable expectation of demand for cabotage ships for the coming years.

Kuene Nagel criticizes several difficulties in the current Brazilian cabotage market, highlighting the high and unsustainable tariffs, when compared to previous periods; the unavailability of space on the ships, generating fewer options for the offer of transport and the constant changes in service, generate a lack of credibility in cabotage transport, which points to great opportunities in this segment.

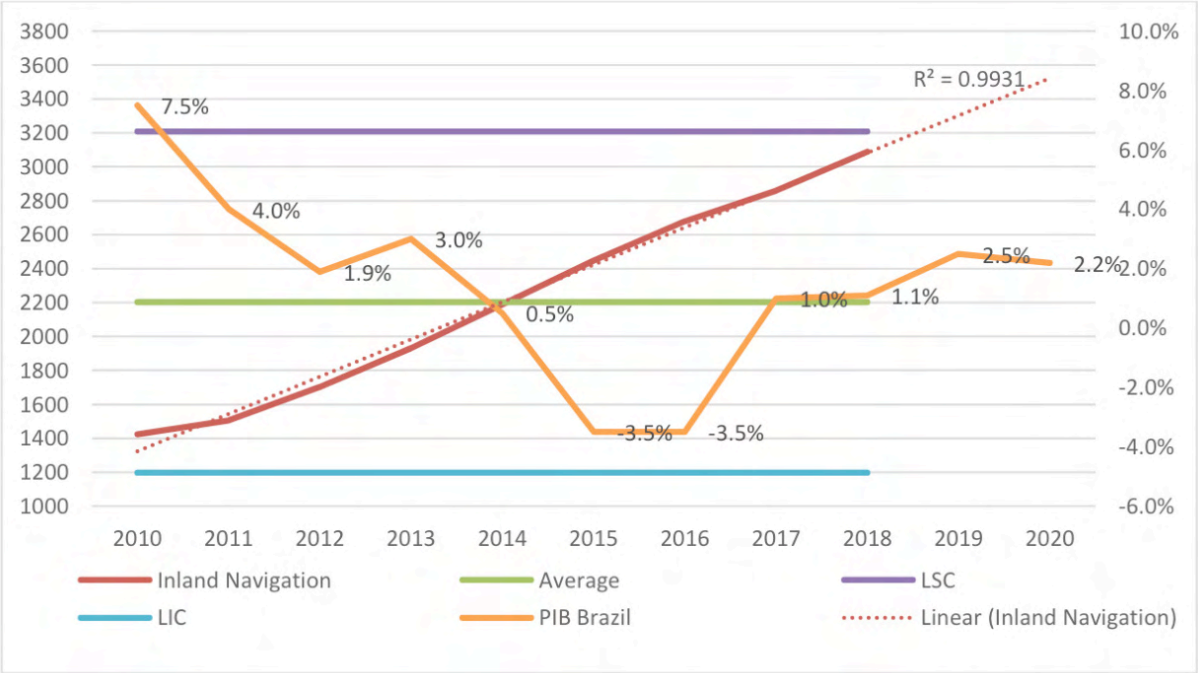

Figure 5 - Inland navigation

Source: Adapted from data from ANTAQ (2019)

Types of Navigation	Demand forecast			
	Realistic (PIB)	%	Optimist	%
Cabotage/LC	12	8%	21	8%
Maritime Support	15	10%	30	11%
Port support	48	32%	93	35%
Inland Navigation	77	51%	120	45%
Total	152		264	

Table 1 – Demand forecast summary.

The company also adds that there is an equalization between supply and demand, where the world market is no longer having a greater supply than demand, with a forecast for 2019 of a lack of regular routes, due to the lack of ships. New ship deliveries are low, 2016 was the year with the lowest number of ship deliveries; many deliveries since 2017 have been postponed and new deliveries are tied to large containers. Another relevant point highlighted was the scrapping of new ships, reaching extreme cases in which ships less than ten years old were scrapped.

All of the above, in addition to global trends in new services offered, especially with greater use of the Panama Canal, confirms the positive expectation of demand for long-haul navigation and cabotage. The chart below shows this equalization between supply and demand from 2019.

According to ABEAM (Brazilian Association of Maritime Support Companies), maritime support navigation provides logistical support to ships and facilities that operate in the exploration and production of oil and gas at sea and for each maritime unit it is necessary 3 to 4 maritime support ships. Based on the 80 maritime units provided for by the EAS, then there is a possibility **of 240 maritime support ships to be demanded.** Maritime support faced a period of difficulties in recent years due to the retraction of the oil and gas sector in Brazil and in the world. The oil barrel must stabilize at USD 70 and USD 80, reflecting a recovery in the sector and an also optimistic forecast of around 120% increase in production until 2027.

Rabobank (a global network of 80 economic analysts who study agribusiness) carried out a study in 2018 on the possible impacts of Chinese demand on soybean production in Brazil, indicating that urbanization and income growth in China will be catalysts for demand for food, triggering an increase in soy imports, which are expected to reach around 125 million tons in 2026 to 2027, of which 90 million tons must come from Brazil. This suggests the need for alignment between the flow of soybeans and the logistical infrastructure in the country, thus demanding several inland navigation ships.

The Pará State Shipbuilding Industry Union added that logistics costs in Brazil are around four times higher than in the United States, with a potential for gains, due to logistical bottlenecks, in the order of 35%. The simple use of ports in the North region itself for export would bring great reductions in these bottlenecks. This improvement would generate minimum demands in the order of 1000 barges, 40 large and 20 small tows, for the next ten years.

From the demands suggested by market expectations and the demands calculated by the historical series, it was possible to carry out a comparison between the two forecast perspectives: the **fleet's historical series and the market**. The table below presents the data organized in a comparative way.

The demands found, whether from historical series or from the market, converge, despite presenting completely different methodologies for achieving the results. This makes the data consistent as it serves as a validation (sensitivity analysis) for the proposed results, confirming the reliability of the results. **There is a demand that varies between 152 ships, 180 ships reaching up to 264 ships in a scenario of strong economic growth.**

FINAL CONSIDERATIONS

The work presented a descriptive, exploratory research on the demand expectations of the Brazilian shipbuilding industry. In Brazil, the merchant marine presents significant data: 426 shipping companies, a fleet of 2404 ships, port handling

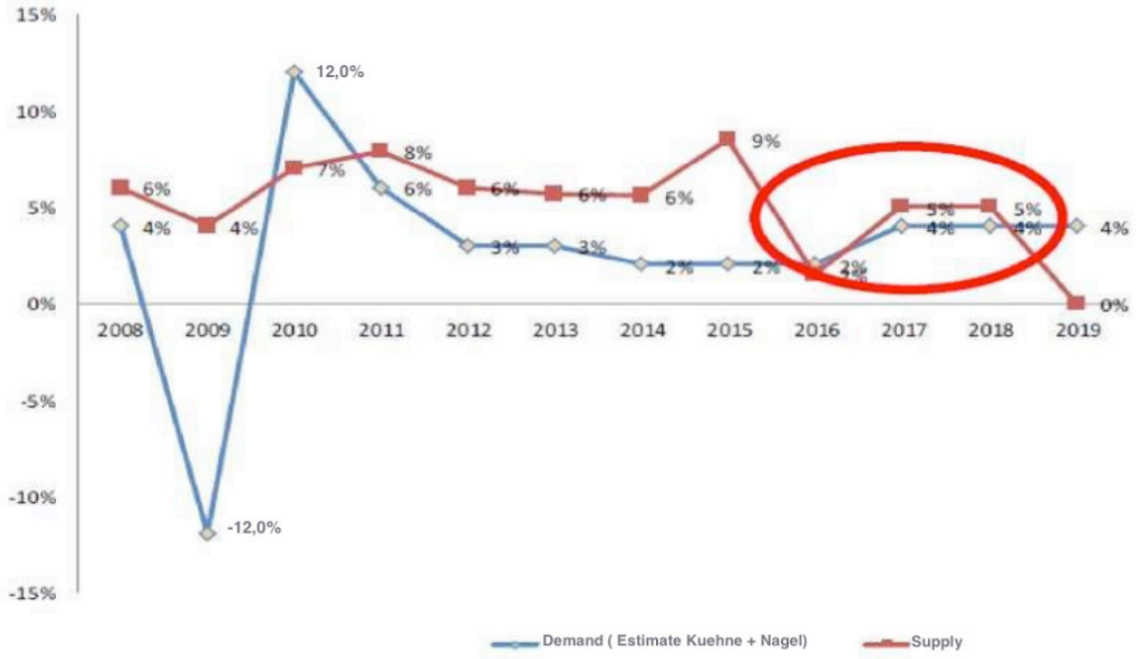

Figure 6 - Reduction of supply in relation to demand

Source: Kuene Nagel (2019)

Tipos de Navegação	Demand forecast statistical analysis				Market analysis		
	Realistic (PIB)	**%**	**Optmist**	**%**	**Expected quantity**	**Annual amount**	**%**
Cabotage/LC	12	8%	21	8%	290 (20 years)	**14**	8%
Maritime Support	15	10%	30	11%	240 (20 years)	**12**	7%
Port support	48	32%	93	35%		**48**	27%
Inland Navigation	77	51%	120	45%	1060(ten years)	**106**	59%
Total	**152**		**264**			**180**	

Table 2 – Comparison between statistical demand and market demand.

of 998.5 million TPB with a financial amount of 322.8 billion dollars in exports and imports in 2016. Following a global trend in the transport matrix, Brazil has been evolving its waterway transport mode, with values of 16% in 2015 in cabotage and waterway transport, a significant increase compared to 5% in 2007.

Demand expectations were defined based on statistical analysis and market estimates, being in both perspectives a favorable environment for shipbuilding. For all of the above, we ratify the need for favorable discussions that meet the demands of both shipowners and shipyards, as the effectiveness of the naval industry is evidenced, in all navigation segments in Brazil, or by the flow of agribusiness, representing inland navigation, whether in the economic scenario, in the increase in exports, thus representing long-haul shipping, as well as in the creation of new businesses in cabotage, representing a little explored window of opportunity in the merchant marine segment.

The suggested data represent an order of magnitude, a sign of the need for future demands. The topic is quite complex and must be continuously discussed with all those involved, economic variables can generate significant distortions, but the demand signs in Brazil are strong. A task force is needed among all those involved to validate and trigger actions that will, above all, feed these demands and activate the Brazilian industrial park.

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