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Analysis by performance indicators and operational perception in the Brazilian port sector during the COVID-19 pandemic

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Abstract The negative effects of the COVID-19 pandemic demanded a series of global actions to contain losses. The dependence of world economies on the international market has established bonds between the various regional economies of the globe. These relationships allow the effects of economic crises to be shared quickly and intensely. The waterway system, through its volume of operation, suffers greater impacts, as it is the main link between economies. This article aims to analyze the impacts of COVID-19 on the Brazilian public port system, based on performance indicators and the empirical perception of those responsible for the strategic management of federal ports. From the literature review and through the application of a survey with employees from Brazilian federal ports, it was possible to see which actions were taken to contain the economic impacts of the pandemic. The data obtained by ANTAQ (National Waterway Transport Agency) show the performance of the port operation through the average time of stay and operation of Brazilian ports from January to June 2020, as well as a comparative analysis with previous years.

Keywords: Performance indicators; Brazilian port sector; Sanitary measures against COVID; Survey in Brazilian ports.

1 Introduction

The closer relations between the different countries led to an increase in productivity for the consequent growth in competitiveness and dynamism between markets. Thus, with the aim of increasing integration at the productive, social, political and cultural levels, and trade between world countries, there was the creation of economic blocks [13].

Since the 15th century maritime transport has been of considerable importance in the economy. In this way, maritime transport and ports have become fundamental in the rise of international trade. In Brazil, port efficiency directly influences competitiveness and the performance of the Brazilian industry, since it is affected by problems related to ports [9].

Currently, with the development of technology, supply chains work optimally, which, favor economic prosperity. However, the presence of pandemics, such as the COVID-19 virus, increase the risk of interruption in supply, besides causing a impact on the supply chain. Scenarios in which disease propagation occurs, there is a great impact on society and economy [14], so the present study aimed to analyze the impacts of COVID-19 on the Brazilian port system based on performance indicators and in the empirical perception of professionals related to the strategic management of ports managed by the federal government. This operational performance will be measured from the average time of stay and operation,

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evolution of tons handled and the number of dockings in the period. The study tried to answer the following questions:

- Have the impacts of the instability of global trade reflected in cargo handling, on the Brazilian waterway modal?
- Did the effects of the health crisis and the respective containment measures impact on operational performance?

The study followed a qualitative approach based on secondary data from the National Waterway Transport Agency (ANTAQ), through an analysis of the performance of: average time of stay, average time of operation, handled tons and number of dockings, in the period of January to June of the years 2015 to 2020. In order to expand the analysis, in view of the consolidation of the agency's data, a questionnaire was sent via web to the strategic sector of the 7 Brazilian public ports managed by federal government, through the Dock Companies The article is subdivided into the following sections: literature review related to the importance of ports in the logistics chain and the Key Performance Indicator (KPIs) of the port sector is presented. Following with the methodology that indicates how the research was done, afterwards the results are presented and discussed. Finally, there are the authors' final considerations on the subject.

2 Theorical framework

This section presents a review of the literature on the importance of ports in the logistics chain, describes the performance of the port sector and its measurement through indicators, and presents the main measures to contain the infection wave adopted during COVID-19 in the sector.

2.1 Importance of ports in the supply chain

The port infrastructure serves as a point of convergence for global logistics, making the performance of its operation an important factor in the behavior of the supply chain. It is possible to see the impact of the performance of ports when observing the economic consequences when port activity is interrupted [6].

Ports started a strategic role in the supply chain, not only performing cargo handling and storage functions [12]. Almost 85% of the volume of Brazilian international trade is directly related to ports logistics activities, making its importance in the logistics chain remarkable [16].

Ports are key points for countries that aim to increase their competitiveness in the global economic scenario. Nevertheless, port activities contribute to regional economic development, through investments in infrastructure and social development [8]. Ports are notorious in the international economy when they demonstrate to be the main link in logistics between markets and global economies [7].

2.2 Key Performance Indicator (KPIs) for the port sector

In the last decades there has been an increase in the use of performance indicators in the port sector, which are pointed out in annual reports [15]. It is essential that every organization measures its results, for any change in process to be possible to assess the resulting impact [16].

States that the use of KPIs (Key Performance Indicator) allows to identify the weaknesses and critical points existing in the process and, thus, assist in the decision process of the best strategies to be implemented [10]. The use of indicators is at the core of performance measurement, serving as a basis for the assessment of a context or situation [7].

As found by Arruda, et al. [3], performance indicators for the port sector can be, but are not limited to:

- Number of dockings: number of dockings, where cargo is handled;
- Operating Time: difference between the time of completion and start of the ship's operation.

- Time of Stay: sum of the time from docking to undocking of the ship;
- Tons Handled: amount of cargo handled for a given period.

2.3 Commercial impact of COVID-19

The five nations most affected by the COVID-19 pandemic until March 2020, China, Korea, Italy, Japan, United States and Germany, are responsible for around 55% of the market supply and demand, 60% of world manufacturing and 50% of manufactured exports. Still, due to their relevance in international trade, the impacts of these economies have repercussions on a global scale [5].

The economic impacts of the pandemic can be felt directly, due to the disruption of the logistics chain that comes from these countries. By side effects, where economies not affected by the pandemic face difficulties in supply and high prices in the international market. And, by a decrease in demand, caused by recessions and postponement of purchases and investments [5].

To contain the problems related to COVID-19, the UNCTAD - United Nations Conference on Trade and Development [17], developed as a suggestion an action plan to mitigate these problems. In Table 1, the actions and their central idea are presented.

For UNCTAD [17], actions to maintain international trade help to combat the pandemic, through the sale and supply of medical equipment, in addition to preventing the countries' economic collapse.

TABLE 1 Containment action plan from UNCTAD [1]

Suggested Action	Central Idea
Ensuring Uninterrupted Transport	Care for sailors and boarded personnel, providing medical assistance and care. Repatriation from any port.
Keeping Ports Operating	The interruption or decrease in port activities may cause operation overload and increase the number of physical contacts. Regulatory hygiene measures must be followed, maintaining the efficiency of operations.
Protect international trade in critical goods and “speed up” clearance and trade facilitation	Adoption of measures to expedite the clearance of essential medical equipment.
Facilitating cross-border transport	Facilitate the movement of workers in the logistics chain across borders. Possibility of lifting the transport ban on weekends.
Ensure the right of transit	Ensure that access to ports is not blocked, so the flow of goods is not reduced.
Protect transparency and updated information	Clearly communicate business information to stakeholders online.
Decrease paper usage	Decrease physical contact, through electronic information and paperless transactions.
Address legal implications for commercial parties	The impacts of the pandemic can lead to delays and generate fines for these problems. It is suggested to rethink incidents and the values attributed to business partners.
Protect shippers and transportation service providers alike	Include measures of economic emergency and social protection in the international chain and among its priority beneficiaries.
Prioritize technical assistance	Adopt priority measures in immediate technical support and development partners.

The impact of the pandemic on global economies tends to be strengthened, as the speed of recession is greater than the speed of recovery [5]. For UNCTAD [17], there is a need for global collaboration so that the negative economic effects are minimized, especially for the most vulnerable economies.

3 Data Collection and Analysis Method

This research can be classified as basic and experimental. In addition, it can also be documentary and field, as there is investigation in documents, as well as the application of a questionnaire [2]. Finally, it is classified as a survey, as it aims to know about certain information or data, for this the questionnaire is applied [4].

Four indicators of comparison of the port system are identified in the perspective of operation: tons handled, number of dockings, average length of stay and average operating time. The indicators were defined based on the research questions described in section 1 (Introduction). To carry out the proposed analysis, this study considered the period from January to June of the years 2015, 2016, 2017, 2018, 2019 and 2020, based on data from the National Waterway Transport Agency (ANTAQ). To this end, the data were tabulated and analyzed in the second half of August 2020.

There was a need to expand the analysis, in view of the consolidation of the agency's data, so a survey was sent via web containing seven questions, six closed and one open. The questionnaire was based on the Delphi method, because the data must be analyzed systematically and must be validated through basic statistics. If the standard deviation calculations are not satisfactory, the researchers must repeat the process [11].

The questions were structured based on the actions proposed in the UNCTAD health containment plan, addressing the impacts on port operations, based on the pillars of labor, systematization, and interference from other modes of transport. The sampling was intentional, and professionals from the strategic management area of the ports were invited to answer the questionnaire. The initial questions aimed to identify the respondents and after the treatment of descriptive statistics, revealed the profiles of the professionals surveyed. Likert scales (1 - No impact to 5 - High Impact) were used to measure the intensity of the presence of the factors listed in port operations.

The questionnaire was applied in the first half of September 2020 and sent via Google Forms to the respective employees. Of the seven units to which the questionnaire was sent, only one did not completely answer the questions and was therefore disregarded.

It was found 244 articles. The search process took place between October and November 2019. The search was performed in both languages: Portuguese and English. There was no definition of publication area.

4 Results and Discussions

This section covers the results of the research. In the first part, the indicators covering the Brazilian port system (federal and private ports) are analyzed, comparing the performance from January to June in the year 2020, regarding the same period in the previous years (2015 –2019). For the first six months of 2020, there is a mark in March (the month of the beginning of efforts to contain the health crisis). In the second part, the analysis of the survey applied to professionals related to the area of strategic management of ports administered by the federal government is presented.

4.1 Analysis by indicators

To consolidate the analysis by indicators, ANTAQ's database was used, as follows.

4.1.1 Evolution of Tons Handled

The Brazilian port sector had a movement growth around of 4.42% in 2020, when compared to the year 2019. To follow this evolution, Diagram 1 shows the amount handled in Brazilian ports from 2015 to 2020.

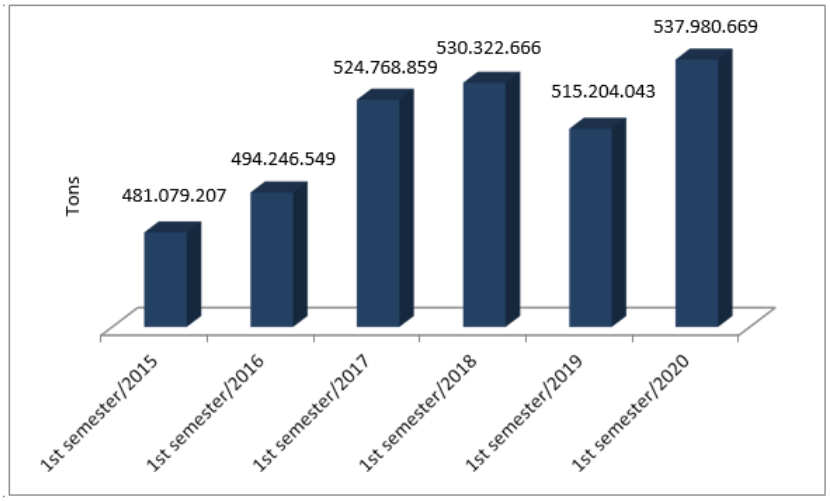
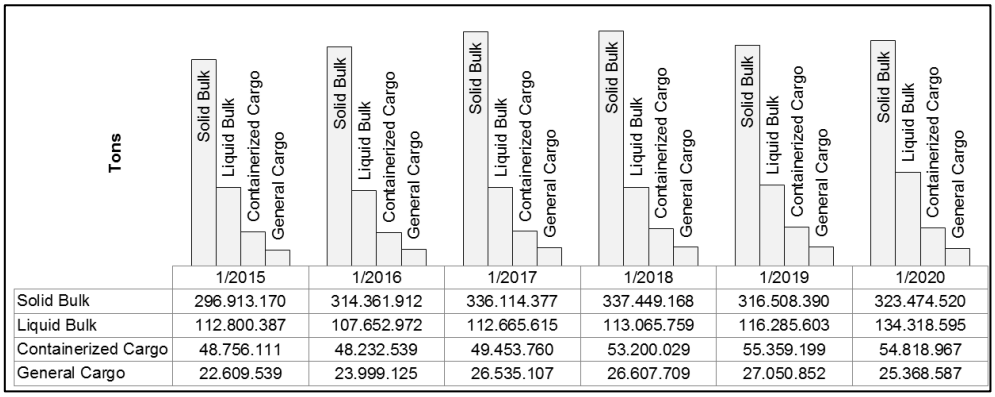


Diagram 1 Amount of tons handled.

The Diagram 2 shows the national port handling by type of cargo. When comparing the performance in 2020 with the average of previous years (2015-2019), there is an increase in handling in all types of cargo, being 1% in solid bulk, 19.4% in liquid bulk, 7, 49% in containerized cargo and 0.03% in loose cargo.



	1/2015	1/2016	1/2017	1/2018	1/2019	1/2020
Solid Bulk	296.913.170	314.361.912	336.114.377	337.449.168	316.508.390	323.474.520
Liquid Bulk	112.800.387	107.652.972	112.665.615	113.065.759	116.285.603	134.318.595
Containerized Cargo	48.756.111	48.232.539	49.453.760	53.200.029	55.359.199	54.818.967
General Cargo	22.609.539	23.999.125	26.535.107	26.607.709	27.050.852	25.368.587

Diagram 2 Handling by nature of cargo

4.1.2 Number of dockings

Regarding the number of dockings, a reduction of 0.91% is observed in 2020 compared to the year 2019. Diagram 3 present the results.

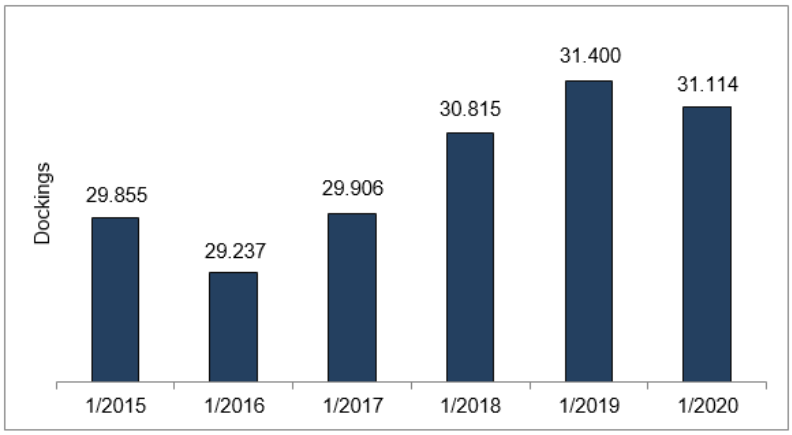


Diagram 3 Number of dockings

4.1.3 Average time of stay

The port sector presented in 2020 the best performance in average time of stay in the last five years, showing a reduction in the order of 11% when compared to the same period in 2019, which can be seen in Diagram 4.

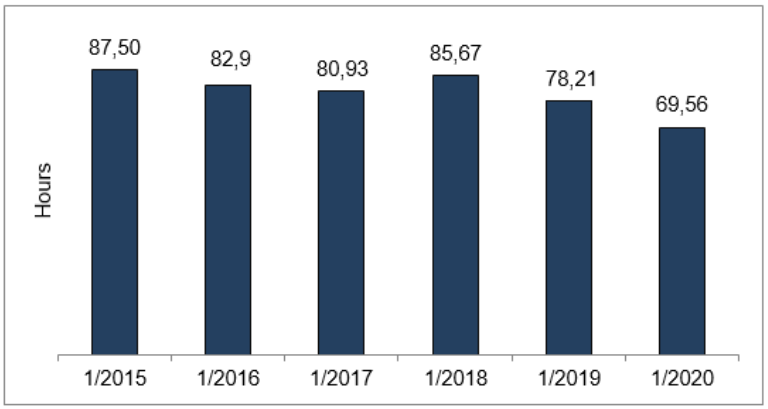


Diagram 4 Average time of stay

In a similar way, the data on average time of stay in the first six months of the year 2020 were computed, noting that the longest time occurred in the month of March, according to Diagram 5.

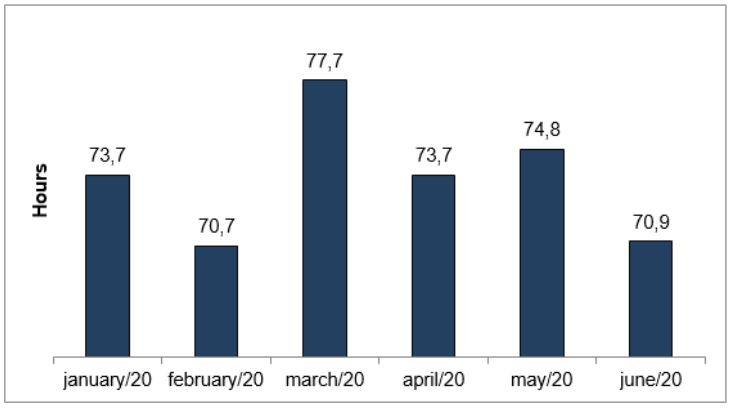


Diagram 5 Average monthly stay

4.1.4 Average operating time

When analyzing the effective operating time, it is possible to see in Diagram 6 that the best performance is 2020, with a reduction of 14.42% when compared to the year 2019.

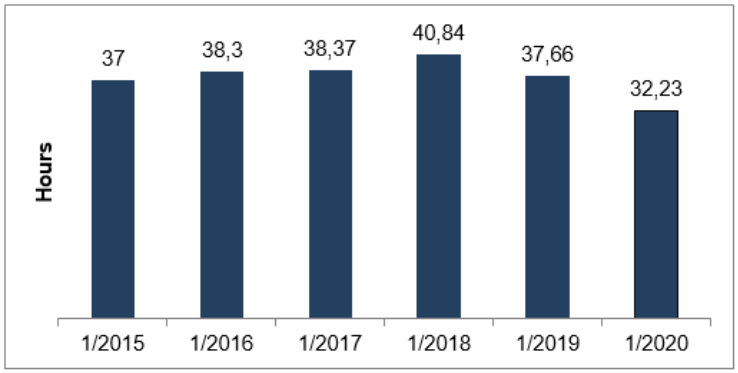


Diagram 6 Average operation time

Regarding the year 2020, it is observed that the worst performance was in the month of March, followed by the month of April, according to Diagram 7.

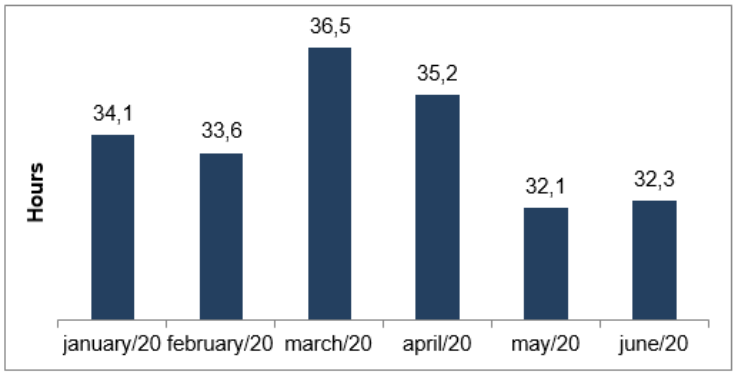


Diagram 7 Average monthly operation time

Based on the data collected, it was found that the national waterway transport performed well. Should the perceived recovery consolidate in the coming months, Brazil, as one of the main exporters of food in the world, showed that it has the necessary conditions for planning and port infrastructure to maintain or even expand its current position [1].

Regarding the port operation, through the indicators of average time of stay and average time of operation, it is possible to see a decrease in performance in March for both indicators, the month in which Brazil began efforts to contain the pandemic, on a possible forced reduction in the capacity of export shipments [1]. However, there is an improvement in performance in the following months, with the year 2020 having better average operating times (stay and operation) compared to previous years (2015 to 2019).

4.2 Analysis of factors influencing port operations

The questionnaire was designed to provide an understanding of the factors that impacted port operation in the seven ports managed by the federal government, through the Dock Companies, based on the strategies described in the UNCTAD action plan to strengthen international trade and facilitate transportation in the days of COVID –19. However, only 6 responses of port authorities were obtained.

4.2.1 Professional profile

Regarding the level of education of the respondents, 100% have completed their degree, and 66.7% have worked in the company for more than three years.

4.2.2 Intensity of the impact of the factors mentioned

For the item change in the scale of work, two DOCAS, or 33.3% of respondents, marked as a very important item (scale 5), as well as the same percentage of respondents is for scale 3, identified as an average value.

As for the use of an electronic system (this item refers to the adaptations made by the Port Authority to avoid paper transactions), three DOCAS, 50% of respondents, indicated with medium importance (scale 3), and two indicated as very important (scale 5).

Adjustments in the provision of commercial information in the port unit's media (this item is related to greater interaction in the delivery of information online to minimize the search for information physically) was rated on scale 4 by 66.7% of respondents.

In the item worker unavailability, one DOCA did not evaluate, and the other DOCAS chose one different scale each, so the item was tied with one evaluation on each scale.

For systematization of the load release by the intervening agencies, 33.3% of respondents indicated scale 1, followed by 33.3% of respondents scale 2 and the other 33.3% indicated scale 3.

Regarding the delay in receiving cargo by road, 50% of respondents indicated scale 2 in the degree of importance.

In the open question: Did the Port Authority adopt other unresolved strategies in this questionnaire? If so, which ones, the answers were:

"Yes. The company, through the Management of Strategic Management/Supervision of Risks and Controls, prepared a study of Risk Mapping having as optimistic, conservative and pessimistic scenarios, with a view to planning for possible events arising from Pandemic. Based on this study, mitigation measures were outlined for the events listed in it, such as: Rigid sanitary measures; restriction of movement of crew members of ships docked in the port; monitoring employees with symptoms based on clinical analysis and specific tests such as PCR; keep away employees within the "Risk Group" and others."

"Implementation, at the headquarters of the hybrid home office regime and special care for the risk group personnel in all areas."

"1) ACTIONS FOR SAFE RETURN TO WORK 1- Acquisition of the Serological Test. 2- Definition of groups to be tested by managers. 3- Management of COVID-19 Positive cases. 4 - Acquisition of 5th Generation Ammonia Quaternary. 5 - Acquisition of PPE's. 6 - Acquisition of Signaling Material for Social Distancing. 7 - Implementation of 5S in the Office. 8- Implementation of good practice, with the return of employment. 9 - Psychological Support. 10 - Handbook with procedures - Develop an educational handbook, with procedures for suspicious and positive cases and with tips on how to behave in the workplace. 11 - Communication Plan Combating COVID-19. 12 - Acquisition of Professional Teams License".

From the answers, it was possible to verify the relevance of the use of electronic systems as a sanitary measure adopted by the ports, with an average score of 3.8, followed by the adequacy factor in the provision of commercial information with an average value of 3.3

5 Final Considerations

The performance of the waterway modal is the most important indicator for assessing the Brazilian economic scenario and of its competitors, since it is the most used modal in international trade [1].

Based on the data collected in this research, despite the uncertainties about the duration of the health crisis and the extent of its effects on the future of the economy, Brazil registered growth in its handled tons, and better operational performance, evaluated by the average time indicators (stay and operating time). Observing other countries facing the crisis, the ports adapted their procedures, with the use of electronic systems being one of the factors with the greatest impact, according to the respondents' assessment, and, even with delays in March, there were no considerable stoppages on cargo loading and unloading operations.

Thus, before the criteria established for the research, it was not possible to find a study that applied directly to the distance education centers. Therefore, it is suggested applying multicriteria methods when it comes to decision-making for location.

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