

Insertion of cabotage in transportation of supplies for the 8th Military Region

Implantación del cabotaje en el transporte de suministros a la 8.ª Región Militar

Abstract: Cabotage shipping is a fundamental part of the optimization of transport networks for large volumes of cargo over long distances, with significant potential for expansion considering the extension of the Brazilian maritime coast and a territorial dimension of Brazil. The reduction in transportation costs and, consequently, the logistic costs, is directly linked to the replacement of the current mode of road transportation by cabotage. In this article, two transportation channels of the military supply chain involved in the 8th Military Region were described: the internal and the external. The methodology applied to the research was developed based on the technical knowledge applied to the case of the 8th RM, comparing transport costs between the two modalities. As a result, it was found that with the insertion of cabotage, some routes crossed by road can be suppressed, favoring the reduction of transportation costs for the Brazilian Army in the Eastern Amazon.

Keywords: Cabotage. Military Logistics. Transportation. Amazon.

Resumen: La navegación de cabotaje es una parte fundamental para la optimización de las redes de transporte de grandes volúmenes de carga a largas distancias, con un significativo potencial de expansión teniendo en vista la extensión de la costa marítima brasileña y la dimensión territorial de Brasil. La reducción de los costos de transporte y, como consecuencia, de los costos logísticos, está directamente relacionada con el reemplazo del actual modo de transporte por carretera por el cabotaje. En este artículo, se caracterizaron dos canales de transporte de la cadena de suministros militares para la 8.ª Región Militar: el interno y el externo. La metodología aplicada a la investigación se desarrolló con base en los conocimientos técnicos aplicados al caso de la 8.ª RM, comparando los costos de transporte entre los dos modos. Como resultado, se constató que, con la implantación del cabotaje, se podrían eliminar algunas rutas realizadas por el modo de transporte por carretera, lo que favorecería la reducción de los costos de transportes para el Ejército Brasileño en la Amazonia Oriental.


Palabras clave: Cabotaje. Logística Militar. Transportes. Amazonia.

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1 Introduction

Transportation in the Eastern Amazon is hampered by a number of natural factors characteristic of the region. Besides the great distances to be traveled for transportation, the logistic infrastructure is lagged compared to other Brazilian regions. The precariousness of the road, water, airport and rail networks characterizes the region as a challenge for logistics activities. In this work, the focus is on road and waterway transportation.

Administratively, the Brazilian Army divides the national territory into 12 sets of states called Military Regions (RM – *Regiões Militares*). The logistical support is performed by Logistical Military Organizations (OM – *Organizações Militares*) linked to each RM, which are responsible for receiving, controlling, storing and distributing supplies to the OM located in its area of responsibility.

In the specific case of the 8th Military Region (8th RM – *8ª Região Militar*), which supports most of the Military Organizations present in the Eastern Amazon, it is imperative the execution of an effective and efficient logistics as a decisive factor for the continuity of the Brazilian Army's action and presence in the region.

In this way, it is latent the challenge of conceiving in the area of 8th RM a logistics capable of adjusting to the multiplicity of working situations, with its nuances and specificities, according to the Campaign Manual EB70-MC-10.238 – Military Terrestrial Logistics (*Manual de Campanha EB70-MC-10.238 – Logística Militar Terrestre*) (BRASIL, 2018a). Among the Logistic Units subordinated to the 8th RM, the 8th Supply Warehouse (8th D Sup – *8º Depósito de Suprimento*) is the one that moves the biggest financial volumes and that delivers the biggest quantity of materials to the Battalions supplied.

For each type of material used by the Army, a military classification is assigned according to the purpose of use. Such procurement items are assigned a classification from I to X. Class I supply items are subsistence items for the troop, including animal feed and water. Class II are intendance materials as uniforms, individual equipment, tents, rucksacks and kitchen utensils. Class III are fuels and lubricants. Class IV refer to building materials including equipment. Those of Class V refer to armament and ammunition. Class VI supply items are engineering and cartography. Class VII are information technology, communications, electronics and informatics; those of Class VIII are human and veterinary health. Class IX are those of motomechanization, aviation and naval; and those of class X are the materials not included in the other classes (BRASIL 2018a).

In general, the largest financial volume of transported supplies and with greater constancy refer to classes I, II and V. Two distribution channels were identified for these supply classes:

- The internal network where the distribution of supplies acquired centrally by the 8th Supply Warehouse (8th D Sup) for delivery to Military Organizations (OM) subordinate to the 8th Military Region (8th RM);
- The external network, where the distribution of supplies acquired centrally by the Logistics Command and transported by the Central Transportation Establishment (ECT – *Estabelecimento Central de Transporte*), from Rio de Janeiro to the 8th D Sup in Belém-PA, takes place, using the road transport modality.

The ECT is an Army Military Organization dedicated to the transportation of supplies of various classes by road, based in Rio de Janeiro – RJ, capable of transporting bulk cargo, palletized and containerized, including dangerous cargo, such as the transportation of class V materials (including explosives).

Every year the ECT performs eight regular national supply transportation missions, according to the General Transportation Plan (PGT – *Plano Geral de Transportes*) approved by the Logistics Command (COLOG – *Comando Logístico*). In this plan, the distribution of transports is made in four axes: Amazonian, North, Northeast and South, which are crossed every semester.

ECT road trains have flexible composition according to demand and types of supplies to be transported. According to Toledo (2018), when there are demands greater than the internal capacity of ECT, its means can be complemented by the 2nd Transport Company/21th D Sup, located in São Paulo-SP and the 18th Transport Battalion, located in Campo Grande-MS. Means from other OM may be adjudicated to the ECT for specific missions.

In this context, the cabotage transport is presented as a complementary option to the distribution of supplies by road modality, focusing on the transport made by ECT in the North axis, from Rio de Janeiro-RJ to 8th D Sup, in Belém-PA.

The ECT trains bound for Belém pass through Marabá city, however for administrative reasons; all supplies must be delivered at the 8th D Sup, in Belém, for conference and distribution procedures. After receipt, the supply destined to Marabá follows back, now in the direction of Belém-Marabá, carrying this supply twice (BRASIL, 2017).

Pitz et al. (2017) studied the transportation problem in the same region, using the results of the choice of the lowest cost modalities and the best location for the possible Distribution Centers (CD – *Centros de Distribuição*). The contribution is in inserting the cabotage transport as a new option for the external channel currently made by trucks, as an extension of the transport options beyond the road modality.

The objective of this study is to present the feasibility for the insertion of a waterway sub modality, called cabotage, using containerized cargo, as an alternative to supply the external distribution channel, optimizing the transport of ECT on the north axis and suppressing two road routes in the internal channel, Belém-Marabá and Belém-São Luís.

The methodology applied for this research is in the application of technical knowledge to the case study of the Army's transportation of supplies in the Eastern Amazon region. By comparing road and waterway transport costs to cabotage costs, we find that cabotage presents itself as a viable alternative for transport on the north axis.

The work is structured in five more sections after this introduction. Section 2 presents information about cabotage with a brief comparison of the cargo capacities of water convoys in the United States and the percentage of investments in the transportation sector in relation to the national GDP, two important incentive programs for waterways and the obstacles to the development of cabotage. In section 3 an introduction is made about the logistics in the 8th RM and some bibliographic reviews in the Army manuals and literature on themes similar to the one proposed in this work. Section 4 presents cost analysis for the transport of the 8th RM, with a table of expenditures with personnel and fuel. The values of container transport by cabotage are also presented to compose the value of the minimum cost

reduction. Section 5 discusses the insertion of cabotage as an option to reduce road costs in the transport mission. Also in this section, the advantages and disadvantages of cabotage and for transport done by ECT are presented, as well as the survey of their costs. Finally, section 6 presents the conclusions.

2 Cabotage

According to Law no. 9.432 of January 8, 1997, providing on the ordering of waterway transport, the concept of cabotage transport is defined as that performed between ports or points in the Brazilian territory, using the maritime route or this one and inland waterways (BRASIL, 1997).

Brazil has a territory of continental dimensions, a large maritime coast and a population of more than 200 million inhabitants mostly concentrated along the coast, in a strip of approximately 200 km from the coast. Despite this characteristic favorable to navigation, the road culture has stood out in the transportation of national cargo, resulting from a great incentive, since the 1950s, to build roads at the expense of other modalities of transport, including cabotage navigation.

According to the Ministry of Infrastructure (BRASIL, 2018b), Brazil has 8,500 kilometers of navigable coastline and 21,000 kilometers of economically navigable waterways. In 2017, investments made by the Federal Government in the waterway sector totaled R\$ 495.69 million, and the National Confederation of Transportation estimated that R\$280.89 billion are needed to resolve structural waterway problems (CNT, 2018). In other words, public investments made in 2017 did not reach 0.2% of the sector's investment needs. In Brazil, it is common for waterways to have low efficiency due to lack of investment in new projects and maintenance of existing ones.

In the United States of America (USA), which is a country of similar geographic extension to Brazil, according to the Bureau of Transportation Statistics (UNITED STATES, 2018) and the United States Army Corps of Engineers (UNITED STATES, 2012), the length of the waterways is 40,200 kilometers. Of this number, about 19,300 kilometers is made up of shallow watercourses (depth of 2.7 to 4.3 meters) and 33,700 kilometers of deep channels of more than 4.7 meters. The information shows that the U.S. has almost double the length of the Brazilian waterways economically navigable and has much greater transport capacity than Brazil. These data are shown in Table 1, elaborated by BNDES (2018).

Table 1 – Brazil-U.S. Waterway cargo capacity

Rivers/waterways	Approximate convoy capacity (t)
Madeira	20,000-24,000
Teles Pires-Tapajós	7,500
Tocantins-Araguaia	2,000-3,000

continue

Table 5 – Continuation

Rivers/waterways	Approximate convoy capacity (t)
Paraguai-Paraná	19,000-22,000
Paraná-Tietê	2,400-6,000
High Mississippi (USA)	18,000-22,500
Low Mississippi (USA)	36,000-60,000

Source: BNDES (2018).

The Mississippi River is one of the longest rivers in the USA (6,270 Km), and together with the Missouri River, it forms the largest river basin in North America. In the 1930's several floodgates were built to maintain the level of the channel with a depth of 2.7 meters ensuring the flow of commercial vessels. The Mississippi canal is maintained by the U.S. Army Corps of Engineers, where at the beginning of the work (1929) sandbanks and rocks were removed, and secondary channels were closed.

The Brazilian Amazon region, the focus of this research, has large rivers that favor river navigation, but could have greater capacity to transport cargo if infrastructure works such as rectification of margins, rock removal in some areas to increase depth and signaling to make them safe waterways with greater cargo capacity were made. Such works would directly reflect in the decrease of the amount of trucks circulating on the roads and in the decrease of the logistic cost for cargo transportation.

For a country with continental dimensions such as Brazil, there is an urgent need to redesign the transportation matrix towards more efficient modes. However, investments in transport infrastructure based on GDP are declining, as shown in Table 2.

Table 2 – Investments in the transport sector (millions R\$)

	2012	2013	2014	2015	2016	2017	2018	2019
% GDP (CNT)	0.28%	0.27%	0.27%	0.18%	0.20%	0.17%	0.16%	0.14%
GDP annual (IBGE)	4,814,760	5,331,619	5,778,952	5,995,788	6,269,328	6,583,318	6,889,176	7,256,927
Amounts invested	13,481	14,395	15,603	10,792	12,539	11,192	11,023	10,160

Source: Authors, based on CNT (2020) and IBGE (2020).

The variables that directly influence transportation planning are cost and time, which are inversely proportional. In general, reducing time in transportation increases the cost of operation (in optimized systems). Adequate transportation logistics planning must provide degrees of freedom that allow the operations manager to analyze the system's trade-offs and make quick and efficient decisions.

The logistic costs, which include transportation, stock, storage and administrative costs, have been configured as high when the costs of other countries are considered. Comparing the logistic costs of the United States of America and Brazil, in relation to the GDP, there is 8.7% for USA and 11.5% for Brazil, and the biggest difference is in the component of transport costs: 4.8% for the USA and 7.1% for Brazil (BRASIL, 2019a).

According to the World Bank (BRASIL, 2019a), cabotage is more efficient and comparatively cheaper than road and rail transport when the distance traveled is more than 1500 Km. In this sense, it is important to point out that the distance traveled on the north axis of the ECT from Rio de Janeiro-RJ to Belém-PA is approximately 3,172 Km.

2.1 Incentive programs for the waterway modality

The Brazilian shipbuilding sector is an important element to support the growth of maritime activities in the country. After going through a long period without stimulus in this sector, the increase in the price of oil and the demands for ships made the government establish programs for the resumption of naval development to stimulate the growth of oil and gas exploration activities in the country.

In 1999, Petrobras launched the Renewal Program of the Marine Support Fleet (Prorefam – *Programa de Renovação da Frota de Apoio Marítimo*), offering charter contracts for ships built in Brazil, specialized in the support of oil and gas exploration activities. The purpose was to increase the demand of the sector and reactivate the Brazilian naval industry with financial inputs from BNDES to the Navy Merchant Fund (FMM – *Fundo da Marinha Mercante*) (DORES; LAGE; PROCESSI, 2012).

In 2005, Transpetro, a Petrobrás subsidiary for product transportation and storage, started the Transpetro Fleet Modernization and Expansion Program (Promef – *Programa de Modernização e Expansão da Frota*), bidding 26 oil tankers to national shipyards that year, with a total of 216 ships predicted for the subsequent phases of the project. Besides the renewal and expansion of Transpetro's fleet to follow the UN resolution about the need for double-hull ships, which offer greater security against oil spills, Promef aimed to stimulate national companies in the sector to return to the conditions of competing in the domestic and foreign markets for the shipbuilding as occurred in the 70s, when the Brazilian naval industry was only behind Japan. In its first phase, Promef had an initial contribution of US\$ 2.5 billion and became one of the most important projects of the Growth Acceleration Program (PAC – *Programa de Aceleração do Crescimento*) (PETROBRAS, 2008).

Despite the large investments, Promef and Prorefam objectives were to build specialized ships to support oil and gas exploration activities, not contemplating direct benefits to cabotage navigation.

2.2 Obstacles to the development of cabotage navigation

According to Brasil (2019a) report, five obstacles that obstruct the sector's participation in the Brazilian transportation matrix were listed. The first one addresses the lack of a specific public policy to promote cabotage shipping, where the existing legal norms, especially Law 9.432/1997, report that there are no initiatives at the tactical and operational levels to promote cabotage, but only general guidelines without goals or frameworks to follow the development of the sector. About the National Logistic Plan (PNL – *Plano Nacional de Logística*), data inform that in 2018 the cabotage represented 11% of the cargo transported in the Brazilian transport matrix and that there is no expectation of changing this percentage to 2025.

The second obstacle is the lack of provision of sufficient information to allow the monitoring of actions to promote container cabotage, since the systems used (Merchant System of the Federal Revenue Service, Port Performance System and Support Maritime Navigation Chartering System, both of Antaq) are not integrated in a way that allows the sharing of information necessary for the monitoring of cabotage activities by operators.

The third one is about the lack of isonomy of fuel prices (bunker) between cabotage and long distance navigation, where the sale of fuel to long distance navigation companies is considered by Petrobras as an export, therefore free of taxes and contributions such as CIDE, Cofins and ICMS. However, for cabotage operators it is considered an internal sale and subject to all the duties. Foreign ships, to take advantage of idle cargo capacity, perform cabotage in Brazilian ports favored by the price of fuel and affecting domestic operators. The bunkering service represents 30% to 50% of the operational cost of ships for domestic companies, being a relevant item in the development of public policies.

The fourth emphasizes that there is no promotion of competition between shipowners in container cabotage shipping. The container market is concentrated in only three foreign companies that make the transport of feeder cargo, which is the transport between two Brazilian ports of foreign products but which is still made by foreign ships, that is, the cargo that could be transported by cabotage shipping is maintained by long distance companies that have lower prices, affecting the national operators.

The fifth and last obstacle presented is the lack of action by public agencies to promote multimodal cargo transport in cabotage. The National Transportation Policy (PNT – *Política Nacional de Transportes*) declares strategies to increase the number of multimodal operators, but does not consider actions at the strategic and operational level to guide the promotion of multimodality. The cabotage depends on other modalities, mainly the road that by its capillarity has the capacity to complement the last route of transport to the client, as the modality of door-to-door delivery.

In the absence of public policies that encourage the prioritization of cabotage navigation, such as investments in integrated logistics, essential infrastructure, updating the legal framework and tax subsidies for fuel (bunker), Brazil is able to use only half of its hydrographic potential for this purpose.

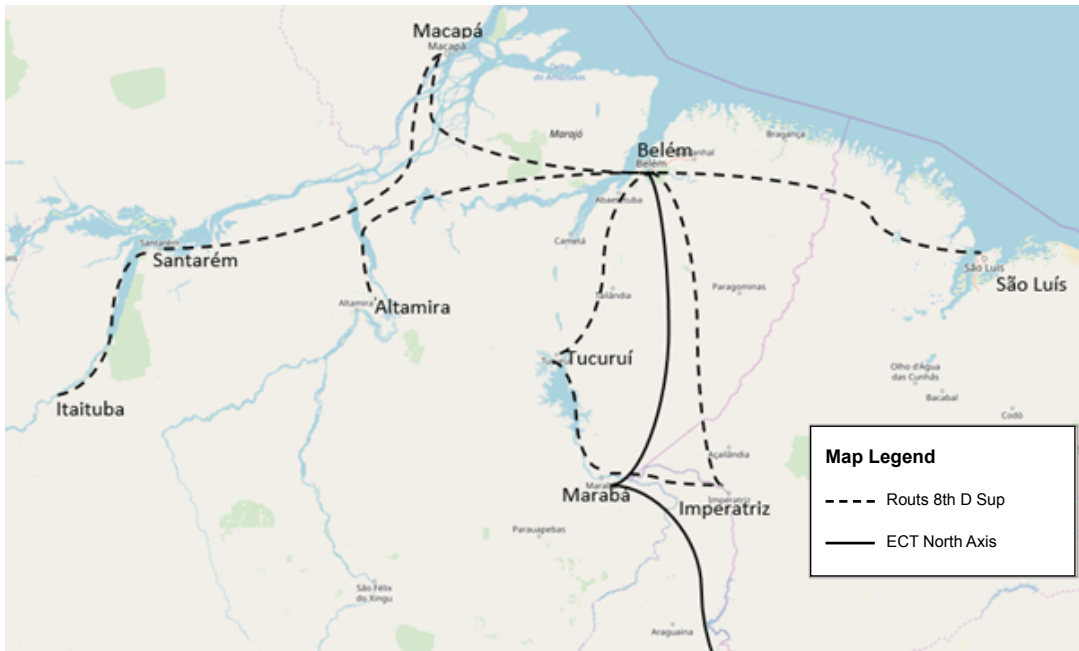
3 Military logistics of the 8th RM

The problem to be studied refers to the choice of the lowest cost modes of transportation network, without a decrease in the quality of service provided by the Army. The facilities are the Distribution Centers (CD – *Centros de Distribuição*), also called Providing Agencies (OP – *Órgãos Provedores*) in military doctrine.

The Army, as a Ground Force, carries out the transportation of supplies using its own means by road, on most routes, and by river when there is no road connection between the origin and destination place or when there is an impediment on the roads. In the case of the 8th RM, currently the CD is located in the city of Belém (8th D Sup) and the main

OM to be supplied are in Macapá-AP, Altamira-PA, Santarém-PA, Itaituba-PA, Tucuruí-PA, Marabá-PA, Imperatriz-MA and São Luís-MA cities, the first four by river mode. Figure 1 shows the locations to be supplied and the supply routes used by the 8th D Sup and by the ECT, on the north axis.

Figure 1 – Main supply distribution routes by ECT and 8th D Sup



Source: The authors (2019).

Military logistics has two aspects that differentiate it from civilian logistics. The first is that it must have the necessary support structure for cases of war and non-war. In general, “each Single Force (Navy, Army and Aeronautics) must have the means of transportation most appropriate to its specific activities, in order to support its own operations” (BRASIL, 2013, our translation). The second is that the permanent state of readiness and know-how acquired over the years in carrying out the transportation of their specific materials must be maintained, even to the detriment of doing it at a higher logistical cost, since in times of war there may be no civilian logistics operators prepared to transport war material to the areas of imminent conflict, at risk of death. In this case, the ECT should see cabotage as a complement to the road routes operated, but not to replace it completely, given the need to maintain expertise in the execution of military road transportation for the North Military Command.

In view of the above, this work will bring subsidies for the improvement of the Brazilian Army transportation network, expanding technical skills with the insertion of cabotage as means of transporting materials over long distances, making the distribution of ECT materials for the 8th D Sup.

3.1 Review in papers about the subject

The article by Pitz et al. (2017) about the analysis of the distribution chain of military supplies in the eastern Amazon brought a suggestion for the optimization of road and river routes used for the distribution of supplies in the area of responsibility of the 8th RM. Pitz et al. (2017) concludes that the 23rd Logistic Battalion of Jungle (23rd B Log SI – *23º Batalhão Logístico de Selva*), in Marabá-PA, should supply Altamira-PA, Tucuruí-PA, Imperatriz-MA and São Luís-MA cities by road modality. At the same time, Belém should supply Macapá-AP, Santarém-PA and Itaituba-PA cities by waterway. The authors observed that there were 43.8% and 7.2% of idle space in river and road transport modes, respectively, even after the application of the proposed optimization. These percentages are reflected in little demand for return transport, since the items transported from Belém have practically only one destination, that is, the destination cities return very few items to Belém.

Carvalho and Silva Júnior (2019) verified that in order to reduce transportation costs, the best location for the Distribution Center that will support the Eastern Amazon region is Marabá-PA city, different from the actual Belém-PA. The results were obtained by applying AIMMS software in order to minimize costs. The average transportation costs found, using the calculation method known as p-median, that Marabá has the best location for road transportation and that the route currently done through Belém is 17.96% longer than the optimized one.

Although there are representative cost savings for the reallocation of the facility, it is important to emphasize that the opportunity cost must be measured, considering that this change will result in financial investments in the construction of new facilities, the need for works on the BR-230 highway (transamazon highway) and the adequacy of the Tocantins River waterway, through the dredging and rock removal of the Pedral do Lourenço.

Thus, in view of the budget restriction and the economic and fiscal crisis in the country, the alternative solution presented would be to use cabotage transport, optimizing the transport network and maintaining the facilities in the places already installed.

Portella and Silva Júnior (2019) considered that the conditions of the existing roads that connect the origin cities (Marabá and Belém) to the destination cities, where the supported OM are located, were in good conditions of traffic and that the demands of various supplies could be met by both Marabá and Belém, without restrictions. To obtain the optimization results the AIMMS modeling software was used, where the transport cost data in km/ton, the distances between the cities and the annual supply offers and demands were entered, and the mathematical model was built according to the characteristics of the transport problem.

As a result, Portella and Silva Júnior (2019) indicated the lowest cost road and river routes to fully meet the demands in each city. In this distribution, the Supply Agency in Belém (8th D Sup) supplies only Macapá city by waterway mode. The result proved to be coherent since the only viable connection route could only be established by river and there was no connection between Marabá and Macapá except by passing through Belém. For the Supply Agency in Marabá, all the road routes were chosen to deliver the supply, which is also

coherent since this OP is located in a central and axis position with all the destination cities, except Macapá.

For the analysis of the case of the 8th D Sup, the only restriction is that the missions have a maximum duration of 5 working days and that they occur during the same week. Drivers and vehicles must be back to Belém until Friday, in order to have a period of rest and maintenance of the vehicles for the next missions, according to the travel schedule in Table 3.

Table 3 – Schedule of travel and discharge activities

Day	Activities
D	Departure of the convoy from Belém/PA; arrival in Tucuruí/PA; discharge of the material and overnight stay.
D+1	Departure of the convoy from Tucuruí/PA; arrival in Marabá/PA; discharge of material and overnight stay.
D+2	Continuity of material discharge works in Marabá/PA and overnight.
D+3	Departure of the convoy from Marabá/PA; arrival in Imperatriz/MA; discharge of material and overnight stay.
D+4	Departure of the convoy from Imperatriz/MA; arrival in Belém/PA (8th D Sup)

Source: Supply Operations Center (COS – *Centro de Operações de Suprimento*) – 8th D Sup (BRASIL, 2019b).

4 Cost analysis

For the calculation of logistic savings, with the contracting of an outsourced company to carry out cabotage in the transportation of material from the ECT to the 8th D Sup, data were collected with the 8th Supply Deposit (BRASIL, 2019b) and with the Central Transportation Establishment (ECT, 2019), which resulted in the following Tables 4 to 7.

Table 4 – Total spent with personnel in the road part (Belém-São Luís)

Rank	Qty	Days in Mission	Pay (per military)	Pay (total)	Pay parcel (pay/30 days)	Bonus (2%)	Total spent (R\$)
Lieutenant	1	2	6,169	6169	411.26	246.76	658.03
Corporal	1	2	2,627	2627	175.13	105.08	280.21
Soldier	2	2	956	1912	127.46	76.48	203.95
Total saved per mission in the itinerary. partial (I)							1,142.19

Source: Own elaboration, based on data of 8th D Sup (BRASIL, 2019B), ECT (2019) and Brasil (2016).

In addition, with regard to the road stretch between the municipalities Marabá-PA and Belém-PA, savings would be made as shown in Table 5.

Table 5 – Total spent with personnel in the stretch of road (Belém-Marabá)

Rank	Qty	Days in Mission	Pay (per military)	Pay (total)	Pay parcel (pay/30 days)	Bonus (2%)	Total spent (R\$)
CPT	1	2	9,135.00	9,135.00	609.00	365.40	974.40

continue

Table 5 – Continuation

Rank	Qty	Days in Mission	Pay (per military)	Pay (total)	Pay parcel (pay/30 days)	Bonus (2%)	Total spent (R\$)
2º LT	1	2	7,490.00	7,490.00	499.33	299.60	798.93
1º SGT	1	2	5,483.00	5,483.00	365.53	219.32	584.85
3º SGT	2	2	3,825.00	7,650.00	510.00	306.00	816.00
Corporal	9	2	2,627.00	23,643.00	1,576.20	945.72	2,521.92
Soldier	14	2	956.00	13,384.00	892.26	535.36	1,427.63
Total Savings Partial (II)							7,123.73

Source: Own elaboration, based on data of 8th D Sup (BRASIL, 2019B), ECT (2019) and Brasil (2016).

Finally, the expenses that can be eliminated with the fuel economy are shown in Table 6.

Table 6 – Total spent fuel per stretch

Stretch	Qty of vehicles	Consumption Km/l	Km total	Spent (R\$)
Belém-São Luis	2 heavy vehicle	2.3	1614	1,403.48
Belém-Marabá	12 heavy vehicle	2.3	1464	7,638.26
Belém-Marabá	2 light vehicle	8	1464	366.00
Total Savings Partial (III)				9,407.74

Source: Own elaboration, based on data of 8th D Sup (BRASIL, 2019B) and ECT (2019)

Considering that the estimate obtained by the ECT of the cost for transportation of a 40-foot container by road is R\$ 37,317.64, a survey of Brazilian Navy bidding processes, of hiring companies for cabotage, was conducted, and obtaining the data from two bidding processes that hired multimodal transportation by the “door-to-door” system and with the use of cabotage, shown in Table 7.

Table 7 – Door-to-door transportation with cabotage according to stretch and container

Minute of the Electronic Bidding Realization	Size Container	Qty	Origin	Destination	Total Value (R\$)	Individual Value (R\$)
Nº 00012/2017	40'	25	Rio de Janeiro	Manaus	699,998.69	27,999.95
Nº 00013/2017	40'	3	Rio de Janeiro	Belém	112,499.93	37,499.98
Nº 00013/2017	40'	1	Rio de Janeiro	Salvador	25,700.00	25,700.00
Nº 00013/2017	40'	3	Rio de Janeiro	Manaus	81,000.00	27,000.00

Source: Own elaboration, based on data of ComprasNet.gov (2019)1.

4.1 Use of cabotage for the external channel

As a result, it was verified that there was an initial saving with the use of cabotage for the distribution of supply through the external channel. The analysis was made as follows:

1 Available at: <<https://bit.ly/2CykAo2>>. Access on: Aug. 23, 2019.

- 1) A road convoy from ECT to the North Axis (Belém) is composed of 12 trucks and two more support vehicles. Each truck can carry the equivalent of a 40 feet container. The individual cost of this Army transport is 37,317.64 and the total is R\$ 447,811.68.
- 2) It was made a survey of the electronic bidding sessions of the Brazilian Navy with the costs for transportation of 40 feet containers, coming from Rio de Janeiro and going to Belém, the value was R\$ 37,499.98 for one 40 feet container. The total cost per cabotage according to this contract would be \$ 449,999.76 for 12 containers.

With the use of cabotage, it was verified that round-trip routes in the Belém-Marabá stretch and the Belém-São Luís stretch could be eliminated, resulting in a minimum cost reduction of R\$ 17,673.66 (Tables 4, 5 and 6), besides other indirect costs that were not included, such as: personnel who works in vehicle maintenance, acquisition of materials for maintenance, decrease in loss due to vehicle depreciation, decrease in greenhouse gas emissions, among others, as shown in Figure 2.

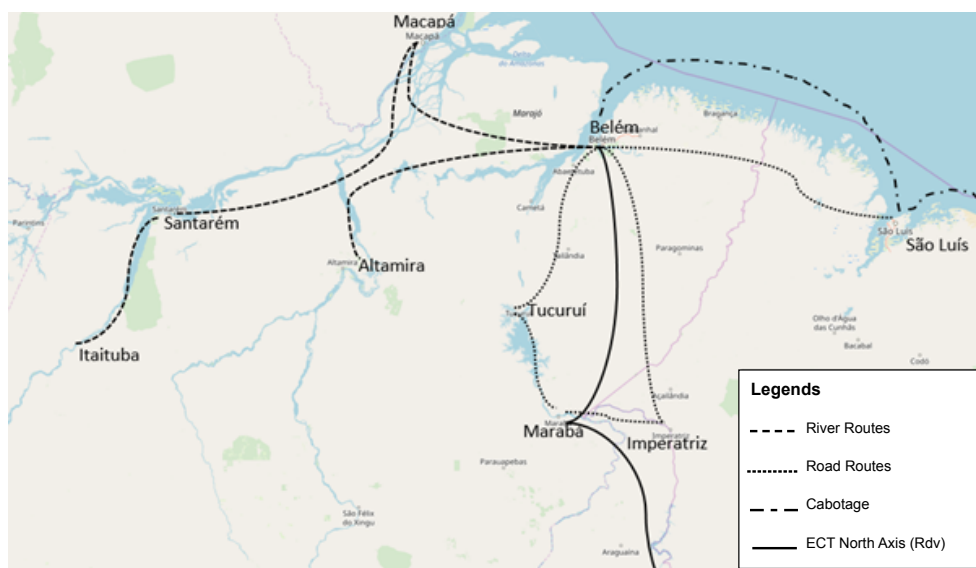


Figure 2 – Supply distribution routes via ECT and cabotage

Source: The authors (2019).

5 Insertion of cabotage in 8th RM

Inland navigation and cabotage represent an option for sustainable investments in infrastructure capable of reducing the average cost of transporting national cargo, which would lead to a reduction in logistics costs. Cruz (2007) concludes that cabotage is about 20% more economical than other modalities of transport, reinforcing that it is a viable transport alternative to minimize the impacts of the road modality on the country's transport system.

According to Pitz et al. (2017), the strategic cargo distribution of the Brazilian Army in the “North Axis” is carried out in duplicate over a stretch of approximately 1400 km.

The North Axis is the designation of the route carried out by the ECT, coming from Rio de Janeiro and with destination to Juiz de Fora, Brasília and Belém cities.

Military transport systems are complex and subject to variations in the internal demands of the Army and climate variations, with high unpredictability and dynamism. Ensuring an adequate service level, optimizing available resources and contributing to the profitability and good management of public resources are fundamental objectives of the transportation administration. To make it possible, it is necessary to have an adequate planning and the ability to adapt to changes without losing the profitability of the operation. In the case of the Brazilian Army, with greater efficiency in the use of available financial resources.

In this way, the option of using cabotage for transporting along the “North Axis” in place of the road one, is attractive because of many aspects. Table 8 shows the advantages and disadvantages of the Army’s use of cabotage for this supply.

Table 8 – Advantages and disadvantages of cabotage

Advantages	Disadvantages
Reduction of transportation costs; Relocation of hired personnel; Acquisition of Know-How in this modality of transport to reduce the dependence on the road modality; Reduction of the cost of maintenance of vehicles; Increased efficiency of the Central Army Establishment (ECT); Expand the options of modalities use for the ECT. Unitization of cargo in the container.	Bureaucratic process for hiring; New assignment without previous expertise; Decreased control over the material; Increased uncertainty of delivery time and possible disruption of logistics flow; Dependence on the Union’s budget for hiring outsourced services.

Source: The authors (2019).

The use of cabotage is promising as a way to minimize costs and make transportation more efficient for the Brazilian Army. This sector needs several operational, institutional and regulatory obstacles to be eliminated for its full development. The main obstacles are: the bureaucracy required for the handling of cargo inside the country (equivalent to the bureaucracy for an export and import); the infrastructure of ships; the high taxes on fuel; the lack of integration between modalities, the cost of practicing and the crew cost.

Although there are many challenges to be faced, cabotage is an alternative for the transport of long distance cargo, and as shown in Table 9, it has been growing sustainably over the last decade.

Table 9 – Development of cabotage in Brazil.

(Millions of ton)	2012	2013	2014	2015	2016	2017	2018	2019
Total transported cabotage	138,985	141,560	147,565	149,197	150,377	156,601	163,141	79,900
Percentage difference from previous year	-	1.85%	4.24%	1.11%	0.79%	4.14%	4.18%	*

Source: Own elaboration, based on the yearbook of the National Waterway Transport Agency (2019).

6 Conclusions

The Amazon region is provided with a vast waterway network that can be better used for inland navigation and cabotage. The waterway modality is the most indicated for transporting large volumes over long distances because it offers lower costs compared to the road modality.

Although the existence of this broad network and even though it is a consensus in the scientific literature, it is not what is observed in the Amazon region, since the potential of the waterways has not been fully utilized due to lack of infrastructure.

The optimization possibilities for the transportation system in the region are numerous; however, the budget constraint obstructs the realization of extensive building works necessary for their implementation.

In order to reduce transportation costs without having to wait for investments from the Federal Government, the use of cabotage to distribute supplies at the strategic level becomes one of the viable options for the Brazilian Army and also relatively easy to include.

Finally, as an opportunity for more studies, it is suggested to analyze the integration between the component hydrographic regions of the Legal Amazon (CMA and CMN) and to encourage their consolidation, since with the centralization of cabotage transport, there may be a reduction in the logistical costs of transport by the Brazilian Army in these Area Military Commands.

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