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Abstract

Although Manaus has a favorable geography for waterway transport and is not fully utilized. The objective of this research is to present a proposal for the implementation of an Urban Waterway Modal on the banks of the Rio Negro that surrounds the city of Manaus, aiming to favor the population that needs transportation to get from one point to another, and thus guarantee the decreased congestion on city streets. This project will focus on field and bibliographic research, the technical and economic feasibility also making a cost survey, and a commuting time survey of public transport users, enabling a new solution to the means of transportation in the city.

Keywords: Modal, Transportation, Waterway

1. INTRODUCTION

Urban waterway transport in geographically favorable locations is historically successful in many cities around the world, the use of rivers, lakes or waterways as transport routes is highly viable, and the displacement of water vehicles is more economical than promoting the same. displacement by road or even by rail, in addition to having less environmental impact.

Due to the large population increase in large cities, the urban mobility scenario is chaotic, directly impacting the quality of life of the population in these large centers. The amount of time it takes to get from one point to another in the big capitals is 40 minutes for short stretches, in some more cities, and at peak times that triple. The disorders are many and can get worse. According to IBGE projections and estimates, the population in Brazil exceeded 205 million. In the city of Manaus in 2010 the data are 1,802,014 million resident people, with an estimate for 2015 of 2,057,711 million. The inefficiency of public transport generates in the citizen the desire for autonomy, more practicality, mobility and comfort. The car itself. Soon the increase in the vehicle fleet grows with the population and is equivalent to 1 car for every 4 inhabitants on average in most Brazilian capitals, according to data from the National Traffic Department (DENATRAN) and the population estimates of the Brazilian Institute of Geography and Statistics (IBGE) 2013.

Among the factors that favor this unbridled increase in the vehicle fleet in the country, we can relate the population culture in relation to the use of cars, the per capita income of each city directly related to the Human Development Index (HDI); cities with higher HDI tend to have more cars circulating on the streets, in addition, data from 2013 (year of the largest fleet increase) indicate that the Brazilian economy was more consumer friendly, being stimulated by the low interest rate; tax reduction on Industrialized Products (IPI).

We can say that the main factor implicating urban mobility in Brazil is that the model created in cities does not favor public transport but rather individual transport. Under political pressure from contractors and automakers, the entire infrastructure of cities is geared toward the automobile rather than public transport.

In the city of Manaus the issue of infrastructure is even more serious. Fruit of invasions, accelerated growth and lack of planning. Narrow roads, no sidewalks, poor quality asphalt, potholes, ripples, alleys, obstacles, open culverts, dead ends, lack of signposts, lack of guidance and pedestrian and driver education programs also mean a lot. in the traffic flow. The neglect on the part of the government and the population itself in investments and practices. Public transport is inefficient, precarious, and expensive, failing to adequately meet such peak passenger demand, leaving the majority of the population unsatisfied and angry at the situation. The population's access to places such as work, school, commerce has consumed a large amount of users' time, which directly influences people's quality of life, reduces workforce, and also limits citizens' right to come and go.

Users suffer daily from public road transportation in the city of Manaus. The collective transport of passengers is a public service of competence of the City Hall and consequently of the State, operated by private initiative, through concession, permission or authorization. As the private sector tends to prioritize the commercial and financial aspects of transport, it does not always offer adequate quality services to the

majority of the population. As a result, public transport by bus has been losing prestige with public opinion, civil entities and the citizens who depend on it.

This transfer to the private sector obliges the City Hall to redefine its role, from executor to regulator and inspector, increasing its responsibility for the quality of services provided to users. Being the public transport by bus in the city of Manaus inserted in the essential services provided by City Hall, it must also pursue quality, as it is a utility service.

Public transport enables the growth of cities, organizing and conditioning the occupation of urban spaces and land use through the articulation between the activities developed in different places. It is therefore an essential public service that must meet social needs and support economic activities.

With the perception of this problem that is happening, there are also good ideas for not solving, helping, attending, improving, enabling and / or supporting urban transport in these large centers. Political authorities and bodies come to much, discussing improvement ideas such as, for example, the creation of more public roads, widening of roads, exclusive track for buses, creating bike paths etc. The fact is that one must invest seriously and committedly in the infrastructure of cities, prioritizing collective road transport. In the city of Manaus, besides political issues, the great impasse is due to the fact that major expropriations need to be made. The challenges to improve the three *â nsito*, and make road transport more efficient and comfortable for users is great. While this does not happen, we look to new variables.

Manaus is a river city, surrounded by the Rio Negro, which greatly favors urban waterway transport. Implementing this system is relatively simple and can be not only effective in moving people from one point to another in the city, but also a great future alternative for interconnecting existing means of transport by road. The use of rivers for this purpose is already consolidated practice in other major cities of Europe and the United States. In Brazil part of the resistance is still due to political issues. Using the river to set up an urban waterway transport system is a simple, inexpensive idea with less environmental impact and could solve part of the city's traffic problem. Thus this project is justified by the need of the population move with comfort, efficiency and convenience through public transport, in the case of this proposal one Waterways Modal Urban as an alternative viable to improve the three *â nsito* in some city streets from Manaus.

2 . MATERIAL AND METHODS

Area Location:

The Negro River is the largest tributary of the left bank of the Amazon River. It has its origin between the Orinoco and Amazon basins. Connects with Orinoco through the Casiquiare Channel. In Colombia, where it has its source, it is called the Guainia River. Its main tributaries are the Rio Branco and the Vaupés River. It disputes being the beginning of the Orinoco River along with the Guaviare River. Drains the eastern Andes in Colombia. After passing through Manaus, it joins the Solimões River and, from that union, the latter becomes the Amazon River.



Fig.1 : Map of the Rio Negro location

Source: Maps, 2018

Public passenger transport through the waterway modal needs to be seen, not as a closed solution to the urban transport problem in the city, but as a possible alternative for discussion and implementation of this system, as a complementary or alternative function for the population.

Each city has its particularities, in Manaus inevitably, the feasibility of a possible transport system supported by the waterway will be a function of costs and demand studies and may in future ensure an intermodal road-waterway integration.

The Urban Waterway Modal will have its route marked along the Manaus coast from Ponta Negra Beach west zone to the Mauzinho neighborhood, east zone of the capital. Relying on the creation of small road and waterway terminals for users to embark and disembark at strategic points distributed along the dashed route. The passengers would travel on fast boats that would take them without the pressure of traffic to several other city neighborhoods with attention especially the center and industrial parks. As a secondary objective would be the reduction of vehicles such as cars and buses on public roads thus reducing part of the problem of displacement on public roads in these regions.

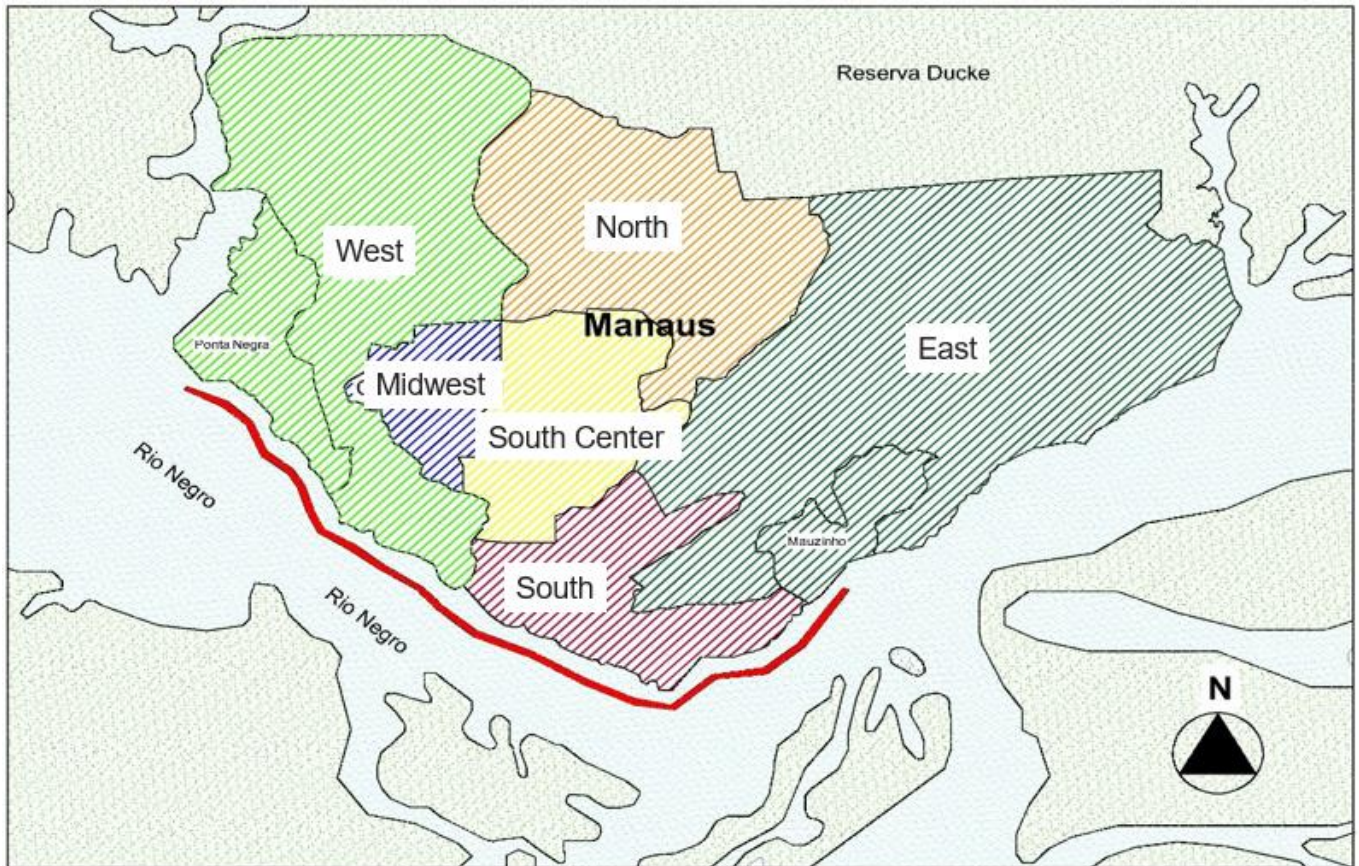


Fig.2 : Map with the path of the area where the urban waterway transport system will be implemented .

Source: Own author, 2018

3. BIBLIOGRAPHIC RESEARCH

All the research done for the development of this project was found not in books, as these specifically addressing the project theme were not found, but in various sites dealing with the subject of urban mobility; public transportation; the waterway modes in Brazil and the Amazon; cargo and passenger vessels and transports; Amazon river crossing, and also much of the research was found on scientific work sites (dissertation / thesis / monograph), public entities websites. But it is important to emphasize that the lack of specific bibliography for this project contributed to the data collected and absorbed in so many virtual articles have been adapted to the idea of implementing this system.

3.1 Field Research

Several steps are foreseen throughout the development of this project. In this topic, field research, represented in Figure 3 below, the steps in which the process of data collection and information to be analyzed is divided that should be done.

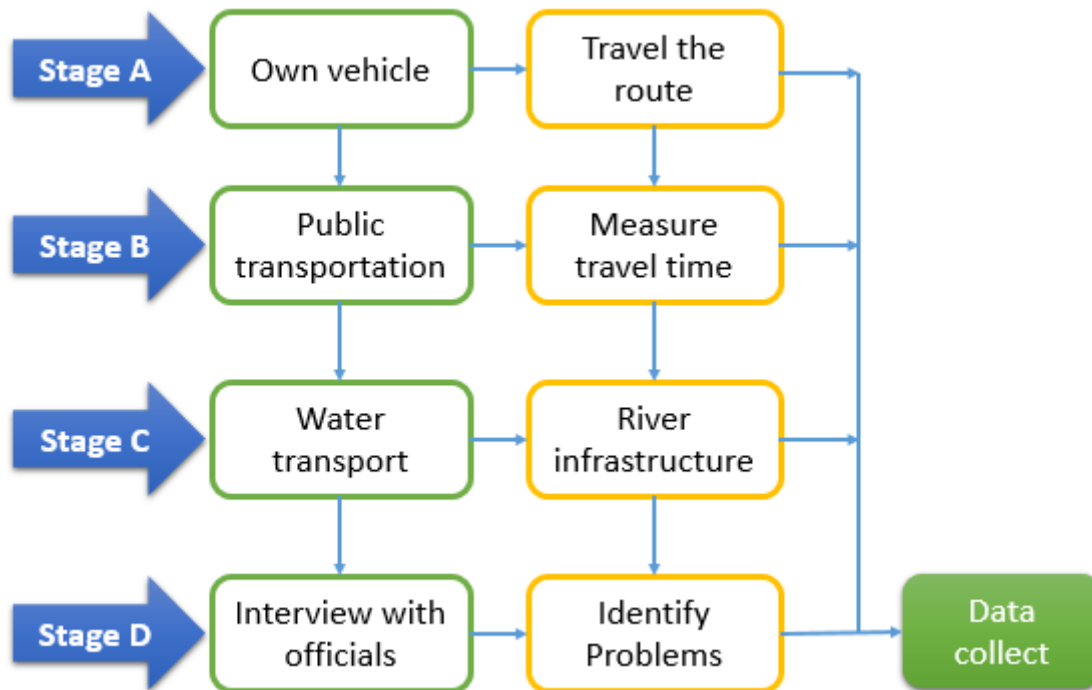


Fig 3: Steps Chart
 Source: Own author, 2018.

The importance of field research aims to observe the delimited area, describe its real situation, explain the problem variables. Determine the forms of access, define the aspects of this field research as well as analyze the information designed and enable solutions for the implementation of the urban waterway modal project.

Topics to be focused on in the project relate to the morphological aspects of the Rio Negro waterfront , governance and institutional aspects of the transportation system, such as organization, stakeholder cooperation and waterway efficiency.

And slap A, Using a own vehicle : it must be traveled by land the way on public roads as close as possible to the edge of river from the area west to the east of Manaus, in order to make the observation d conditions urban roads, analyzing their infrastructure and traffic conditions . Timing the travel time from the starting point to the end point, and fuel costs .

Step B, p or through a public transportation: The goal évivenciar the experience through which pass every day, users who need this means of locomotion. Timing the time spent on this route and analyzing the condition of the vehicles, terminals and stopping points of these buses, so that you can also study the feasibility of a multimodal road - waterway interconnection with the implementation of Urban Waterway Transport in the future.

Step C, Using Fast Traffic Waterway : One of the most important steps in this project is to map the area and analyze the river infrastructure on its bank for possible installation of the departure and arrival terminals in strategic locations to facilitate User access to various points of the city along the delimited route, from your starting point to your ending point.

Step D Interviews, public opinion polls and interested public agencies concerned. Conduct interviews

with directors of public agencies such as the Municipal Department of Urban Transportation (SMTU), Municipal Secretariat of Infrastructure SEMINF, Union Heritage Superintendence (SPU), Amazon Environmental Protection Institute (IPAAM), National Department of Transport Infrastructure (Denit) among others, in order to find out if there is interest on the part of these bodies to implement this modal in favor of the population and to improve the traffic in the city traffic, study together with these agencies the rules for the implementation of this sistema. Perguntas as “What are the strengths and weaknesses of this project”? “What threats and opportunities can the future bring”? “What development options or possible strategies can be identified for the project”? “Are there government programs or development trends that may influence the use of this mode”? “Is there interest for the near future in a connection with other modes”? Challenges, development options, political and environmental issues, etc. Public opinion survey raising questions that address the direct interest of the population regarding the use of this mode, what are the expectations / demands of users, their needs in public transport. Data should also be checked with the State of Amazonas Public Services Regulated Agency (ARSAM) for data on ports and locations for the deployment of floating rafts used as passenger embarkation and disembarkation points. Consultation with these bodies will provide important information for project development.

4. ANALYSIS AND DISCUSSION OF RESULTS

According to the proposal will be necessary for its implementation, two important items listed below:

4.1 Floating Ferry Costs

The final stage of this project will budget the final costs through a bidding notice, analyzing the type of vessel and its consumption to make comparative table of travel time and cost of this type of transport. Ferry costs and deployment costs for passenger departure and disembarkation points. Data will be presented in Excel tables.

The major challenge for engineering in the implementation of this waterway modal is due to the inconsistency of the Rio Negro, which raises the water level in flood and low in drought. However, as there are already several examples of floating ferries around the river, it was found that the most viable infrastructure for boarding and disembarking passengers in the region is a floating ferry to meet the inconstancy of the river. In the city of Manaus, the embarkation and disembarkation of passengers and cargo occurs, basically, in four berths located along the left bank of the Rio Negro, namely: São Raimundo / Aparecida Berth, Quay Roadway (Manaus Public Port), Waterfront Manaus Moderna Avenue and Demetrius Ferry Dock. At the São Raimundo terminal a large passenger reception infrastructure was built. The following images show the floating fingers ferry docked at the terminal.



Fig 4: Floating ferry with fingers from behind.

Source: Own author, 2018.



Fig 5: Floating ferry with fingers in the port of São Raimundo Manaus

Source: Own author, 2018.

The floating fingered ferry favors the docking of small to medium sized boats, proving to be the most suitable for the deployment of this system, using it as small embarkation and disembarkation stations. In addition, the structure of the ferry demonstrates its capacity for passenger traffic, is covered with a metallic structure of tiles also metal, which provides comfort to users and shelter from bad weather, whether it is intense sun or rain. Their fingers allow two or more midsize speedboats to dock at one go without any hassles, and passengers have the security to board and disembark via them. The floating raft can be moored to the river bank without the need for an onshore infrastructure such as earthmoving and / or drainage services.

4.2 Speed Express Boat

The choice of vessel type for this proposal should first consider the amount of passengers to be transported. For this system to be effective it is necessary that the chosen vessels carry at least 100 passengers at a time, which will significantly affect the cost of tickets per user. The user comfort is then analyzed, the average speed reached by the boat in the delimited route to be traveled, and the fuel consumption. In the northern region, there are several models of fast-moving vessels that can adapt to the

conditions of this mode, being the aluminum monohull jet boat the model most commonly used in transport under the proposed conditions. For the cost survey you have numerous options, including via the Internet you can find models used in major shopping sites such as Mercado Livre.com, OLX, good deal.

To get the budget of this boat, of nautical companies and assemblers in Manaus and in the region or in companies of other States, a nautical project is required, where the main characteristics of the vessel will be presented as number of seats, dimensions and type of engine. The final stage of this project will budget the final costs through a bidding notice. For this proposal it was possible to obtain a sale value of boats already existing in the market (used), which will serve as a basis for calculating the final cost of implementation of this waterway. The images below illustrate some models of these speedboats used for passenger transport.



Fig 6: Express boat

Source: Own author, 2018

In topic four (4) - Costs, the values obtained from the budget of a floating ferry already in operation will be presented. It is important to note that the budget purchased for floating raft is not the one with fingers like the one that is moored at the São Raimundo Waterway Terminal, located in the west of Manaus, described above as the most suitable for this system. Since the difficulty in getting a budget for that specific ferry, it needs the project of it, the origin of where it was built, costs with the project. It was found that the São Raimundo Waterway Terminal is managed by DENIT, a fact that makes it even more difficult to get the design and cost of the ferry used to embark and disembark passengers at that terminal. A visit to six shipyards in the city of Manaus, seeking budgets for it, was frustrating to find that none obtained the project of that floating. In addition, shipyards in Manaus do not provide budgets without a ferry project by a naval engineer, preferably active in their engineering sector. However, an incessant search for six shipyards, namely: Bertoline Shipbuilding located at Rua Raimundo Nonato De Castro; São João Shipyard on Nelson Rodrigues Street, Erin Rio Negro Shipyard and Northern Shipyard both on São Pedro Street, Rio Amazonas Shipyard on Belém Street and Bibi Shipyard in the southern region of the city; finally resulted in something concrete to add to this proposal.

The São João shipyard has provided a budget for an already built and functioning floating raft larger than suggested in this proposal, but from these costs a good and broad idea of the investment required to

obtain a floating raft can be obtained.

Due to the complexity and impasse to get the Balsa with fingers budget that is docked at the São Raimundo Waterway Terminal, the budget for this proposal shown below refers to a 65m long floating raft with a cargo capacity of 1,500. / t. This reference will assist the parameters for cost viability with the implementation of this project.

The unit costs of the specific floating ferry services described in the spreadsheet below are based on a budget provided by Estaleiros São João Nildo Tavares S / A. The same is attached to this project to prove the data obtained. The values presented in the spreadsheet formulation are consistent with those established by the company's cost and budget department.

By searching electronic shopping sites, it was possible to obtain some express vessel costs, which will serve as the basis of cost parameters. Below is the image of the speedboat electronic portal announcement whose value is presented in the budget spreadsheet of this project for verification.

5. Conclusion

It can be concluded that there is no shortage of motivators to encourage the waterway or waterway modal in the Manaus region. However, it was observed that there are no incentives for this mode compared to incentives for the road mode. The highways are the priority for the Amazon. This premise leads to many derivations, as it goes against common sense, which prescribes the construction of infrastructure where there is more economic activity, which is the discourse for prioritizing the most developed regions over peripheral regions, doomed to underdevelopment. However, the waterway mode is almost as important for the development of the state as road transport.

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To Northern University Center - UNINORTE / LAUREATE.

To the Institute of Technology and Education Galileo of Amazon (ITEGAM), Brazil.

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