Urban Mobility in Brazil: A Comparative Between Manaus and Sao Paulo

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Abstract

Urban mobility is one of the main topics when it comes to urban planning, in Brazil, it is one of the most troubling subjects since the country had a demographic boom in the 60s and 70s leading to unplanned cities that were not capable of properly preparing for its population increase. In order to evaluate what Brazil's cities are lacking, Manaus and São Paulo were compared to leading cities in urban mobility like Hong Kong and Prague reviewing the main indicators which leads to those cities being ranked higher than Brazilian cities. Being the cycle lanes one of the biggest disparities between cities like Prague and Manaus, the urban mobility plans of the Brazilian cities were evaluated to present their guidelines and their plans to unite with the global trend in urban mobility.

Keywords: Urban Mobility; Cycle lane; Public Transport;

1. Introduction

With the growth of the population and cities, there is an increasing need for modes of transport that can serve this population, ensuring that they can go to their places of work, leisure and study. Thus making sure

that the economy flows together with activities performed by the population throughout the city. Attributing improvements to the urban mobility system is a constant need as the demand for the service is of interest to the cities and countries in which it operates.

If urban mobility is not effective in a given city, then there will be a reduction in its productivity and economy indexes, since urban mobility consists of the displacement of people, that is, the labor required for the continuous execution of economic activities.

In Brazil, mobility is a delicate topic as many cities grew in a disorderly pace due to historical events that occurred mainly in the 60s and 70s, causing a rural exodus that caused problematic experiences in the present day of Brazilian cities.

This paper aims to make a comparison between the Brazilian capitals of Manaus and Sao Paulo with global cities which are references in this theme in order to identify the factors that determine their quality of urban mobility and what their cities can learn from each other. Also making a comparison between the urban mobility plans of both Brazilian cities seeking to identify the priorities set by each city in order to improve the mobility present in these large cities.

2. Theoretical Foundation

According to Gomilde and Galindo (2013) [1] urban mobility is understood as the possibilities of displacement of people and loads in cities, either through collective or individual modes, not necessarily motorized. Gomilde and Galindo (2013) [1] also affirm that urban mobility should be considered sustainable when it is capable of enabling people universal access to the city and all the opportunities offered by it in order to contribute to socioeconomic progress without destroying the environment and using road infrastructure rationally.

This being the basis for the formulation of the project that became the National Urban Mobility Policy Guidelines Law (Law No. 12587/2012) [2], this law recognizes and divides urban modes of transport into motorized and non-motorized, classifying them by object, service characteristic and nature.

2.1 Global Overview

In order to observe the global panorama of urban mobility, we used the ranking of "sustainable city mobility index" by Arcadis (2017) [3], it is possible to visualize the global panorama of urban mobility more precisely, as it is invalid to make a direct comparison between global cities, as each city grows and adopts different methods to deal with its geographical, historical and cultural consequences.

According to the information provided on the company's website, Arcadis is a global engineering and management consulting company based in the Netherlands. Through its collected data, it discloses its ranking consisting of the 100 best cities evaluated according to the chosen criteria, These criteria include traffic fatalities, bus and subway stops per square kilometer, annual passenger traffic, the economic viability of public transport modes, city congestion time and many other indicators out of a total of 23.

According to the data presented in the survey, it is possible to observe the European predominance in the ranking since it has cities that occupy 7 of the top 10 positions, according to Arcadis (2017) [3] this European leadership is due to the fluid integration between cities. present in territories of the European

Union.

First place, however, was awarded to the city of Hong Kong which together with the cities of Seoul and Singapore awarded Asia with 3 positions in the top 10 of the ranking. Hong Kong City, despite being one of the most densely populated cities in the world, can meet its limited space challenges through its subway system that carries approximately 12 million passengers daily.

According to LSE (2015) [4] in its publication "Towards New Urban Mobility" European cities like London and Berlin have public transport investment guidelines as well as technology companies that are specializing in electric cars and transportation applications. , the LSE considers these factors as indicators that make these cities ahead of many others when it comes to identifying new transport methods and how to use them to serve the entire population more and more effectively.

Berlin as well as others have in their guidelines a high priority for investments in cycling infrastructure, where according to data collected by the LSE (2015) [4], the number of cyclists has been growing since 1970 with a big boom between 2004. and 2012 where there was a 40% increase in the total number of cyclists in the German capital.

When we bring the ranking observations to the Brazilian situation we find only two cities in the top 100 of the Arcadis ranking (2017) [3], being São Paulo and Rio De Janeiro in 47th and 63rd respectively, unfortunately the city of Manaus did not reach any of ranking positions.

The index developed by Arcadis makes São Paulo the main financial center of Brazil and although it is of economic importance the city still faces the challenges that are common to cities that developed without proper planning causing a social segregation that pushes those with lower purchasing power to the suburbs, but still depending on them as labor force forcing them to move large miles to the place of service. According to Arcadis (2017) [3] over 80% of citizens who own a car would be willing to leave them in the garage if a better public transport option were offered.

2.2 Manaus and São Paulo

Observing the current situation in a national panorama, it is possible to verify that urban mobility is one of the elements present in urban planning that most finds problems in Brazil due to the strong rural exodus that occurred in the 70's and 80's causing an urban expansion to the city. which a large part of the cities were unprepared giving rise to problems in the demand for urban services and the ability of cities to supply them.

According to EMBRAPA (2017) [5] the areas that are considered urban in Brazil represent 0.63% of the national territory and concentrate 160 million inhabitants, this value being equivalent to 84.3% of the entire Brazilian population, ie , more than half of the Brazilian population lives in an area that does not even occupy 1% of the Brazilian territory.

Establishing the fact that more than 80% of the Brazilian population is in urban areas, it is necessary to adapt and evolve the transport models in order to guarantee the constitutional right of the citizen to come and go.

The city of Manaus, object of our study had 1,802,014 inhabitants and a demographic density of 158.06 inhabitants per square kilometer (inhab / km²) according to data from the 2010 IBGE census [6]. The IBGE estimate [6] for Manaus in 2019 is of a population of 2,182,763 inhabitants and a demographic density of

191.45 inhabitants per square kilometer. This value can be considered small when comparing the city of Manaus the city of São Paulo which obtained the value of 7,387.69 (inhab./km²) in the last census conducted by IBGE [7] in 2010 and in its estimate has approximately 8 thousand inhabitants per square kilometer in 2019. It is possible to observe a large discrepancy of almost 7800 inhabitants per square kilometer when comparing the city of Manaus to São Paulo.

Looking at the past of the cities present in the study, it is possible to verify that, like most Brazilian cities, they grew in a disorderly way, thus negatively impacting their planning capacities.

According to Nogueira, Sanson and Pessoa (2007) [8], in the case of Manaus the city had its explosion in the 70s of the twentieth century with the establishment of the Manaus free zone and at the end of the same decade there was a large expansion directed to the North. and East, an expansion carried out through regular and irregular occupations, which caused a growth that was disproportionate to what urban infrastructure would be able to absorb.

In the case of the city of São Paulo, according to data available on the City Hall portal [9], the demographic explosion occurred mainly in the years when the 1st and 2nd World Wars occurred, which were periods that favored the local production of consumer goods.

According to a survey conducted by the National Confederation of Municipalities (CNM) [10] in 2018, the city of Manaus has the fifteenth largest car fleet in Brazil with 363,000 units and the eighth largest motorcycle fleet with 184,000 units. The city also has the sixth largest bus fleet totaling 7699 units.

In comparison, the city of São Paulo occupies the first place in all the categories mentioned, having more than 5 million cars, 10 times higher when compared to Manaus. São Paulo is the only city in Brazil according to data provided by CNM [10] that has 7 digits in its number of bikes, this value being exactly 1,097,476 bikes, to overcome this value would need to join the other 4 cities that follow just below São Paulo in the survey so that if it were possible to reach a larger number than the SP fleet.

Based on the data collected by the CNM [10], it is possible to observe that the population of São Paulo has a large focus on individual motorized transport modes, be they cars or motorcycles. This mode of transport becomes unfeasible as the city grows as infrastructure is unable to accommodate such a high value of vehicles.

In a study conducted by the company Urban Systems for the Connected Smart Cities ranking [11], the city of Manaus was out of the 50 best cities in 2017 and São Paulo ranked first when analyzing urban mobility, in the 2018 survey. Manaus ranked 20th in the ranking and São Paulo maintained its first place.

According to the publication on the connected smart cities ranking (2018) [11] the criteria used to rank cities in the ranking include the proportion of buses per car, the average age of the vehicle fleet, buses per inhabitant, cycle paths and other modes of transport. public transportation, among others. These criteria are met by the capital city of São Paulo, which has the integration of different types of transport, with the largest availability of mass transit modes, with almost 100 km of subway lines and almost 300 km of rail lines. above that the city still offers over 400 km of cycle paths and has the largest offer of shared ride companies consisting of Uber, 99Pop and Cabify applications.

The city still has three urban bus terminals that connect the city with other Brazilian states, the city still benefits from the proximity and ease of access to the international airports of Guarulhos and Viracopos.

2.2.1 National Urban Mobility Policy

On January 3, 2012, Federal Law No. 12,587 [2] which established the National Urban Mobility Policy, similar to the master plan, was enacted. Federal law established that all municipalities above 20,000 inhabitants must draw up a mobility plan. The plans were prepared and effective from the beginning of 2015, so both cities of Manaus and São Paulo fit the criteria of the urban mobility plan.

As described in the Manaus Urban Mobility Plan (2015) [12] the guidelines governing its focus include the requalification of urban public transport, the implementation of the cycling system in Manaus, expansion and reconfiguration of the road network, among other guidelines. Observing the plan for the city of São Paulo [13], it has guidelines such as priority for public transportation, qualification of the public transport system and priority for pedestrians and active modes.

Based on the data arranged in both planes, the concern to prioritize urban public transport is noteworthy as it is more efficient in transporting the population when compared to individual modes. According to Folha de São Paulo (2016) [14], which performed a simulation on Pacaembu Avenue, took into account the average of the city of São Paulo, where a passenger car carries around 1.2 passengers per trip. 48 people, although a regular bus has a much larger capacity.

After the simulation the data obtained confirm the need for investment in a more efficient and viable public transport for the population, since for the transport of these 48 people only one bus would be enough and it occupied 50 square meters (m²), 48 bicycles occupied 92 square meters (m²) and 40 cars obeying the average of 1.2 passengers per trip occupied 840 square meters (m²). According to the Manaus Urban Mobility Plan (2015), 3.7 million trips are made daily in Manaus, 39.5% of which are made by public transport.

3.0 Methodology

To make the observation and comparison between the cities of Manaus and São Paulo, the objectives of this study as to the effectiveness of their urban mobility was used as a base bibliographic research, in national and international publications that serve as a reference for the evaluation of cities your urban mobility.

In order to observe the global panorama and identify the items that benefit the best cities in the urban mobility field, the Sustainable Cities Mobility Index 2017 [3] was published as the main source of research. the data for the 10 best cities in the urban mobility category, which uses the factors that make them the reference cities in comparison to the cities studied in order to understand the indicators that distance them, since only one of the cities studied Arcadis Rankings.

In order to observe the national panorama of Brazil where the cities are the object of the study, the publication Connected Smart Cities 2018 [11] by Urban Systems was used, paying attention exclusively to the item of mobility and observing the evaluation indicators to identify the main differences between the study cities. Thus, for the population and demographic density framework of Manaus and São Paulo, the data provided by the IGBE on its official website was verified, using the 2010 census data and the estimates of subsequent years.

In order to identify the priorities of both cities in relation to current mobility issues, we observed the urban

mobility plans available on the websites of the municipalities of both cities [12] [13]. Through the mobility plans it is possible to obtain data related to the amount of daily trips made in the study cities, the future projections for these cities and their priorities. Through these data tables and tables will be prepared to see which city is best aligned with your mobility plan and which city has the best alignment to the global landscape in future scenarios.

To obtain the values related to the vehicle fleets of the study cities, we used the technical studies provided by the National Confederation of Municipalities [10], thus obtaining the size of the municipal fleets of both cities and the relationship between the states, data These are used to compose the panorama of the current situation through graphs, identifying the collective and individual transport fleets. In order to obtain comparison parameters, the cities of Hong Kong, Singapore and Prague were used together to provide a perspective of the scenario of the cities under study regarding their private vehicle fleet and indicators. obtained from official documents of the Ministries of Transport of their respective countries.

4. Results and Discussions

From the results obtained it is evident the predominance of public transport as a priority in the global scenario, where cities are reducing the use of private cars targeting cities like Hong Kong and Singapore where the ratio cars per person is significantly lower when compared to the city. Manaus and São Paulo as can be seen in table 1.

Table 1 - Inhabitants / Car Relationship (2017)

| City	Population	Private cars	Inhabitants / Car Ratio
Manaus	2.130.264	358.429	5,94
São Paulo	12.106.920	5.582.546	2,17
Hong Kong	7.413.100	600.443	12,34
Singapura	5.612.300	502.187	11,17

Source: Author (2019)

However, it is possible to observe that the city of Manaus is still far from the Brazilian average of 1 car for every 3.89 inhabitants, an indicator that makes the city of Manaus reach higher positions in the ranking of Connected Smart Cities, the city of São Paulo, however, surpasses the Brazilian average despite efforts to reduce the.

Graph 1 [12] [13] [17] [18] shows that Brazilian cities have a large share of the use of the collective transport mode, similar to the major reference cities in Europe, however, through graph 2 [12] [13] [17] it is noticeable that despite the use of modal it is not efficient as its speed when observing the average speed of the buses that make up the collective fleets of these cities.

This fact weighs on the congestion indicators evaluated in the Arcadis ranking, since the reduction in bus modal speed is mainly due to congestion in cities. Although the city of Prague has a smaller urban area and a population 3 times larger than the city of Manaus, the average bus speed in Prague is almost 6.5 km / h higher than in Manaus, which is one of the objectives of the Manaus Urban Mobility which consists in

improving the modal bus system and its fluidity in traffic.
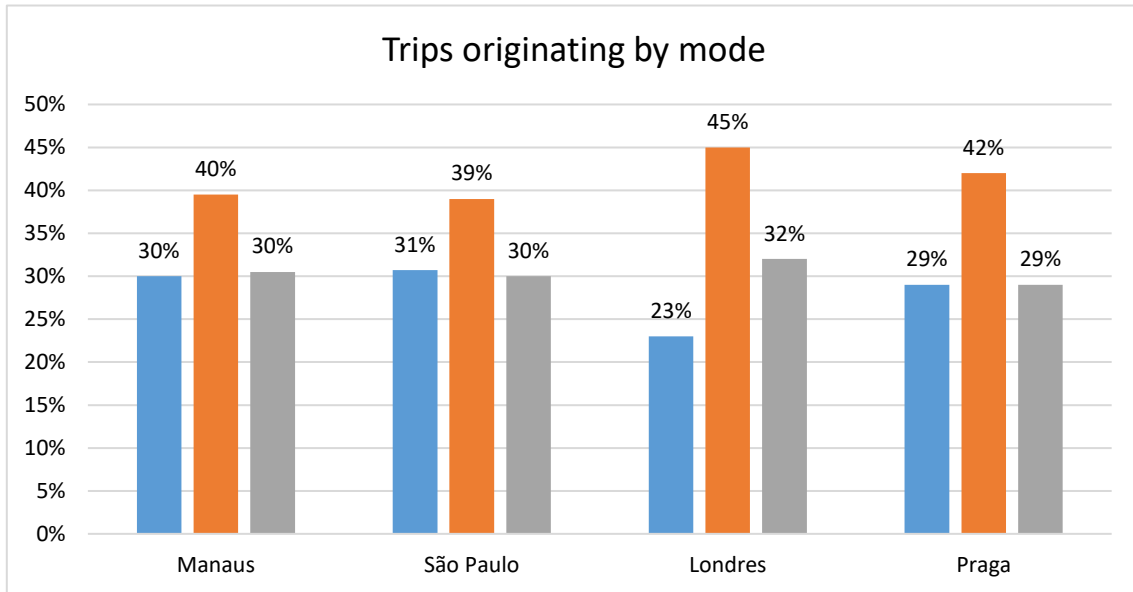
Graphic 1 - Trips by mode (2015)

Fonte: Author (2019)
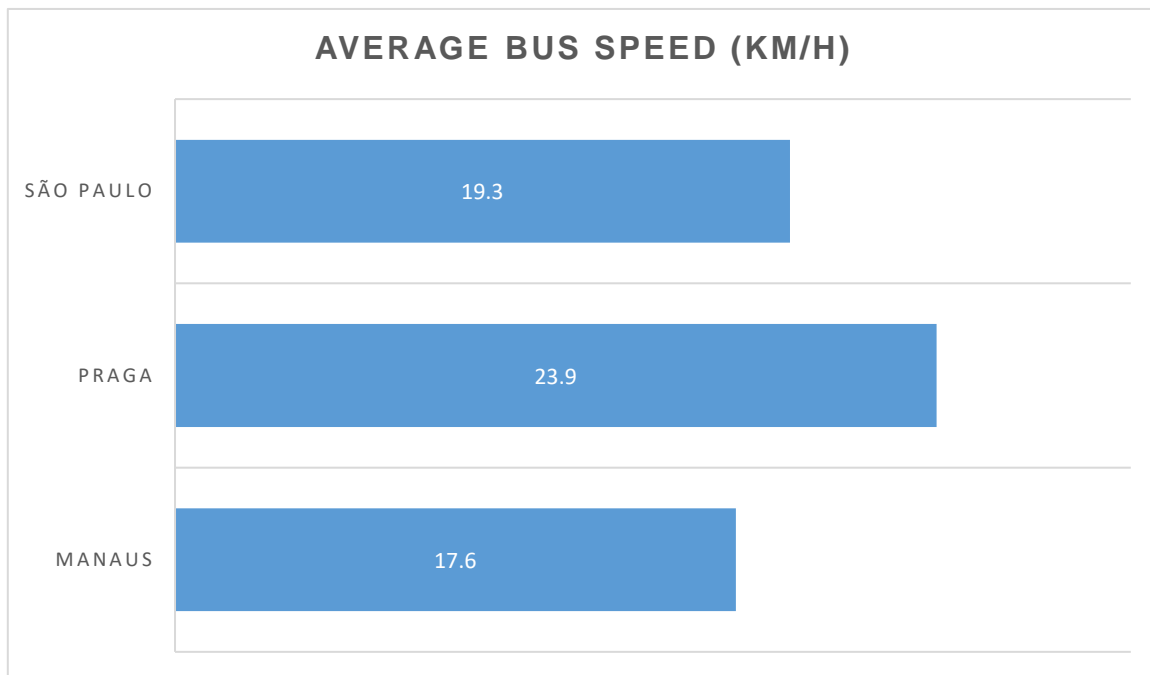
Graphic 2 – Average Bus Modal Speed (2015)

Source: Author (2019)

Being the share of trips made through the collective mode and the average speed very important indicators for the Arcadis ranking that ranks the city of Prague as the fifth best in the world in terms of mobility and São Paulo as the forty-seventh and Manaus out of the top 100. Although it is necessary to check two other indicators that account for most of the score, they are the fatal traffic accidents and the size of the cycling infrastructure that can be observed respectively in tables 3 [12] [13] [17] and 4 [17] [19].

Table 3 - Fatal Accident Ratio / 100 thousand habitants (2017)

City	Population	Fatal Accidents
Manaus	2.130.264	224
São Paulo	12.106.920	762
Praga	7.413.100	17

Source: Author (2019)

Table 4 - Cycling Infrastructure (2017)

City	Cycle Mesh (km)	Cycle Mesh / Total Mesh Ratio%
Manaus	37,4	0,46
São Paulo	498,4	2,93
Praga	477	12

Source: Author (2019)

It is observed that the city of Manaus has a very small bike mesh size when compared to the cities of Sao Paulo and Prague, where the city of Sao Paulo despite having a larger bicycle network than the city of Prague, the ratio when measured with The city's total network eventually declines to just 2.93% while the city of Prague has a cycling network that accounts for 12% of its total network, making it one of the city's priorities to opt for this environmentally friendly method of transport. environment and city decongestion. However, the São Paulo cycle network is a reference in Brazil and is one of the main points of the city in the indicators evaluated by Connected Smart Cities, where this same indicator is responsible for making the city of Manaus not reach higher positions.

5. Final considerations

The study was designed to present the points in which urban mobility reference cities stand out in comparison to the Brazilian cities of Manaus and São Paulo, highlighting the indicators in which both cities can evolve to become international references and improve the quality of life of its inhabitants.

Through the theoretical framework it was possible to understand the main points used in international and national ranking that classify cities and thus compare their strengths and weaknesses, thus obtaining a small overview of the points to improve.

Besides the possibility of study regarding the urban mobility plans of the capitals Manaus and São Paulo verifying thus the guidelines adopted by the municipalities in their projects and how they try to adhere to the global pattern present in the cities references of the urban mobility theme.

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