

ASPECTS OF URBAN TRANSPORT IN THE ENVIRONMENT: THE CASE "BUS RAPID TRANSPORT" (BRT) IN SÃO JOSÉ DOS CAMPOS MUNICIPALITY

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Abstract: - Concern for the environment is a key aspect in all contemporary public policies, among these policies, planning of urban mobility is one of the most important. A system that has shown positive results in several cities around the world is the Bus Rapid Transport (BRT), so we sought to evaluate the contribution of this system for the preservation of the environment in comparison to transport systems with conventional buses. From the evaluation of the city of São José dos Campos project, it was realized that the BRT's have positive characteristics compared to traditional vehicles, contributing to sustainability policies.

Key-Words: - BRT, Urban Mobility, pollution, environment

1 Introduction

Brazil is a country of continental dimensions, the integration of all its locations is a very interesting question, in addition, Brazil has 17 cities with population over 1 million inhabitants [3], which makes urban mobility is one of the main aspects of public managers. All this urban complexity has direct effects on environmental pollution, among the aspects of pollution, gases emitted by vehicles, is one of the main air pollution factors [4]. The search for quality and mobility efficiency is a challenge to be pursued, because each location has specific and different demands of others in regard to the needs of the population, relief, hydrography and climate. In the 70s, the city of Curitiba (Paraná, Brazil) served

as the basis of the implementation of the Collective Transport System with greater integration and quality services. Among the implemented projects, was created public transport lines in the model of Bus Rapid Transport (BRT). This caused the population to realize that good governance could bring quality services to their citizens. [1]

The BRT Project is a public transportation system by bus that aims to provide greater efficiency and sustainability in urban mobility, and to promote greater speed and acceleration of the flow in car traffic in cities around the world. As seen in Brazil, the project has already been implemented in several major cities, such as Brasilia (Federal District), Rio de Janeiro (RJ), Salvador (BA), Goiânia (GO), among many others, being implemented BRT system

for the first time in the country in 1974 in Curitiba (PR). [6]

The latest deployment of BRT's in Brazil took place in 2016 in the city of Rio de Janeiro, that with the Olympic Games in the same year, allowed approximately 11.7 million passengers were served during the event [2]. Currently, BRT is already deployed in 140 cities around the world.

2 The Bus Rapid Transport (BRT) in São José dos Campos

From the successful experiences mentioned, the implementation of BRT in Curitiba and Rio de Janeiro, other municipalities have sought to adopt the same solution for improvement in urban transport systems for passengers and improving urban mobility. São José dos Campos is an example of these cities, located in the state of São Paulo (Figure 01), in the Southeast, is an important economic development center of the country.



Figure 01: Location of the city of São José dos Campos in São Paulo

São José dos Campos is a city with economic development rates above the national average (Table 01), with an important set of industries mainly in the aeronautics segment (EMBRAER) and important educational centers (Technological Institute of ITA Aeronautics and Federal University of São Paulo (UNIFESP), and the implementation of the BRT can serve as a model to be used by other municipalities.

Table 01: Comparison of Economic Development Indices [3]

ECONOMIC DEVELOPMENT – IDH 2015	
SÃO JOSÉ DOS CAMPOS	0,807
SÃO PAULO	0,783
BRASIL	0,727

2.1 Urban Mobility in São José dos Campos (SJC)

As noted earlier, São José dos Campos is a city with a high economic growth rate in comparison to other municipalities. In Brazil there is a culture of individual transportation as a synonym for comfort and status (Figure 01), as most transport services does not meet the expectations of efficiency, quality and comfort of our population.

Therefore, the population of São José dos Campos can get around most of own transport (cars and motorcycles), which in the near future, it may generate greater congestion and parking lots, air and noise pollution and increased accident rates. With a quality public transportation, the population would benefit, as would raise the quality of life of people currently suffering in bus queues and use a road network without an efficient interconnection system.

FROTA DE SJC 398.816 VEÍCULOS

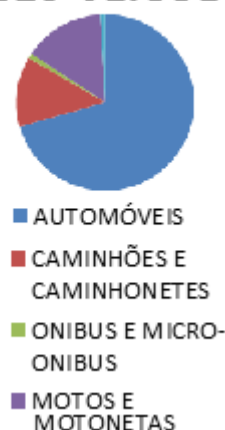


Chart 01: Vehicles Fleet Distribution in São José dos Campos

The quality of transport should be compatible to the industrial economic city park which has 1,863 industries, among which several large companies in the global scenario, such as Embraer, GM, Avibras, Mectron, Johnson & Johnson, Monsanto, Petrobras, Vale Solutions Energy among others. The human contingent that these companies employ (about 46,600 workers in 2013) require a more efficient mobility.

2.2 The Project São José dos Campos and the search for a more sustainable transport

Reduce environmental impacts, boosting the car flow and improve urban mobility are the main

objectives of the Project. And there are several features in the Project to demonstrate how their innovations can become more sustainable regional reality of transport and also streamline the flow of people and cars with greater harmony between environment and urban mobility.

There in Sao Jose dos Campos, the appreciation of environmental preservation, and 52.36% of the territory is protected area. The municipality has a total area of 1099.6 square kilometers. It has seven public urban parks (Parque Santos Dumont, Roberto Burle Marx Park, Green Park, the Herons Way Park, Aranha Vicentina Park, Senhorinha Park and Alambari Park) in an urban green area 1.3 square kilometers to 353.9 square kilometers of urban area Total [5].

The installation of BRT, facilitating the displacement of the population and consequently reducing the flow of private vehicles, should collaborate in the preservation of green areas and the reduction of environmental pollution.

As the population is predominantly established in the urban area (Figure 02), and the municipality extends over a vast region, BRT should facilitate the movement of citizens (Figure 02).

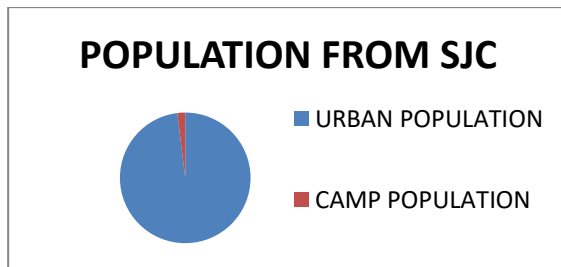


Chart 02: Population Distribution in São José dos Campos [3]

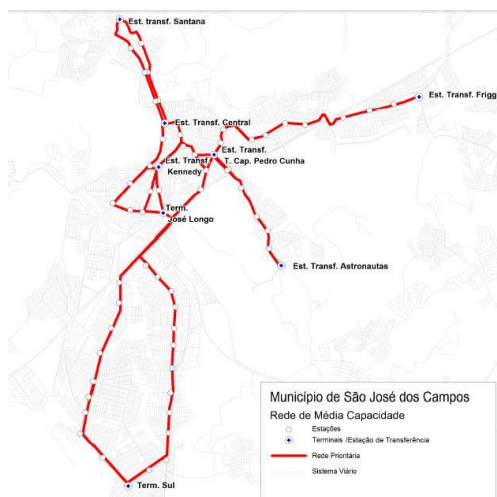


Fig. 2 Network first phase BRT São José dos Campos

2.4 Air pollution

Air quality is monitored by the Environmental Company of the State of São Paulo (CETESB) for a specific station. Although not present air pollution levels comparable to large cities, it is necessary to take measures to prevent the advance and rewind the current levels of pollution, and major pollutant emission problems are caused by "burning" [4] areas of cleaning processes where they put fire in the existing vegetation, and are considered crimes with imprisonment and fine.

Vehicles and industries also emit pollutants in considerable volume. All these factors damage the health of the population, fauna and vegetation and can interfere with the heritage of the city (corrosion and deterioration of public goods). As a way to mitigate air pollution caused by vehicles, the implementation of BRT would remove a large portion of the roads vehicles. And with prior planning, the city could grow sustainably without causing harmful impacts on the environment.

Based on the planning and within the available resources, demand changes (daily and seasonal variations) and other external factors, carried out the programming of PT services, always seeking the best relationship between supply and demand, generating orders operational service (daily schedule), detailing:

- Amount and allocation of line for vehicles, often traveling time, itineraries, timesheet (timetable); and
- Allocation of human resources (drivers, sales agent).

2.5 Noise and Visual pollution

The implementation of the BRT should also bring an improvement in the levels of noise and visual pollution. With the reduction of private fleet of city roads, the bus must have a much smaller impact on noise pollution, less traffic, the noise of cars accelerating, braking and honking must be reduced substantially.

To ensure visual comfort, the implementation of a standardized system of color and signposts to identify the vehicle, gives users greater ease of movement and connection between neighborhoods and a cleaner look of the city.

With the minimization of various types of pollution, health improvement of population, reducing the level of stress and increasing the quality of life.

2.6 The BRT project compared to conventional buses

The vehicles of the BRT system are designed for greater efficiency and comfort of the users, while conventional buses have a capacity ranging from 50 (fifty) to 150 (one hundred fifty) passengers, BRT seeks to increase the capacity to approximately 200 (two hundred) passengers, expanding access to bus and making it faster traffic, also reducing the average interval between vehicles. Moreover, the specific bus of this system have a larger structure, with greater comfort for passengers and the driver with various ports to facilitate inflow and exit of individuals [2]. According to Philip Abramovitch (2014) [9], conventional buses have an average speed of fifteen (15) kilometers per hour compared to 23 (twenty-three) to thirty (30) kilometers per hour BRT, as can be seen given by the BST would increase by approximately 50% the average collective speed. The project has characteristics in its structure and system that assist in better balance between public transport and the environment, promoting less pollution, less environmental impact and encouraging sustainability in the social reality of big cities.

An example of contribution to the environment, were the best practices of BRT in Rio de Janeiro, in the Barra Grove station, solar power is present, this energy feeds the battery turnstiles, some essential systems such as automatic doors, and lighting inside the station.

Regarding the cost factor, the BRT has a lower implementation cost compared to other types of transport, thanks to its technology that is 100% national and exclusive corridor for the operation of the bus, allowing greater speed and regularity [6]. Furthermore, BRT buses are larger in their structures, therefore, their operating costs are lower because they can withstand a much greater number of people than a conventional bus.

Figure 03 below shows the BRT system over other systems in the item passenger carrying capacity per hour-sense:

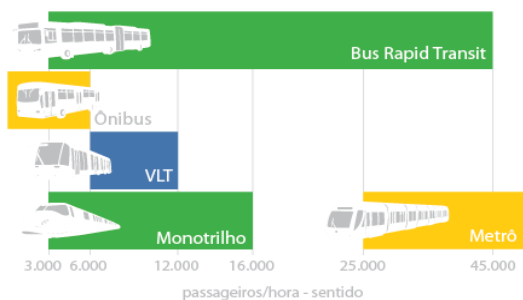


Figure 03: Scheme passengers / hour - sense [6]

Another important factor for the reduction of pollutants is that although much of the BRT buses are diesel, which is one of the main pollutants in cities, there is a constant search for these vehicles are used more favorable fuel the environment such as ethanol and biodiesel, but especially the latter. Biodiesel is made from renewable sources such as soybean oil and animal fat, emitting less polluting than diesel itself [8]. Also in relation to biodiesel and according to the Ministry of Agriculture (2013) [10], in relation to air quality in the city there is a decrease of 70% pollutant emissions when considering pure biodiesel. As these renewable energy used in BRT, it contributes to the reduction of pollution in large urban centers, improving the quality of life and making the air cleaner.

Next, the graph 03 of Abramovich [9], we evaluate the comparison between the pollution of conventional buses and the buses of the BRT:

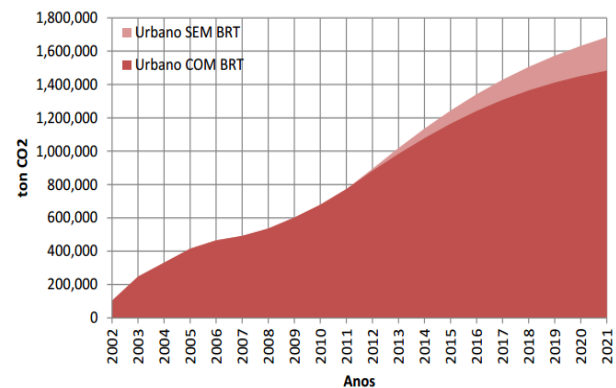


Figure 03: Analysis of CO2 emissions for urban buses with and without the BRT system

Despite technological and sustainable design, diesel is still the predominant fuel in BRT, as analyzed by the National Association of Urban Transport Companies (NTU) in 2012. And even with the predominance of diesel you can see the improvement in mid-year 2012 forward, the BRT system emitting less pollutants into the atmosphere. This is because there is a strong search for renewable fuel, such as biodiesel previously mentioned and alcohol.

The characteristics previously mentioned about the BRT system demonstrate their ability to make more efficient and sustainable urban mobility, which is the main objective of the Project. These characteristics accompanying the technologies are increasingly designed to transport and incorporate this process the environment in order to build an increasingly negative and less harmonic relationship.

3 Conclusion

With the phenomenon of global warming, there has been an environmental imbalance, an increase of CO₂ in our atmosphere, we know that the greenhouse effect leads to an increase in global temperature, heat rises and consequently, our health is affected, we perceive this vulnerability of the population and the need for measures to reduce this environmental impact this imbalance.

We also realize that the emission of gases in the atmosphere increases with economic growth, as many industries and industrial processes, more people using cars as a means of mobility and mostly inefficient public transport. Although deforestation of the Amazon region has contributed to global warming, we can not ignore our share of direct contribution in this environmental vulnerability scenario, we know that one of the biggest polluting gas emitters in the atmosphere is the public transport as well BRT comes as Project one alternative with a vision of the need for environmental awareness improvement by our public officials.

People need quality public transport so you have more urban mobility options, so consciously collaborate with our managers in search of improving the lives of the population and greater environmental awareness, when everyone is involved in the necessary process changes, these changes can lead to less resistance and greater legitimacy and acceptance of actions by the population.

In this context the proposed BRT is a modern alternative to traditional public transport, aiming at a greater adherence of the population in the use of public transport, it offers an alternative to the population and contributes to the reduction of congestion, a problem that will only increase with population growth and its complexity, BRT creates an alternative to reduce the flow of private cars, improving the population's quality of life by providing a public transport quality and providing an improvement in urban mobility with reduced environmental impact compared to other means of transport. As seen with the analysis of the BRT project and its impacts on the environment, we can see that the strengths compared to the negatives make BRT a viable alternative to the big cities.

The Brazilian reality of urban mobility is a reality common to many major cities around the world, damaging the health of people with high concentration of people and cars, large congestion as discussed above and the absence of proper planning that meets a more dynamic flow [12]. The BRT project arises in a context that can not be ignored, and affirms the need for change and improvement of this

reality, so it is an investment that can bring good results in the medium and long term.

Despite large investments in traditional bus technology, renewable energy and a more advanced and sustainable structure, the results show that the BRT allows this most harmonious relationship between society and environment, avoiding large emissions of pollutants into the atmosphere and making that urban mobility is not as harmful to the environment.

Moreover, the simple society initiatives can make much more dynamic and sustainable process. People feel included in the process to promote the preservation and balance between the environment and development of transport, they are encouraged to have sustainable practices because there is an exchange. In addition to sustainability, BRT provides more comfort in the daily lives of passengers and the driver himself and avoid from problems in the flow (car congestion, traffic, disruption in traffic flow) as well as social problems and the very health of urban society (breathing problems, everyday stress, conflict and extreme tiredness).

Considering the characteristics and presented data, it is possible to conclude that the BRT is a system that continuously grows around the world because it has significant results to sectors of society as a whole. It is a project that is growing in Brazil because it is an efficient alternative to congested major cities of the country and to mitigate the conflict between transport and environment, and to promote improvement in social life and health of urban society. Despite the obstacles (such as the predominant fuel still be the diesel and the initial investments required), the BRT project has strengths that justify its implementation, promoting the development of cities and the country and improving the environmental condition of the mobility of their society, implementing a balanced relationship between technological and industrial development with a sustainable concern for the environment.

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