

## **GEOPROCESSING APPLIED TO THE STUDY AND IMPLANTATION OF BICYCLE PATHWAY IN THE DISTRICT OF VILA CARRÃO, SÃO PAULO**

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### **Abstract**

This article aims to propose a model to assist managers and other decision makers in urban planning in the study of the best location for the implantation of a bicycle path. For this, it seeks to emphasize the importance of the use of geoprocessing techniques in consonance with the criteria involved in this means of transport, as well as demographic aspects and other factors, with emphasis on urban planning and mobility. The region where the study was conducted is located in the city of São Paulo, where the various factors that influenced the use of bicycles in this locality were investigated. The use of the geoprocessing together with the field visit used in the research proved to be efficient in obtaining data and models capable of assisting in the construction of assertive processes in decision making, which led to the proposal to implement a cycleway linked to two important poles and travel attractors.

**Keywords:** Mobility, Geoprocessing, Urban Planning, Bicycle Path.

## Introduction

The unbridled growth experienced in the urban centers in the middle of the twentieth century ended up exposing the unpreparedness and lack of urban planning of the great metropolis on the part of its managers. Such neglect of this theme has led to the agglutination of large portions of the populations in the more peripheral areas of the cities.

The history of urbanism in São Paulo begins in this same period and is directly linked to the creation of the public works sector, destined to the cadastral mapping of the city, the opening of new roads and its paving. (SIMÕES JR., 1990).

The large contingent of people migrating to the cities in search of work has led to the exponential growth of the population in the metropolis without proper planning. Associated with the low remuneration received

in return for the labor force, and the fact that the demand for employment did not reach all, many individuals were forced to settle in regions further away from the center, places without the minimum of essential public services, such as, basic sanitation, the first favelas are established. (PAULO, 2011).

With the majority of the population located at the ends of the city, and the supply of jobs concentrated in the great center, the model of transportation that has been disseminated throughout society, motorized has been adopted. At first, it was considered as the only alternative to travel to the capital of São Paulo, and over the decades it became the ideal of consumption for many people to escape the poor service of collective transportation.

This positioning contributed to our current crisis scenario in urban mobility, as the cities ended up favoring one mode of transportation to the detriment of the others, the individual automotive. As a consequence, public spaces gave way to numerous avenues in order to drain the growing fleet of vehicles.

In this way, the interventions directed to other modalities of transport have become stagnant due to the lack of localities for their implantation. With this, the employability

of new techniques of data collection and analysis became indispensable for more assertive decision making.

In this way, geoprocessing emerges as an effective alternative to obtain models that are consistent with reality, and of a better interpretation of the actors involved in the decision-making processes of cities. Making a foundation capable of directing improvement actions for both planning and urban mobility.

The present study consists of an approach that aims to demonstrate the applicability of geoprocessing as a facilitating tool for urban planning, where it is intended to use its techniques in the analysis of parameters for the implementation of a cycling infrastructure, besides proposing the choice of the best route in a given region of the city of São Paulo.

The research also sought to highlight the concepts involved in this theme to bring the discussion a panorama of bicycles at the national level, and the events that made possible the emergence of cycle paths. In this way, intend to expose the importance of reviewing the policies destined solely and exclusively to a specific modality of transportation.

## **Theoretical framework**

### **Urban Mobility**

Urban mobility has become a hot topic in the debates of public managers and the civil community, as it is one of the most relevant guidelines for day-to-day living in large conurbations.

For Campos (2006), urban mobility can be contemplated through measures directed to the best of land use and occupation, as well as to provide transportation management in order to guarantee the accessibility of goods and services to all inhabitants.

In this perspective, it is essential to formulate policies aimed at promoting the fairness of transport on urban roadways, where priority must be given to higher-capacity and less polluting modes, like a bicycle and walking.

Implementations of new transport models can consequently suffer heavy retaliation from the modalities currently favored by the current urban planning format.

In cities such as São Paulo, where the predilection for automotive vehicles became latent in the mid-twentieth century, it is possible to conceal measures aimed at guaranteeing an egalitarian space in the municipal road system. According to Villaça; Zioni (2005), this fact is due to the commitment of classes with greater purchasing power to optimize the time of travel between their homes and workplaces, so they end up pressing the use of motor vehicles, as they do not find it difficult to access their points of interest.

The change of this current paradigm passes through the implementation of new methods capable of making possible the verification of models, in order to facilitate the decision making by the portion of actors with the power to infer. To discuss the urban transport policy in order to implement bicycles as a mode of transport, it is an important measure to disseminate it along with other means of transportation (PETTINGA et al., 2009).

### **Bicycles In The Brazilian Context**

The bicycle is considered as one of the most democratic means of locomotion and most used by Brazilians since it is accessible to all social classes present in the public road. Its presence is noticeable both in developed regions, with greater infrastructure, and in the peripheries and rural areas, in which a large portion of individuals with low purchasing power attends in many different ways your necessities. (BRASIL, 2007).

It is also noted that its use requires greater attention from the authorities belonging to a population of 60 thousand people, where it represents 14% of travel intentions, to municipalities with 500 thousand inhabitants, in which motorcycles have equal representation. It is thus a vehicle used by an expressive number of people in various localities of the federation, regardless of the cultural aspects, inclement weather, purchasing power or level of schooling. (BRAZIL, 2007).

Although these data are more than ten years old, the results demonstrate the potential of using this modal as alternative transportation in Brazilian cities. Data produced by

Brazilian Association of Industry Import Trade Export Bicycles, Parts and Accessories (ABRADIBI), related to sales show that the size of this fleet may further encompass the opponents of this modal category and inflate its quota in the road systems.



Chart 01 - Evolution of the bicycle market - Sales (units).

Source: Author, adapted ABRADIBI, 2016.

Chart 1 shows that during the period from 2005 to 2014, the level of sales remained practically stable without an upturn in the level of consumption, even in a period of economic recession (2008), which shows the great demand for the medium carriage.

Contrary to the belief of many, its use as a mode of transportation is not related to a simple demand question, since the supporters of this modality adopt it because they see incentives for its use. According to Aves and Galves (2016), only the competitive advantage between travel times is not enough for people to use the bicycle on their journeys. There are many variables to be considered for your capillarization in the urban context.

It is worth in this point to portray the fragility of the cyclists before the other components of the road system since these are more exposed to the weather and are susceptible to accidents when they are faced with the lack of infrastructure to receive them. Like this, the lack of spaces and security restrictions end up impeding the consolidating a road infrastructure for cyclists (Gondim, 2001).

From the moment in which its implantation considers the attraction motives of the cyclists, bicycle trips tend to consolidate, even in the face of automobile repulsion (ANTP, 2007).

For this, it is fundamental to identify these factors and take them into account in studies of implantation of cycle paths. Brazil (2007), describes several aspects to be considered for the implantation of cycle paths, among some criteria are: (1) to take into account the slope of the terrain; (2) social-demographic aspects; (3) road hierarchy; (4) address points of interest to cyclists; (5) promoting intermodal integration with other means of transport; and (6) cover areas with traffic-generating poles.

## **Geoprocessing**

Geoprocessing is one of the resources that has gained space in urban planning, its use is characterized by encompassing various information systems to portray models as close as possible to the real world. One of the most adopted systems for this resource is the Geographic Information System (GIS), composed of mathematical techniques and areas of computing geographic data processing (ANTONIO, 2013).

According to Pereira (2001), the advent of geoprocessing occurred between the 1960s and 1970s, along with the evolution of computing in this period in related fields that enabled the emergence of the Digital Terrain Model (DTM), Computer Aided Design (CAD), among other innovations.

One of its greatest attributes is the fact that it facilitates the analysis of data banks since it uses graphical and cartographic resources to demonstrate several types of information. In this way, it provides managers and urban planners with a dynamic tool capable of establishing several interdisciplinary relationships in fields such as Urban and Environmental Planning (ANTONIO, 2013).

The adoption of this system in the processes of case studies and in the observation of the phenomena arising from urban space may contribute to more assertive measures and decision-making capabilities of obtaining a better return to society and also reducing the number of resources necessary for these activities.

## **Methodology**

This study is descriptive in which, according to GIL (2002), it seeks to describe the aspects of certain populations or phenomena or proposes to investigate the level of service of public services. As for the means of investigation, it fits in bibliographical research and case study.

The case study, according to YIN (2015), aims to investigate and understand complex social phenomena, where it is investigated in its natural environment, focused on contemporary events. In order to understand the research problem, data were collected from electronic websites of public agencies in order to validate the data obtained.

The other data were obtained through a field visit, to ascertain the situation of the equipment intended for the use of bicycles. The development of thematic maps was performed in the open source software for geo-processing Quantum Gis 3.2 Bonn, for the manipulation of georeferenced files, its use in the study was due to the fact that it is free and easy to use program that made it possible to compile and manipulate the data in a practical way.

Information on topographic aspects of the terrain, demographic density, locality of traffic generating poles and existing bicycle infrastructure was used in the study, in order to suggest the implementation of a cycle route in the region.

## **Case study**

The study area of this work is in the eastern zone of the municipality of São Paulo, in the district of Vila Carrão. The region has an estimated area of, 7.5 km<sup>2</sup>, and a population of approximately 83,281 inhabitants, and a population density of the order of 11,104 inhab / km<sup>2</sup> (SÃO PAULO, 2017).

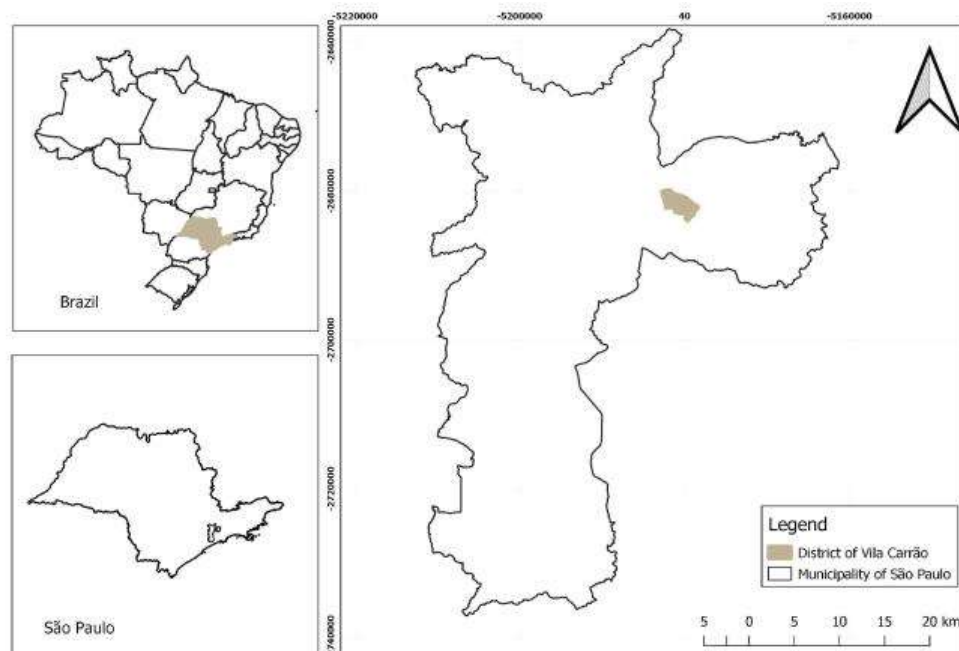


Figure 01- Location of the study area.

Source: Author, based on METRÔ, 2007.

The choice for this area of study is due to its proximity to important traffic-generating poles, a large public transport service, and the presence of important road cycling equipment to be connected.

It is understood that the district needs to connect to the other cycle equipment because it is in an important corridor of connection with the central region of the city. Another point to consider is the number of the population of the surrounding area, citizens from which they access their limits to move to the workplaces, or other activities, not only in the capital but also in its surroundings and in the neighboring districts, as Tatuapé and Mooca.

Another favorable point for the construction of a bicycle lane in this locality is the representativeness of the movements performed by bicycle outside the zones of origin (figure 02).

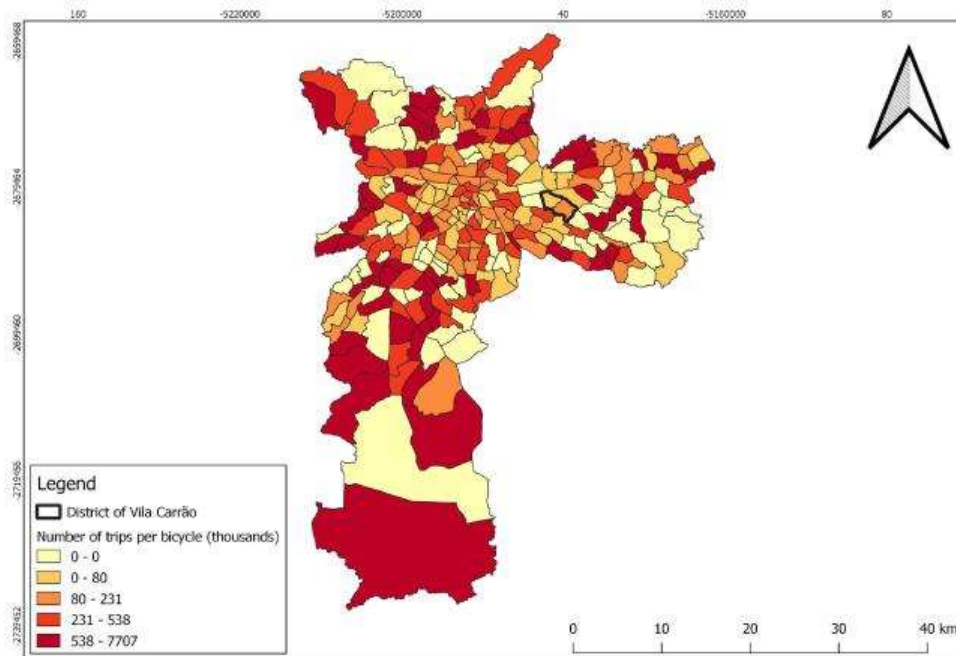


Figure 02 - Number of trips per bicycle made daily.

Source: Author, based on METRÔ, 2007.

Although the data date from 2007, and currently the most recent research is still not available to date, this scenario already demonstrates the need to think public policies aimed at this issue. It has to be considered the current infrastructure implemented to date, in which it has 498.3 km of bicycle routes, of which 468.0 km are cycle tracks/ cycle paths, 30.3 km are cyclic routes, intermodal integration, the municipality counts on 6149 parking spaces and 121 parabolic units installed in bus terminals and train and subway stations (CET, 2018).

Although it has counted on the increasing investment, the implantation and location of these enterprises encounter with a certain lack of courage on the part of the managers and urban planners, with this it, is not difficult to realize how the dispute by space in the highway tends to favor the automotive ones to the detriment two cyclists. These, in turn, are obliged to travel in narrow and poor bands (figure 03).



Figure 03 - Cycle course implemented in the district of Vila Carrão

Source: Own collection, 2018.

The images show the way the space dispute faced by the cycle paths occurs. In order not to take tracks intended for motor vehicles, many are squeezed along the curb, which can be considered part of the range for cyclists as long as they are in good condition, provided they have the proper treatment (BRASIL, 2007).

For example (A) referring to the Vila Carrão cycle track, one has the notion of the state in which a good portion of these roads are encountered, cause the middle wire is in most cases in poor conditions, there are in certain points, ramps are used to give access to the garages of residences and trades. A very common interposition is that of trees without pruning that invades the slopes (B).

Another problem detected in the cycling route is related to the sinuous path faced by cyclists, making it little used and the reason for questioning by the residents of its vicinity.

## **ANALYSIS AND DISCUSSION OF RESULTS**

The application of the geoprocessing enabled a design based on the data collected more consistent, with a path generally performed by cyclists, in turn, it is, also worth noting the importance of the field visit to carry out the measurement of the data represented in the thematic maps.

Thus, the parameters adopted during the study were then used to select the path of a cycling path. The proposed route aims to connect neighborhoods of the region, crossing the more densely populated parts, in order to connect with the existing "Green Way" cycle path, which interconnects the neighborhoods of Itaquera and Tatuapé.

Another criterion adopted for this design is to guarantee cyclists the connection with the Carrão subway station, whose structure has a public bike rack and allows the transfer through its urban terminal, access to bus lines to the central region, and neighborhoods of the east zone and intercity bus.

These proposals come against a probable alternative route to the detriment of the existing infrastructure, precisely because it does not count on a linear route and enter terrain with constant sequences of slopes and slopes, in addition to travel points of little interest to the users of bikes. Figure 04 shows the comparison between the already implanted trajectory (red traced) and the indicated one based on the data collected in the study (traced in black).



Figure 04 - Study of the location of the route.

Source: Author, 2018.

It is intended with this route, crossing avenues and streets of less intense traffic to connect the region of Vila Carrão with the district of Tatuapé, these routes, in turn, on-site visits have demonstrated to have a considerable amount of people accessing to jobs and public equipment. Based on this scenario, it was sought in the proposal of intervention presented in figure 05, to consider in the choice of the track route routes

that would provide greater safety to cyclists, as well as smoother paths in order to assure them greater comfort in the displacements.

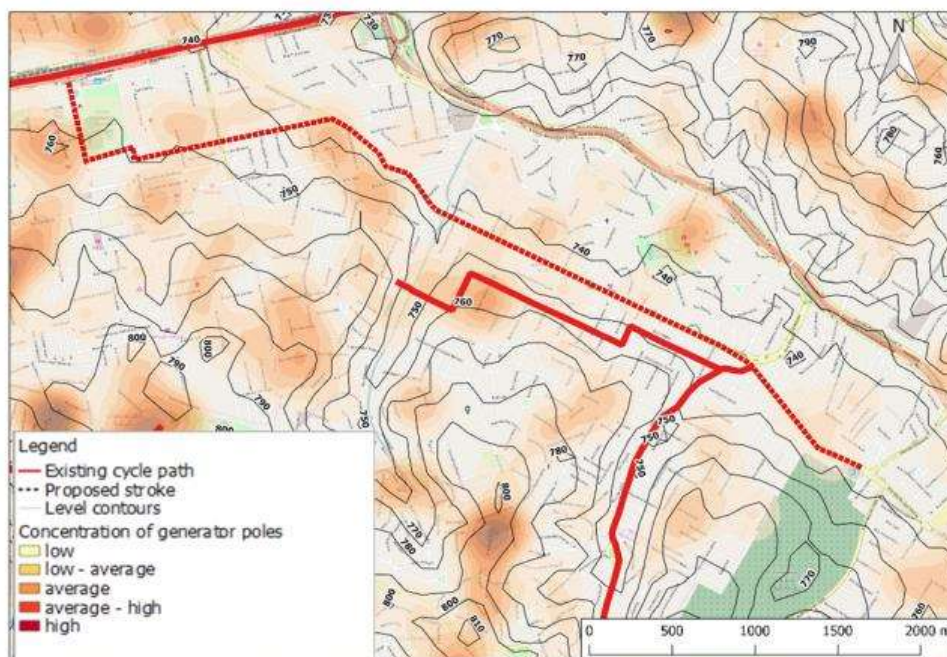


Figure 05 - Proposal of a bicycle path.

Source: Author, 2018.

The smoother paths allow for less tiring routes to the adepts for bicycle trips, as well as allowing them access to trades and services allocated in the surroundings of the route, this change allows more practical access to the trades and service providers, so it can be stimulated the use of bicycles to get to jobs and possible points of interest on the part of cyclists.

### Final considerations

The decision to locate a cycle route should consider certain aspects, which may generate interest on the part of cyclists in using their daily commutes. It should also be aimed at meeting the demand of its users, not only in terms of the number of journeys made in its route but also meet the needs of those who choose this mode of transportation.

In the search for techniques to be used in order to achieve these objectives, the use of information systems linked to the knowledge of interdisciplinary areas can provide urban managers and planners with an efficient data set in decision making.

The model presented in this study, based on the use of geoprocessing, has been plausible in view of the need to impose new resources aimed at a better way of evaluating urban planning measures.

The geoprocessing technique presented together with specialized bibliographical references, coupled with the field visit, may favor the study and analysis not only of urban planning and transportation issues but also of other fields in which the public authority operates. Although this research has been restricted in addressing some of the criteria necessary for the implantation of cycling routes, there are no obstacles to other models being elaborated on this presented, through other aspects not raised in this study.

Even so, it is possible to affirm that the model presented in this research can meet the premises for the implantation of a bicycle infrastructure compatible with the reality and the wishes of the bicycle enthusiasts. The adoption of geoprocessing can help in the decision making of a better route, conceivable to the displacements within the current road network and with the other members within the urban fabric of the metropolis.

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