Extended Abstract


Rio de Janeiro city has a wide range of urban transportation. Subway, trains, buses, bike paths, cable cars and also water transportation. Recently, these modes have been awarded with public investments: expansion of the subway, modernization of railways, construction of dedicated lanes for buses and bicycle paths, and the number of boats on the water transport has increased. However, the improvement in the quality of urban mobility at the city is not perceived. Traffic jams, crashes in urban facilities, overcrowding of public transport and poor conditions of services are part of the public transport problems in the city. This research analyzes the VII Administrative Region São Cristóvão (VII RA-SC), comprising the following neighborhoods: São Cristóvão, Benfica, Mangueira and Vasco da Gama. These places have great passenger capacity of transport modes (train and subway) and also features several bus lines that make the interconnection with the rest of the city and also with nearby cities. The region also has several urban equipment, such as public parks, shopping and leisure centers, hospitals, museums, educational institutions and is also home to large companies in the telecommunications segments, engineering and oil industry. The overall objective of the research is to evaluate the VII RA-SC from the perspective of sustainable urban mobility from an index that incorporates the social, environmental and economic dimensions. The specific objectives for the development of analysis are reviewing the literature on sustainable urban mobility, the existing legal framework, characterization of the existing transport system in the VII RA-SC, modeling and calculation of Urban Mobility Index – São Cristóvão (IMS-SC). The calculation of IMS-SC has limitations due to the unavailability of recent data. Initially, the reporting period was the years 2012 to 2014. However, certain data only have surveys until 2012, therefore, researched period is between the years 2010 and 2012.
The subject Urban Mobility can be subdivided into four sub-items: definition the concepts of Urban Mobility and Sustainable Urban Mobility, establish the connection between land use and planning of transport, defining the macroaccessibility and microaccessibility concepts and presentation of the legal framework in planning public transport in Brazil. Thus, draws up a panel of concepts on the subject and how the public planning has been organized according to the new concepts that have been introduced in the thematic discussion.

Lately, the Urban Mobility expression has been often used, in many diverse ways. The popularization of the term is positive, because the debate does not end with the government, it involves ordinary citizens with a problem that affects everyone, regardless the social class. However, the trivialization of expression may be negative, especially when authorities think about the issue of urban mobility in a simplified way. The improvements in urban transport tend to fail when deployed without a planning of the transport system and without the awareness and participation of the people directly involved. Not only by lack of planning, but also by lack of information to people affected by the changes. In a recent research conducted in several European cities, at EURFORUM (2007), many problems about urban mobility were raised, and the challenges looming on the future. Despite the differences between these cities and the Brazilian ones, it seems that they all have similar problems: uneven growth in transportation, huge traffic jams in the cities due to the increasing use of private vehicles and imbalance in the division between the transport modes and harmful effects on the environment and public health generated by vehicles powered by fossil fuels. The same problems have been observed in Brazil. In a generic way, it addresses the problem of urban mobility with the purpose of moving people and goods according to your requirements. However, providing transportation has not brought satisfactory results for the cities and their populations. In this sense, the research brings a new concept of sustainable urban mobility, a theme that has been studied by several authors. The establishment of this concept is crucial so that we can understand the problem in all its entirety, which could lead to a solution of the problem completely. According to the EURFORUM (2007), the objectives to be pursued in the planning of sustainable urban mobility for a city must be: accessibility, sustainability, integration of transport modes and also from
demand management, reduction of pollutant emissions and noise, road safety for all users of the transport system, development costs in the transport system in order to establish a fairer pricing system, taxation so that the cost of transport infrastructure is seen as associated with the shortage of a particular well, verification of quality standards in accordance with pre-established indicators and competition among transport system operators to be optimized its technical efficiency and is stimulated the development of innovative initiatives.

The relation between land use and public transport planning is explained by the influence that both issues have on each other. That’s why is necessary to understand the connection between the themes. The transport system can be an inducer of occupation of a given region, according to the land use conditions, and land use may increase the use of public transport as well.

Accessibility is the ease of movement of from one place to another, by a means of a transport mode. It can be subdivided in two others: Microaccessibility refers to the ease of access to means of transport and desired destinations. The Macroaccessibilidade refers to the ease in crossing the space and achieve desired urban buildings and equipment.

Since the beginning of the Brazilian democratization process in 1988, several laws were developed in a way to plan and organize the public transport, be it federal, state and municipal levels. At the federal level can be cited: the 1988 Constitution that established the guidelines of the urban development policy, and hence the planning of public transportation, placing both under the responsibility of municipalities. The Statute of Cities (Estatuto das Cidades), law enacted in 2001, establishes guidelines for the Master Plan of cities and adopts the mandatory preparation of an urban transport plan in accordance with the size of each municipality. In 2005 it established the Resolution 34, which deals specifically with new guidelines for the preparation of the Master Plan and the Director Plan of Transport and Mobility. The PlanMob Guide, launched in 2007 and revised in 2013, proposes methodologies in order to assist municipalities in developing their transport plans. In 2012 has been launched the National Policy on Urban Mobility, which introduces the most current concepts of urban transport planning. At the state level, was launched in 2014 the Master Plan for Urban Transport of Metropolitan Region of Rio de Janeiro (PDTU RMRJ), which
outlines a diagnosis of the study area transportation and proposes some solutions for public transport. At the municipal level, the Master Plan of the City of Rio de Janeiro, launched in 2011, deals with the urban policy in the occupation and land use, the planning of public transport and the connection between the themes. Finishing the theme, the City of Rio de Janeiro is preparing the Urban Mobility Plan of the City of Rio de Janeiro, which must organize and plan the means of public transport by the year 2026.

The aim of this study is to analyze the VII Administrative Region São Cristóvão (VII RA-SC) from the perspective of sustainable urban mobility with a view that the central research question demand to see how some of the challenges to achieve sustainable urban mobility in Rio de Janeiro behaved between 2010 and 2012, when the city received many investments in urban transport area. As cutout for the case study of this exploratory research, the question is put back for VII RA-SC: How the transport system in this region behaved in the period studied from the perspective of sustainable mobility?

It is necessary to clearly define the concepts of INDICATOR and INDEX. Sometimes the terms are confused and even considered synonymous. Thus, it is necessary to define them correctly, so that further discussions on the adopted methodology may be easy to understand. The INDICATOR is, more simply, the data collected from a particular phenomenon. Its main objective is to aggregate and quantify information in a manner that their significance becomes more apparent. The INDEX concept is to analyze data through the addition of a set of elements with established relationships. The index is useful as a decision-making tool and forecasting, and is considered to be a higher level of aggregation of a set of indicators or variables.

In the context of Sustainable Urban Mobility, indicator is a variable based on measures that represent as accurately as possible a phenomenon that want to check. Thus, three aspects can be highlighted to be submitted to the adoption of a particular indicator: what should be measured and what impact on what activity? why the phenomenon should be measured? and how the phenomenon should be measured? The quality of the measurement should be taken into account. The index function is to be a decision parameter. This function can be presented in accordance with the following parameters: support decision-making,
establishment of goals and standards, dissemination of information, establishment of a focus in the discussion, promoting the idea of an integrated and monitoring action and evaluation of development a particular action. The IMUS index, presented by Costa (2008), has been widely researched in several municipalities in the evaluation of sustainable urban mobility. This index has such main objectives: to establish a hierarchy of criteria to characterize urban mobility, establish a system of weights to these criteria, add criteria to strike a balance between low quality criteria with high quality and set up an easily understood tool and simple to apply to several cities. The result is a tool that has nine fields (Accessibility, Environmental, Integrated Planning, among others) and thirty-seven subjects, representing subdivisions of the fields (in the first issue cited, Accessibility, for instance, there are accessibility to the transport system, universal accessibility, physical barriers and legislation for people with special needs). Machado et al. (2012) also proposed the establishment of an index, IMS (Sustainable Mobility Index). Following the model suggested by Costa (2008) in the calculation of IMUS, the authors propose the adoption of an index from two basic criteria: availability of data and the ability to collect them annually. The IMS was used for the metropolitan area of Porto Alegre (region with 31 cities).

In addition to the subject of academic studies, the subject Indices of Urban Mobility has been the subject of other studies developed in Brazil. Some organizations, governmental or non-governmental, have carried out some researches and surveys in the field of urban mobility and focus on survey indicators. However, the topic has not been used yet in the planning and evaluation of transport systems of large cities. In the specific case of Rio de Janeiro, both PDTU - RMRJ (SEAERJ, 2014a), which has been recently prepared, as the PMUS - RJ, in development, do not mention, in their scope, to develop Urban Mobility Index. An Urban Mobility Index in the planning of public transport could be used as a behavior measuring tool of a transport system as well as a calibration tool to that system. The economic advantage can also be considered, since the transport system itself feeds back important information to self-evaluation. In this case, the system tends to be more efficient, reducing the socioeconomic impact that poorly formulated and watertight plans may bring. A third aspect is presented: the democratization of data collected. The systematization of data collection that would be used for the preparation of IMS
might make them accessible to the entire population. And that would bring transparency information relevant to society as a way of monitoring and evaluation of public policy of transport.

The purpose of using an urban mobility index in this study is to evaluate the current status of existing public transportation in RA-VII SC, diagnose shortcomings and point out ways that can solve the problem. It should be noted that the index is a tool that can be used to achieve the objectives listed, but is not intended to be the ultimate solution to existing problems. The proposed methodology is dynamic because of continuous process to calculate the index. As new elements are introduced to the process, previously adopted indicators will be subject to review in the process and so will suffer adaptation as a way to adapt to the new characteristics of the analyzed region. Similarly, the constant evaluation of the process may introduce new indicators to methodology or even dispense indicators of little relevance. Thus, it is proposed the adoption of a specific sustainable mobility index for VII RA-SC, IMS-SC, obtained according to the procedure established by Machado et. al (2012) in the calculation of IMS. According to the available data on the region and simplicity in applying the index, it is the most appropriate to the case method.

For VII RA-SC was developed a new index, the IMS-SC. The index is based on the three dimensions of sustainability: social, economic and environmental. The typical characteristics of each of the dimensions are: social (which gathers information regarding the conditions and changes in demographics, public health, recreation and leisure, education, housing, infrastructure and social services, community development, public safety, status of communities indigenous and archaeological and historical resources), economic (characterized by indicators that reflect the conditions and the changes on production, trade and services, fiscal and monetary data and human resources) and ecological (covers information on the conditions and changes in natural resources such as soil and air, including climate and air quality, water quality and quantity, wildlife and vegetation, nature reserves and natural habitats and resources such as minerals, metals and fossil fuels). Regarding the indicators used in the study of Machado et al (2012), some indicators have been replaced in order to reflect more faithfully the conditions of existing urban mobility in the studied
region. Dimensions, as presented, are subdivided into themes, with the aim of present three distinct characteristics for each of them.

It was observed that there is a mismatch between the improvements that are being implemented in the city of Rio de Janeiro and what has been researched in various parts of the world, and also in Brazil, about Sustainable Urban Mobility. While the public planning does not care nor cover all facets of urban mobility (social, environmental, economic and technical), researchers go further: not only deal with the subject of multifaceted way, but also the usefulness of a mobility index. Some examples of issues that are usually neglected by the government planning in public transport are intermodal integrations to encourage non-motorized transport modes, infrastructures that allow cycling or displacement walk safely and signals for the preservation pedestrian integrity. The IMS-SC puts some microdata in evidence, but there is much more relevant information to be produced and used in support of public policies. It is necessary to go further, not only analyze all the issues presented, or even others that may arise in the future. It is essential that a transport system can be constantly monitored and reassessed, otherwise fails difficult to solve may appear, or exhausted before the planned time. The use of urban mobility index is not only necessary to measure the progress and performance of a transport system, but also to calibrate the system and renew the planned route. It can also be used a methodology of selection and use of indicators adapted to the reality of the city of Rio de Janeiro and its population, through the methodology discussed in this research. The measures initially met the expectations of governments and planners have been supplanted front of the new agenda to be fulfilled. Mobility is not just a question of reducing the travel time between two points, or provide comfort to users of the transportation system. Of course, the basic needs must be met, however it is necessary that many other elements enter into the equation for urban mobility solutions, otherwise it may cause environmental damage, or have transport modes early saturated.

Rio de Janeiro has had, in recent years, many elements that could have been used in urban planning, especially planning of sustainable urban mobility: theoretical knowledge, widely factor analyzed in this research, legal framework, which has a set of laws that stimulate sustainable transportation and planning for the existence of a network of diverse transport modes, especially in RA VII-SC,
that could meet the population more efficiently. However, what is observed in the region is a poorly designed planning in urban transport. The neighborhood of the region have such a variety of transport modes and nowadays suffer the effects of saturation of transport (congestion, overcrowding, poor access, etc.), which shows the consequences of this planning.

Lately, the neighborhoods of the region have become a hub traffic generator, what has increased the flow of vehicles in the region. Along with the poorly designed planning, this factor has contributed to the deterioration of life in neighborhoods in general, since this increased traffic in the area was not accompanied by a schedule of transport. A lot of bus lines circulating in the region, overlapping paths, the coincident destinations of these routes and also the transport modes not integrated are the facts which prove this idea. The use of IMS-SC in the planning of transport could be a tool to pinpoint the problems described. The absence of a PDTU - Urban Transport Master Plan covering all the precepts of sustainable urban mobility, can be pointed out as the biggest problem in relation to the city transport system in Rio de Janeiro and its metropolitan area. Without the presence of this document, there are no guidelines, achievable targets and indicators that would serve as a guide for the transport system. Hence the origin of many problems in transport: without planning is impossible to built an efficient system that can serve the people.

**Keywords**

Sustainable urban mobility; index of sustainable urban mobility; urban mobility planning; São Cristovão neighborhood.