TRANSIT ORIENTED DEVELOPMENT FOR BRT CORRIDOR IN RIO DE JANEIRO

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ABSTRACT

This paper aims to reflect on the future of a region that is currently underused in Rio de Janeiro, Brazil, which will receive Bus Rapid Transit. These are districts situated in the northern zone of the metropolitan area, bordering the major highway artery known as Avenida Brasil. This region is rich in history and infrastructure, but lacking in retrofitting and maintenance. This study's point of view is taken from the intersection of the fields of architecture, urban planning and public transport. It shows the potential, the opportunities and the challenges presented by this region and it could serve as an example for other studies of the urban regeneration of degraded and underused areas. It is expected that the gain in mobility will modify the behavior of the local community and its relations with the rest of the city, making room for a new challenge to promote urban regeneration and efficient mobility. It might also lead to attracting and absorbing public and private investment geared to socio-economic development, thereby improving the quality of life for the local population. The study is part of broader work that is still being developed, to perform an analysis and put forward proposals that encourage a future urban design integrated with the local transport, seeking to upgrade the urban social life and mobility.

Keywords: Transit Oriented Development, Bus Rapid Transit, Sustainable Mobility

INTRODUCTION

Rio de Janeiro, in Brazil, is currently enjoying prominence on the world stage, largely due to the agreements to bring the 2014 World Cup and 2016 Olympic Games to the city. Belying its unrivaled natural beauty, the Rio de Janeiro Metropolitan Area (RJMA) presents considerable challenges to the efforts to provide enhanced quality of life in its public spaces. Some of the obstacles are extremely complex, but if they can be overcome, the RJMA can be a better host to international events and provide improved quality of life for the population.

Like most developing metropolises, especially in Latin America, the RJMA is very disorganized, largely due to the rapid growth of the urban population during the 20th century, when rural areas and small towns offered few job opportunities, whereas the bustling urban centers acted as magnets, particularly in view of the industrial transformation that was taking place. The speed of the migration was quicker than the ability of the city authorities to provide housing and basic infrastructure. So the migrant population settled on the urban periphery and participated only marginally in the labor market and social infrastructure (Neira Alva, 1996).

Nevertheless, the supply of unregulated housing and informal work provided a survival option for this population segment. The social disparity became increasingly evident, dividing the city into two parts: the official and the unofficial. The landscape showed a concentration of wealth and spreading pockets of poverty, creating degraded areas with obsolete infrastructure (Bahia, 2000). The 'informal' city, largely ignored by the official one, mainly comprised illegal settlements located in unsuitable areas and with inadequate installations. The population suffered from a lack of basic services, such as education, health, transport, sanitation and security, but also from discrimination, difficult access to formal work, civil hazards and social exclusion. Over time, these urban agglomerations grew ever larger. The *favelas* (slums) were no longer perceived as temporary settlements and became an integral part of the urban landscape. Their negative impact was no longer restricted to the illegal settlements, but also began to have repercussions on the 'official' city. As a result, the metropolis started to become aware of the scale and complexity of the urban disorder, with its social inequality, poor distribution of public resources, lack of mobility, burgeoning crime, social exclusion, low level of socio-economic development, housing shortage, and many other problems.

Opportune moment

Despite all the difficulties, the RJMA has great expectations for the not-too-distant future. The mega sporting events, the possibility of producing oil from the offshore pre-salt layer, the extensive security program for the pacification of the *favelas* and the groundbreaking UNESCO World Heritage title of exceptional Urban Cultural Landscape have enhanced the city's fame. To honor the commitments that have been undertaken, the city is investing in planning for the period up to 2016. This includes goals for the installation or adaptation of sports arenas, transport infrastructure, ecological structure and urban environment.

Focus of the study

In dealing with such a wide ranging and complex subject, this work restricts itself to seeking out, within its own limitations, analyses that can contribute to improve the functioning of the city within the overlapping Architecture, Urban Planning and Transport Engineering context. The study is part of a broader work that is still being developed, to conduct an analysis and put forward proposals for the RJMA. In this paper, we shall present some basic concepts that

help to define the case study, as well as some project guidelines that will help the development of the study further ahead.

The approach for this case adopts concepts and definitions discussed by Banister (2008), focusing on sustainable mobility issues, keeping in mind Cervero (2002), Cervero et al 2008), and Zhang (2007), focused on transit oriented development of cities, Martins et al (2004), trying to determine principles of urban design linked to urban logistics provided by sustainable transport alternatives, such as public and non-motorized displacements, and reinforced by Bodmer et al (2005), looking at a new managerial model for the relation between transport and land-use. The findings of Litman (2012), oriented to defining the sets of performance indicators related to sustainable transport achievements, are also considered. It is also important to keep in mind factors affecting social impacts of transport, as analyzed and compared in different contexts by Geurs et al (2009), and also recent reflections on and comparisons of sustainability and livability concepts mentioned by Miller et al (2013). It is essential to remember that the case of Rio de Janeiro bears similarities with other cities in developing countries, where the burden on social policy prevails in the approach adopted.

BASIC CONCEPTS

The reasons underlying this work and defining the field of study happens for three brief topics may be summed up in three areas that reflect basic concepts regarding the issue: urban mobility, road transport and urban evolution.

Urban mobility

Ensuring efficient urban mobility is a key factor in holding sporting events, but is also important in providing accessibility for the local population. Lack of accessibility and mobility can lead to social exclusion, by restricting access to essential opportunities in employment, education, health, leisure, and other areas. Giving priority to policies in favour of public transportation helps to strengthen social justice, alleviate poverty and include the disadvantaged (Melo, 2005). That is why it is important to put into practice ideas that are geared to the common good and make the city more democratic, such as the creation of a sustainable mobility network and discouraging automobile use. There follows more information about urban mobility models.

Automobile culture

For quite some time, much of society has accepted and submitted to a culture wherein the automobile is the dominant urban mobility protagonist. This culture tends to overwhelm any concerns about public and non-motorized transport, which is reduced to playing a secondary role. With its priority treatment, the car has become the most efficient transport option, providing, in most cases, a more comfortable and faster ride than the public services. In a vicious circle, the increasing popularity has stimulated higher high demand from people

wanting to use cars to get around the city. However, the road capacity is unable to cope with such strong demand and the urban environment has begun to rapidly deteriorate, with long traffic jams, high levels of noise and air pollution and a city that is inefficient and unsustainable.

In an effort to improve urban mobility, solutions have been introduced to meet the automobile's insatiable 'vampire-like' need for arteries, in the form of roads, parking lots, gas stations and drive-in services (Neira Alva, 1996). Lerner (2003) warns that this 'urban cholesterol' - referring to the automobiles clogging up the veins and arteries of the cities - even influences people's awareness, to the point that it is still very difficult to convince society that this is an unsustainable path. Consequently, cities are still planned for private vehicles rather than for people. And the more infrastructure there is for the automobile, the more its use is encouraged. As the demand increases, stimulated by the increased capacity, so the available space becomes over congested and new investment is required. This vicious cycle does not resolve the need for urban mobility and continuing along this path is a step backwards for humanity, with repercussions that will tend to get increasingly worse if nothing is changed.

Sustainable transport network

In response to the automobile culture, the development of a sustainable mobility network has been conceived, building on the notion of a city planned for people rather than cars. Hence, public transport is abandoning its view of the citizens as users and is starting to treat them with the respect they deserve, as customers, since it is the citizens that decide how they are going to get around, based on the format that best serves their needs, in terms of cost, safety, comfort, waiting time, travel time, and their objective. Thus, making the public system attractive is the first step in trying to win customers and compete with the automobile on a fairer basis. Within this competitive environment, a matter of extreme importance is the range of accessibility to the services. In the case of the automobile, it is virtually a door to door service, with the vehicle reaching its destination with the minimum possible human wear and tear, largely because the route is not tied to a fixed schedule. Competing on this basis is unreasonable, because there is no possibility or sense in providing public transportation that meets the travel requirements of every single citizen in the metropolis. Nevertheless, when all the flows are integrated, they do form a transport network. A multi-modal network allows a variety of trips to be made, using different parts of the network. A dense and varied network augments the options for getting to one's destination, by offering different ways of making the same trip (Costa, 2011).

However, it is obvious that having to make several transfers within the transport system is not very convenient for the customer, as these are time consuming and physically demanding. Consequently, it is not enough to provide a network with plenty of connecting options; the public transport service must offer more than that to offset the disadvantages, in order to compete with the automobile. In this, the urban transport stations have a key role to play: forming inter-modal or multi-modal centers that provide safe and sheltered transit and offer other services that add value and make the process more interesting. Another important

complement is the non-motorized displacements that integrate the public transport modes. It is therefore also important to emphasize that urban transport stations must be effectively integrated with the city spaces to and from which the people walk, thereby ensuring full and inviting accessibility.

Adequate integration between the different modes of public transport and with non-motorized modes is essential to build a sustainable mobility network. Acting together, they will be strengthened and better able to compete on even terms with the automobile. Thus, the goal is more integrated mobility that can provide an easier, quicker and cheaper service, through streamlining, cost reduction and increased mobility (ANTP, 2004). The advantage of sustainable mobility policies, according to Bustamante (2007), is bringing greater dynamism to urban functions, with larger scale and enhanced circulation of people, goods and services, leading to more appreciation of public spaces, sustainability and economic and social development. The creation of a sustainable mobility network helps to make the city more democratic, where it is easier to come and go, with fewer obstacles.

Road transport

When providing a public transport network, it is almost a rule of thumb to install railway services as a structural solution to the majority of urban mobility challenges. It is undeniable that railway transportation, such as the subway, is able to provide efficient high capacity public transportation that, when located underground, offers the benefit of being able to suitably integrate the dense urban fabric without segregating the territory. However, some cities, particularly in developing countries, are opting for road transport solutions, such as BRT. This mode has proven to be very viable, in terms of cost, efficiency and travel time. These run along a separate lane with defined stops (with ticketing and boarding from covered raised access platforms).

Lerner (2003) argues that its benefits go beyond the exclusive lane that puts the bus operations at maximum frequency, with direct or interlinked routes, in an effort to give buses a performance level that is close to that of the subway, providing ‘subway style’ surface transportation. According Vuchic (2007), BRT consists in an integrated bus infrastructure independent that must contain the following elements: predominantly segregated right of way without sharing with taxis, buses or emergency vehicles; reliable service and at regular intervals; one station island for both directions-shaped with system security, weather protection, information for passengers, prepayment and minimum spacing of 300 to 600 m in the central areas and greater distances in the suburbs; articulated or bi-articulated bus, with several accesses through wide doors proportional capacity; referential treatment of buses in most crosses, and, use technology Intelligent Transportation System (ITS) to monitor location and movement of the vehicle information for user, electronic payment, among others.

Structurally, BRT can also be instrumental in reorganizing the road traffic composition, since it generally occupies a lane that had been in general use, previously dominated by the automobile. By becoming a quicker alternative that is comfortable and cheap, BRT does its

own advertising, rolling past congested lanes clogged with private transport and thereby attracting new customers. Thus, this transport mode can also play an educational role, in the understanding of citizenship and how to live in a society. To build a sustainable mobility network, one needs to seek a balance between cars and buses. Everyone must understand their role in creating an efficient city. This does not mean that we should adopt an attitude of eliminating the automobile, but simply to understand better that this mode cannot be used without discretion or concern for the welfare of the citizens, as if the users did not live in the society and had no responsibility for their city. It is believed that the automobile can be used rationally, particularly for travel where it is really necessary, as on a shopping trip or for medical treatment.

BRT nevertheless has certain limitations, such as its capacity, which is less than that of the subway. According to Costa (2011), the first BRT, introduced in Curitiba, has carried up to 20,000 passengers / hour. In 2000, the city of Bogota inaugurated its TransMilenio BRT, which has carried 47,000 passengers / hour on its busiest corridor, thanks to the use of innovations such as the possibility of simultaneous stops for more than one bus (up to six) and lane duplication, so that one bus can overtake another without disrupting the entire highway flow. It should be noted that the TransMilenio attained this capacity at the cost of considerable sacrifice on the part of its customers. The National Bus Rapid Transit Institute - NBRTI (2006) notes that if it adopted the standards deemed appropriate for the United States, the Bogotá system would have a capacity of only 32,000 passengers / hour.

There are BRT lines that have been wrongly implemented, in anticipation of strong demand. This question of capacity is interesting, because the service currently provided by conventional buses is inefficient and has become synonymous with delays and insecurity. In cities where the bus service is of poor quality and it is not feasible to introduce subway lines, as in developing cities, BRT can be a solution. Despite of not achieving the performance capability of technologies rail, the BRT has the advantage of ensuring provision of quality public transportation at low cost and short run time. The vast infrastructure of road targeted primarily to the use of private transport can use to public transport. Expressways already outlined in the cities represent essential structures for urban mobility, but are mostly congested by cars. The underutilization of the bus service and road infrastructure also generate spending being wasted through traffic jams, discomfort and lack of commitment of bus services offered. The cost of implementing the BRT on existing road layout ensures minimum quality for the existing bus customers in the short term. According Vuchic (2007), large cities that operate bus services in mixed traffic may include the BRT to improve the performance of the transport service with less investment than rail transportation.

Finally, BRT can also be a first step in defining domain priority in favor of public transport. Having consolidated an extensive public transport network, it can be supplemented by a high-capacity technology, such as the railway. This is an advantage of a system that operates within a framework of long term urban planning, because it does not stifle the road infrastructure, but allows flexibility to accept other technology, without rendering the urban environment obsolete.

Urban evolution

There is currently a strong association of the evolution of large cities with a need for territorial expansion proportional to the population increase. This reasoning can even be a logical solution when the existing area is really very close to saturation point. However, this strategy is often erroneously applied in urban areas where there really is no need for territorial expansion. In Brazil, most cities still have underutilized areas that are already equipped with urban infrastructure such as water supply, sewage collection, transport, education and health, as well as jobs. This underutilization can be confirmed by the number of existing buildings lying idle.

According to the National Household Sample Survey - PNAD (2008), Brazil has 7.54 million vacant properties, of which 72% are located in urban areas and 28% in rural areas. Of these idle properties, 6.31 million are in habitable condition, 894,000 are under construction or being renovated and 340,000 are not in a habitable state. Most of these vacant properties are in urbanized locations, often in or near the city center, and served by infrastructure. When one compares the idle properties with the housing deficit, the situation seems irrational. In the RJMA, there are 414,623 vacant homes and just 65.68% of these would be sufficient to meet the local housing (deficit) need (João Pinheiro Foundation, 2000).

The cost of public services is high and when it is applied to neighborhoods where there are many idle homes it means that an unnecessarily small population is being served and may even represent wasted resources. Insofar as the government invests resources in neighborhoods with a high proportion of idle properties, to serve the remaining population, this also means that services are being provided to idle properties, which can easily be interpreted as wasteful, since the infrastructure is not being used wisely. As quoted by the Brazilian Institute for Municipal Administration - IBAM (2001) from the City Statute Law, the loss caused by this mismatch is the high per capita cost of public facilities and services:

> "the municipal authorities (...) must heed the just claims of residents in areas lacking any infrastructure and, as part of that task, provide services and equipment for any idle land that happened to lie on the route" (Source: IBAM, Brazilian Institute for Municipal Administration, City Statute Law for... Rio de Janeiro, 2001. p. 25)

The result is a city where the basic public services are unsatisfactory, because the resources are misused. Besides the waste, the urban fabric of the city is compromised in the poorer neighborhoods, which enter a downward spiral of depreciation. The lower the quality of life in the area, the less appreciation the local population shows for its public spaces, which leads to an exodus and abandonment of the neighborhood. As a result, the city finds it very hard to follow a path of sustainable, durable and rational development.

The public authorities try to get round this using Article 182 of the 1988 Federal Constitution, which gives municipal governments the power to require owners of urban land that contains no buildings, is underutilized or lying idle to put it to suitable use or else have it compulsorily divided up, built upon or otherwise utilized; see the urban property tax increased

progressively over time; or have it expropriated, against payment in government bonds. The main objective of this measure is to avoid land within the city remaining idle and to ensure that buildings are adequately maintained. However, this will be wasted effort unless the government carries out more rational urban planning and constantly reassesses the existing urban spaces.

A portion of the property lying idle is in old industrial areas, because, during the twentieth century transformations in industrial processes and strategies led to the obsolescence and abandonment of extensive manufacturing and dock areas (Souza, 2007). According to Frenkel (2008), beginning in the mid-1970s, a new phase of capitalism has emerged, marked by new technological changes, the increasing importance of the third sector, burgeoning trade on a global scale and the obsolescence of the traditional model of storage, which has been replaced by containers. These changes have made some industrial zones archaic and devalued, with a lot of idle properties. The negative aspect of these areas containing many idle properties is not restricted to their immediate surroundings. The impact may be felt throughout the city as a whole and goes beyond the inefficient distribution of public resources. To better understand the repercussions on the city, one basically needs to classify the neighbourhoods, as: underutilized, with urban infrastructure that is not maintained; consolidated, with functioning urban infrastructure; and in expansion, which are new neighborhoods where the infrastructure is still being installed.

The population that remains in the underutilized neighborhoods is unable to complain loudly enough for the urban infrastructure to be maintained. Thus, they become increasingly marginalized, with poor quality of life and a feeling of abandonment, unable to arouse public interest. The consolidated neighborhoods, on the other hand, are able to offer a good quality of life and therefore space and property in these areas is much sought after. However, these relatively few attractive residential neighborhoods are submitted to self-destructive forces, because so many people want to live there that it becomes profitable to build in excessive and devastating quantity (Jacobs, 2009). One then sees developments offering the minimum space required by law. That model is eventually accepted by the population and becomes the standard for the city. Those who cannot afford to acquire this minimum space in a consolidated area will seek it in new neighbourhoods, which are expanding and do not have all the infrastructure in place, and therefore may not be able to offer a satisfactory quality of life.

The result is a city that is missing the opportunity to balance a supply of good properties within an area with a good quality of urban life, at a fair price. Soon, there will be a false sense of property scarcity, when in fact, as shown above, there is idle capacity in the major metropolitan areas of Brazil. The false sense of scarcity also helps to drive the advertising of expansion into new neighbourhoods that are far removed and without infrastructure. According to Harvey (1992), this movement within the city is further exacerbated by the new suburban. The biggest loser is the city itself, which is running away from its problems and sees erosion of the concepts of living together, looking after what one has, citizenship, social belonging and mutual support.

This subject encourages discussion about whether there is a real need to promote the expansion of the city through the creation of new neighborhoods or increased density of areas far from the center, when no effort has been made to rationally exploit the existing urban property environment. The city has idle land within neighborhoods that already have infrastructure, while all around, housing developments multiply in areas that have not yet been urbanized and are far from the places where jobs, commerce and urban services are to be found. According to Martins et all (2005) the densification of human activity (economics of agglomeration) occurs around locations that are particularly accessible (economics of location). These two types of urban economics are the reason behind private investment in land use. They only become location inhibitive when the concentration of activity reaches the point of generating diseconomies; in other words, the costs exceed the advantages of the proximity to the urban facilities provided, due to an environmental surcharge (pollution), the price of overcrowding (congestion) or a combination of the two, leading to declining property values. The urban space then loses its original location attributes (with negative repercussions on land productivity). To ensure the development of the area (or even to secure its market area), it is necessary to intervene in the urban space.

CASE STUDY

The coming together of the basic concepts presented above and the planning for the RJMA in 2016 has led to the delineation of a strategic region for the city. The Olympic Games facilities are spread across the city, but the greater part of the investment is concentrated in the Expansion Area, in the districts of Barra da Tijuca and Jacarepaguá, in the western zone of Rio de Janeiro. Adjustments to existing infrastructure are being made in consolidated districts such as the Central Business District (CBD), Copacabana and Maracanã, as well as in under-utilized districts such as the docklands, the old industrial zone along the Avenida Brasil and in the district of Deodoro.

The planning, shown in Figure 1, includes improved urban mobility, through completion of a stretch of subway Line 4 (connecting Barra da Tijuca with the southern zone) and four BRT lines. The public investment for these events has stimulated thinking not only about the legacy of these events for the local population, but also about the direct and indirect possibilities in the wake of the events. The opportunities arise from positive changes in regard to urban mobility. The Public Transport Project involves the implementation of transversal lines across the historically predominating radial lines. This investment represents the unprecedented creation of a public transport network that will allow new displacements to occur that are currently repressed, especially transversally and against the traditional flow into the city center. This new scenario helps to guide the city towards setting up a sustainable mobility network, where public transport is strengthened in relation to the automobile culture.

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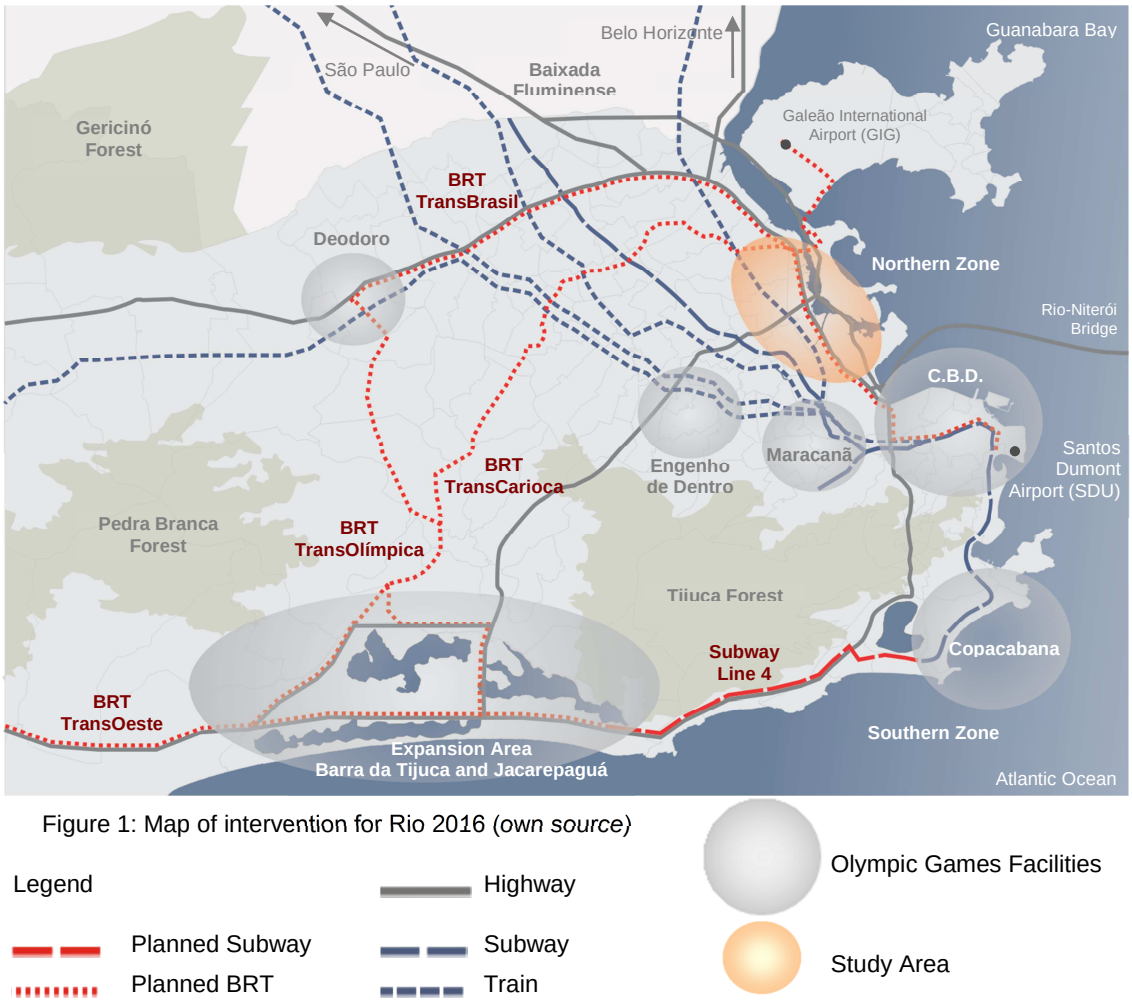

Figure 1: Map of intervention for Rio 2016 (*own source*)

Note that this new plan is counting on BRT as a mobility solution. It involves approximately 16 km of new subway lines, compared to more than 150 km of BRT lines. This decision redirects the focus of public transport planning, which was previously centered on the subway. This switch to BRT is largely due to the difficulty of building a larger subway system. The original subway plan for the RJMA, comprising six lines, was drawn up in the 1960s, and today, more than forty years later, the network consists of just two incomplete lines. The difficulties faced are: insufficient financial resources; geological, with waterlogged soil and a shallow water table; and the long construction time, which is much greater than the government mandates, thereby considerably reducing its political appeal. With BRT, the

planning becomes feasible and reliable, thus increasing the likelihood of its implementation and the fulfillment of the sporting commitments undertaken by the city.

The mobility gains will benefit all of society, but especially those who are most touched by it, the population living along the new lines. Of these, the only line that runs entirely through consolidated but underutilized neighborhoods is the TransBrasil, a BRT line that has been created on an existing highway - the Avenida Brasil - that runs through old and run down industrial areas in the city's northern zone. The local bus services provided on this highway are low quality and the only structural public transport service is the Gramacho-Saracuruna railway branch line.

The highway, like much of the RJMA, is lacking in cross flows. This lack of communication also helps to segregate neighborhoods, segment functions and make it difficult to connect places that should be fully accessible. The physical barrier formed by the road becomes a psychological one also, in some cases making it easier to get to the city center than to the other side of the avenue. The landscape of this obsolete industrial area is like a concrete desert, barren and uninhabited, with no urban social life. The notion of wilderness is reinforced by insecurity, the relatively low occupation density and even the large expanse of roadway, which adds to the sense of open space. Yet it is an area with a rich history and infrastructure that is in dire need of maintenance and renewal of the urban space. It has some public facilities and private enterprise, in non-residential properties, reinforcing the impression that there are good services that can survive even in difficult circumstances. And the area is strategically well located in relation to the rest of the city, as shown in Figure 1, because it is close to:

1. Central Business District and the docklands that are undergoing rapid transformation;

2. Guanabara Bay, which is in the process of being cleaned up;

3. the intersection of major traffic flows between the Central Business District - Baixada Fluminense and the northern zone - Expansion Area;

4. Galeão/Tom Jobim international airport and subway and railway lines, and,

5. Federal University of Rio de Janeiro.

To examine these opportunities, the study area, shown in Figure 2, was limited to the districts of Bonsucesso, Maré, Olaria and Ramos. The area will also benefit from the TransCarioca transversal route, linking Barra da Tijuca and the Galeão/Tom Jobim airport, that will connect the TransBrasil with all the subway and railway branch lines providing RJMA radial transport. At the same time, in 2011, the city issued Supplementary Law No. 57/2011 establishing an Avenida Brasil Area of Special Urban Planning Interest (AEIU, 2011), where it sets out parameters for increasing economic activity and reutilizing properties in the area. The legislation no longer restricts itself to industrial use, but encourages occupancy for mixed uses involving residence, commerce and services. Thus, it is hoped that the areas strengths, combined with implementation of BRT and the Avenida Brasil AEIU will enable the

transformation of the urban landscape in these neighborhoods and of their relationship with the rest of the city. It also creates an opportunity for reflection on the future possibilities of this area, throwing out a challenge to promote urban renewal and efficient mobility in this degraded area, in order to be able to absorb public investment and attract private interest in its socio-economic development and, as a result, improving the quality of life for the local population.

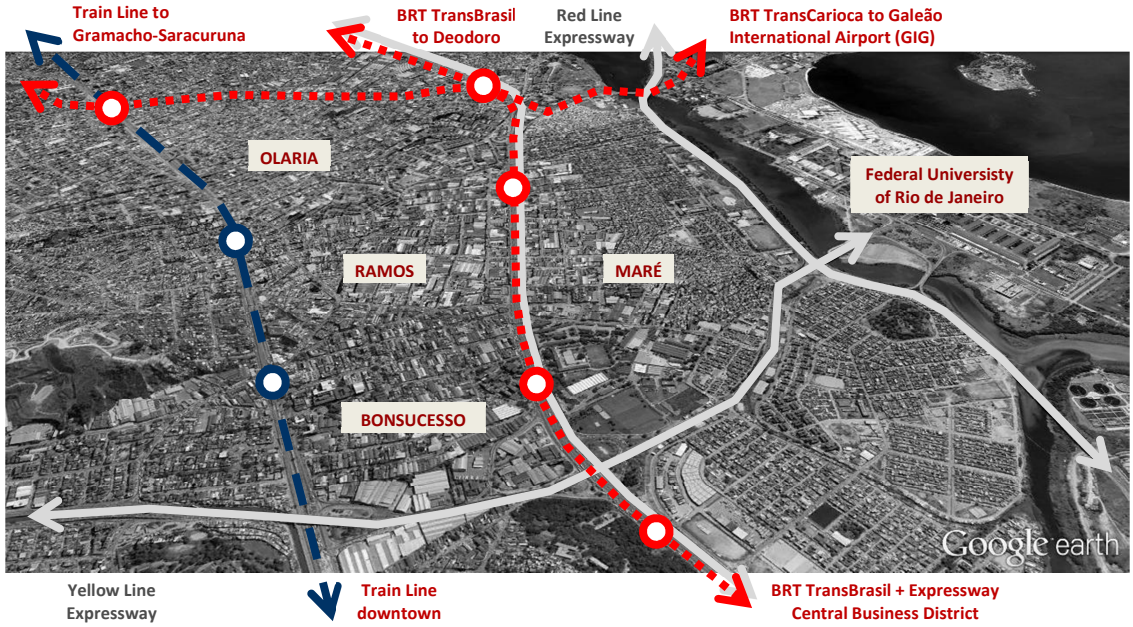

Figure 2: Study Area (own source)

Legend

Highway

Train Station

Train

Planned BRT Station

Planned BRT

PLANNING GUIDELINES

With a view to supporting future work that is still in development, guidelines were sought that will induce urban planning that is coordinated with the local transport and offers certain strategies to promote a decent urban social life and a balance between the different transport systems. Some of these project guidelines are presented below.

Transport and land use

Through studies following the introduction of transport lines, one can perceive changes in the landscape, such as appreciating land values, in addition to the accessibility gains. Unlike the literature on rail transportation, there is not yet enough data on the BRT system for a proper analysis of the product to be made. That is because most studies of the impact of public transport on land values are still focused on heavy railway systems. In the case of railways, as a rule, there most definitely is a significant positive change in property values. On the other hand, traditional bus services have an almost imperceptible influence on the urban

landscape and land use patterns, because, unlike the rail system, they are unable to yield substantial gains in terms of accessibility and mobility.

BRT may be an exception to the rule, because it is not a simple bus line. Some authors, such as Levinson, Zimmerman, Clinger and Rutherford (2002), argue that investments in BRT in Ottawa, Pittsburgh, Brisbane and Curitiba have indeed yielded benefits in terms of land use, and that these were every bit as great as those that would have been generated by investment in railways. Weighed against that, a study of dedicated BRT lane services in Los Angeles, by Vuchic (2002), found small negative effects on residential property values. In the case of Curitiba, the action to implement the BRT transport system was not restricted to the field of transportation, but was also integrated with urban planning of land use aimed at guiding the densification of residential and commercial land use near the corridor. In this particular case, it was possible to highlight the strengthening of the north-south road axis, defined by population density and the zoning of residential and commercial areas, which gave rise to a high density transportation corridor.

In Seoul, a series of urban reforms was carried out parallel to the implementation of BRT. One of these was a campaign for land restoration, turning it into attractive public spaces. According to Cervero and Kang (2010), the introduction of BRT helped to intensify land use along the corridors, mainly through the conversion of single-family homes to multi-family ones and the introduction of mixed-use projects. It is believed that, as a result, the property capitalized the benefits of accessibility: the price of property within 300 meters appreciated by 5% to 10%. For commercial and other non-residential uses, the impact ranged from 3% to as much as 26% within a smaller 150-meter impact zone. This confirmed that railway transport is not the only one capable of triggering changes in land use and value and that quality services can also be provided by road vehicles.

This relation between transport and land use is what some scholars call "Transit Oriented Development" (TOD). Such planning must be applied alongside an efficient transport network, in order to optimize the transport benefits in favor of urban development, and vice versa (Alain Bertaud, 2002). In the case study, the TransBrasil will generate benefits for the local population but, by itself, will not guarantee appreciating property values, much less socio-economic development. It is necessary to plan the urban space, balancing the uses and potential of the transport system. The combination of transport and urban planning aims to achieve a single integrated result. Such public investment stimulates a virtuous cycle, as it yields benefits to the owners of private property, which in turn stimulates economic development, which then feeds taxes back into the public coffers.

Urban density

Along with the strong tendency towards the expansion of urban areas, presented in the concept of urban evolution, there is a school of planning that induces the dispersal and segmentation of activities on the ground. One influence on this concept comes from the observations of Ebenezer Howard, a British reporter, on the living conditions of the lower classes in London towards the end of the 19th century (Jacobs, 2009). Besides repudiating

the errors and misconceptions of the city, he also rejected the very model of urbanization and considered it an affront to nature that so many people have to live in crowded conditions. It was a reaction to the horrors of city slums, brought about by his concern about city overpopulation (Hall, 1995).

Howard's recipe for the salvation of the populace was to do away with the whole notion of the city. So in 1898 he put forward a plan to contain the growth of London and repopulate the countryside, where villages were in decline, by building a new type of social agglomeration, the Garden City, where the city's poor could once again live in touch with nature (Jacobs, 2009). This idea became popular and was referred to by some experts as orthodox urban planning. His idea was that the street is a bad place for humans; houses must be set back from it and focused inwards, preferably onto an area of vegetation. Hence, the presence of a greater number of people is, at best, a necessary evil, and good urban planning should at least aim to create the illusion of isolation and privacy, as in a modern suburb. According to Costa (2003), this traditional growth leads to various problems, such as the high costs of urbanization, the transportation system operating at its capacity limit, the high cost of housing, loss of a sense of community, and the inefficient use of resources. According to Segre (2005), there are other conflicts, such as the declining appreciation of public space, the presence of cars and roads with fast moving traffic, population moving away, abandonment and deterioration of infrastructure and traditional public spaces, large enterprises that supplant traditional activities in the public spaces, such as supermarkets and shopping malls, among others. Jacobs (2009) criticizes this type of growth as "unurban urbanization" and warns about its economic and social inefficiency.

Under this new reasoning, rather than suburbanization, a concentration of activities is sought. However, this density solution must not attain an excessive level, so as to avoid other problems, such as the forming of heat islands and wind shadows. One must bear in mind that high density, with buildings close together and very tall in relation to the road width, tends to turn the streets into narrow canyons. According to Corbella and Yannas (2003), there is a thus a difficulty in dissipating anthropogenic heat, leading to the forming of heat islands. The higher temperatures negatively affect people's thermal comfort and force air conditioning systems to consume more electricity. What is more, air pollution and visual and acoustic discomfort also contribute to reduce the quality of life of residents and visitors.

Increasing the density of strategically important regions, such as the study area, can be a way to make better use of their space and infrastructure and thus reduce the heavy cost of providing urban services. One way is to better understand the idleness of properties, discovering the reason and the state of idleness of those properties. That way, these unused locations may be seen as ripe for transformation.

Mixed land use

Besides the issue of population concentration, is also important to understand the distribution of land uses within the urban area. On a superficial basis, one can adopt two main urban types of usage: segmented or mixed use. The use may be defined basically as consumption,

production and dormitory. The organization of these activities directly affects the movements of the citizens, as they leave their homes to satisfy their needs and desires.

Following the reasoning of orthodox urban planning, rational organization of cities has been sought through segmentation into zones, according to function: housing, work, culture and leisure, with highways created for circulation. There was a concern with geometrically ordered space, which corresponds to the functionalism and rationalism associated with the reasoning underlying industrial production. The separation of economic activities and human settlements is a major problem, because it separates work from life (Lerner, 2003). This kind of urban planning increases the distance between the consumption and production of goods and the dormitory areas, which in turn means longer trips. Transportation then plays a secondary role, deriving from the activities. This sectorial view undermines the financial sustainability of the transport companies, since this spatial segregation of home and place of work generates unbalanced mono-directional commuting trips at peak hours, with overcrowded roads and vehicles in one direction and relatively empty roads and vehicles in the other direction. And idle transport equipment is a waste of the system, which justifies higher ticket prices.

The city represents the integration of functions and a structure for both living and working. The more integration there is between urban functions and mixture of income and age levels, the more humane the city is (Lerner, 2003). If the urban setting is configured to provide a variety and density of uses within a more limited radius then it increases the chance of satisfying those needs and desires closer to where one lives, within a dense mixed land use format. Reducing major journeys leads to more sustainable use of modes, such as non-motorized or public transport. Non-motorized transport, particularly, is encouraged by the shorter distances, which are less tiring. As for motorized trips, the shorter journeys mean shorter travel times, less human stress-related wear and tear, reduced environmental impact, and, especially, a mobility gain that favors social inclusion.

The proposal of the modern Compact City (Rogers, 1995) allows the integration of urban design in combinations that reduce the space given over to the road system, mix land uses and encourage public and non-motorized transport. In this model of dense urbanization and diversified use lies the possibility of providing a better quality of urban social life, with better use of public resources and a more balanced and less centralized relationship between neighborhoods. Hence, the area delineated for study can become more independent and empowered.

Activity hubs

As shown previously, the accessibility provided by BRT can be a factor in raising land values. The reasoning is that the closer it is to a station, more accessible and valuable the land is. So, the ground on which the station itself is located should appreciate most in value, due to its unparalleled accessibility. However, most stations have an architectural profile as merely a space for concentration and dispersal, a funnel for travel between the neighborhood and the rest of the city. The benefits of accessibility, property appreciation and a large influx of

customers call for an examination of the opportunity for the station to form new partnerships, such as with public utility facilities or private enterprise. The vocation of the facilities/ventures can be directed at meeting needs and complementing the existing activities installed within the neighborhood, and covers a variety of uses, such as commerce, services, leisure activities and even housing.

Within the Brazilian context, we see the São Paulo subway system looking for partners to develop real estate projects in the vicinity of its stations. And shopping malls have already been built at Santa Cruz and Itaquera. According to Leonardo Santos (2002), this is a way of attracting users and also non-fare income, through a share of the profits from these projects, which contributes to the financial stability of the operators. A more structured example is the Hong Kong subway system. According to Ferreira (2001), its strategy for implementing associated projects is based on guidelines for the construction and management of properties over or adjacent to the tracks, aimed at yielding financial benefits for the company and increasing demand for the system, through the creation of new communities that have the stations as their focal points; the integration of buildings, subway and road system as comfortable environments geared to both work and housing; the generating of resources through the developments that will contribute to expanding the system; and limiting the company's risk in relation to financial agents.

The installation of facilities and projects associated with the station involves the application of concepts for increasing density and diversity of use. The station overcomes the notion of it being a place of transition or for just passing through and becomes a living space, a public utility and a hub of activities. Mixed usage reinforces the station's role as a focal point for micro-accessibility, encouraging non-motorized transport and attracting services and investments. From the point of view of the transport system, this can be a source of non-fare revenue, from renting space, and even a way to enhance the service and attract more users, which in turn leads to increased fare revenue. For the city, the forming of activity hubs contributes to diversifying usage across the urban landscape and is able to promote new, more balanced and decentralized movement. From the user's standpoint, it represents a service gain that can be enjoyed during the usual journey to satisfy needs and desires, thereby minimizing the number of trips during the day for that purpose. It is an added service that can be decisive when choosing a sustainable mobility network, because the client can access daily services, such as stores, restaurants, gym, events, etc., more practically and conveniently.

Although it represents a concentration of services that are useful to the transport service customers, the creation of an activity hub must not be confused with creating an introspective shopping mall. That type of venture closes people off, turning the street into a place devoid of urban social life. The proposal must be for extrovert environments that provide a context for vibrant social life on the streets. These issues can be better understood in the next topic, on the landscape relationship.

Landscape relationship

Besides the aesthetic, ecological, botanical or gardening appeal, the composition of the landscape is also derived from the coming together of diverse features of density and distribution of use within the urban setting. For the case study, it is important to ensure the creation of an inviting urban landscape around the stations that helps to reinforce the sense of it being at the center of things and thus attract more customers. Accessibility, urban vitality and natural security are important points to bear in mind when creating this landscape, so that people have a sense of belonging to, respect for and ownership of the public space.

As the vitality of the public spaces diminishes, we lose the habit of participating in the urban life on the street. The natural and spontaneous policing of public spaces, generated by the simple presence of people, has been replaced by security officers and the city itself has become less hospitable and more alienating. It must be remembered that security is indeed highly significant in the choice of transport mode: station accesses with little movement of people inhibit the use of the transport service and encourage the use of private vehicles by those who own one. The formation of dense neighborhoods with mixed land use naturally contributes to urban social life and consequently to natural security (Richard Rogers, 1995). This sense of natural security inhibits minor illicit activities and reduces the need for armed security.

Stations play a key role in this format. The TransMilenio BRT, in Bogota, brought a significant change in the urban life there. Previously, the bus stops on the sidewalks generated a peculiar urban dynamic, as the people, whether pedestrians or bus users, gave life to the place. With BRT, access to the system moved to the center of the roadway, resulting in minimal interference with the immediate surroundings, bringing people together in an orderly and timely fashion, at greater intervals. This meant that old commercial points of reference nearby were sidelined by the system. The introduction of the new transport system eliminated the permeability between the transport system and local businesses (Parias and Luna, 2002), bringing a perverse dynamic to the market, since the expected value enhancement, from the undeniably more efficient new public transport system, did not occur.

From this, one can better understand the relationship between the activity hub and its surroundings. A lack of dialogue between them can be damaging to the urban landscape and represent lack of social life and natural security. Therefore, this hub must be directed outwards, enhancing its relationship with the public space and with the neighborhood. Furthermore, it is important to think in terms of 24/7 architecture that is adapted for the night. By applying the concept of urban lighting, the light inside the building complements the exterior lighting, thereby doing its part to create natural security. The visual permeability or transparency also contributes to conveying the feeling of being watched from outside and treating the station as a product displayed in a shop window. This creates a psychological environment of being watched, which inhibits minor illicit activities, as well as reinforcing the role of city sub-center.

CONCLUSIONS

From among the small sample of concepts gathered in this article, we can highlight certain guidelines that may aid the study, which is still being developed, with analysis and proposals for the case study:

1. Strengthen the station as a center for the neighborhood and surrounding areas by forming a hub of activities;

2. Complement the sustainable mobility network, in terms of micro-accessibility, by setting up local feeder lines, and upgrade the public spaces, making them accessible and attractive;

3. Retrofit idle properties and put up new buildings in empty urban plots, to provide decentralized and diversified public facilities, and,

4. Encourage and provide guidance for increasing the density of mixed-use private ventures, while controlling the proportion of each activity.

It is hoped that this article can assist other studies, as well as its own continuity, in developing analysis and proposals, focused on the delineated area, covering the districts of Bonsucesso, Maré, Olaria and Ramos. The aim is to encourage interdisciplinary work involving architecture, urban planning and transport engineering that reflects on the future and plans the transformation of cities into efficient, clean, enduring and sustainable environments.

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