Theoretical and Empirical Researches in Urban Management
Volume 11 Issue 1 / February 2016

URBAN TRANSPORTATION AND MAJOR SPORTING EVENTS—WHAT IS LEFT AFTER THE GAMES: AN ANALYSIS OF SYDNEY AND CAPE TOWN

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Abstract
Mobility patterns, transportation infrastructure and urban form influence each other, and are the basic principles of transit oriented development (TOD). The article starts by discussing the potential that transport projects have as a strategy for urban development, and propose two different typologies of TOD: nodal and polar. It then analyzes the particular cases of Sydney and Cape Town, where transportation projects for the Olympic Games and World Cup, respectively, were based on the assumption that transportation would be the driving force for a desired change in urban development.
Keywords: Urban form; urban mobility; TOD—transit oriented development; Sydney; Cape Town.

1. INTRODUCTION

According to UN projections, the urban population will double between 2000 and 2030, and the area occupied by this population will increase from 200,000 km2 to 600,000 km2 (UN, 2012). This means that the impact of the urban population on the land will be the result of demographic growth and territorial expansion, both factors that lead to an increased demand for transportation.

There is therefore a direct relationship between the supply of transportation infrastructure, territorial expansion and urban form. As Michael Meyer put it (2008, p. 17), "The road network has been the most important influence on urban form in the United States in the last fifty years." Peter Calthorpe (2000, p.

67), a fierce critic of urban sprawl and one of the founders of new urbanism, points out that for every 10% increase in the road network in the USA, there is a corresponding 9% increase in traffic; in other words, increasing the road network worsens rather than alleviates the problems caused by automobile traffic.

Recently there has been an increase in the number of studies on transportation in relation to land use and spatial indicators based on density, mixed use, accessibility and urban design (Bagley et al, 2002). According to Ewing et al. (2007), five strategies considered together can have a positive influence on the choice of less damaging transport modes, such as public and non-motorized transportation: density, diversity, design, destination accessibility and distance to transit.

Urban density, which is measured by the number of people or services per unit area, directly affects energy use and transportation-related emissions. It is precisely because of this that suburbs are criticized since, as Newman argues (2006, p. 277), “low-density suburban land uses can be even more damaging than high-density uses because of the extent of land loss and automobile dependence they imply." Based on empirical studies, Kenworthy (2006) points out that urban density accounts for 84% of the variance in car travel.

Diversity refers to the mixing of different types of land use to ensure that distances can easily be covered on foot or by bicycle (Ewing et al., 2007). Echoing studies by Jane Jacobs, Jabareen (2006) argues that in addition to ensuring mixed use, the esthetic and formal diversity of the built environment, together with the diversity of cultural and social groups, strengthens the vitality of urban space.

Road design concerns primarily accessibility and connectivity. The VTPI (2009) argues that road planning should prioritize the smallest elements in terms of urban mobility, i.e., it should be geared first toward pedestrians and cyclists, inverting the logic by which more road space is reserved exclusively for automobiles. Indicators related to street design include street density, intersection density and the percentage of cul-de-sacs per region (Krizek, 2003).

On a larger urban scale, connectivity refers to the density of connections and interconnections in the road network, so that an increase in connectivity reduces the need for motorized travel as alternative direct routes for pedestrians and cyclists are available. Salingaros (1998) points out that the crossing of simultaneously operating networks with different capacities and scales allows multiple connectivity between activities and determines the shape of the urban structure.

Destination accessibility in turn is related to the distances people travel to reach different places of interest in urban space and implies a physical and temporal connection between the means of transport

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used. Lastly, transit accessibility refers to the distance to transit highlighted by Ewing et al. (2007) as the shortest distance from a person's home or workplace to a bus or train stop or station.

These five factors synthesize the relationship between urban form and mobility and can provide a starting point for generic strategies prioritizing pedestrian travel or travel by public transportation. It is in this relationship that TOD (transit oriented urban development) has a role to play.

2. URBAN FORMS ASSOCIATED WITH TOD

TOD favors concentration of the population and activities in areas that are close to transportation services, can easily be reached on foot or by bicycle and are well-served by multiple routes, allowing demand to be concentrated and the efficiency of public transportation to be maximized and reducing the need for motorized travel (Jabareen, 2006; Litman, 2008).

However, Cervero (2004) points out that the mere existence of a TOD does not guarantee increased use of public transportation and that physical and environmental measures must be adopted to ensure greater acceptance of public transportation over motorized travel. He highlights urban density as a key factor, on the assumption that the more people and services there are concentrated close to public transportation, the more this will be used (Cervero, 2013). It should be mentioned, however, that Schwanen and Mokhtarian (2005) found that people who choose to live close to transport facilities, particularly train stations, were already users before they moved; in other words, rather than people's modal choice being determined by their proximity to a station, their decision about where to live was linked to a previous modal choice. Nevertheless, Lund et al. (2004) reported that a 10% increase in population density in the vicinity of transit facilities can increase public transportation ridership by 5%. In other words, there is a tendency, albeit reduced, for transit supply to attract users, and if this supply is in an area where there is a higher density, the number of users will increase.

In TODs based on heavy rail transit, the distances between stops are greater and priority is given to greater population density and mixed use in the vicinity of stations. When these stops are far apart, but linked to urban centers, the TOD model results in transit villages (Dittmar, Ohland, 2004). This may be considered the classic TOD model and could be referred to as nodal TOD because it produces or consolidates development nodes far from, but linked to, the main urban center.

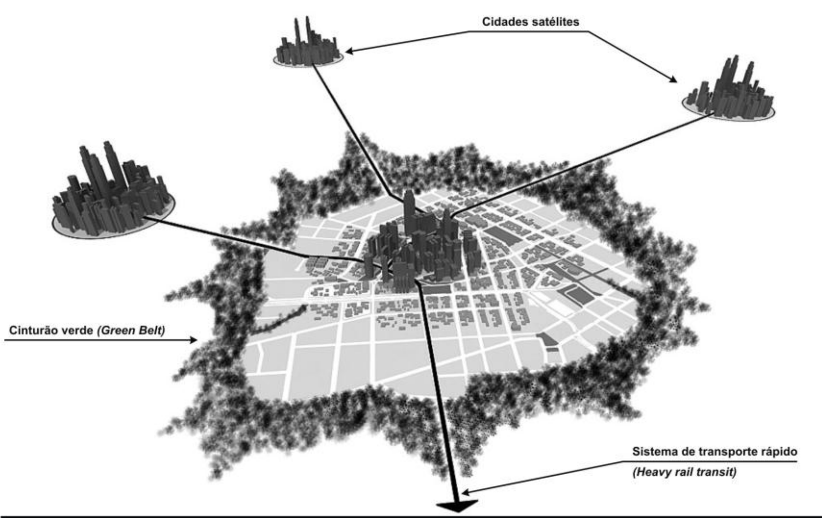

FIGURE 1 – THEORETICAL MODEL OF A NODAL TOD.
Source: Prepared by the author based on Petersen (2004).

Although greater density and mixed use in the vicinity of transit stations is of particular importance in the classical TOD model, some authors point out the benefits of TOD projects distributed along medium-capacity transportation corridors. Cervero (2004, p. 12) argues that linear TOD projects, with origins and destinations distributed along transit corridors, allow bidirectional flows that make the system more efficient, as shown in Figure 2.

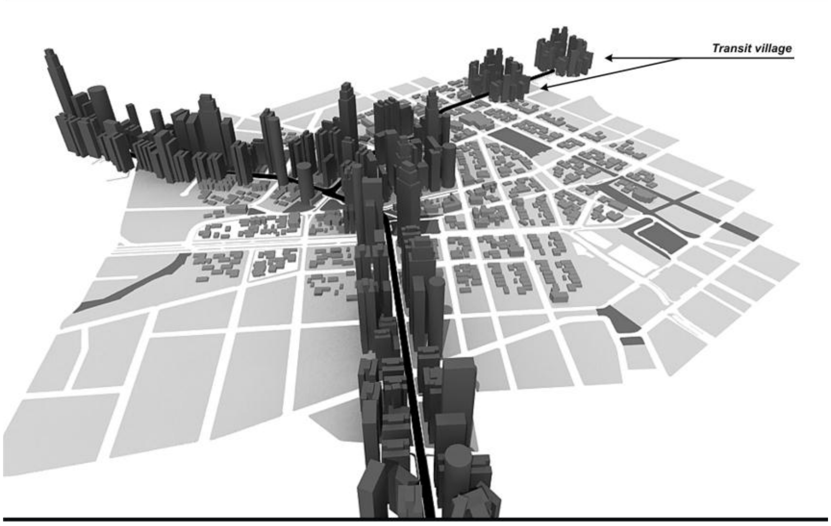

FIGURE 2 – THEORETICAL MODEL OF A LINEAR TOD.
Source: Prepared by the author based on Petersen (2004).

According to Litman (2008), TOD-based strategies typically produce a two- to fivefold increase in the number of public transportation passengers and reduce the number of automobile journeys by 8% to 32% compared with conventional land-use planning.

Hence, the choice of main mode when developing a transportation system will have an influence on urban form. And there are pros and cons associated with rail- and road-based medium- and high-capacity transit. Subway and rail systems, for example, although offering high capacity—between 30,000 and 60,000 pphpd (passengers per hour per direction)—and greater speeds than other urban systems, require exclusive infrastructure. This leads to higher implementation costs, usually in the order of $ 30 million to $ 100 million per kilometer in the case of elevated systems and between $ 45 million and $ 350 million per kilometer in the case of underground systems (IEA, 2006; Wright; Fjellstrom, 2003). Light rail transit (LRT) systems generally have the same capacity as bus rapid transit (BRT) systems, but both share the same road space as automobiles at crossings and have inferior performance to that of underground systems. However, there is a large difference in cost: while the cost per kilometer of BRT varies between $ 500,000 and $ 15 million, the corresponding figure for LRT varies between $ 13 million and $ 40 million. Despite the very large variation in costs per kilometer for each mode (in the case of BRT the cost can vary by as much as a factor of thirty), making it necessary to consider each case individually, it cannot be denied that BRT systems, because they are generally smaller, are an important alternative to rail transit for fast, medium-capacity public transportation, particularly in developing countries.

In linear BRT- or LRT-based TODs the distance between stations varies from 400 to 800 m, and trips from the origin or destination (i.e., homes or commercial buildings) to a station can be made on foot. Greater population density can therefore be promoted along the whole corridor. In contrast, the distance between underground stations and train stations varies from one kilometer (for urban underground systems) to tens of kilometers (for metropolitan trains), making it more important for users, who often depend on feeder lines or car park facilities, to be close to stations.

The argument presented here is that rather than merely addressing the transportation needs of cities hosting worldwide sports events, transportation projects for such events should be urban restructuring projects. As urban restructuring is linked to the supply of medium- and high-capacity transportation, TOD is a suitable model to use as the basis of urban development.

In the following sections we analyze two cases of cities that hosted major sports events and developed medium- and high-capacity transportation projects to allow access to stadiums. In both cases, advantage was taken of the event and the transportation infrastructure to restructure part of the city. In addition to describing the cases, we evaluate the results obtained by integrating a transportation system with an urban restructuring project. The two cases studied are: Cape Town, which hosted eight games during the 2010 FIFA World Cup and chose a BRT, and Sydney, which hosted the 2000 Olympic Games and chose a metropolitan train system.

3. CAPE TOWN: PERFORMANCE OF A LINEAR TOD

In the years preceding the World Cup, Cape Town had been suffering from increasing traffic congestion and declining use of public transportation. Analyzing one of the main roads, Marine Drive, Roger Behrens (2008) noted that from 1989 to 2004 the average speed had fallen from 38 km/h to 15 km/h and that the mean number of southbound vehicles per hour had increased from 1,429 to 3,438. Public transportation's modal share fell from 49% to 39%, while private automobile share and non-motorized share increased from 44% to 48% and 7% to 13%, respectively. As a result of the increasing number of automobiles, partly attributable to the poor quality of public transportation, private transportation in the central area of Cape Town accounted for 67% of trips between the hours of 6 am and 7 pm in 2006 (Strydom, 2010). As with other cities in various countries that hosted the World Cup, public transportation to the area where the stadium was located was one of FIFA's main concerns and was considered by the authorities to be an important legacy for the city (Cape Town, 2009), primarily because it involved infrastructure needed for urban improvements that had been promised as the lasting results of major sports events (Pillay, Bass, 2008).

The stadium originally chosen for the FIFA 2010 World Cup games was the Athlone stadium, situated in a low-income district with a population of 128,000 predominantly black inhabitants and an unemployment rate of 28%. After South Africa had been chosen to host the games, the choice of stadiums was revised. In Cape Town activities were transferred to Green Point Stadium (Figure 3), located in an area with a population of 64,000 made up predominantly of whites, an unemployment rate of 6% and an average income four times that of Athlone (Swart, Bob, 2009, p. 119). The official reason for the change was that the new stadium was close to the city center, could be easily reached by tourists and was also close to beaches and other leisure facilities, such as the Victoria & Alfred Waterfront.

FIGURE 3 - GREEN POINT STADIUM SEEN FROM TABLE MOUNTAIN.
Source: Author, 2011.

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Cape Town already had an extensive public transportation network including metropolitan trains, buses and minibus-taxis, but major investments were needed to modernize it and leave a positive legacy. The Green Point Stadium area could only be reached using the few buses that served the area or, more importantly, minibuses, which represent an important mode share in the city (Wilkinson, 2010). The stadium's closeness to the central district—only 2 km away—meant, according to statements made by those responsible for managing operations for the World Cup during interviews given in the area, that a significant proportion of trips to the stadium were made on foot. This is evidenced by the fact that the Fan Walk connects these very places. Nevertheless, part of the legacy left by the World Cup was the first stage of a BRT project known as MyCiti (MyCiti, 2010). The BRT project for Cape Town is expected to be completed in 2020. By 2012 three of the main axes had been completed: the first connects the airport to the city center; the second connects the center to Green Point Stadium; and the third, the center to Table View. The axis connecting the center to the airport does not have any intermediate stops as it is an express route and therefore does not have any link with the urban development of the areas it passes through. The axis connecting Green Point Stadium to the center was the main transportation project for the World Cup. During the event, more than 130,000 people used the special bus services between Century City Park, the Grand West Casino pay-and-ride facility and the University of Cape Town (Vieira, 2010). However, while this axis served its purpose during the games, after the event it became less important, indeed almost irrelevant. The reasons are simple: the stadium is in an area with a low population density occupied mainly by the middle classes, who do not use public transportation; the workers who do use public transportation to go to the center live to the southwest of Green Point, from Sea Point on (Figure 4), an area served by normal buses that are not integrated with the network and, more importantly, minibuses. In other words, the complete failure when planning the BRT to consider land use and land occupancy along the axis and the socioeconomic dynamics of the region explain why the system operates at a loss even during the rush hour.

FIGURE 4 - EXISTING BRT MYCITI LINES.
Source: Google Earth, 2012.

It is the third axis, which goes from the centre of Cape Town to Table View, that most closely resembles a BRT. On this section, which is approximately 16 km long, buses circulate in separate corridors; the thirteen stations are long, allowing all the doors on the buses to be used for passengers to board and alight; the fare is paid in advance; and the corridor is made of concrete so that buses can travel faster and are safer and more comfortable (Figure 5). There are feeder lines from the terminus at Table View that feed passengers from different districts into the system.

FIGURE 5 - A MYCITI STATION, SHOWING THE EXCLUSIVE CORRIDOR.
Source: Author, 2011.

Rather than analyzing BRT in Cape Town as a transportation system, our purpose here is to analyze how BRT is serving a TOD, as it is by supporting this type of development that BRT can benefit the areas in which it is introduced.

A more detailed analysis of the section between Central Station and Table View reveals that the population density along the corridor is extremely low. Figures 6 to 9 show that the area between Woodstock and Section is occupied by factories and warehouses.

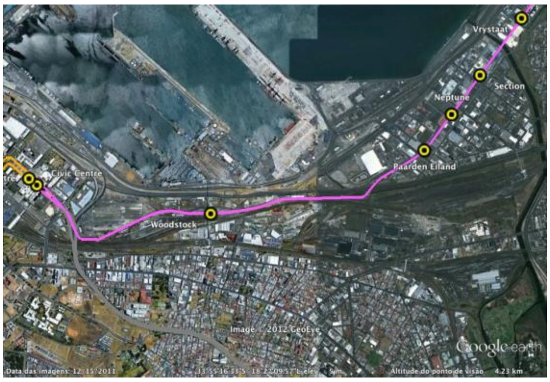

FIGURE 6 - THE SECTION BETWEEN WOODSTOCK STATION AND SECTION STATION.
Source: Google Earth, 2012

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FIGURE 7 - DETAIL OF THE AREA NEAR WOODSTOCK STATION
Source: Google Earth, 2012

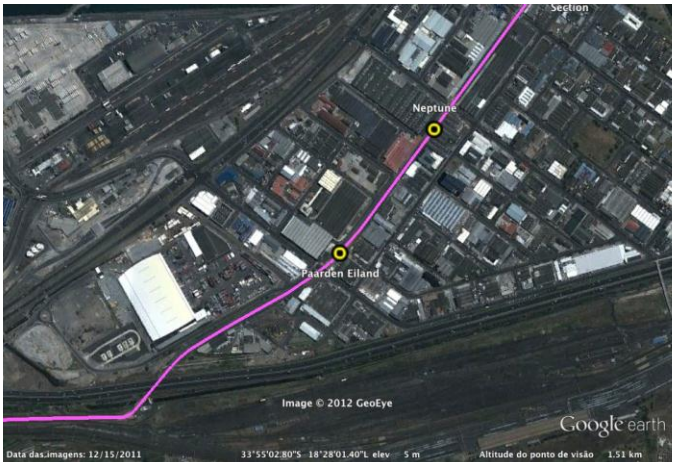

FIGURE 8 - DETAIL OF THE AREA NEAR PAARDEN EILAND AND NEPTUNE STATIONS.
Source: Google Earth, 2012

FIGURE 9 - AERIAL VIEW OF THE AREA NEAR WOODSTOCK AND PAARDEN EILAND STATIONS.
Source: Author, 2011.

Even if there are changes in land use and occupancy guidelines, any transformation will be slow and uncertain, as the area's proximity to the port area and road network make it more suitable for industrial use than residential use. Furthermore, access to the stations even for those who work in the area—mainly in warehouses rather than large factories—is made difficult because of the barriers created by the roads and railway lines.

Another example of the failure to consider land use and occupancy when planning the BRT can be observed between Milnerton and Sunset Beach stations (Figures 10 and 11).

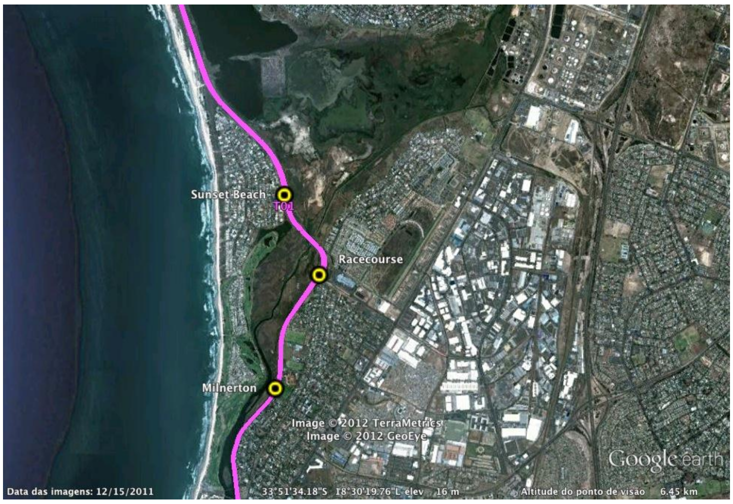

FIGURE 10 - SECTION BETWEEN MILNERTON AND SUNSET BEACH STATIONS.
Source: Google Earth, 2012.

FIGURE 11 - OCCUPANCY BESIDE MILNERTON STATION.
SOURCE: AUTHOR, 2011.

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The area is swampy or surrounded by water and will remain that way regardless of any land use and occupancy changes along other sections of the line as it is an environmental protection area. In other words, the BRT corridor here will be like a tunnel, without any connection with the surrounding area.

In the same area, Figures 12 and 13 show that there are residential condominiums near Racecourse station, indicating the potential for integration between the transportation system and urban occupancy in the area. However, as can be seen from the pictures, these are not only medium- and high-quality condominiums, with lot sizes between 300 and 1,000 m2, but also relatively far from the stations, which are difficult to reach because of the road system.

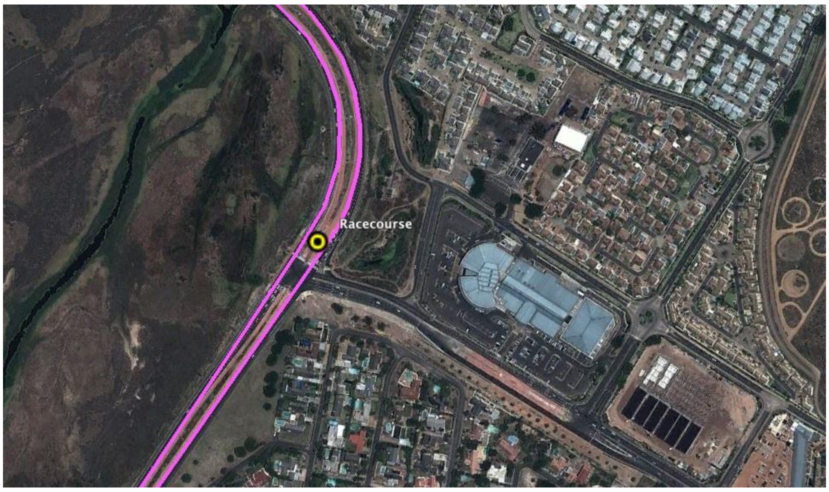

FIGURE 12 - SECTION BESIDE RACECOURSE STATION.
Source: Google Earth, 2012.

FIGURE 13 - OCCUPANCY BESIDE RACECOURSE STATION.
Source: Author, 2011.

It comes as no surprise, therefore, when return trips during the two rush hours (7am to 9pm and 5pm to 7pm) were observed on two weekdays, to find that very few passengers board or alight at any of the stations between the center and the Table View terminus. Although from the point of view of transportation the BRT in Cape Town complies with the technical requirements for a complete BRT specified by the Institute for Transportation and Development Policy (2007), it fails to play a role as a driver of urban development, or TOD, and while it is true that the BRT is important for districts to the east and north of Table View, all 16 km of the corridor between this terminus and the central station operate like a tunnel, in isolation from the urban context in which it exists.

4. SYDNEY: PERFORMANCE OF A NODAL TOD

The provision of urban transportation for the Olympic Games (OG) is a considerably more complex task than the provision of transportation for the World Cup. The added complexity is a result of various factors, from the number of sports events, which require a range of different facilities and occupy an area tens of times greater than a football stadium, through the number of athletes, who spend longer in the city, to the number of supporters.

Sydney already had a well-established transportation system before the OG. The subway and rail system in the metropolitan region is a radial network made up of 307 stations and 18 lines and carries 1 million passengers a day (NSW Transport City Rail, 2011). When it was chosen to host the OG in 2000, the city already had a ten-year history of metropolitan planning: the Sydney Greater Metropolitan Region had been set up in the 1990s, and metropolitan plans had been proposed in 1995 and 1998 with a view to integrating land use, transportation and activity-center developments in the suburbs.

As part of this metropolitan strategy, Auburn, in the Homebush Bay area, was chosen as the location for the Olympic Park. Various projects had gradually been carried out to improve this area, which had previously been home to waste dumps and factories, and the Olympic Park, together with the opening of the Bicentennial and Millenium metropolitan parks, transformed the area. As an urban strategy, the Olympic Park was to be the driving force behind the consolidation of Auburn as a center for services and would enhance the importance of another municipality, Parramatta, as a regional center. However, public transportation to the Homebush Bay was limited.

According to Pitts and Liao (2009), a city like Sydney, which has adequate infrastructure, can choose to concentrate new investments in areas where they will have less impact on local residents. This is a further justification for locating the Olympic Park far from the center.

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Even so, the transportation estimate drawn up in 1995 for the event was the most underestimated of all the estimates for the event. Initially, the cost was estimated at $ 25.8 million, but the actual amount spent was $ 381.7 million. The justification for this discrepancy was the increased costs of logistics, traffic management and contracts with private companies for transportation during the event (Official Report of XXVII Olympiad, 2000).

In 1997 an agency (ORTA) was set up specifically to coordinate transportation. The main project to allow mass access to the park during the OG was the Olympic Park rail loop, a 5.3 km-long extension loop connecting the Olympic Park to Lidcombe station, through which three lines serving Sydney Central Station pass.

The station on the Olympic Park rail loop was to be the entrance to a new area with commercial buildings and offices, forming a center that would generate trips after the OG (Sydney Olympic Park Association, 2002), as shown in Figures 14 to 16. Also in the region near the Olympic Park, residential developments are still being built; these are more than 1.5 km from the station, relatively far for pedestrians.

Because it provides for a high-capacity transportation system and stimulates construction of tall mixed-use (but primarily business-use) buildings through changes to zoning, the transportation project for the Olympic Park has the characteristics of a nodal TOD.

FIGURE 14 - OLYMPIC PARK, STATION AND COMMERCIAL AND RESIDENTIAL AREAS.
Source: Google Earth, 2012.

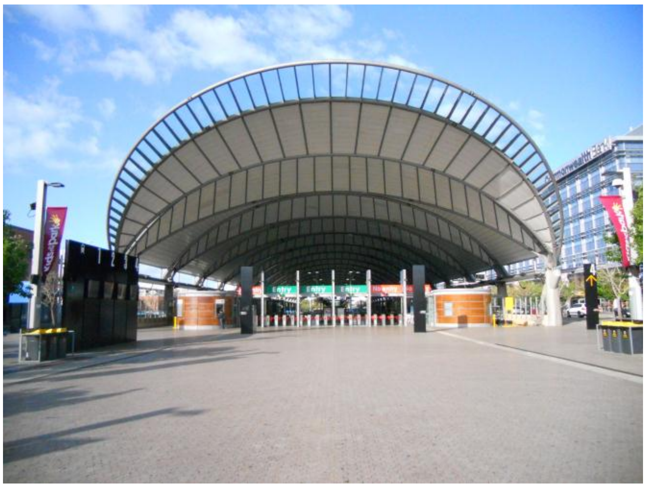

FIGURE 15 - OLYMPIC PARK RAIL LOOP STATION.
Source: Author, 2011

FIGURE 16 - PUBLICITY FOR BUILDINGS NEAR OLYMPIC PARK
Source: Author, 2011

To cater for the OG, the organizers also took circumstantial measures to reduce traffic, including decreeing a school holiday for the duration of the competition, changing workers` start and finish times, promoting distance working, informing users of peak traffic times and organizing campaigns to encourage use of public transportation instead of automobiles. As a result, the number of bus users per week fell to 3.2 million during the event, fewer than the corresponding figure for a normal August week in the same year—3.4 million passengers (Hensher; Brewer, 2002).

While this shows the efficiency of Sydney's planning for major sports events, it also suggests that Sydney missed the opportunity to increase subway and rail's share of metropolitan transportation as a legacy of the OG. The supply of subway and rail transportation in the metropolitan area decreases significantly with increasing distance from the city of Sydney, particularly in the east-west direction. Within the middle ring each district is served by on average two lines while in the outer ring there is only

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one line to each district or, in some cases, none at all, showing the economic polarization between Sydney and the rest of the metropolitan region.

The idea that while the system worked well for the OG it neither transformed modal share nor consolidated the region around the Olympic Park as a trip generator was expressed by Irene Simms (in Cashmann, 2011, p.181), a councillor at Auburn, where the Olympic Park was built, when she stated that the residents of Auburn rarely use the existing facilities because of the lack of public transportation and road connectivity. The population in the south of the city is less well-off—20% of the inhabitants do not have their own automobile and depend exclusively on public transportation—and it was precisely public transportation to the area around the Olympic Park that was not expanded. The Olympic Park rail loop benefitted tourists who, as was to be expected, stayed in Sydney. While tourists could take advantage of the rail loop, little was done for residents of nearby areas, and the facilities at the park were left unused.

Cashman (2011, p.183) also notes that public transportation is inadequate in nearly all the towns in the vicinity of the park. Even in Auburn, where the Olympic Park is located, users have to travel more than two kilometers to a subway or rail station. Figure 17 shows that the lack of public transportation makes it necessary for people in the western part of Auburn to use their own vehicles to get to work. Furthermore, analysis of socioeconomic data shows that the population in municipalities farther from the city of Sydney has a greater percentage of unemployed parents. As they are unable to acquire their own automobile or use public transportation, it is difficult for them to go to other areas.

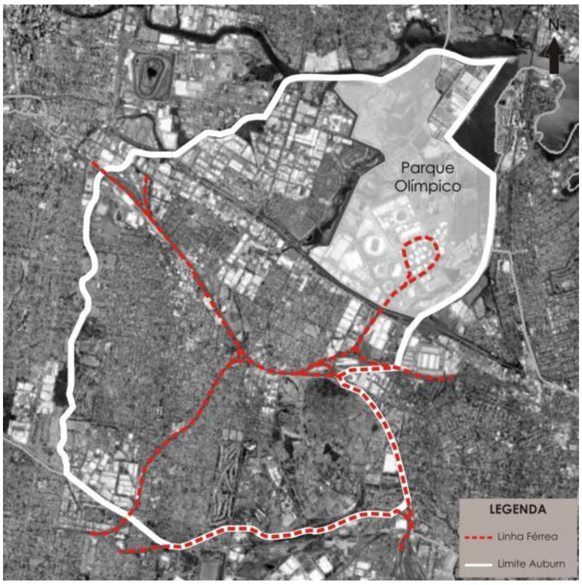

FIGURE 17 - THE AREA AROUND THE OLYMPIC PARK SHOWING THE LIMITED ACCESS TO THE SUBWAY AND RAIL NETWORK.
Source: Author, based on Google Earth, 2012

According to Sue Holliday, former chief planner for the OG, the most significant legacy of the Games was the expertise in planning major international events, evidence of which is that the organizers were hired to provide consultancy for the Beijing OG (The Independent, 2008). The lack of integration and connectivity of the Olympic Park with the urban form is one of the reasons it is not often visited by tourists or the local population. Consequently, even though a high-capacity transportation system was built and zoning around the station was changed, the lack of an overall vision of the regional and metropolitan dynamics meant that ten years after the OG were held, full advantage had not been taken of the Olympic Park to develop a nodal TOD.

5. FINAL CONSIDERATIONS

One of the main requirements stipulated by the owners of the rights to the OG and World Cup for these events is the provision of transportation infrastructure and services. These require the greatest public investment and are also considered one of the main legacies of such events.

Because of their size, such projects can change the urban configuration and development axes of parts of a city. TOD involves a set of measures to ensure that transportation is the driving force behind this urban reconfiguration and that non-motorized transportation and public transportation are prioritized.

Cape Town and Sydney were chosen for this article because the former hosted the 2010 World Cup and chose BRT, the latter hosted the 2000 OG and chose a metropolitan rail system and both adopted TOD projects. However, as described here, because the main BRT axis in Cape Town crosses swamps and industrial areas it operates as though it were traveling through a tunnel (taking users from one end of the axis to the center) and does not promote development in the surrounding area; in Sydney, the size of the Olympic Park and the lack of road and transportation links to neighboring towns prevented a business area becoming established near the park as initially intended.

These two striking examples illustrate the solutions and problems that Brazilian cities hosting these competitions can avoid to ensure that major investments in transportation do in fact produce the desired urban changes.

ACKNOWLEDGMENTS

This research was partially funded by Fundação Araucária and CAPES.

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