The Rio Games Legacy in Mobility: Challenges Beyond Infrastructure

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The City of Rio de Janeiro, Brazil, a city of 6.5 million inhabitants, had several years to plan, invest, and prepare for the 2016 Olympic and Paralympic Games. A significant part of these efforts were in mobility infrastructure and operations, as they would become a fundamental legacy for the city. Silva, Maiolino and Torres, who were involved in these efforts in various capacities, discuss this experience and some of the challenges that go beyond investments in infrastructure such as behavior and operational changes.

The City of Rio de Janeiro experienced a 7-year period, from 2009 to 2016, of generous investments to the high capacity public transit system. The driving catalyst for these investments were the 2016 Olympic and Paralympic Games. These investments translated into new transit infrastructure. High capacity transit corridors, accessible stations, and transit hubs were built with newly available financial and land resources, ultimately becaming the Games' greatest legacy.

The new infrastructure not only provided an efficient means of travel for spectators during the Games, but more importantly, increased the availability of reliable public transit services and expanded access throughout the region for the resident population. In addition to the infrastructure upgrades, operational measures were also upgraded for the Games. Perhaps the most important of such measures was the operational integration of all public transit authorities (at state and municipal levels) and private operators focused on resilience, what still functions to this day.[1] Fare integration across different modes of transportation in a single multi-trip travel card, was another measure which, however, was only implemented during the Olympic and Paralympic Games. The lack of a permanent solution for fare and funding affects the performance of the whole network and is a challenge yet to be overcome.

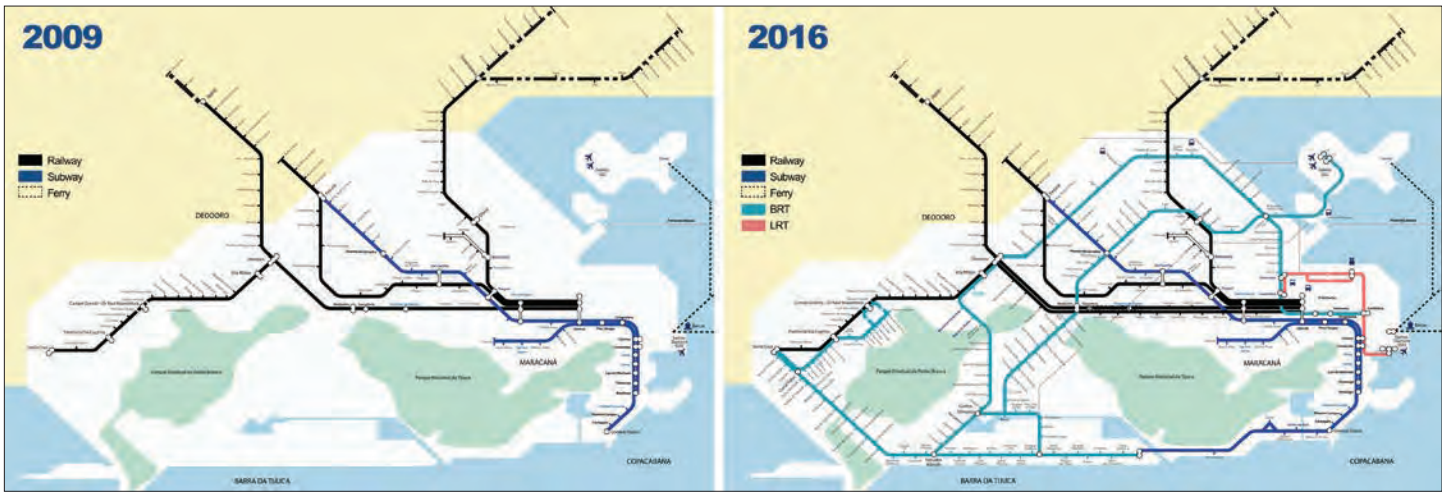
[1] It is important to note that the bus fleet and routes including the entire BRT System in Rio are run by dozens of private operators organized into four consortiums that operate in four different geographical regions. The metro, suburban rail, LRT, and ferries are also operated by different private companies. Buses, BRT and LRT are regulated by the city while metro, suburban rail and ferries are regulated by the state government.

Infrastructure

In 2009, before the Games, Rio's network consisted of five metropolitan rail lines extending over 270km with 101 stations (89 stations within the city limits), two Metro lines reaching 37 km and 33 stations, and three ferry lines. The infrastructure expansion of the mass transit introduced two new modes of transportation, 122km of BRT (Bus Rapid Transit) and 8km of LRT (Light Rail Transit), as well as adding 16 km of metro service (Maiolino, 2015). The implementation of a fully dynamic BRT System provided several multimodal transit hubs granting maximum flexibility to users and expanding access throughout the region (Figures 1 a & b).

To understand the impact of the transportation network improvement, the Institute for Transportation and Development Policy (ITDP) launched the People Near Transit Index (PNT), that measures the number of residents who live within a 1 km radius of a transit station (Marks, 2015). Utilizing the 2010 heavy rail – metro and train – transportation network as a base, the PNT determined that approximately 36% of the city population (2.2 million) were within a short walking distance of a transit station. The projected PNT in 2018 will reach 52% of the population, translating to roughly 3.5 million residents (ITDP, 2015). In addition to the 2016 transportation network mentioned above, by 2018 a fourth BRT corridor will be ready thus expanding the network's reach (Figures 2 a & b).

The new network not only provided the expansion of public transportation corridors but also an increase of transit hubs. Consequently, this expansion required a government alignment on design and resources to provide a fully accessible



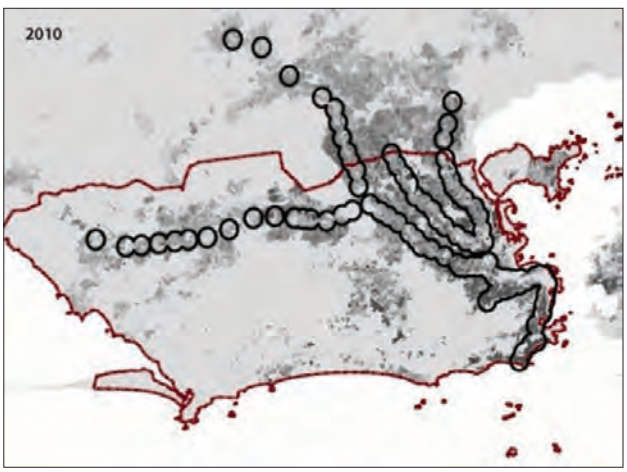
Figures 1 a & b: Upgrades to Rio de Janeiro's Transport Network 2009-2016. (source: Maiolino, 2017).

integration between different modes of transportation.

Three primary types of solutions for multi-modal transit hubs were considered. The most common is one based on direct proximity. This occurred when the new station was located very close to the existing one, separated only by an at grade pedestrian crossing. Examples of this solution type include the LRT-Metro downtown connection (eg. Cinelandia and Carioca stations), the LRT- Santos Dumont Airport connection, the LRT- Novo Rio Intercity Bus Terminal connection, and the BRT-Galeao Airport connection (Figure 3).

The second type of design solution considered was one based on a multi-level integration, primarily accessed by ramps, stairs and elevators between the existing mode, usually the heavy rail infrastructure, to the new BRT system. Prominent examples of this interchange are Magalhães Bastos, Vila Militar, Vicente de Carvalho and Madureira (Figure 4). With this solution, the users must access two distinct paid areas, which are connected by an open public area. The design of the stations underwent discussions among different operators and public authorities and presented only a medium level of complexity. The existing stations had to undergo small layout changes to accommodate the multi-modal integration, which posed minimal challenges. The main constraint, however, with this design solution was coordinating financial resources and land acquisition required to make these changes feasible.

The third solution was direct integration, which is both effectively functional and perceived by users as the smoothest and easiest transition between modes. Two clear examples are the Alvorada Terminal that connects two different BRT corridors and the Jardim Oceanico Station that integrates the new Metro extension with the new BRT corridor (Figure 5).



Figures 2 A & b: Comparative maps of Rio's PNT Index 2010-2020; developed by the Institute for Transportation and Development Policy .(source: ITDP, 2015)

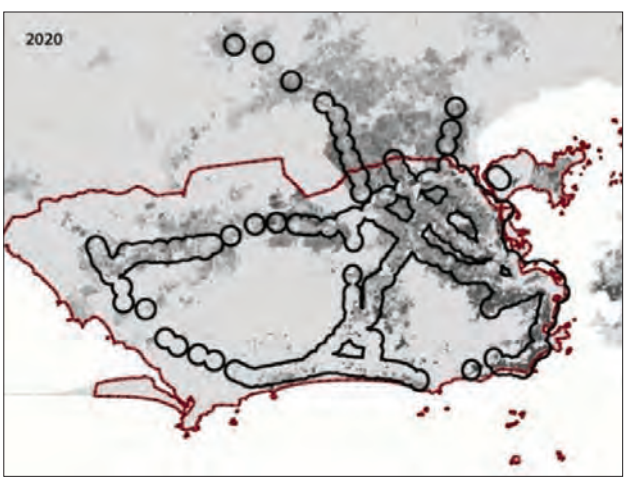


Figure 5: LRT- Santos Dumont Airport connection. (source: SMTR, 2016)

The direct integration between the two BRT corridors did not pose a problem institutionally nor complexities with fare collection and management. Here, the only true challenges were design and infrastructure because there was only one operator and one public authority. In the Alvorada Terminal, the users transition between corridors by walking a few meters to access a new staging area, where there are no additional turnstiles or fare collection (Figures 7 a & b). It is important to highlight that BRT system in Rio is highly interchangeable. While distinct corridors exist, the network provides integrations both at transit stations as well as through different BRT routes that smoothly transition from one corridor to the next. This flexibility in the system has garnered much approval since new routes have eliminated the need to physically transfer stations.

Unlike the Alvorada Terminal, the Jardim Oceanico Station is a multi-modal transit hub. This BRT-Metro connection was institutionally much more difficult to reach a design solution. Both

Figure 6: BRT-Train Magalhaes Bastos connection. (source: SMTR, 2016)

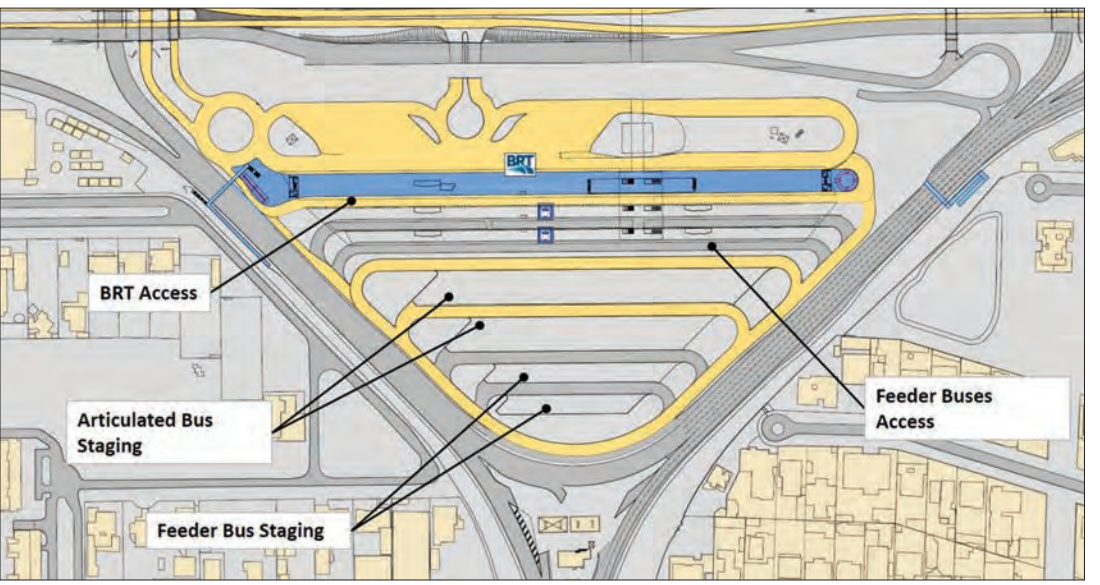


Figure 7 a & b: View and schematic layout of the BRT-BRT Alvorada integration station. (source: SMTR, 2016)

stations were completely new, ran by two different transit agencies and governed by two different levels of government (city and state). In addition to these complexities, the stations were integrated into an active, high-income neighborhood, also adding to the delay in reaching a solution. The final infrastructure design solution was developed considering various aspects like: future expansion of the metro line, avoiding a viaduct, a direct BRT-Metro connection, and a weaker connection to regular bus lines. To accommodate this solution, an operational scheme was necessary. An integration zone inside Metro's paid area was provided to allow a smoother transition between the BRT station and the Metro station (Figures 8 a & b).

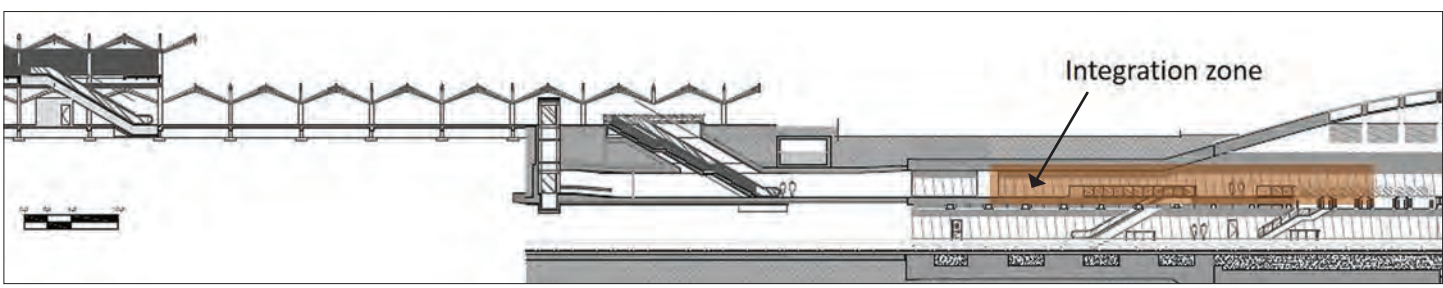
When land was available, transit hubs where a design solution included the integration of regular city buses were provided at the Recreio, Alvorada, and Olympic BRT Terminals. At these hubs, the users alight in a covered area equipped with bathrooms and other pedestrian facilities and then pass through a set of turnstiles to reach the BRT system. Still, in the other hubs, the regular city bus stops are located adjacent to the new hubs and users must traverse pedestrian bridges or crossings to reach the high capacity transit stations connecting to either the BRT or heavy rail.

Accessibility was integral among all design solutions. While types 2 and 3 posed a certain level of complexity between the transit agencies either with retrofitting stations or ensuring new stations were constructed to code, it was imperative that measures were taken to provide accessible transit stations for all users. Brazilian law requires that all new construction meet accessibility guidelines. Federal mandates together with the Games requirement to ensure accessible transit for all created the impetus that transit agencies needed to work together to design fully integrated and accessible transit stations. The main challenge when designing for accessibility was not at the transit station, per se, as all new transportation infrastructure provided level boarding, accessible turnstiles, and tactile paving, but rather with the multi-modal integration. To assure a fully accessible integration, sufficient elevators, escalators, and accessible ramps were provided at each transfer. Further still, each transit operator provides staff to help individuals requiring assistance navigating the transit station.

Despite the high level of complexity, limited financial and land resources, varying transit authorities, different transit service timetables, and a tight implementation schedule, some priorities were defined to reach good results. In the case of Rio de Janeiro, the priority was to provide the easiest access for users between transit modes.

Coordinated operation, communication and contingencies - CIMU

The new transportation infrastructure added yet another layer of complexity for Games Time and post Games Time transit operations, communications and contingencies. Since 2011, the city managed transit and traffic operations via the Rio Operations Center. This operational command center included the participation of the regular bus operator and the two rail operators as well as other necessary city agencies. While the command center had been effective in its operation, little had been done to coordinate integrated communications and contingencies between the transit operators and the city. Just prior to Games Time, two new transit operators, namely for the BRT and LRT systems, were introduced in the command center.



Figures 8 a & b: Section and view of the BRT-Metro Jardim Oceanico integration station. (source: SMTR, 2016)

The addition of these two new transit modes combined with the complexity of operating an already saturated public transit network as well as managing the Games Time demand required effective institutional integration to provide efficient service. In addition to the complexities that arise when converging four different transit operators, timetable integration was also one of the biggest challenges during Games Time. The BRT and rail-based systems have different operating hours. While the BRT operates 24/7, the metro and train do not, complicating after-hours integration within the complete transit network. To mitigate potential crises during Games Time, a coordination unit (the CIMU, Integrated Center of Urban Mobility) was created for the exchange of information between transit operators and coordination of contingencies (Detoie & Martins, 2016).

Communications between the city and the different transit operators were essential for efficient public transit service for spectators and residents alike. Just as important were communications with the users of the public transit. The city utilized this mega event to establish partnerships with companies running digital apps for trip planning in order to maximise communication for the daily users of public transit. These companies were invited to take part in the CIMU to advertise the most up-to-date digital tools such as multimodal trip planning and "push messages" to spectators and daily users, and voice over/talk back for individuals with visual impairments. During the event, approximately 3.5 million alerts with geolocations were sent to transit riders using CIMU unit. These partnerships went beyond trip planning and became a real-time communication tool for CIMU for public transit users during and after the event (Silva et al., 2017). This unit has since been adapted to function in the city's post Games daily routine, mainly for big events such as music festivals, New Year's Eve, Carnival, etc.

Fare integration

The main challenge was and still is fare integration. During Games Time, the City and State provided a solution of a daily, multi-trip Games Transit card, accepted by all modes, except ferry and intercity buses, for approx. $8.00 USD. The original agreement, as per Bid documents, to offer free public transit services to spectators (IOC, 2008), was cancelled. The agreement of this cancellation was made between the local RIO2016 Organizing Committee and the City.

It is important to highlight that the public transportation communications plan for the Games only included the high capacity network, namely the BRT system, train and metro. Access to the four Olympic zones were provided within this high capacity mass transit network, though depending on the origin of the spectators a transfer between modes was necessary. The Games Transit Card became highly useful as it not only provided swift transfers but also granted access to Games Time services restricted to spectators and workforce. Due to the late inauguration of some transportation infrastructures, the necessary tests to run at maximum load were not completed. As a result, Metro Line 4, BRT Transolimpica and the final section of BRT Transoeste had services dedicated exclusively for the Games demand.

The cost and revenue of Games Transit Card solution were shared between the public transit operators. This solution also helped with the issue of free flow at stations that experienced heavier crowds. The shared revenue allowed transit operators to provide free flow at the departure of venues and the Olympic Park without affecting their individual revenues.

The operational actions associated with introducing the Games Transit Card included new points of sales with bilingual assistants, a technological solution to provide access to the turnstiles of the different transit modes, and a communications plan. Approximately 800,000 transit cards were sold during Games Time. Fare integration between the modes was deemed successful as the train, metro, and BRT systems reached peak levels of passengers several times throughout the Games period (Prefetirua do Rio, 2016).

While the Games Transit Card solution was economical for Games spectators, fare pricing and integration remained a financial burden for the daily user. It is important to highlight that ticket fares are in accordance with the related mode. There are independent agreements between each system and level of government, like Bus-BRT, Bus-LRT, BRT-Train, BRT-Metro and Train-Metro. The Bus-BRT fare integration was and continues to be cheaper than the bus-rail integration, which affected the performance of the whole network, post Games Time. Unfortunately, discussions about financing infrastructure and operation are not on the political agenda yet. Still, it would be easier if all modes of public transportation were under the same governing authority.

Conclusion

Providing adequate public transportation goes beyond infrastructure delivery. Construction and expansion of the high capacity transit system and multiple accessible transit hubs are a starting point. Once the infrastructure is in place, it is important to have integrated operations and communicate to users using the most up to date tools. An integrated and affordable fare solution for the whole network is also important to provide alternatives for users. The first two points were completed successfully for the RIO2016 Games and Legacy.

Infrastructure and operational solutions are definitive, while others are still at distinct stages of improvement. Coordinated

operations and communications, which started before the mega event, is still in progress. On the other hand, fare integration was temporary and only provided during Games Time. This remains the biggest challenge for the city and its metropolitan region.

Even with fare constraints, the new public transportation network changed users' behavior and also the management of public authorities and transit operators. An urgent discussion for suitable fare governance that allows users to travel based on their needs, travel time, and convenience and not on the money spent, is necessary. It is time for politicians to embrace this agenda and for the society to demand it.

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