Urban Revitalization and Sustainable Urban Mobility (SUM)  
An Analysis of Public-Private Partnership (PPP) Framework Influence by Example of Porto Maravilha, Rio de Janeiro, Brazil

Marcelo Julião de Seixas

Supervisor:  
Dr.-Ing. Wulf-Holger Arndt

Co-supervisor:  
M.Sc. Amr Ah. Gouda

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Berlin, 01.02.2018
Statement of Authenticity of Material

This thesis contains no material which has been accepted for the award of any other degree or diploma in any institution and to the best of my knowledge and belief, the research contains no material previously published or written by another person, except where due reference has been made in the text of the thesis.

__________________________________________
Marcelo Julião de Seixas
Berlin, February 1st 2018
Abstract

Several cities have been suffering from degraded areas, which promote serious negative consequences on their social, economic, and environmental aspects. Therefore, these brownfields urge for urban revitalization, in order to contain and reverse the deterioration process, whose non-intervention tends to expand its harm to neighboring areas. However the lack of public resources, in several countries worldwide, is a major obstacle for implementing such actions.

In this context, public private partnerships have been applied in multiple urban projects, as an alternative way for overcoming financing difficulties. Moreover, urban transformations has great interrelationship with urban mobility, which is constantly shaping and being shaped by the built environment and its flows. Therefore, it becomes essential to question whether PPP framework is appropriate for implementing urban revitalization projects, and to investigate its impacts on sustainable urban mobility.

Using an exceptional case study in Rio de Janeiro, Brazil, this study firstly evaluated Porto Maravilha impacts on SUM, through the comparison between previous and current situations, focused on walkability and MIT disincentive. In sequence, based on these evidences and interviews with project main actors, the influence of PPP framework was critically analyzed.

The study concluded that PPP model is an important tool, for both financial and technical feasibility of urban revitalization projects, which framework showed to be capable of enabling significant improvement on SUM. The analysis also revealed that enhancements are needed, and recommendations were made on aspects that may reduce project exposition to external economic factors.

Keywords: sustainable urban mobility (SUM), urban revitalization, Public-Private Partnership (PPP), Porto Maravilha, walkability, disincentive of Motorized Individual Transport (MIT).
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<tr>
<td>AEIU</td>
<td>Area of Special Urban Interest</td>
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<tr>
<td>BOT</td>
<td>Build Operate and Transfer</td>
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<tr>
<td>BRT</td>
<td>Bus Rapid Transit</td>
</tr>
<tr>
<td>BRS</td>
<td>Bus Rapid System</td>
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<tr>
<td>CDURP</td>
<td>Port Region Urban Development Company</td>
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<tr>
<td>CEDAE</td>
<td>Companhia Estadual de Águas e Esgoto</td>
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<tr>
<td>CEF</td>
<td>Caixa Econômica Federal</td>
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<tr>
<td>CEPACs</td>
<td>Certificates of Additional Building Potential</td>
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<td>CPN</td>
<td>Porto Novo Concessionaire</td>
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<tr>
<td>DB</td>
<td>Design and Build</td>
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<tr>
<td>DBFO</td>
<td>Design Build Finance Operate</td>
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<tr>
<td>DBO</td>
<td>Design Build and Operate</td>
</tr>
<tr>
<td>DFB</td>
<td>Design, Finance and Build</td>
</tr>
<tr>
<td>GIS</td>
<td>Geographical Information System</td>
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<td>HPSI</td>
<td>Housing Plan of Social Interest in Porto Maravilha</td>
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<td>IBGE</td>
<td>Brazilian Institute of Geography and Statistics</td>
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<td>MIT</td>
<td>Motorized Individual Transport</td>
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<tr>
<td>PMREIF</td>
<td>Porto Maravilha Real Estate Investment Fund</td>
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<td>POU</td>
<td>Public Order Unit</td>
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<td>PPP</td>
<td>Public-Private Partnership</td>
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<tr>
<td>RO</td>
<td>Rehabilitate and Operate</td>
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<tr>
<td>SPV</td>
<td>Special Purpose Vehicle</td>
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<td>SUM</td>
<td>Sustainable Urban Mobility</td>
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<tr>
<td>UFRJ</td>
<td>Federal University of Rio de Janeiro</td>
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<tr>
<td>UN</td>
<td>United Nations</td>
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<tr>
<td>VLT</td>
<td>Light Rail Vehicle – Tram</td>
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<td>WBSCD</td>
<td>World Business Sustainability Council for Development</td>
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1 Introduction

1.1 Decay of Urban Centers

Cities are living systems with great complexity and dynamism, whose characteristics are affected over time, by the different physical, social and economic changes. Human development is constantly transforming societies and citizen’s behavior, which therefore reflects over urban spatial demands. Neighborhoods are continuously subject to alterations in their function, due to the evolution of activities, production processes and flows. The non-adaptation of urban environment to meet demands promoted by these changes, especially on infrastructure aspects, causes the reduction of area’s importance and vitality, which may lead to a process of decline, with harmful consequences. Lower economic activities or serious social problems can trigger a process of real estate devaluation, jobs reduction, land dereliction and even environmental degradation. This context can evolve and push the area further into a vicious cycle, in which its conditions become increasingly worse.

Several city central regions experienced these contexts during the process of urban sprawl, where industrial facilities underwent a process of displacement to periphery areas, due to the inconvenience of their permanence in central zones. This is the case of some waterfront areas, whose city growth has hampered logistics for accessing port region, causing serious problems for both the population and the viability of port activities. The increased time spent on congestion has become costly for freight operations, while heavy truck traffic through urban central areas has promoted high levels of pollution, unpleasant conditions for pedestrians, in addition of accentuating the traffic problem. As a result, former factories and sites previously used as harbor facilities in coastal cities experienced the reduction of activities and region’s emptying, giving rise to abandoned areas. These processes gave rise to the so-called brown fields, which currently represent complex challenges for cities.

1.2 Need to Revitalize Urban Centers

The presence of brownfields generates several negative externalities at economic and social aspects, becoming a serious urban problem, whose effects reflect not only within its spatial limits, but also in surrounding areas. It promotes area abandonment, real estate devaluation, closure of local commerce, dereliction of
public spaces, and encouragement to crime and illegal practices. Moreover, these areas often present unhealthy conditions, due to the lack of proper infrastructure maintenance. Flows of people and vehicles change in order to avoid proximity or intersection with brownfields, while businesses and services move to other locations, due to the worsening of economic conditions. Furthermore, this emptying process causes an underutilization of existing urban infrastructure, reducing the efficiency of public spending, and giving rise to a vicious circle, where situation becomes continuously worse. Its negative characteristics can be seen analogously to a cancer, which if untreated expand its harm to neighboring areas. Therefore, a brownfield requires an urban revitalization to stop its worsening process and reverse situation, bringing life and dynamism back to its area.

Urban revitalization processes can be seen as great opportunities, since many of decaying areas occupy central and strategic neighborhoods, which have great spatial potential for implementing several new uses. These processes thus become tools to perform urban transformations capable not only of reversing the harmful process, but also by creating basis for a more consistent and sustainable development. New uses can be given to these areas, in order to induce the direction of urban development towards a more efficient and integrated coexistence with others neighborhoods. In this context, urban revitalization generates positive externalities for broader areas, and thus creates a virtuous circle of development. However, its implementation is not linear, and involves numerous complex and interdependent actions, whose results often occurs in the long term.

If on the one hand, the abandonment and emptying promote serious social problems, on the other hand, they become a facilitator for carrying out major physical urban transformations, which would be unlikely or economically unfeasible in overcrowded, heavily occupied and expensive areas. This is the occasion of some former port areas which, through the reduction of their economic dynamism, gave rise to vast underutilized areas at waterfronts, and housed revitalization projects with large urban transformations such as: Porto Madero – Argentina, London Dock – UK, Hafen City – Germany and recently Porto Maravilha at Rio de Janeiro, Brazil.
1.3 The History of Public Private Partnerships in Brazil

The conditions, conducive to the formation of public private partnerships (PPP) in Brazil, result mainly from the combination of poor public services, and the lack of public resources to promote large investments in infrastructure. The interest in its application was influenced by the limitations of public spending, and by the relative success achieved in the United Kingdom, where early experiences of PPPs began in the 1990s. The possibility of attracting private funds, in a context of scarce public resources, would allow important investments for the country’s development, thus reducing the large deficit of existing infrastructure.

The process of PPPs’ development in Brazil begins during the presidency of Fernando Collor through the creation of the National Privatization Plan, established by Law no. 8,031/1990. This program aimed at promoting initiatives such as the sale of public assets through a privatization process, in addition to developing instruments that, enable the State moving away from activities previously provided exclusively by it, and bring the private sector closer to its operation. The law express among its reasons and objectives:

“the reduction of public debt, contributing to the improvement of public sector finances; contribute to the modernization of country's industrial park, increasing its competitiveness and strengthening business capacity in the various economy sectors; contribute to the strengthening of the capital market” (Law no. 8,031/1990)

Moreover, Brazilian federal government has issued further laws aiming to foster private sector initiatives, and the creation of partnerships. The Law no. 8.666/1993 established rules for bids and public administration contracts, while procedures for concessions and permissions to provide public services were defined by Law no. 8.987/1995. Therefore, the bases for a greater participation of private sector have been created since 1990, and culminated with the institution of Law n. 11.079/2004, which then defines the general rules for bidding and contracting PPPs at the federal, state and municipal levels.

According to PPP Knowledge Lab since 1990, Brazil had faced already 784 PPP projects summing a total investment of 329 US$ billion. Most of the projects focused on infrastructure improvements for electricity generation,
telecommunications, basic sanitation, rail construction, in addition to roads through the country. More recently, it has been identified the increase of investments within urban areas, with projects in the field of urban mobility as the implementation of subways, trams and airports.

1.4 Research Problem and Importance of the Study

Investments in urban infrastructure have not been sufficient to adequately address the intense growth of urban population, and therefore cities are facing serious problems, with increasing impacts on their residents. In the field of urban mobility, large and medium Brazilian cities are experiencing growing problems of pollution, congestion and traffic accidents, with considerable part of population without access to adequate public transport systems. This situation stems mainly from the lack of investments in infrastructure during the last decades, period in which Brazil has consolidated itself as an urban country, where according to IBGE (2010) 84% of its population lives in urban areas, and 21% in cities with more than 1 million inhabitants.

Moreover, the lack of integration between urban and transport planning contributed to accentuate even more these problems. Urban areas have grown and expanded, giving priority to road transport, thus creating a context where cities suffer from inefficient mass public transport and chaotic traffic. The lack of adequate urban mobility conditions generates several economic losses, worsening of social conditions, and environmental impacts, which take alarming proportions when considering the continuous and faster increase of urban population.

Cities need to be rethought aiming at the development of sustainable urban mobility, in order to become more compact, integrated, and efficient. Land mix use should be promoted as a way to reduce the demand for long journeys and to encourage active transport, as well as, public spaces must become more attractive to pedestrians, ensuring safety and comfort for citizen. Similarly, public transport system needs to become more integrated and efficient, in order to encourage the modal shift, and consequently reduce vehicles flow and their negative aspects. However, how can these improvements be implemented in a context of severe public resource scarcity? Where would the resources come from?
The use of PPP, as an alternative way to promote investments in urban infrastructure, has already become a reality, with projects being implemented in several cities. However, this raises the question whether the PPP framework is indeed appropriate to support the development of sustainable urban mobility (SUM). Once the profit component is involved in urban infrastructure projects equation, would it not generate an antagonistic conflict of interest between improvements and profit margins? What are the risks involved in this context, and is it worth assuming them? Therefore, studying the characteristics of this relationship becomes critical to guaranteeing public interests and improving results. According to the United Nation (UN), it is expected that by 2050, two-thirds of the world’s population will live in urban areas, which further intensifies the importance of understanding PPP models, and its consequences on SUM promotion.

1.5 Research Focus and Objective

Urban revitalization process is a very broad and complex theme, which encompasses interrelated features between, economic, social, cultural, spatial and environmental spheres. However, this study focuses mainly on spatial aspects with pronounced impact on SUM, by analyzing the urban transformations with greatest impact on walkability and the discouragement of motorized individual transport (MIT) aspects.

This research aims to analyze the influence of the PPP framework on the promotion of SUM, based on results and developments achieved in Porto Maravilha revitalization project, and from this analysis, highlight important issues in the PPP context that may be improved. In addition, the evaluation of Porto Maravilha features may become a reference case, serving as lessons learned for future urban revitalization projects, and enabling the development of more effective measures for SUM promotion.
2 Literature review

2.1 Urban Revitalization Process

Over time, degraded urban areas aroused attention to the need for performing new functions, which the aging of buildings and urban equipment, often generate opportunities for social and cultural improvements, as well as real estate development. According to Holland (2014) the term revitalization means to give new life, vigor, strength and vitality, meanwhile urban revitalization means to impart new life or strength to a neighborhood and revive its depressed economy. Vileniske (2014) asserts that the term revitalization can infer physical, social, cultural and economic dimension, and Spandau (2010) emphasizes that it is a process that comprises a set of urban management strategies to enable the (re)development of problematic, deprived and abandoned urban areas. In other words, urban revitalization can be defined by, a strategic planning process of upgrading areas for ‘higher’ social, cultural, and economic uses, preserving their historical heritage and environment. It provides, through medium and long-term interventions, links between territories, activities and people.

Several terms are used to describe these processes, and are often used by researchers as urban renewal, rehabilitation and requalification. Although these concepts present some differences, the actions represented by them are intertwined and have, as a common point, the plan to recover a decaying or degraded urban area, by improving its social, economic, cultural and environmental conditions. The main target is to ‘rebuild’ urban aspects, in order to improve local residents’ quality of life. According to Ramlee (2015), studies refer these terms to public policies that aim the resolution of urban issues, such as economic decline, environmental decay, community abandonment, unemployment, and other social problems. Their analysis contributes to a better understanding of urban revitalization concept.

Urban renewal is marked by the idea of demolishing existing buildings, and replacing them with new constructions, which usually have different typological characteristics, and perform new economic activities adjusted to the process of urban transformation. Urban Rehabilitation does not represent the destruction of buildings, but its re-adaptation to new demands in terms of urban functionality. It is usually a question of adapting the degraded urban fabric, emphasizing the residential character, in which complementary interventions are usually made with
adaptations both in the buildings, in order to make them livable, as in the urban landscape, in the surroundings public areas. Urban Requalification is mainly an instrument for the improvement of population living conditions, by the construction and recovery of infrastructure, and the valorization of public space with measures of social and economic dynamization.

2.2 Sustainable Urban Mobility

Concept of sustainability

To better understand the concept of sustainable urban mobility (SUM), it is essential first, to comprehend the terms that compose it: sustainability and urban mobility. The concept of sustainability or sustainable development originally focuses on long-term environmental issues related to the use of natural resources, environmental degradation, and in particular to climate change. As expressed at Brundtland Commission in 1987, sustainable development “is development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (UN report, n.d, chapter 2). The concept itself is very broad and has evolved during time. According to Goodland (1995), the meaning of these ‘needs’ is now widely accepted as goals that encompass economic, social and human development, and environmental and ecological health. He further explains that, in the context of natural resource policy, sustainability would mean, limiting the exhaustion of resources in a rate at which they can be replenished, or other alternatives can be identified. In other words, one can define sustainability or sustainable development, as the search for practices that meet the current human demands, without causing irreversible damages from the environmental, economic and social aspect, as well as the development of means for their impacts to become smaller.

Concept of mobility

A practical meaning of mobility could be understood as the capacity with which people and goods can move from one place to another. In this context, the greater the number of options to move between two points, and the shorter the time spent, greater would be the mobility. However, when applying this concept to an urban area, its analysis gains more complexity being influenced by a great number of factors. Urban mobility has great dependence on urban infrastructure, availability
of transport modes, as well as economic and social factors. The decision of how to move between points, within an urban area, does not rely solely on the time spent and the route traveled. It can be influenced by prices, comfort, and safety provided by each of available transport mode, in addition to individual subjective factors, such as health, tradition, or pleasure. Cidell & Prytherch (2015) argue that transportation is not only a technology for moving people or goods between places, but a system that is mediated through existing social realities, and that gives rise, in turn, to particular types of society.

**Concept of SUM**

Approaching the two concepts, sustainable urban mobility consists on the promotion of mobility for citizens and goods, in an environmentally appropriate way, but above all, ensuring sustainability also for the social and economic aspects involved in these flows. SUM goes beyond just an efficient public transportation. It is intrinsically connected with good spatial planning, and the urban built environment. The street design, for instance, has great influence in the way population moves, which large blocks and wide avenues attract larger car flows, while push pedestrians away, due to the longer walking routes, greater risk of run overs, higher noise, and air pollution. Such avenues tend to become invisible walls that section neighborhoods, and reduce integration between areas, in addition to hampering the existence of small local commerce, which consequently reduce even more sidewalks’ attractiveness. On the other hand, streets dimensioned taking human scale into account creates ‘soft edges’, advocated by Gehl (2013) as fundamental factor to attract pedestrians. Active façades and adequate public space, create an inviting atmosphere for pedestrians, as well as encourage small displacements to be carried out on foot. The greater presence of people on the street tend to promote positive externalities such as greater social interaction and sense of community; local economic dynamism; lower crime rates, due to the continual "eyes on the street"; and better health indexes. The World Business Sustainability Council for Development (WBSCD) defines sustainable mobility as:

“The ability to meet the needs of society to move freely, gain access, communicate, trade, and establish relationships without sacrificing other essential human or ecological values today or in the future.”

Walkability and Disincentive of Private Motorized Transport

The incentives to walkability, as well as the discouragement of MIT are essential factors for promotion SUM. Private cars and motorcycles are responsible for the emission of atmospheric pollutants, high levels of noise, congestions, in addition of an inefficient use of urban space, through their innumerous parking lots. “The transport sector is responsible for 23% of global emissions. Urban transport is the single greatest source and growing - largely because the use of cars is on the rise” (Hawken, 2017, p.136). Therefore, encouraging active transport and modal shift become important actions to promote sustainability. Walkability can be seen as the set of factors that provide favorable conditions for walking and cycling, in addition to promoting greater attraction for public spaces. According to Gehl (2013), pedestrian and bicycle traffic saves space and contributes positively to green accounts, by reducing the emission of pollutants and carbon. He explains that a bike path can carry five times as many people as a car lane, and that ten bikes fit into the space of an average parking slot.

Studies have shown that, there are several aspects that influence the choice of transport mode. For instance, the presence of continuous sidewalks and small blocks can cause an increase in the number of people walking and accessing the local commerce within neighborhood, Moudon (2001). Gehl (2013) observes the importance of convenience factors on walkability attractiveness, arguing that inviting people to walk and cycle is not enough, and that city design must provide options of siting down and spending time at public space. Furthermore, several studies explain the benefits of walkability in the individual and collective health, (see Lovasi et al., 2011; Owen et al., 2004; Saele & Handy, 2008).

The discouragement of private transport can be done either through incentives that encourage the modal shift, as improvements in public transport system, or through the implementation of measures that restrict private vehicles use. Several studies analyze the relations between the built environment and transport mode choice (Camagni et al., 2002; Cervero & Radisch, 1995; Cidell &Prytherch, 2015; Owen et al., 2004) however there is still a demand for better understanding of how interventions in the built environment, such as the introduction of high-quality transport infrastructure, specifically influence the modal shift, Heinen et al. (2017).
**Land use**

There is a co-production between transport and space, where the means of transportation shapes the space, as well as the space itself, also influences the transport, constituting a relationship with intrinsic characteristics that should not be analyzed separately. A review by Saelens & Handy (2008) of 13 previous studies of walking and the built environment, showed that land mixed use generally supports walking factors. The special importance of access to recreational and open space, as an important variable related to walkability behavior, was analyzed by Frank et al., (2007). Erwing (1996) supports that, a well balance mix of non-residential and residential uses, promotes shorter journeys closer to people’s homes. He further explains that people are much more likely to walk, when they have somewhere specific and nearby to go.

A well elaborated spatial planning has special importance in promoting sustainable urban mobility, since it can reduce the number and distance of trips, as well as encourage the modal shift towards more sustainable transport modes. Camagni et. al (2002) state that, public transport can be strongly influenced by the structural organization of an urban area. They assert that, the more dispersed and less structured the development, the lower the level of efficiency and competitiveness of public transport, and consequently the lower its use.

Once the planning of a new urban area is done, taking into account the mobility point of view, the shape of plots, blocks and also their uses, could be totally different. To promote a good urban planning it is necessary to take into account both, the scale from pedestrians inside a neighborhood, as well as the relations between neighborhoods and other city areas, Gehl (2013). A well balance should be sought in order to avoid large displacements, and reduce the demand of motorized transport. Planning should be done in a way to attract users to use public spaces as an extension of their houses, offices, and schools. As much life there is in the streets and squares, better tend to be the urban environment, and its positive externalities.
2.3 Public Private Partnerships

Public-private partnerships (PPPs), defined in a practical and simplified manner as cooperative institutional arrangements between public and private sector actors, have aroused great interest worldwide, but their definition does not have unanimity among scholars. Some approach the topic by seeing it as a real partnership with gains for both partners, while others focus on negative aspects, often associating its concept to some kind of ‘privatization’ or ‘contracting out’. Bovaird (2004) defines it as “working arrangements based on a mutual commitment (over and above that implied in any contract) between a public sector organization with any organization outside of the public sector” (p. 01). Hodge & Greve (2007) observe that, for many people PPPs are linked to infrastructure projects, and constitute institutional arrangements aiming cooperation, which are expressed through the establishment of new organizational units. Furthermore, Savas (2001) suggests that “Privatization and public-private partnerships reflect market principles and together constitute a strategy for improving public management.” (p. 15).

This research does not aim to discuss the definition of PPPs but rather to analyze their practical influence on urban revitalization processes and at SUM promotion. Therefore, the PPP concept adopted in this study was used in greater agreement with the definition presented by the PPP-Reference Guide (2017) elaborated by the World Bank, that defines PPP as:

“A long-term contract between a private party and a government entity, for providing a public asset or service, in which the private party bears significant risk and management responsibility and remuneration is linked to performance.” (p. 01)

Public-private partnerships are characterized by the creation of more durable links between parties, whose contract duration, depending on the nature of the activity, ranges from 5 to 30 years. Regardless of the absolute number of years, the main concept involved in PPPs is that their contract has a sufficiently long duration to motivate private partner to consider the costs incurred throughout the entire project life in its decisions. The long-term commitment of private partner, to meet operational performance indexes, encourages him to analyze cost-benefit relationships not only during the implementation phase, but also at operation period. This framework enables the implementation of long-term return actions, encouraging more efficient solutions. In this sense, PPP constitute an
arrangement where government declares its need for capital-intensive, long-lived infrastructure, and the desired asset is built by a complex combination of public and private financing, which is subsequently often operated by the private partner under a long-term contract, Savas (2000).

Private partner investments during deployment phase tend to be larger, the greater the importance of operation phase for project results. Moreover, according to PPP-Reference Guide (2017), PPPs tend to reduce construction time and cost overruns for new infrastructure assets, when compared to traditional public procurement. It argues that PPP structure gives private partner more control over project design and implementation activities, while at the same time prevents the reimbursement of excess costs, which could occur in traditional hiring contracts. In PPP framework, efficiency comes from the integration of project design, construction, and operation into a single agent, which generates incentives for cost optimization and better service delivery, without prejudice to public policy planning, Brito & Silveira (2005). PPPs can take different formats depending on the assets involved, the risks and liabilities assumed by each partner, in addition to the different forms of private partner remuneration. Therefore private partner can be involved in several ways such as:

**Design or Engineering Work**: it consists in the design of devices able to meet performance requirements. It also involves the development of technically feasible means to transform concepts and processes into reality. In this situation, the private partner has responsibility for developing systems to be produced or deployed, and assumes responsibility for technical performance during project operational phase.

**Build, Renovate or Rehabilitate**: It consists in the physical construction or improvement, depending on the PPP agreement terms. Dependent on PPP scope, the private partner can implement the entire asset from its inception or promote adaptations and improvements to an existing one. One practical example could be the construction of a new highway, or the expansion of its capacity.

**Finance**: In some Public Private Partnerships, the private partner assumes responsibility to provide necessary, even partial, financial resources to carry out the implementation and operation of project. In these cases, private partner involves its own resources in the venture, either through the use of equity or through financial commitments with financial entities, such as bank loans or
debentures issuance.

**Operate:** In this situation the private partner has responsibility for operating the asset or providing specific services related with it, meeting minimum performance levels agreed in contract. Using the highway example, operation activities would be the maintenance and conservation of asphalt, as well as the provision of services to its users.

The combination of the above responsibilities can lead to different types of PPP, which may also include the possibility of transferring back the asset to public authority, after a certain period. The most common configuration of PPP are: Design and Build (DB); Rehabilitate and Operate (RO); Design, Finance, Build (DFB); Design, Build and Operate (DBO), in addition to Design, Build, Finance, and Operate (DBFO). The latter configuration is very common in concession contracts, which is the occasion of the case study addressed in this study.

![Diagram of PPP models and degree of risk transfer](image)

**Graphic 1 - PPP model and degree of risk transfer. Source: Author**

The way in which private partner receives its remuneration plays a key role in the success of a PPP, since private partner decisions are highly influenced by their financial impact. The remuneration mechanism should then be designed in such a way, that the private partner payment is linked to performance indicators. This framework gives private partner the incentives to deliver services in accordance to expected performance, generating better financial returns, while the objectives of public partner are met. It promotes flexibility for the private partner to better exploit their expertise and potential, without opposing the goals pursued by public partner.
Furthermore, a Special Purpose Vehicle (SPV) should be created to represent the PPP, segregating all previous assets and liabilities from private partner and its subsidiaries, which enable greater transparency throughout the entire project life. Moreover, PPP models are alternative ways for fundraising and have greatly importance, especially for Latin America countries, since their governments usually suffer from lack of resources to meet the demand of infrastructure.

**Public Private Partnership Constraints**

**Poor planning and coordination** - As explained earlier, PPPs differ from common business relationships and involve much greater complexity. Public Private Partnerships demand better planning, as well as very well-designed studies, since they have longer duration and their feasibility is based on long-term estimates. Furthermore the monitoring of PPPs demands qualified professional teams, with great knowledge of involved mechanisms and its possible consequences.

**Masking Public Debt** - The PPP structure has high dependence on estimates and feasibility studies, which are subject to errors as very optimistic forecasts. To enable investments in infrastructure and reap political results, public governments can influence parameters, used in feasibility studies, and raise funds masking unsustainable financial modes. They intend to circumvent the accounting processes rules to which local governments are subordinated by country’s laws. In Brazil, for instance, the Complementary Law nº 101/2000, most known as ‘law of fiscal responsibility’ decreed in 4th May 2000, establishes public finance standards, and among other things, maximum limits for government indebtedness.

**Risks and Warranties** - PPP framework involves greater risks, and therefore demands more robust warranties. Its long-term life becomes more susceptible to future economic conditions and also to changes in political willingness, which can severely affect its results. On the other side, PPP framework can also be seen as a political risk itself, in a sense that, the current government makes decisions during the PPP creation, whose impacts will remain for several years, even during further mandates.
2.4 Rio de Janeiro Context

Over time, degraded city zones, whether being peripheral or central, require revitalizations actions to bringing life and dynamism back to the place. According to Moura et al. (2006), the need for urban renovations and revitalizations processes became more evident in the last decades of the twentieth century, due to the aging of industrial and port areas, characteristic of heavy industrialization phases. She also pointed out that such areas often arouse real estate, cultural and social interests, thus giving rise to ideas of urban revitalization.

The port area of Rio de Janeiro had passed through decades of constant degradation and deterioration of its social conditions. The decrease in port activities has reduced its economic importance, and the construction of an elevated motorway transformed the area into a passageway for cars. This area has great cultural value, and presented a contrast between its historic sites and the precarious conditions of abandoned buildings and poor public infrastructure. A large number of homeless, and a notable presence of crime and prostitution, were a common situation in this area. This environment completely discouraged the use of public space, thus creating a vicious circle in which conditions became worse and worse over time. Cultural institutions and civil society organizations long sought public actions that could guarantee the preservation of historical sites, and promote the improvement of social conditions. Revitalization plans were elaborated in the past however they were not implemented, due to the high complexity and lack of resources.

Taking advantage of a favorable political conjuncture obtained in 2008, by the alignment of the three political spheres (Federal - State - Municipal), Rio de Janeiro city hall developed Porto Maravilha project, aiming the complete revitalization of city former port area, covering 5 million square meters. This project proposed the complete restructuring of the water supply, sewage, lighting, gas and telecommunications networks, as well as the implementation of a new mobility concept, including the reconfiguration of road system and the deployment of a modern tram. "Porto Maravilha was conceived for the recovery of urban infrastructure, transport, the environment and the historical and cultural heritage of Port Region", Porto Maravilha (2017). The project foresees the improvement of urban infrastructure as a way to boost its development and support a greater population density intended for this area. According to Porto Maravilha project
“demographic densification projections indicate leap from the current 32 thousand to 100 thousand inhabitants in 10 years”, Porto Maravilha (2017).

In this context, several actions were planned aiming at the development of sustainable urban mobility as a way to support the increase of users, as well as to promote region’s attractiveness and land value increase. The project suggested actions that prioritize pedestrians, and the use of public transportation, instead of private vehicles. It was planned the implementation of a cable car, providing access to the top of Providência hill, as well as the construction of a tram network, connecting all other transportation modes present within project area. The plan also foresees the reconfiguration of roads and sidewalks, with a key point being the replacement of a long elevated motorway, known as Perimetral, by a system of road tunnels. Then, an extensive public boulevard would be implemented in its place improving region environment and enabling real estate development.
3 Methodology

3.1 Problem Identification and Research Interest

Several cities suffer from degraded areas, which promote serious negative consequences on their economic, social, environmental and cultural aspects. Brownfields have already lost their capacity of organic regeneration and urge external actions, in order to contain and reverse the deterioration process. Without an intervention, the consequences tend to gain greater proportions extending the damage to neighboring areas. However revitalization projects require complex urban transformations, over long periods of time, which significantly increases the amount of resources needed. Therefore, the lack of public resources, in several countries worldwide, becomes a major obstacle for achieving the much needed revitalization in these areas.

In this context, PPP framework has been applied in multiple urban projects, as an alternative way for overcoming financing difficulties. However, a balance between public and private interests, as well as benefits from such model, needs to be investigated with a focus on sustainable urban mobility. Several studies indicate correlations between the built environment and sustainable urban mobility, and therefore understanding which influence a PPP environment exert on these relationships became essential for achieving better results. Moreover, the prospect of increasing demand for urban investments, especially at developing countries, due to the increase of urban population and cities fast expansion, makes the study of PPP features even more important.

In this circumstance, PPPs focused on urban revitalization can be analyzed as a powerful tool able to promote important urban transformations towards improvements on citizen’s life. Nevertheless it must be questioned if this model, involving the private sector, is an appropriate framework for tackling this issue, and furthermore identify what are the risks and consequences, especially on SUM. In addition, the study of PPPs becomes even more important, especially in Latin American context, where such relationships are always observed with great distrust from population. There is commonly the suspicion regarding corruption, and the real intentions behind PPP’s decisions, whether they focused on the best for the project or to favor the private partner.
3.2 Hypothesis and Research Question

In order to guide the research process and better organize the analysis, a hypothesis was elaborated suggesting that, PPP framework impacts positively in SUM promotion. Despite the great public suspicions about contradictions between PPP models and the guarantee of public interests, the hypothesis was framed asserting a positive relation, as a form to instigate the critical sense, and stimulate an even deeper exploration. To conduct the investigation, the following research question was then formulated: Is there a conflict between PPP framework and SUM promotion at urban revitalization projects? Aiming to support the analysis of PPP framework influence on SUM promotion, and to delimit the scope of research, focus was given on two main topics: walkability and the disincentive of MIT. Therefore, a literature review was carried out on SUM theme, urban revitalization projects, and their involved processes, in order to better understand the status-quo.

The land use and spatial features influence on transport, which in turn influences housing and the environment, thus affecting the local economy, and so forth, which ultimately makes boundaries between variables and parameters unclear. In these situations, commonly on urban studies, Campbell (2003) argues that, “case studies may far better deal with these ‘loose ends’ than traditional statistical analysis” (p 03). He further acknowledges that, case studies are useful not only to identify best practice, but also to better comprehend the phenomenon, through the vividly detailing of its practice.

Therefore, it was decided to carry out such analysis, through the study of a specific project that had concrete actions already taken. This would then enable the measurement of real progress made at urban mobility, in addition to allow the analysis of decisions, and facts occurred in a PPP environment, as well as its consequences with great deepness. The evaluation of these two aspects would then enable to, first verify whether the project actually promoted improvements on SUM, and second, to better analyze what kind of influence the PPP framework exerted on results.
3.3 Case Study

According to Yin (1994), case studies are an appropriate methodology for situations with specific characteristics, where there is great difficulty in separating the phenomenon from the other aspects of its context, and reduced control over the events. Case studies can better handle complex urban processes whose boundaries are open-ended, and the inputs and outputs are unclear. In addition, the use of an exceptional case study, despite the greater difficulty in generalizing its analysis, is more effective in challenging existing analytical assumptions and promoting the evolution of theory. Its own existence can prove that something is indeed possible, and its exceptionalism may form an innovative model for the future, Campbell (2003). Furthermore, a single well done exceptional case study, presented in an easily translatable format, can be more convincing and useful than an imprecise set of multiple cases, where the analysis may be based on a shallow set of lower common denominator comparisons. This is the case, for instance, of Jane Jacobs' ‘Death and Life of Great American Cities’, which despite being based on a single case city (New York), promoted a noteworthy influence on urban planning thinking and practices.

During the literature review, several examples cities were considered and finally Porto Maravilha project at Rio de Janeiro was chosen, due to its objective of implementing sustainable urban mobility concepts; significant urban physical transformations; recent implementation; project pioneerism; the city great international visibility; and its marked influence at Brazilian and Latin American contexts, in addition to data accessibility. Moreover, Rio de Janeiro has a distinctive urban configuration, with a large and diffused presence of ‘favelas’ located on the hillsides throughout the entire city, which represents great mobility challenges.

The possibility of comparing the various urban revitalization cases, present in literature review, was disregarded given the nature of revitalization process proposed by Porto Maravilha. Its significant size, great amount of resources, controversial urban transformations, and complex financing model, located within the complex aforementioned context of Rio de Janeiro, makes its study an exceptional case. In this way, the comparison of previous and current situations was considered more appropriate to support the evaluation SUM, and identify the influence of PPP model on its results. Therefore, two other specific assumptions
and questions were formulated, as a form to guide the particular evaluation of these two aspects. The walkability theme was addressed from the premise that Porto Maravilha improved walkability standards within region, and to proceed with its investigation, the following question was then created: To what extent has Porto Maravilha impacted walkability within region? To approach the theme of disincentive of MIT, it was framed the supposition that changes promoted by Porto Maravilha discouraged MIT, and to guide the assessment, it was formulated the question: What progress has been made by Porto Maravilha in discouraging MIT?

3.4 Research Structure and Methodologies Applied

To answer the research question and assess the different variables, the study was divided into three main parts, each one having a clear and specific objective. The first part is devoted to identifying goals of Porto Maravilha related to urban mobility, and to analyze how actions toward these objectives were implemented. The second part aims at evaluating the impact of implemented actions on SUM, within project influence area, and finally the third part focus on the investigation of PPP framework influence on results.

![Research Structure Division](image)

The aforementioned structure made it possible to, deeply investigate each of the topics, identify their preponderant factors, and understand the details of Porto Maravilha project. Afterwards, a joint analysis of the three parts findings was carried out, in the discussion and conclusion.
3.4.1 Methodology Applied in Part One - Porto Maravilha Objectives and Its Implementation Phase

In order to understand which physical and social aspects exert influence on SUM, an extensive literature review was carried out. At this phase the author has gone especially deeper into ‘soft elements’, whose relationship with SUM is not so obvious. These were mainly social and human aspects, which stimulate sensations and influence citizens’ behavior, thus impacting indirectly on urban mobility, due to their personal choices and decisions. There were factors such as the composition of building’s facade and its visual communication with streets, lighting, aesthetic pleasure, the creation of ‘soft edges’, and the importance of human scales at even simple structures. The social and economic activities, the rhythms of flows, and other issues related to experiences and sensations, were also object of the study.

The identification of Porto Maravilha actions and its evolution was performed based on the analysis of official documents, such as municipal laws and regulations; academic publications such as articles, master's theses, editorials, specialized blogs; and media news related to the project planning and implementation phase. The data organization sought, as far as possible, to reflect project implementation chronological sequence. Firstly, the context of project creation was analyzed, in addition to its goals, institutions involved in its implementation, and its economic framework. Especial attention was given to the PPP framework established to implement project activities, whose analyses were based mainly on official documents, reports and municipal legislation.

With great influence on walkability factors, the aspects of land use mix were examined by analyzing maps, regulations and actions taken throughout the Porto Maravilha implementation. Similar analysis was carried out for aspects such as, the improvement of sidewalks, creation of boulevard, and the implementation of cycling infrastructure. Photos were used to illustrate the analysis, and show the pre and post-project situations. Furthermore, there were analyzed activities that, although related to walkability, were mainly focused on the disincentive of MIT. These actions promoted large physical transformations in the region, and its analyses were performed using mainly official data from, the concessionaire Porto Novo (CPN), Rio de Janeiro City Hall, and impact studies carried out before project implementation.
3.4.2 Methodology Applied in Part Two - Evaluation of Sustainable Urban Mobility within Porto Maravilha Area

The second part intended to evaluate the impact of Porto Maravilha activities on sustainable urban mobility, within project influence area. Based on the literature review, aspects that have a major impact on SUM were identified, and then, considering also the availability of data, 6 specific aspects were chosen: street design; convenience; safety; physical conditions; land use mix and modal shift. To evaluate these aspects the research relied on: analyzes of aerial images from Google Earth; measurement of as-built projects; analysis of official statistical data, and application of questionnaires. The variables assessed on each of these aspects are listed in the Figure 2 below.

![Figure 2 - Assessed variables. Source: Author](image)

Most of physical measurements were made using the as-built maps and drawings of the project, since most of them were elaborated during 2016, and therefore had high compatibility with reality. Previous conditions measurements were carried out considering the same field topographic records, used during the elaboration of Porto Maravilha executive projects. Moreover data from Google Earth, GIS open source forums, and Open Street Map, both for the previous and current situation were used.
Questionnaires

One strategy used to deal with the data limitations was the application of questionnaires, as a way of filling some information gaps. Therefore, the author focused on studying academic material related with surveys and questionnaires techniques, in order to enable its proper elaboration, and adequately conduct the survey. The questionnaire was then elaborated with 13 questions, with different formats, including single answers, multiple choices, and table of evaluations, as a way to maximize the collection of information, while maintaining its reduced size. The questionnaire followed a logic in which some questions were skipped according to participants’ answers, which allowed different amounts of total applied questions for each respondent. The survey was focused on users from Porto Maravilha area, and it was conducted both by online questionnaires and field survey, addressing the following topics:

Table 1 - Topics addressed by questionnaires. Source: Author.

<table>
<thead>
<tr>
<th>Question</th>
<th>Type</th>
<th>Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Single answer</td>
<td>For how long the respondent has accessed Porto Maravilha area.</td>
</tr>
<tr>
<td>2</td>
<td>Multiple choice</td>
<td>Reason(s) for currently accessing Porto Maravilha area.</td>
</tr>
<tr>
<td>3</td>
<td>Single answer</td>
<td>How often the respondent access Porto Maravilha area.</td>
</tr>
<tr>
<td>4</td>
<td>Multiple choice</td>
<td>The transport mode(s) currently most frequently used to access Porto Maravilha area.</td>
</tr>
<tr>
<td>5</td>
<td>Single answer</td>
<td>If the respondent changed the transport mode AFTER the completion of Porto Maravilha main works.</td>
</tr>
<tr>
<td>6</td>
<td>Multiple choice</td>
<td>The transport mode(s) used BEFORE Porto Maravilha works.</td>
</tr>
<tr>
<td>7</td>
<td>Multiple choice</td>
<td>Reason(s) for changing the transport mode. (only for the ones who have changed)</td>
</tr>
<tr>
<td>8</td>
<td>Multiple choice</td>
<td>Which reason(s) would lead the respondent to shift from MIT to Public transport. (only for MIT users)</td>
</tr>
<tr>
<td>9</td>
<td>Table of evaluation</td>
<td>Evaluation of traffic conditions. (only for MIT users)</td>
</tr>
<tr>
<td>10</td>
<td>Table of evaluation</td>
<td>Evaluation of public transport conditions.</td>
</tr>
<tr>
<td>11</td>
<td>Table of evaluation</td>
<td>Satisfaction regarding walkability variables.</td>
</tr>
<tr>
<td>12</td>
<td>Table of evaluation</td>
<td>Evaluation of Porto Maravilha impact on SUM aspects.</td>
</tr>
<tr>
<td>13</td>
<td>Single answer</td>
<td>Respondent’s monthly income.</td>
</tr>
</tbody>
</table>
The collection of answers made up a total sample of 472 respondents, 303 by online questionnaire and 169 by field survey. The last Brazilian census was conducted in 2010 and its subdivision sectors did not fit spatially with Porto Maravilha area. Using therefore Porto Maravilha project estimation of 32 thousand inhabitants residing in its area, and considering a 95% confidence interval, the total sample of 472 respondents correspond to a margin of error of 4.5%. The sample presented a significant diversity regarding, the relation with the area, frequency of access and economic profile, as shown in the graphs below:

**For how long respondents have accessed Porto Maravilha region**

![Graph 2 - Respondents' share regarding how long they have accessed Porto Maravilha region. Source: Questionnaires.](image)

**Frequency of access to Porto Maravilha**

![Graphic 3 - Respondents' frequency of access. Source: Questionnaires.](image)

**Respondents' Income Profile**

![Graphic 4 - Respondents' income profile. Source: Questionnaires.](image)
Online Questionnaires

The online questionnaires were applied using the Online Pesquisa (onlinepesquisa.com) services, due to its high credibility in Brazilian context, a key factor to increase the number of participants. An experimental pilot survey was conducted with a small group of people, from September 26th to October 8th, 2017 as a way to assess, the clarity of question formulation, response time, existence of errors, and collect suggestions. A request for feedback was sent to participants, along with an individual link to access the pilot online survey. This procedure proved to be valuable, as it led to improvements on questionnaire formatting, and a better formulation of questions, avoiding then misinterpretation. The responses from the 17 participants of this experimental survey were discarded, and not considered in the analysis of this study.

After improvements, the online questionnaire was then applied from October 12th to November 03rd, 2017 obtaining 303 participants. For greater dissemination of the survey, the author identified and contacted strategic agents that could contribute with it. Personalized e-mails were sent to community leaders, residents associations, local companies, institutions, and also messages via author's social networks were used. The control, to prevent same participant from responding more than once, was carried out by Online Pesquisa website, through the identification of computer IP.

On Site Questionnaires

The same questions of the online questionnaire were applied on site, by a master student of Federal University of Rio de Janeiro contracted for such. Carolina dos Santos Santana conducted the field survey from October 23 to October 27, 2017 achieving 169 respondents. The online format did not allow identifying if any concentration of participants occurred in a particular sub-sector of Porto Maravilha area. Therefore, to ensure better spatial distribution of respondents, the author defined together with Carolina, specific areas for applying the field survey as shown in Figure 3. Carolina was remunerated by this service through an overall price.
Questionnaires Data Analysis

Afterwards, the data from both the online and field surveys were tabulated together in an excel sheet, and then performed the analysis of results. The questionnaire data were used to evaluate several aspects regarding walkability and disincentive of MIT use. There were analysis such as: for how long, frequency, and reasons users access the region; transport modes used before and after Porto Maravilha implementation; reasons for modal shift; evaluation of current traffic conditions; evaluation of public transport, pedestrian convenience and safety aspects; reasons that could discourage cars use; and Porto Maravilha impact on sustainable urban mobility. Moreover, several filters were applied during the analyses, in order to identify groups of respondents, and their behavior based on factors such as: frequency of accessing the area; means of transport used; monthly income and place of residence.

To perform the analyses, comparisons were made between previous and current situations based both, on indicators when specific information was available, and through a qualitative analysis, in cases which the measurement of indicators were not possible. Some aspects, which could only be measured in the current situation, were then evaluated by its comparison with parameters obtained from academic studies, found through literature review.
Limitations

The analysis process in part two suffered from some limitations. There was a lack of data, lack of access to some existing official data, and differences in the statistical data coverage area and project spatial limits, which in the latter case required some approximations. In addition, Porto Maravilha project is still on progress and not fully implemented, which required to concentrate analysis, referring to physical changes, in the subsectors whose project physical implementation was concluded: Sectors A, B, C, D and N.

Moreover, the lack of financial resources made it impossible, for the author, to develop this research being present in the analyzed area. The great physical distance therefore constituted an important limitation when analyzing some variables, and their specific details.

3.4.3 Methodology Applied in Part Three – Influence of PPP Framework in SUM Promotion

In order to better understand the results from parts one and two, and to better comprehend the influence of PPP framework on the results, interviews were conducted with experts, to support the investigation. The evaluation of PPP framework influence was then carried out by conducting individual interviews, with main actors involved in the project, and analyzing their responses. It was sought to balance the number of respondents between public and private partners, as well as interviewing experts, who did not participate directly in the project, but the final number of responses depended of interviewees effectively participation. The list of participants and their involvement with the project are listed below.
Table 2 - List of Interviewees. Source: Author.

<table>
<thead>
<tr>
<th>Item</th>
<th>Interviewee</th>
<th>Involvement with Porto Maravilha</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Jorge Arraes</td>
<td>- CDURP President (2010 to 2012)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Special Secretary of concessions and PPPs of Rio de Janeiro (2013 - 2016)</td>
</tr>
<tr>
<td>2</td>
<td>Alberto Silva</td>
<td>- Special Advisory for the CDURP Presidency (2010 - 2012)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- CDURP President (2013 to 2016)</td>
</tr>
<tr>
<td>3</td>
<td>Luis Carlos Lobo</td>
<td>- CDURP Director of Operations (2010 - present day)</td>
</tr>
<tr>
<td>4</td>
<td>Luiz Eduardo Oliveira Silva</td>
<td>- CDURP Civil Engineer (2010 - present date)</td>
</tr>
<tr>
<td>5</td>
<td>José Renato Pontes</td>
<td>- CEO of Porto Novo Concessionaire (2012 - 2017)</td>
</tr>
<tr>
<td>6</td>
<td>Alexandre Chiavegatto</td>
<td>- CEO of Porto Rio consortium (2014 - 2016)</td>
</tr>
<tr>
<td>7</td>
<td>Gabriel Estellita Lins</td>
<td>- General Manager of Operations at the Porto Novo Concessionaire. (2011 - present day)</td>
</tr>
<tr>
<td></td>
<td>Cavalcanti</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Ronaldo Balassiano</td>
<td>- No direct involvement with Porto Maravilha project.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Professor and researcher at UFRJ. Research Area:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Transportation Planning</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Post-Doctorate - University of California, Berkeley (2006/2007)</td>
</tr>
</tbody>
</table>

The topics covered by questions were:

- Main challenges faced in project implementation;
- Reasons for using PPP Framework;
- Incompatibility of interests involved in PPP frameworks;
- Gentrification;
- Positive and Negative aspects;
- Elevated motorway (Perimetral) removal;
- Suggestion of improvement to PPP framework.

A set of questions was elaborated on the topics above, and each interviewee received 4 or 5 questions, more closely related to their expertise, and performance during the project implementation. There were sent 12 specific questionnaires between October 30th and December 11th, 2017, obtaining 7 replies written by e-mail, and one via audio recording.

The decision to use this method was due to the overloaded timelines of respondents' agenda, which was confirmed in the first attempts to schedule telephone or videoconference conversations. Through the written interview, respondents had greater flexibility to answer the questions, without a specific
schedule, at a time that suits them best. By this methodology, it was reached a return of 66% of requested interviewees.

The interviews' answers were then grouped by theme, and analyzed jointly with collected data through: Official statistics; News; Data from the CPN and CDURP; and the questionnaires cross-analyses. Similar to what happened in Part Two, physical distance made it impossible to conduct interviews in person, and written questionnaires greatly reduced the author's interaction with interviewees.

### 3.5 Interpretation of Results

To complete the research, an overall joint analysis was made by reexamining the formulated hypotheses and assumptions, and by answering each research question based on results, obtained through the entire research process. The investigation of facts, the evaluation of SUM aspects and the analysis of interviewees' arguments, supported a critical evaluation of Porto Maravilha achievements regarding, walkability, disincentive of MIT, and also enabled the author to suggest improvement actions, toward better results at SUM promotion. Following, it discusses the influence of PPP model on achieved results, and performs considerations regarding possible conflicts, between PPP framework, and SUM promotion at urban revitalization projects.

The project current condition was then analyzed, with special attention to financial difficulties faced at the present, and it's recently actions related to these. Lastly, final considerations were made regarding the importance of PPP model for the implementation of urban revitalization projects, as well as suggested enhancements in the model, in order to prevent certain problems from occurring in similar projects.
4 Part One - Porto Maravilha Objectives and Its Implementation Phase

4.1 Porto Maravilha Institutional and Funding Framework

Through Complementary Law Nº 101/2009, of November 23rd, 2009, Rio de Janeiro municipality established the Urban Operation Consortium, which allowed public authority to raise private resources, in order to invest in the requalification of public spaces. It also created the Area of Special Urban Interest – AEIU which delimited the project area, however not restricting its effects, whose influence area exceeds AEIU legal boundaries. Porto Maravilha project, since its inception, aimed at the promotion of sustainable development, as can be seen in the second article of the law that establishes it:

“The purpose of the Urban Operation Consortium is to promote AEIU urban restructuring, through the expansion, articulation and requalification of public spaces within port area, aiming to improve the quality of life of its current and future residents, in addition to environmental and socioeconomic sustainable development.”

(Complementary Law Nº 101, 2009, Art 2º)

Several project principles demonstrate alignment with sustainable urban mobility concepts:

- Prioritization of collective transportation over the individual;
- Promotion of adequate use of urban voids or underutilized, or idle land;
- Promote area integration with city, and stimulate residential use, enabling better use of the existing urban structure;
- Enable the creation of public facilities, leisure areas, and ensure the safe circulation of pedestrians and cyclists;
- Provide actions that ensure sustainability, especially for resident population;
- Valorization of urban landscape, urban environment, and the material and immaterial cultural heritage.

The Area of Special Urban Interest (AEIU) covers approximately 5 million square meters located in Rio de Janeiro former port area. It encompasses three entire neighborhoods named Saúde, Gamboa, Santo Cristo and partially the Cajú neighborhood. About 32.000 people live in this area and its commercial characteristics attract a much higher number of users during the day. Several offices and commercial establishments are located within AEIU influence area,
whose intersection between Presidente Vargas and Rio Branco avenues consists in Rio de Janeiro financial center.

![Image of Rio de Janeiro](image)

*Figure 5 - AEIU. Source: Porto Maravilha*

In order to manage all the activities involved in Porto Maravilha project, the Port Region Urban Development Company (CDURP) was created through the Complementary Law Nº 102/2009, dated November 23\textsuperscript{rd}, 2009. CDURP is a mixed public and private company, whose main function is to implement and manage the concession of public works and services within AEIU.

Supported by cities statute, Federal Law 10.257 (2001), an instrument to raise funds was also created: The Certificate of Additional Building Potential - CEPAC. It determines that, in order to recover degraded regions, cities can create consorted urban operations, in which the municipality establishes specific rules for new buildings. A new urban occupation plan was then developed, with higher land use index for specific plots, which enables future entrepreneurs to build larger proprieties and higher buildings. A total of 6,436,722 CEPACs were issued, corresponding to an additional total construction potential of 4,089,502 m\textsuperscript{2}.
To make use of this additional potential feature, it was necessary to purchase CEPACs, in equivalent amount of total additional area (m²) desired, although respecting the limits of new occupation plan. The Complementary Law Nº 101/2009 also indicated, that CEPACs shall be freely negotiated, but convertible in the right to build solely within the AEIU, and in accordance with guidelines of the Consortium Urban Operation. In addition, the law also determined that all funds, collected from the sale of CEPACs, could only be spent in infrastructure improvements and services within AEIU, as illustrated in Figure 7.

Each CEPAC is equivalent to a specific amount of additional square meters to be constructed, and its conversion depends on the location of the new development, as well as its purpose. In order to stimulate housing construction within area, the project determined that one CEPAC enables the construction of more square meters at residential enterprises than commercial ones. Its proportion varied according to the sector, where the difference can be more than double, if the new
venture is for residential use.

The project financing is based on the valuation of CEPACs, whose life cycle is explained according to Figure 8 - CEPACs life cycle. First, the CEPACs were issued by the city hall and sold at an auction. The Porto Maravilha Real Estate Investment Fund (PMREIF), managed by Caixa Econômica Federal (CEF) bank, bought the CEPACs as an asset, expecting to negotiate them in the future at higher prices, thus obtaining profit from the transaction. Any real estate investor then needs to purchase CEPACs from PMREIF, in order to make use of its additional building potential. Such amount of negotiated CEPACs becomes extinct upon authorization to build, issued by city hall.

The sale of CEPACs would then provide financial resources for infrastructure improvement within AEIU, as well as the provision of services over 15 years. As the improvements are being implemented, there is a land value increase, attracting new ventures, and consequently increasing the demand for CEPACs. Through this virtuous circle, CEPACs are valued, promoting financial return for their initial investor, and also funds to implement the whole project. This model, however, is highly dependent on CEPACs' appreciation, without which the project loses its economic viability.

Figure 8 - CEPACs life cycle. Source: Author.
4.2 Public-Private Partnership

On November 26th, 2010, a public-private partnership (PPP) was created between CDURP and the Concessionaire Porto Novo S.A. (CPN), establishing an administrative concession that aimed to provide services and works, focused on the revitalization, operation, and maintenance of AEIU. CPN was formed by three of the largest construction companies in the country, and its shareholder structure consisted of: 37.5% of OAS; 37.5% of Odebrecht and 25% of Carioca Christiani-Nielsen Engenharia. CPN was responsible for implementing all the infrastructure improvements, as well as promoting the maintenance and operation of the entire AEIU for 15 years. This includes services such as maintenance of street pavements; solid waste collection; sweeping sidewalks and squares; cleaning and maintenance of monuments and public equipment; conservation of green areas; maintenance of drainage system; road safety management, and maintenance of public lighting. No power of police or even to impose fines was given to the concessionaire, remaining these responsibilities exclusive to public authority. A better understanding of each partner’s role is reflected in their institutional missions and visions;

**CPN Mission**: To revitalize, operate and preserve in an integrated way the AEIU for its social, residential, tourist, commercial, cultural and leisure use, with efficiency, security, and reliability.

**CPN Vision**: To transform, until December 2016, AEIU in the most qualified place in Rio de Janeiro, to work, investment, live and leisure, by improving infrastructure and providing high quality services.

The public partner, CDURP was responsible for coordinating AEIU development plan, to monitor service performance levels, and pay monthly installments to CPN, in accordance with services rendered. In case of non-compliance with minimum levels of service quality, determined by contract, CDURP could impose penalties on CPN, reducing its monthly counterpart. Its mission and principal values are:

**CDURP Mission**: Orchestrate actions to integrate and empower urban areas, in order to give everyone the right to a sustainable city.

**Transparency**: To always inform people about project actions in an appropriated, clear, and understandable language.
Respect for diversity: To treat people always with equality, and respect differences of opinion, regardless of social, ethnic, gender, cultural or economic status.

In June 2011, PMREIF bought all CEPACs at an auction promoted by city hall, which promoted financial conditions for starting project implementation. The auctioned price for each CEPAC was R$545.00, and together with some real state land negotiations, resulted in a total operation of nearly 8 billion Brazilian Reais. Approximately 50% of this amount would be allocated at infrastructure improvements and 50% would provide resources for operating costs over the 15 years. This was the main instrument to create financial feasibility for the project. In addition, the agreement allowed the creation of new businesses within AEIU, where profits from these would be shared between the public and private partners. This mechanism would then create a conductive environment for new business development, both by partners. During Porto Maravilha implementation, some projects were studied, such as integrated refrigeration and heating services, underground parking, kiosk installation, as well as data transmission services, however, most of them were not implemented. In the field of data transmission, a company named TCR Telecom was created, and implemented fiber optic cables for high-speed data transmission throughout the entire AEIU. It provided service for a while, but for several reasons including regulatory agencies decisions, and lobbying, it did not go ahead.

During Porto Maravilha implementation phase, the virtuous circle related to CEPACs' commercialization, a fundamental factor for the maintenance of project economic feasibility, had been working well. CEPAC's price reached R$ 1,706.03 in December 2016, representing significant gain for its investor (PMREIF). Its economic liquidity however was heavily affected by a financial crisis that has settled in the country, generating serious consequences for the real estate market and for the entire project at current days.

Table 3 - CEPAC price evolution Source: Porto Maravilha.

<table>
<thead>
<tr>
<th>CEPAC Price Evaluation</th>
<th>Dec 11</th>
<th>Dec 12</th>
<th>Dec 13</th>
<th>Dec 14</th>
<th>Dec 15</th>
<th>Dec 16</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEPAC price (R$)</td>
<td>545</td>
<td>1.132,07</td>
<td>1.179,07</td>
<td>1.516,92</td>
<td>1.592,86</td>
<td>1.706,03</td>
</tr>
<tr>
<td>Annual variation</td>
<td>-</td>
<td>107,72%</td>
<td>4,15%</td>
<td>28,65%</td>
<td>5,01%</td>
<td>7,10%</td>
</tr>
<tr>
<td>Accumulated variation</td>
<td>-</td>
<td>107,72%</td>
<td>116,34%</td>
<td>178,33%</td>
<td>192,27%</td>
<td>213,03%</td>
</tr>
</tbody>
</table>
4.3 Land Use Mix

Porto Maravilha region, mainly composed by Saúde, Santo Cristo and Gamboa neighborhoods, was characterized by the lower number of residences, compared to the high number of commercial buildings. Office buildings predominated along Rio Branco and Presidente Vargas avenues constituting city financial center, which attracted great amount of user during working hours. The area experienced an intense daily pendulum movement of people, with several activities being performed during the day, and a complete emptying at night. This promoted a special negative impact on the sense of security at public spaces, especially for pedestrians and residents. Night emptying attracted activities such as drug traffic, and prostitution, which further worse local social conditions.

Aiming the promotion of mixed land use, a fundamental feature for the entire revitalization process, Porto Maravilha determined different conversion rates for CEPACs, as a measure to induce real estate development direction. The amount of additional square meters, that each CEPAC allowed its holder to build, depended both on its use, as well as on its location. New residential developments required fewer CEPACs than commercial ones for the same additional built area. This measure aimed to induce, through economic factors, residential real estate development, without restricting the flexibility of developers' choice. This objective becomes more evident in sectors D3 and E1, where three times less CEPACs are required for residential projects compared to those for commercial use. Furthermore, the index analysis shows Porto Maravilha intention to economically encourage the development of less developed areas, such as the sectors B3, C3, D3, E1, F1 and I1, which present high conversion rates.

Table 4 - CEPACs conversion rate. Source: Porto Maravilha, adapted by Author.
Public authorities carried out several actions aiming mixed land use, and encouraging a greater diversity of economic classes to live within area. In September 2013 the city government launched Porto Vida project. It was a residential complex that would first be used to host referees of Rio de Janeiro Olympic Games, and later be handed over to owners in 2017. Its sale had special financing conditions, and aimed at low-income public employees. Its implementation began, but the decision to no longer be used as a hosting place for Olympics’ referees, in the middle of 2014, seriously affected the project. Without the prospect of billing with hosting services, the project lost its economic feasibility and ended up being paralyzed.

In June 2014, Law No. 5,780 was sanctioned, exempting the payment of urban property and waste collection taxes, for all properties within AEIU that were object of new residential units’ construction, or conversions into residential use. The exemption would remain for the entire construction phase, limited to a maximum period of 48 months. In order to prevent the primary purpose of the law from being circumvented, properties that benefited from this exemption would then be prohibited from changing its use, for the next 20 years. The law also created tax incentives to promote new residences, by exempting taxes related to construction activities, as well as to sales of residential properties within AEIU.

To ensure that proposed real estate development occurred in a sustainable manner, Porto Maravilha established several urban development rules, to be followed within AEIU. The new urban occupation plan, as already mentioned before, allowed a higher rate of land use by the construction of higher buildings, but also established new urban parameters for them. New buildings deployed within AEIU should meet:

- Adequate spacing between buildings avoiding blocking the wind. Some Rio de Janeiro neighborhoods, like Copacabana and Ipanema, suffer from the heat island phenomenon intensified by its buildings position. They were built without lateral spacing between them, which avoid wind flow to neighborhood's inner areas. During summer, high temperatures associated with lack of wind flow create an uncomfortable environment for public spaces use, and pedestrian walks;

- To have systems, in order to promote water consumption reduction and rainwater reuse. Porto Maravilha did not establish exact parameters or
specific technologies, as these must evolve during the 15 years of life project. It just provided a guideline to be followed;
- New buildings must have features aiming lower energy consumption, such as solar heating systems, installation of green roofs or architectural solutions that allow greater use of natural lighting and ventilation;
- Use of environmentally certified materials for its construction;
- Must provide bicycles access, and offer adequate bike parking infrastructure;

4.4 Social Housing

Rio de Janeiro government also tried to stimulate greater economic and social diversity, within Porto Maravilha area, by the elaboration of the Housing Plan of Social Interest in Porto Maravilha (HPSI). These objectives would then approach housing and workplaces, with positive impacts on urban mobility, and public safety, through a more lively and integrated urban space. Five public hearings were held with popular participation to discuss about which measures should be considered in the Action Plan. These discussions resulted among other goals, the construction of 5,000 housing units of social interest, the definition of Urbanization Programs for areas of special social interest at Morro da Providência, as well as the promotion of education and health equipment, in line with the expected population growth. The plan, however, was criticized mainly for its funding model. The Observatory of Cities, coordinated by the Institute of Urban and Regional Planning and Research of Rio de Janeiro Federal University, questions the lack of concrete strategies to make feasible the actions foreseen in the Action Plan. It argues that linking HPSI financing, with Minha Casa Minha Vida federal program, makes it even more difficult to obtain resources, since it becomes subject to federal government-defined withholding of expenses.

4.5 Sidewalks Improvement

An important item for the sustainable urban mobility concept, advocated by Porto Maravilha, AEIU sidewalks underwent an intense process of improvement, not only in terms of extension, but also in terms of quality. As a result of the prolonged process of degradation, through decades, AEIU sidewalks had very poor
pedestrian conditions with discontinuities, bottlenecks, barriers, holes and pavements with inappropriate materials, which in many cases led to risk situations for citizens. Several sidewalks were initially destroyed to enable the construction of new underground networks, and were rebuilt only after the complete infrastructure implementation. Obviously from an engineering point of view, this sequence was commonly disregarded in Rio de Janeiro context before Porto Maravilha, given the lack of efficient coordination between public utilities companies. In this way, a positive aspect was evidenced with the better structured planning for sidewalks construction, which avoided rework, and intended to minimize inconveniences for citizens since implementation phase.

The sidewalks renovation design promoted a better coexistence between the several public facilities installed on it and citizens activities. The positioning of lighting poles, access ramps, public garbage cans, trees, and gardens was performed in a way to ensure space for adequate flows of pedestrians, cyclists, and wheelchairs. Some advances promoted by Porto Maravilha are not easily identifiable, but they have a significant impact on walkability aspects. The provision of inspection boxes was strategically carried out, enabling adequate access to underground network maintenance, without damaging the pavement, and avoiding blockage of the passage. Sidewalks with high flow of pedestrians received greater investments, being covered with granite, which constituted an improvement not only aesthetic, but also of durability. Aiming lower maintenance demand, CPN implemented reinforced subfloors to support the granite pavement, preventing the occurrence of future settlements and consequently damages. Anticipating the demand for sporadic transit of vehicles, promoted by events or emergency activities, some strategic sidewalks received even more resistant granite slabs to withstand the possible extra load.
4.6 Boulevards and Squares

The most evident and symbolic case of Porto Maravilha improvement is the Prefeito Luiz Paulo Conde boulevard, that was constructed in the area where the elevated motorway (Perimetral) existed before. The boulevard goes from Armazém 8 to Misericórdia Square, providing walking access to various cultural and tourist spots, along its 3.5km long. This extensive boulevard, dedicated to pedestrians and cyclists, represented a large increase of public space, and great improvement of AEIU environment, with great presence of gardens and trees throughout its entire length. Since its inauguration, several events have been held with a large presence of citizens and tourists, with special emphasis on festive activities during the Rio 2016 Olympic Games.

In addition to floor renovation, a large number of benches, lighting poles, garbage cans and children's recreation areas were installed, and special attention was
given to landscaping. Despite the long extension, its design aimed to give spaces a human scale and create ‘soft edges’ defined by Gehl (2013) as a fundamental factor to promote attractiveness for pedestrians.

![Figure 12 - Renovated Maua square and recreational equipment. Source: Rio 2016.](image)

Cycling Lines Implementation

According Pereira Passos Institut, Rio de Janeiro city had a total of 141 km of cycle lanes in 2007, with 54km placed between Central and South zones. Porto Maravilha project envisaged the implantation of 17Km of cycle lanes, representing an increase of 31% in city central area, as well as promoting connection with the existing city bicycle route system. Although some bike lanes have already been built, and others are in the implementation phase, there is still a long way to reach the proposed objective.

![Figure 13 - Landscaping and soft edges. Source: Porto Maravilha.](image)
4.7 Tram and Cable Car Implementation

The relationship between Rio de Janeiro and urban trams is long standing, and its first use began in 1859 with animal traction. The electrification of city’s tram lines started in 1928, and just two years later, there were more than 400 kilometers of electrified tramways in Rio de Janeiro. This transport mode reached its peak in the 1940s, but quickly fell into decay during the following decade, simultaneous with the growth of road vehicles, and had its activities stopped in 1962. The only line that remained active was the one connecting city center to Santa Teresa neighborhood, due to its high tourist potential.
In June 2016, the first stage of 14 km of tram rails was inaugurated, starting activities within port area, and in February 2017 the second line went into operation. Along its total 28 km of length and 25 stops under implementation, the tram connects with ferry, subway, train, bus central station, airport, cable car, cruise terminal, and has provision to connect also with the future Bus Rapid Transit (BRT) Transbrasil extension. With an average distance of 400m between stations, frequency between 3 and 15 minutes and a capacity of 300,000 passengers/day, the VLT serves both for short intra-region displacements, as well as a connector between the other transport modes. It also functions as a local integrating agent, while connecting several important cultural facilities, and tourist spots.

Particular attention was given to accessibility, where all stations are about 20 cm high to stay leveled with tram compositions, and have smooth and non-slip ramps that facilitate access for users with special needs. The platforms also have podotatil floor and system of public warning by loudspeakers, which facilitate the locomotion of users with visual deficiency. Internally, all compositions have a specific place for wheelchairs with adequate positioning of validators and door actuators, however the downside is not allowing the transport of bicycles inside it. Powered by electricity the tram has its supply by a third rail installed between the train's rolling rails, which dispenses the use of overhead wiring (catenaries), so commonly seen in trams structure. It consists in a sustainable transport mode, with low visual impact, which preserves the region visual identity and attends Porto Maravilha concept of placing all infrastructure in the underground.
The use of cable cars is not new in Rio de Janeiro city, where one of its most well-known postcards worldwide is precisely the cable car of Pão de Açúcar hill, whose operation started more than 100 years ago. The Providencia cable car, inaugurated in July 2014, connects the top of Providencia hill to Central do Brasil train station and Gamboa, important points of connection with other modes of public transportation. Its 16 gondolas offer capacity to carry one thousand people per hour in each direction along its 721 meters of extension, and serve 5,000 residents of one of the steepest hills in the city. The construction of health posts, elderly gyms and educational centers also took place in the vicinity of cable car stations.

Figure 17 - Tram at Rio Branco Avenue. Source: Porto Maravilha.

Figure 18 - Cable car photo and network system. Source: Porto Maravilha, adapted by Author.
4.8 Perimetral Demolition

Porto Maravilha provided a complete road system reconfiguration within AEIU, and had as key point, the replacement of an elevated motorway named Perimetral by a system of tunnels. This enabled the creation of an extensive public boulevard aforementioned, and had a fundamental contribution to AEIU real estate development. Without removing the Perimetral, the project would lose its economic feasibility, in addition of making several proposed urban improvements impossible.

The Perimetral was composed by 4 lanes, two for each direction, and had a traffic capacity of 4000 vehicles per hour in each direction. The Rodrigues Alves Avenue, located below Perimetral, despite having three lanes for each direction, presented the same traffic capacity of 4000 vehicles per hour due to the great amount of traffic lights and other interferences along its way, CCY Consultoria de Engenharia (2009). The Perimetral consisted in a very important road link connecting Rio de Janeiro South Zone with Brasil Avenue and Rio Niteroi Bridge. It had an average flow of approximately 90,000 vehicles per day, and its removal reflected not only the AEIU, but the traffic in the entire city.

Its removal lasted 16 months and was carried out in several phases combined with several other actions, whose main objective was to minimize the impact on the city traffic. Its initial mark happened on November 24th, 2013 with the implosion of a long stretch between Pereira Reis Avenue and Silvino Montenegro Street. In this first phase, the traffic at Rodrigues Alves Avenue was maintained between Pereira Reis avenue, and Rio de Janeiro main bus station, enabling access to March 31st viaduct, one of the three main alternatives to cross the area.
A number of transit interventions have been implemented throughout the entire AEIU, and even in surrounding areas, such was the Perimetral influence in city’s traffic. It was promoted the alterations in traffic flows directions, works for routes improvement, creation of new taxi parking places, implementation of buses exclusive lanes, and the construction of new accesses routes.

Even with all mitigating measures, the demolition has generated great repercussions in the media, and strong opposition from the public opinion. During the planning phase CPN conducted an opinion poll, where almost 90% of Rio de Janeiro population stood against Perimetral demolition. The public prosecutor’s office also requested several explanations regarding the mitigation plan, and made a series of additional requirements, under threat of prohibiting its demolition.
4.9 Dedicated Bus Lanes and Parking Spaces

Since its conception, Porto Maravilha project has demonstrated its intention to prioritize public transport use in detriment of private vehicles. Throughout the entire project implementation, several simultaneous actions were carried out, in order to encourage public transport use. Exclusive bus lanes were implemented in several strategic avenues, within AEIU and its influence area, which promoted greater speed for buses trips, and reduced space for private cars. In March 2012 the Bus Rapid System (BRS) was implemented in Rio de Janeiro central area, providing great improvement to bus traffic. This system redistributed bus stops between the several lines that served central area, resulting in a lower number of stops made by each bus, and consequently increasing average traffic flow. Presidente Vargas Avenue also gain a second exclusive bus line in its central track, which played a fundamental role in this system, since it allowed the overtaking of buses that were embarking and disembarking passengers.

![Exclusive bus lanes Presidente Vargas Avenue. Source: noticias.r7.com.](image)

Similar BRS system has taken place at Rio Branco avenue, however it established full restriction for cars and motorcycles traffic between 05am to 21pm. Several companies have their central offices in the various buildings along this Avenue, which had intense traffic of vehicles, and high incidence of congestion. The restriction to private vehicles provided better circulation flows for buses and taxis, and also generated physical conditions for the implementation of a tram line from
VLT on the avenue.

Another action toward the disincentive of MIT consisted in the reduction of parking spaces availability. Throughout Porto Maravilha implementation phase, several parking areas were gradually removed, giving space to tram's rails implementation, sidewalks enlargement, and bicycle paths. According to a CPN, more than 1,000 parking spaces were suppressed, promoting a reduction in circulation of 2,500 vehicles per day, within Porto Maravilha influence area.
4.10 Main Challenges

4.10.1 Coordination Between Stakeholders

The lack of coordination between public utilities companies, coupled with the lack of existing infrastructure records generated a lot of energy expenditure. The city infrastructure is maintained by several companies such as: Companhia Estadual de Águas e Esgoto (CEDAE) for water and sewage systems; Rio Águas for storm drainage systems; Light for electrical distribution systems; Rio Luz for street lighting, CEG for gas system and several other companies in the telecommunications area.

Porto Maravilha activities demanded great interaction and several negotiations with each of these companies, to enable carrying out its works without damaging existing structures. Coordinated actions were necessary to ensure the smooth operation of all systems, as well as optimize solutions. As a representative of the public authority, CDURP played a key role in this matter. It held meetings with all stakeholders, explaining the local government priority on Porto Maravilha project and its importance to Rio de Janeiro. For various situations, impasses were attended by the president of CDURP, the special secretary of PPP concessions in Rio de Janeiro, and in some specific cases by mayor. Due to CDURP constant interventions, public service companies began to accept Porto Maravilha activities as part of their routine, and started to adapt themselves to this need. This enabled, over time, the progressive creation of a cooperative and more efficient environment.

4.10.2 Strong Opposing by Public Opinion

With great visibility, and promoting significant transformations in city center, Porto Maravilha project impacted the routine of a large part of the population of Rio de Janeiro. During project's implementation, both local residents, and AEIU floating population experienced several changes in circulation flows, work-related disruptions, and had many doubts about project's effective results. Influenced by the history of public works in Brazil, in which several projects are unfinished, the population of Rio de Janeiro had great distrust that the project would be implemented in its entire scope. A large part of the population was afraid that this would be another project to become unfinished.
The action with greater impact of Porto Maravilha, the Perimetral removal was an extremely controversial topic and generated much apprehension in Rio de Janeiro population. The strong opposition promoted by several society sectors culminated in a public civil action from state public ministry requesting the State Court Justice to establish the immediate suspension of Perimetral demolition. This action called for further studies, and additional mitigating actions to minimize the impact on city traffic due to Perimetral demolition.

4.10.3 Lack of Data on Existing Underground Infrastructure

The little information available of the existing infrastructure of hydraulic, electrical, gas and communication cables was indeed a major challenge for Porto Maravilha implementation. Build a new fully underground infrastructure, in a region whose records were almost non-existent, required great flexibility and constant adjustments in projects. The high incidence of interference generated great inconvenience, not only for the progress of activities, as well as for the city as a whole. The solutions developed to overcome these unforeseen interferences often required additional side activities, thus demanding the simultaneous closure of streets not previously planned. This also impacted the activities duration, since several interferences could only be removed in a phased manner, and in short periods. These were the cases where it was necessary to interrupt the water or energy supply.

![Figure 24 - Interferences. Source: CPN.](image-url)
4.10.4 Archeological Remains

Located in a historic area of Rio de Janeiro city, Porto Maravilha found in 2011, during excavation works, an important archaeological site, which also required special attention and adaptations. Activities at Barão de Tefé Avenue found a former dock named Cais do Valongo, which was built in 1811 and from where landed at least 500,000 enslaved Africans until the first half of 19th century. Vassallo & Cicalo (2015) argue that this site represents a unique testimony of African diaspora in the world, due to its good state of preservation, and because it represents the physical and symbolic continuity of slave departure sites on the African coast. Due to the importance of this archaeological site, changes were made in the project transforming the previous avenue into an open-air museum. On July 12, 2017 Cais do Valongo was declared a World Heritage Site by UNESCO and became an important tourist site. During the entire project activities, several other structures were found, demanding studies and project adaptations.

Figure 25 - Cais do Valongo after Porto Maravilha works. Source: Agência de Reportagem e Jornalismo Investigativo.
4.11 Strategies and Applied Instruments

The success for Porto Maravilha implementation was highly dependent on population acceptance, and therefore several strategic activities were created to promote project support. The execution of a pilot project and the development of efficient communication with local residents can be highlighted as important ones.

4.11.1 Pilot Project

Porto Maravilha project had a first phase of implementation carried out with city hall own resources, through its municipal works department. Several urbanization activities were carried out in 24 streets, located mainly in sector A, and served as a demonstration of what would be implemented in the entire AEIU. Completed on first of July 2012, it had fundamental importance in promoting the support of local residents, and reducing the mistrust involved in the project.

At this first phase, in addition to infrastructure improvements, the project could demonstrate the respect and importance given to the preservation of cultural heritage, presented within region. It was during this first stage that Cais do Valongo historical site was found, and the actions that followed, with project's modification in order to preserve it, conveyed much confidence to population, and several civil society organizations.

Figure 26 - First phase area. Source: Porto Maravilha
4.11.2 Communication with Local Population

One of the main strategies used by the Porto Maravilha project was the approach to local population, and the creation of efficient communication channels with them. Understanding local residents’ needs, as well as providing clear information about the project, were a fundamental element for increasing the number of Porto Maravilha supporters. Social workers from CPN carried out a socio-economic survey, visiting 10,171 units, between households and commercial establishments, identifying important characteristics, which supported future decisions regarding services and social projects. The attention given to communication can be highlighted by three distinct actions that aimed at approaching local people to the project:

Meu Porto Information Stand.

A large stand was installed within AEIU, which visitors could access the history of Rio de Janeiro port area, the ongoing Porto Maravilha activities, and future projections for the entire region.

![Figure 27 - Stand “Meu Porto Maravilha”. Source: Tecnoarte news and Porto Maravilha.](image)

Assistance from Social Workers

The joint action between engineers and social workers was fundamental in mitigating the discomfort created by Porto Maravilha activities, as well as to build a trusting relationship between residents and CPN. They visited residents in advance, explaining about activities, envisaged alterations, phases, the reasons for such works, and also identified resident’s main demands and suggestions.
Professional Qualification and Social Programs

CPN promoted several social and professional qualification programs, in order to enable residents for benefiting from Porto Maravilha Project. Table 5 shows the extent of actions undertaken, as well as the number of people involved in them.

*Table 5 - Social activities. Source: CPN.*

<table>
<thead>
<tr>
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<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Socio-educational</td>
<td>18</td>
<td>48</td>
<td>79</td>
<td>74</td>
<td>55</td>
<td>125</td>
</tr>
<tr>
<td>Quality of Life / Culture</td>
<td>16</td>
<td>99</td>
<td>188</td>
<td>274</td>
<td>430</td>
<td>313</td>
</tr>
<tr>
<td>Professional Capacitation</td>
<td>20</td>
<td>84</td>
<td>121</td>
<td>37</td>
<td>35</td>
<td>15</td>
</tr>
<tr>
<td>Number of Participants</td>
<td>17.072</td>
<td>77.782</td>
<td>62.909</td>
<td>74.599</td>
<td>143.20</td>
<td>125.17</td>
</tr>
</tbody>
</table>

7
5 Part Two - Evaluation of Sustainable Urban Mobility within Porto Maravilha Area

Urban mobility has a great interrelationship with the built environment, which shapes and is shaped by spatial settlement patterns. Mobility significantly affects urban environment since it make areas more or less accessible, which has great influence in several economic, social and environmental aspects, such as land values and use, area’s attractiveness, transport patterns, pollution and so forth. Therefore, the analysis of Porto Maravilha impacts on SUM aspects becomes an important factor for this study, in order to identify to what extend this project was successful in this regard.

5.1 Street Design and Circulation Patterns

The streets set of characteristics, in their various scales from corners to entire neighborhoods, exert a special influence on its environment and consequently on users’ behavior. The street design, through its signposts and structures, defines an intrinsic set of rules and hierarchies for displacements, as highlighted by Cidell & Prytherch (2015):

“when mobile bodies and vehicles enter the street, they must enter a legal arena where competition for space and mobility is framed by a clear set of rules establishing and defining streets’ space, potential users, and rights to proceed or duties to yield.” (p. 52)

Many of its features impact on displacements behavior, inducing or discouraging specific transport modes and influencing citizens’ life. The impact of Porto Maravilha on some of this features are analyzed below.

5.1.1 Block Sizes

Blocks are the basic units of urban fabric formation, and their boundaries, delimited by crossings, exert special influence on displacements of both pedestrians and vehicles. City space worked reasonably well until the rapid development of car traffic that has sharply increased competition for urban space. From that moment, the conditions for urban life, and pedestrians have become worse and worse over the years, Gehl (2013).
The development of sustainable urban mobility conditions involves the increase of flexibility, and variety of pedestrian crossing opportunities, providing shorter and more direct routes. Ewing and Office (1996) argued that several features of walkability depends on block size, having the most obviously, the fact that greater number of intersections means more places where cars must stop and pedestrians can cross. They also suggested that “a dense network of streets disperses traffic, so that each street carries less traffic and can be scaled accordingly; this makes streets more pleasant to walk along and easier to cross” (p. 11)

In this context, the blocks dimensions therefore exert a great influence on the way the displacements occur. Since 1960’s Jacobs (1961) claimed the importance of small blocks to facilitate social interaction on streets, and its importance on the success of local small businesses. Larger blocks require greater displacements, which discourage pedestrian movement and supposedly provide greater fluidity to vehicle traffic, given the greater distance between intersections. The current configuration of several cities consequently reflects the policy of prioritization given to vehicles over several years.

Porto Maravilha, through the reconfiguration of region's road system, performed several physical modifications at streets, which resulted in better conditions for pedestrians. The analysis of the average block sizes showed that physical changes promoted their reduction, especially in sectors B and C whose alterations were more significant. The comparison between current configuration and previous one shows that Porto Maravilha activities promoted a reduction of 18.5% in the average blocks’ area in sector B and 15.0% in sector C.

Table 6 - Reduction at block average sizes. Source: Author.

<table>
<thead>
<tr>
<th>Sector</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Block size reduction (m²)</td>
<td>-</td>
<td>18.5%</td>
<td>15.0%</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

This changings were related mainly to the construction of Binário Avenue, which created new accesses, and promoted greater diversity of previously inaccessible routes. The avenue increased public space, both by the construction of new roads, as well as by the rehabilitation of existing ones that were previously occupied by illegal parking spaces, and consequently blocked. The construction of a tunnel,
and the demolition of an abandoned warehouse, gave space for the implementation of Binário Avenue. The tunnel, besides being accessible for pedestrians and bicycles, also houses passage to the tram, as showed in Figure 28 and Figure 29.

![Image: Figure 28 - Binário Avenue. Source: Google Earth adapted by author.]

![Image: Figure 29 - Tunnel Nina Rabha. Source: Google maps.]
5.1.2 Block Density

Regardless the blocks exact shapes, some researchers also use block density as a proxy index for measuring connectivity. The number of block per square mile represents in somehow the average of their sizes, and greater block density means smaller blocks and more intersections. Frank et al. (2000) used block density as an approximation for indicating street connectivity, since the blocks are typically defined as enclosed polygon, delimited by roads or flows on all their sides. Cervero and Kockelman (1997) describe blocks in a more traditional way, as areas of land surrounded by streets.

The comparison of AEIU block density, with some literature references standards, showed that analyzed sectors still do not have a satisfactory configuration for walkability promotion. A minimum of 100, and preferably over 160 blocks per square mile are claimed by some authors, as an appropriate density, Cervero and Radisch (1995); Cervero and Kockelman (1997) and Frank et al. (2000). Table 7 shows the number of blocks per square mile, of analyzed sectors within AEIU.

Table 7 - Block Density. Source: Author.

<table>
<thead>
<tr>
<th>Sector</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Block Density (blocks/mi²)</td>
<td>91,5</td>
<td>67,3</td>
<td>73,8</td>
<td>44,9</td>
<td>21,2</td>
</tr>
</tbody>
</table>

This low block density is consequence of its previous use as port area, which blocks were set, with large dimensions, to shelter warehouses required for port activities. Despite the poor results in this index comparison with literature review standards, the changes made by Porto Maravilha, reducing the average block sizes aforementioned, promote improvements, although with limited effect.

5.1.3 Street Connectivity

The greater the number of multiple routes that a street design provides to achieve the same displacement between points A and B within a specific area, better will be its connectivity. Street connectivity represents how well connected the street, or sidewalks network is in a given region, and has great influence on encouraging non-motorized modes of travel. This feature fundamentally depends on the density of intersections between the possible paths, as well as the number of options that each of these intersections provides for pedestrians or vehicles. It has been
advocated that more intersections give pedestrians better sense of freedom and control, as they do not need to take always the same path to a given destination, Ewing and Office (1996). Well connected street networks increases accessibility for public safety services, as firefighters, police, and ambulances among others. In addition, well connected physical framework creates more appropriate conditions for active transport, as well as encourages social interaction, given its greater probability of promoting encounters at intersections.

![Figure 30 - Street Connectivity. Source: A.B. Jacobs.](image)

**Intersection Density**

To analyze the impact of Porto Maravilha at Street Connectivity, two specific indexes were measured and compared. The first one was the intersection density, which is measured by dividing the number of street intersections by its correspondent area. The analysis was focused on non-motorized perspective, and so all cul de sacs that permitted pedestrian crosses were considered as a valid intersection, which would not occur from the vehicles traffic point of view. The intersection density increased in sectors B and C, which had significant changes in road networks, while the other sectors maintained the same values than previous conditions.

<table>
<thead>
<tr>
<th>Sector</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Previous - (intersection/mi²)</td>
<td>164,7</td>
<td>139,4</td>
<td>103,3</td>
<td>107,8</td>
<td>63,6</td>
</tr>
<tr>
<td>Current - (intersection/mi²)</td>
<td>164,7</td>
<td>149,0</td>
<td>125,5</td>
<td>107,8</td>
<td>63,6</td>
</tr>
</tbody>
</table>

Despite the considerable upgrading in sectors B and C, the analyzed region still present indicators below the parameter of 160 intersections/mi² suggested by Cervero and Kockelman (1997) as a good density. The only exception was sector A.
Link-Node Ratio

In order to analyze if there were changes on the quality of each intersection, regarding its number of options routes, the second index analyzed was the Link-Node Ratio. It is determined by summing the number of street segments, and diving by number of intersections. In other words it is the number of street ‘links’ divided by the number of street ‘nodes’ for a specific study area. In this case all cul-de sacs were considered as a node. Higher ratios then indicate better area connectivity, as it represent a higher average amount of available routes in each street intersection. Sectors B and C that underwent major changes did not show significant changes in this indicator, with Sector B evolving from 1.83 to 1.87 while sector C from 2.07 to 2.06. The other sectors maintained its previous indicator values.

Table 9 - Link-Node Ratio. Source: Author.

<table>
<thead>
<tr>
<th>Sector</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Previous - (links/intersection)</td>
<td>1.83</td>
<td>1.83</td>
<td>2.07</td>
<td>2.00</td>
<td>2.22</td>
</tr>
<tr>
<td>Current - (links/intersection)</td>
<td>1.83</td>
<td>1.87</td>
<td>2.06</td>
<td>2.00</td>
<td>2.22</td>
</tr>
</tbody>
</table>

Ewing and Office (1996) suggest that a link-node ratio of 1.4, is a good target for network planning purposes, and according to Handy et al., (2003), at least three cities have adopted the link-node ratio as a standard, with values of 1.2 and 1.4.

Despite the low density of intersections caused by large blocks, the analysis showed that the existing ones provide a large number of path options. A possible improvement for these indicators, and consequently to walkability, would be the opening of passageways through blocks, thus shortening routes for pedestrians and cyclists.
5.2 Modal Shift

5.2.1 Current Modal Share

The current modal share, based on the questionnaire answers, indicates a greater concentration of public transport use, having bus and VLT as the main modes. 70% of all respondents make exclusive use of public transport mode to access Porto Maravilha area, while 18% use only MIT, and 12% of users switch frequently between both.

*Table 10 - Public and Private Transport share. Source: Questionnaires.*

<table>
<thead>
<tr>
<th>Public x Private Transport Use</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Public Transport - Exclusive</td>
<td>70%</td>
</tr>
<tr>
<td>Private Transport - Exclusive</td>
<td>18%</td>
</tr>
<tr>
<td>Both Private and Public</td>
<td>12%</td>
</tr>
</tbody>
</table>

The bus, indicated by 34% of the respondents, is the most used mode, followed closely by the tram with 32%, and private cars with 28%. Graphic 5 shows the questionnaire answers regarding modal share. Sum of the percentages surpass 100% since several users indicated to frequently use more than one modal, such as subway + bus, or ferry + tram, for instance.

*Graphic 5 - Transport mode use. Source: Questionnaires*
The analysis of user’s monthly income, based on the transport mode, indicates that MIT users have a monthly income significantly higher than public transport users. This result reflects a common characteristic in several other urban areas, given the high cost related to cars’ acquisition, use and maintenance. The group of users that frequently alternate between MIT and public transport presented even higher income rates as shown in the Graphic 6.

![Monthly Income x Transport Mode](image)

**Graphic 6 - Monthly income and transport mode. Source: Questionnaires.**

The modal share, presented for Porto Maravilha region, demonstrates the perverse logic of MIT use. Although used by 28% of respondents, cars represent the largest consumption of public space, both while in movement and specially when parked, in addition to be the main reason for traffic congestion. Furthermore there is a direct relation between fatalities and air pollution with motorized vehicles, in which car use represents greater per capita contribution. This problem becomes even more serious with the perspective of car fleet growth, where according to Hidalgo & Huizenga (2013), there were 2.5 new motor vehicle registration for every new children born in Latin America on 2010. The analysis of Rio de Janeiro motorized fleet, according to Armazém de Dados data base, shows an increase of 51% in the last ten years, which further highlights the urgent need for measures toward sustainable urban mobility.
5.2.2 Modal Shift

Porto Maravilha caused a significant change in the way users access the area, where almost half (42%) of questionnaire respondents indicated changing their transport mode, after the completion of project main works. The analysis of this group, that had totally or partially changed the transport mode, indicates a migration from MIT to public transport. Within this sample, the number of users who exclusively use public transportation increased by 7 percentage points, while the exclusive users of MIT decreased by 9 percentage points. Furthermore the number of users who make frequent use of both public and MIT increased by 2 percentage points.

The analysis of transport modes separately allows us to better assess how these migrations actually occurred. The comparison between situations before and after Porto Maravilha suggests a positive result regarding SUM promotion. The tram
implementation had great influence on results, where 65% of users who have changed the transport mode, currently make frequent use of it. In general, there was a reduction in the use of road transport, and on the other hand an increase at rail public transport (subway, tram and train), as well as active transport. Road transport indicated reduction of 28 percentage points in bus use, and 7 percentage points in car use, while the increase in active transport reached 14 percentage points for cycling and 3 percentage points for walking. The Graphic 9 shows the complete results.

The advances in modal shift, achieved in Porto Maravilha, become more relevant when examined to which modal migrated the users who abandoned the car use. The tram has become a frequent mode to 52%, while the subway to 44% of users who abandoned the car use. Most surprising refers to the 30% of users from this group, who indicated cycling also as a new frequent transport mode, used to access project area.

When asked which reasons led them to change the previously used transport mode, the main reasons were: the time gain (60%); better comfort (48%), and closer proximity to the stop/station with the final destination (31%), as shown in Graphic 10.
The understanding of reasons that led users to migrate from MIT to public transport is essential to guide future actions towards modal shift. Moreover, the analysis of responses from current MIT users, regarding factors that would influence them migrating to public transport, showed great concern with the travel time, conditions of safety, and comfort provided by public transportation. Graphic 11.

**I would stop using MIT if public transport:**
- were faster to reach the destination. 53%
- were more secure. 42%
- were more comfortable. 32%
- had stations closer to my destination. 28%
- I do not intend to stop using car / motorcycle. 26%
- were cheaper. 16%
- allowed me to take my bike inside it. 8%
- Other. 7%

An interesting fact was the low impact of public transport ticket pricing, as an influence factor in this group’s decision, which was indicated by only 16% of respondents. A remarkable data was the response of 26% of current MIT users, who stated not intending to migrate to public transport. This group, therefore,
constitutes the most difficult target public in stimulating the modal shift. It is characterized by a higher income profile, and has the work as the main reason to access AEIU (75% of this sample).

5.2.3 Public Transport

Porto Maravilha activities impacted positively public transport, not only promoting user increase, as previous analyzed, but also improving its quality and efficiency. Through the questionnaires, public transport users evaluated six different topics, whose high satisfaction rates reflect several of these improvements. Graphic 12 shows users’ assessment for each analyzed aspect.

**Public Transport Evaluation**

![Graphic 12 - Public transport evaluation. Source: Questionnaires.](image)

The positive evaluation for the proximity of terminals, stations or bus stops reflects the greater distribution of public transport access points promoted by Porto Maravilha improvements. The implementation of tram, as well as the cable car provided greater public transport service coverage, reaching places previously unmet, such as the top of Providência hill. The users’ evaluation indicated high satisfaction to comfort levels, a result that was certainly influenced by the presence of subway and tram systems within area, which are notably more comfortable than other public transport modes.

The total time spent during public transport trips, obviously goes beyond the AEIU physical boundaries, and is influenced by traffic conditions from other city areas. Surprisingly, the item ‘time taken to reach destination’ was positively evaluated by
more than half of users, which contrasts with the daily situation of the city as a whole. According to TOM TOM Traffic Index ranking, Rio de Janeiro presents the worst congestion rates among Brazilian cities, ranking as the eighth worst in the world. It also indicates that Rio de Janeiro citizen loses in average 164 hours per year in congestions, and that road trips at peak times can last up to 81% longer, than in normal traffic conditions. The item with lowest approval rating was costs related to public transportation, with 45% of users positioning themselves as dissatisfied with ticket prices, and which further analysis is done in the Convenience aspect analysis at “Public transport ticket prices” topic.

**Subway System**

Five subway stations are located within Porto Maravilha influence area: Central do Brasil; Presidente Vargas; Uruguaiana; Cidade Nova and Praça Onze.

![Subway stations and Porto Maravilha area. Source: Author](image)

The flow of passengers in these stations increased by 41.31% between 2011 and 2016 representing an addition of 13.7 million passengers per year, or an average of 37,500 additional passengers/day. The growth of passenger flow presented at these stations, however, accompanied the average increase of the entire subway system, maintaining its share participation constant around 18.5%. This growth tends to continue, with further increases in the coming years due to the recent inauguration of Line 4, which extends subway system to Rio de Janeiro west zone, and the complete implementation of tram lines.
Urban Revitalization and SUM: An Analysis of PPP Framework Influence

**Subway Passengers - Porto Maravilha Area**

![Graph showing subway passengers in Porto Maravilha area](image)

*Graphic 13 - Evolution of subway passengers in Porto Maravilha influence area. Source: Armazém de dados.*

**Ferry System**

Rio de Janeiro ferry system is composed by 5 stations, connecting Praça XV to four other destinations: Arariboia, Charitas, Cocotá, and Paquetá. Its flow of passengers is characterized by a pendular movement, composed mostly by users that live in Niteroi and work at Rio de Janeiro.

![Rio de Janeiro ferry system](image)

*Figure 33 - Rio de Janeiro ferry system. Source: visitriodejaneiro.city*

The analysis of the annual flow of passengers, between the years 2011 and 2016, shows a gradual reduction of passengers transported by ferry, with a slightly more pronounced decline from 2015.
This decline is probably related to the closure of bus terminals near ferry central station, which occurred to permit the execution of Porto Maravilha works. First, the bus terminal located in front of ferry station was closed in February 2014, with part of its bus lines extinguished, or transferred to Misericórdia terminal, distant 750 meters. Finally, this terminal was also closed in November 2014, with another redistribution of its bus lines to different avenues. With the start of operation of VLT line 2 in February 2017, passenger flow tends to grow again as it connects the ferry to the tram system and increase connectivity.

**Bus System**

The bus system underwent a major redesign of its lines and terminals at AEIU. The first most significant change occurred in July 2012, with the relocation of the Padre Henrique Otte terminal to enable the construction of Gasometer viaduct accesses. A similar situation occurred in February 2014 at Praça XV and Misericórdia terminal, as commented before.

The available data did not allow analyzing exclusively the bus lines that serve Porto Maravilha area, but the system as a whole. The data comparison between 2010 and 2016 suggests an suspicious improvement in system efficiency, which, despite a significant reduction in the number of lines (-27%), had an increase of passengers (+16%). This is mainly reflected in the average number of passengers per kilometer which increased by 10%. However the data indicate system average numbers, and it is worth mentioning that several city neighborhoods, especially in
periphery, suffer from low frequencies and overcrowding.

**Train System**

Porto Maravilha area hosts the main railway station of Rio de Janeiro. The Central do Brasil station is the main station of the railway system, which through 270 km of rail network and 102 stations, connects city center to districts at North and West Zone of Rio de Janeiro, as well as other municipalities within metropolitan region. From 2011 to 2016 the flow of passengers in Central do Brasil showed a total increase of 7.4 million passengers / year (22.40%) following the growth of the entire system, which can be evidenced by its almost constant participation.

![Train Passengers - Porto Maravilha Area](image)

*Graphic 15 - Evolution of train passengers at Central do Brasil. Source: Armazém de dados*

**Tram (VLT) System**

Starting the operation in June 2016, the VLT, responsible for connecting all other public transport modes within region, has been expanding its network and number of stations. An opinion poll conducted with 600 people, in November 2016 by Ibope Inteligência, indicated high approval rate. 88% of users evaluated the system positively, with 70% praising the comfort, promoted by the adequate cleaning and temperature inside the wagons, Concessionária do VLT Carioca S.A. (2017). The survey also pointed out that almost half of users use the VLT regularly from Monday to Friday, and 66% at least twice a day. The work was indicated by 70% as the main factor of displacement in working days, while the waiting time in platforms and the lack of system information near the stops was indicated as the main faults.
Cable Car System
With free travel, the cable car provided a significant improvement in the mobility level for Providência hill residents, however due to financial problems its operation was paralyzed in December 2016. Residents needed to use again the long stairways, constituting a major setback for the community, and also impacting tourist activities. The first favela in Brazil, Providencia hill attracted many tourists, both for its historical importance, as well as for the beautiful view provided by its morphology. The resumption of operation is still suspended, due to financial problems of city hall.

Public Transport Connectivity
Higher levels of connectivity are essential to promote more efficient public transport. Increasing transit connectivity is one of the most important tasks in transit-operations planning, Guihaire (2008). It is influenced by the level of coordination between the different transport modes, transit routes, coverage areas, speed, frequencies, and operational capacity of each one. Data analysis reveals that users, who changed the transport mode after Porto Maravilha implementation, began to make frequent use of a greater number of modes than before. It points out to a probable improvement in the connectivity of public transport, which became better interconnected with the VLT implementation.

Number of transport modes frequently used

![Bar chart showing the number of transport modes frequently used before and after Porto Maravilha implementation.](image)

*Graphic 16 - Number of transport modes frequently used. Source: Questionnaires.*
5.2.4 Traffic Conditions

The evaluation of current traffic conditions, within AEIU by MIT users, revealed that, even with the great reduction of parking lots, only 29% of MIT users declared themselves dissatisfied with this item. This fact suggests that, despite contributing to the modal shift, the reduction of parking lots had limited effect on it. Users showed greater dissatisfaction with the time spent on congestion, and with costs related to private vehicles use. Therefore, these aspects appear to have greater impact on users' temperament and decision. The data analysis also suggest that such users do not blame the exclusive lanes for buses, or the speed limits, for the longer time spent on congestion, since these aspects had high satisfaction rates. Graphic 17 shows the data.

Graphic 17 - MIT users' perception of traffic current condition. Source: Questionnaires.

5.2.5 Vehicles Flow at Perimetral and Tunnel

The replacement of Perimetral by Marcelo Allencar tunnel, as previously mentioned, constituted one of the main traffic alterations of the entire project. Despite the significant increase in road capacity, promoted by its additional lanes in each direction, the tunnel has been presenting smaller flow of vehicles than Perimetral.

Between December 16th to 18th, 2009, CCY Engineering and Consultancy carried out a traffic study, which identified through a vehicle counting survey, that an average volume of 41,446 vehicles accessed Perimetral, in Brasil Avenue direction, per working day. Without any vehicle count data available, for the same
dates as the reference values, the closest period with similar conditions was then used. According to CPN monitoring, made by automatic vehicle counters from January 09th to 13th, 2017, there was an average volume of 30.583 vehicles in the same direction, which represents a reduction of 26.21% in traffic flow. The analysis in the other direction towards South zone shows similar behavior with a reduction of 26.77% in the average daily flow. The 2009 count data indicated 48.348 vehicles per day while CPN monitoring 35.407. Both counting data represents only small vehicles, and do not include buses, since their transit was prohibited in both the Perimetral and tunnel.

The intense traffic during peak hours was the main reason for congestions, and the flow behavior during these hours was also analyzed. During the 2009 vehicle counting survey, a maximum peak of 3.735 vehicles/hour were identified towards Brasil Avenue, and 3.405 vehicles/hour in the opposite direction. These peak volumes closely approximated Perimetral traffic capacity, which according to CCY were 4.000 vehicles/hour for each direction, and represent 93.4% and 85.1% respectively. The tunnel peak volumes from 2017 presented lower flow for Brasil Avenue direction with 3.181 vehicles/hour (64% of traffic capacity), and higher value for the opposite direction with 3.702 vehicles/hour (74% of traffic capacity) as shown in Table 11.

Table 11 - Traffic data of Perimetral and tunnel Marcelo Allencar. Source: CCY consultancy and engineering

<table>
<thead>
<tr>
<th>Item</th>
<th>Perimetral</th>
<th>Tunnel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nº of lanes per direction</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Maximum traffic capacity</td>
<td>4.000</td>
<td>5.000</td>
</tr>
<tr>
<td>Data Collection</td>
<td>2009</td>
<td>2017</td>
</tr>
</tbody>
</table>

**Direction: Brazil Avenue**

<table>
<thead>
<tr>
<th>Item</th>
<th>Perimetral</th>
<th>Tunnel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Daily Flow</td>
<td>41.446</td>
<td>30.583</td>
</tr>
<tr>
<td>Peak Flow</td>
<td>3.735</td>
<td>3.181</td>
</tr>
<tr>
<td>Used Capacity</td>
<td>93%</td>
<td>64%</td>
</tr>
</tbody>
</table>

**Direction: South Zone**

<table>
<thead>
<tr>
<th>Item</th>
<th>Perimetral</th>
<th>Tunnel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Daily Flow</td>
<td>48.348</td>
<td>35.407</td>
</tr>
<tr>
<td>Peak Flow</td>
<td>3.405</td>
<td>3.702</td>
</tr>
<tr>
<td>Used Capacity</td>
<td>85%</td>
<td>74%</td>
</tr>
</tbody>
</table>

Although the replacement has provided greater traffic capacity and better service levels, it is not possible, based on data analysis, to claim that this encouraged car use, since the traffic flow decreased at tunnel. However, it is important to note that Perimetral had two additional accesses in each direction, with routes no longer
available in the tunnel, which may justify part of the traffic reduction presented in 2017. Specific traffic data from the entire region would be required to support this assertion however it can be recognized that according to Naess et. al, (2001) “more free-flowing traffic in the road network will cause a higher proportion of the commuters to choose car mode” (p. 01).

5.3 Convenience

According to Gehl (2013), inviting people to walk and cycle is not enough, and city design must provide options of sitting down and spending time in the city. The open and public spaces must attract citizens to their use, and therefore convenience factors have a great impact on attractiveness. The impacts of Porto Maravilha in such aspects are analyzed below.

5.3.1 Availability of Public Equipment

Great demand to divert from other pedestrians, as well as obstacles on sidewalks can discourage people from walking, and a relatively clear and pleasant space to move is an important prerequisite for a comfort walk. Likewise, the presence of comfortable places to stay and rest, as well as interesting things to be seen has great influence in walking experience. The presence of suitable places to sit is fundamental to enable the walk, especially for the elderly, children and for longer displacements.

Porto Maravilha, through its alterations caused a significant increase in sidewalks comfort providing to pedestrians much better environment. Users’ evaluation, of Porto Maravilha impact on sidewalks attractiveness, reflects these improvements as show in Graphic 18. New seats were distributed along the squares and
boulevards, as well as several architectural elements were designed to serve as a place of rest. Monuments and ladders have been constructed in such a way to became places where people can casually and spontaneous sit to rest or look around. Despite the advances identified, there is still a lot of room for improvement in this area, since a significant number of 36% of users were dissatisfied with the availability of seats in public areas, as shown in Graphic 19.

**Sidewalks Attractiveness**

![Image of Sidewalks Attractiveness](image_url)

*Graphic 18 - Sidewalks attractiveness. Source: Questionnaires.*

**Convenience Aspects Evaluation**

![Image of Convenience Aspects Evaluation](image_url)

*Graphic 19 - Convenience aspects evaluation. Source: Questionnaires.*
Cleanliness of sidewalks and public spaces are another important factor for building pleasant environments for pedestrians, and obliged to comply with the contract requirements, CPN implemented more efficient cleaning service, which achieved better results. During the physical transformations, a significant number of garbage bins were installed throughout the entire AEIU, and a new garbage collection system was implemented. Underground storage collectors, in addition to possessing greater capacity, ensured that garbage bags were not carried by rain or stirred by street dogs, a common problem before. Truckers were adapted to perform the emptying of these collectors more quickly and efficiently. In addition to the shorter collecting time, this system also provided lower demand for cleaning and maintenance of surface drainage network.

![Figure 35 - Garbage bins and underground garbage container. Source: Porto Maravilha.](image)

Porto Maravilha project, in addition to establishing regulations that oblige new buildings to provide access to bicycles and suitable places for their parking, had also implemented several bike racks nearby public transport stations. These equipment are very important to encourage active transport, and to promote sustainable urban mobility. According to Hook, W. (2003), average trips distances in most developing cities are extremely short, and “bicyclists and pedestrians are more efficient users of scarce road space than private motor vehicles, helping to combat congestion” (p. 1). A partnership between city hall and a private bank provides many bike stations, where citizens or tourists can rent a bike using your cellphone. These bikes can be returned at any station, giving good flexibility to the users, and furthermore the low renting prices becomes another incentive for its use. Other cities have similar systems that do not require stations, which promote even more comfort and flexibility for users, and are therefore an opportunity for improvement in the existing one.
5.3.2 Proximity of Important Destinations

An adequate placement of important and busy destinations is an efficient way to promote SUM. The greater proximity to frequently visited destinations, such as banks, hospitals, schools, pharmacies, public transport stations, among others, allows shorter trips, and stimulates active transportation. This urban setting would keep average travel distances below thresholds that would discourage walking or cycling. It would also provide greater demand for public transport, and therefore the need for using cars would be minimized, Banister (2008).

The perception of questionnaire respondents indicated user's high satisfaction with the availability, and proximity of important destinations, within Porto Maravilha area. It hosts the city financial center, several historical buildings, and potential tourist attractions, which after revitalization works have attracted more activities, such as shows, conferences, theater plays, in addition to related commercial establishments such as restaurants and cafeterias. The analysis of answers, from respondents that live within AEIU, showed a higher level of satisfaction in comparison with the total sample, Graphic 20. This data reflects the good presence and diversity of services available within area, and indicates, based on questionnaires responses, a characteristic that can potentially enhance the attraction of residences.
Pedestrian crossings are intersections between users from various modes of transport, which require an ordering of flows to avoid collisions and accidents. Given the condition of greater vulnerability, pedestrian crossings should be designed aiming greater protection to pedestrians. A cultural problem in Rio de Janeiro, drivers usually do not stop for pedestrians who are outside the security strips, even when there is no proper pedestrian crossing, or traffic lights. The clarity and delimitations of circulation spaces destined to each modal become fundamental in avoiding mistaken decisions and consequently accidents.

The renovation of squares and sidewalks, as well as the construction of new avenues, made possible the implementation of adequate pedestrian crossings, both in their physical configuration and spatial distribution. Several raised pedestrian crossing were implemented, which increased the visibility for drivers, working as a traffic-calming device and reducing vehicles average speed, as well as provided greater comfort to pedestrians, by the elimination of ramps and steps. These improvements can be identified by the high satisfaction rate indicated by users as afore shown at Graphic 19.

### Graphic 20 - Proximity of important destinations. Source: Questionnaires.

![Graphic 20 - Proximity of important destinations](image-url)
5.3.4 Tree Density

Rio de Janeiro has a tropical climate, with an annual average temperature between 20 to 30 degrees, and peaks that can reach up to 45 degrees on summer. In this context, the availability of shelters from sunlight and shadows are very important for citizens’ comfort and health. Shade can be provided by various means such as trees, marquees, awnings, public transport shelters, and also by the buildings themselves. Studies suggest that the increase of urban tree cover can save significant amount of energy used for cooling buildings (Huang, Akbari, Taha, & Rosenfeld, 1987) and have substantial effect on urban air temperature (Akbari, Pomerantz, & Taha, 2001) and (Shashua-Bar, Pearlmutter, & Erell, 2009).

Porto Maravilha urbanistic alterations provided a significant increase of trees in AEIU, with more notable advances in sectors B, C, and N, as shown in Table 12. The trees, in addition to providing shade for pedestrians, together with the flowerbeds and grass, create a very pleasant aesthetic condition for sidewalks and public spaces. The greater presence of green areas also increases surface permeability, which contributes to avoiding floods promoted by the intense summer rains, very characteristic of the region. Despite the greater presence of trees, some specific points of the landscaping project aroused controversy, as the case of Mauá square that could host a much larger number of trees. Prioritizing the Museum of Tomorrow aesthetic view, much of the square has no trees, which ensures a clear view of museum structure, but creates an extensive area without shadows.

Table 12 - Increase of trees. Source: Author.

<table>
<thead>
<tr>
<th>Most expressive sectors - Increase of trees</th>
<th>Sector B</th>
<th>Sector C</th>
<th>Sector N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trees - Before (units)</td>
<td>401</td>
<td>330</td>
<td>341</td>
</tr>
<tr>
<td>Trees - After (units)</td>
<td>644</td>
<td>488</td>
<td>540</td>
</tr>
<tr>
<td>Previous Tree Density (unit/hec)</td>
<td>7,44</td>
<td>9,41</td>
<td>9,30</td>
</tr>
<tr>
<td>Current Tree Density (unit/hec)</td>
<td>11,95</td>
<td>13,91</td>
<td>14,73</td>
</tr>
</tbody>
</table>

5.3.5 Public Transport Ticket Prices

The prices of public transport tickets, controlled by the state government are periodically adjusted to compensate effects of inflation, and ensure economic viability for service providers. Between January 2011 and December 2016, ticket prices rose by 32% for the train and the subway, 52% for buses and 100% for
ferry. On average, these values are higher than the period inflation measured by IPCA index, which according to Brazilian Central Bank was 46.8%, Banco central do Brasil (2017). The comparison between ticket prices evolution, and the official minimum wage, shows a slight reduction for the various transport modes, with the exception of ferry ticket prices that increased sharply in 2012, as shown in the Graphic 21. A simplified analysis of data would indicate a cheapening of public transport tickets, when compared with the minimum salary. However Brazil has been experiencing an economic crisis, with high levels of unemployment, and lower family incomes. Citizens have been losing consumer purchasing power, and the great dissatisfaction with public transport costs, already shown in Graphic 11, reflects the current citizens’ fragile economic situation.

![Ticket Cost / Minimum Official Wage](image)

**Graphic 21 - Ticket cost / minimum official wage. Source: Author**

### 5.3.6 Pollution

The lack of access to Rio de Janeiro historic air quality monitoring data, made it impossible to evaluate the impact of Porto Maravilha on this indicator. The lower amount of soot on the surfaces, where the Perimetral existed before, suggests that there was a reduction in suspended particulate material. Concerning noise pollution, although there was no data of constant monitoring to permit an adequate quantitative comparison, it can be affirmed that there was a noticeable reduction in the noise level, especially along the Boulevard. The transfer of car flow, from Perimetral to tunnels, reduced the level of noise on surface, which is confirmed by user’s perception regarding the impact of Porto Maravilha on noise pollution,
5.4 Safety

5.4.1 Street Lighting

Public lighting exerts a special influence on pedestrian perception of safety, and has great impact on walkability. The darkness induces a sense of insecurity because it hampers visibility, and people recognition at a distance. In the context of Rio de Janeiro, a city that historically suffers from significant crime rates, the security factor becomes even more important at sidewalks use. Studies show that higher levels of light influence, both the reduction of crime (Painter, 1996), and the sense of security witnessed by pedestrians (Peña-García, Hurtado, & Aguilar-Luzón, 2015). Gehl (2013) points out that not only public street lights, but also light from buildings along streets can contribute to the feeling of security when darkness falls.

Porto Maravilha has brought significant improvement in light levels throughout the AEIU. The comparison of the previous situation with the current one show a significant increase in the number of lighting poles with highlights for the sectors N (78%) and sector B (12%). In addition to the greater availability of public lighting, there was a substantial increase in the quality of luminaires. In order to meet performance indexes determined under contract, and provide operational savings, CPN decided to invest in LED-type luminaires with remote monitoring devices.
These luminaires have individual sensors that transmit real time data to operational control room, facilitating the identification of faulty luminaires more quickly, which reduce the need for routine inspections. Each luminaire can be dimmed and have its intensity adjusted remotely, which provides both energy savings and greater flexibility for the system.

5.4.2 Pedestrian Injuries Promoted by Car Traffic

The statistical analysis of traffic accidents, involving pedestrians within AEIU, shows a progressive improvement in safety indexes between 2011 and 2016, which contributes greatly to increase walkability. The number of accidents involving pedestrians has been significantly reduced, however the severity of accidents that still occur have higher lethality. CPN is responsible for traffic operation in this region, and its performance has great influence on the results. Several traffic agents are positioned at crossroads of greater flow to provide better coexistence between vehicles and pedestrians. In addition, cameras have been installed on all major AEIU avenues allowing 24-hour monitoring, from CPN control room. It has direct contact with Rio de Janeiro operational center, and has mobile motorized teams that can be quickly dispatched to meet occurrences or traffic demands. The CPN's performance however has limited scope with an instructive character, since it is not allowed to issue fines and therefore instructions are often ignored by drivers.

Pedestrian Accidents and Injuries

![Graphic 23 - Pedestrian accidents and injuries. Source: CPN](image-url)
5.4.3 Policing and Pedestrian Robberies

Porto Maravilha, in a joint action with Rio de Janeiro municipal guard, established a Public Order Unit (POU) on December 26th, 2012 at a busy location within AEIU, where an illegal parking lot once operated before. The 267 policemen belonging to this POU enabled greater presence of police force at Porto Maravilha area, thus providing supposedly better sense of safety, especially for pedestrians.
The analysis of security statistical data shows an increase of pedestrian robberies, theft of cars, and homicides even after the installation of the POU, Graphic 24. When comparing AEIU numbers with the entire city, it is noticed however, that the increase in crime grew at a slower rate than municipal one, Graphic 25.

**Graphic 24 - Street safety. Source: Instituto de Segurança Pública – RJ**

**Graphic 25 - Participation of AEIU on Rio de Janeiro crime rate. Source: Instituto de Segurança Pública – RJ**
5.5 Physical Conditions

5.5.1 Sidewalk Geometry and Quality

The reconstruction of AEIU infrastructure and sidewalks enabled the implementation of a design pattern that provided improvements to pedestrian flows. It also allowed the implementation of more appropriated construction techniques, as already aforementioned in chapter 4, and the use of better materials, which were reflected at users’ perception. Their evaluation regarding sidewalks conditions showed a high percentage of satisfaction.

Sidewalks Conditions Evaluation

![Graphic 26 - Sidewalks conditions evaluation. Source: Questionnaires.](image)

5.5.2 Podotating Floor Length

The better arrangement among the various public elements present at sidewalks, promoted a significant improvement in its environment, especially for visually impaired pedestrians. The smaller number of obstacles, and the greater standardization of their positioning facilitates the locomotion for them. Furthermore podotating floors were implemented along several sidewalks, and especially at pedestrian crossing. Analyzed sectors showed a total increase of more than 2.100m on podotating floor length.
5.5.3 Ramps at Pedestrian Crosses

The greater uniformity, at sidewalks design implemented in the AEIU, promoted a special effect at intersections for wheelchair users. More than 315 ramps were installed at pedestrian crosses in sectors A, B, C, D and N. In addition, the new buildings are obliged to comply with regulations, providing access to wheelchair users, which contribute to a better overall accessibility. The concern to provide universal accessibility has been present since project implementation phase, where several temporary ramps were installed during the works.

![Figure 39 - Provisory and definitive ramps at pedestrian crosses. Source: Google maps.](image)

Exclusive ramps were also implemented for cyclists, thus avoiding conflict points with wheelchair users, and providing greater continuity for bike paths. In addition, cycling ramps are an important factor in stimulating active transport, as they reduce the risk of falls, and significantly increase cyclists’ comfort, by providing a smoother flow.

5.6 Land Use Mix

Several studies show the relations between land use mix and walkability behavior, in which greater diversity in land use suggests higher rates of walking, Cervero (1996); Christian et al. (2011); Owen et al. (2004) and Sallis et al. (2004); A review by Saelens and Handy (2008), of 13 previous studies of walking and the built environment, showed that land mixed use generally supports walking factors. Moreover, the special importance of access to recreational and open space was analyzed by Frank et al. (2007) as an important variable related to walkability behavior. Improvements in infrastructure, provided by Porto Maravilha, coupled with the expectation of high real estate valuation, have attracted many investors. The project intended to promote land use mix, and expected a large population growth within AEIU, from 32 thousand to 100 thousand inhabitants in 10 years. As
the project was being implemented, new developments were installed with many of them having their inauguration even before Porto Maravilha main works completion. Figure 40 shows the spatial distribution of development projects.

Figure 40 - Porto Maravilha development projects. Fonte: Porto Maravilha

Several hotels have settled within AEIU, with highlights for international brands as Marriot, Novotel and Ibis which provided a large increase in region’s hotel capacity. The segment with the largest number of projects launched were commercial buildings focused on hosting offices, where some large companies, such as L’Oreal and Odebrecht, have settled up their headquarters offices within area. Despite the relative success in attracting new enterprises, little progress was made in increasing the number of dwellings, whose residential projects presented less impact then commercial ones so far.

An instrument, implemented at the creation of Porto Maravilha project, determined that “the region's tangible and intangible heritage must be recovered and enhanced, and that at least 3% of the amounts collected from CEPACs sales must be invested for this purpose” Porto Maravilha (2017). Therefore, great progress was made in areas as culture, sports and leisure by the implementation of several important ventures within AEIU. A brief description of the remarkable ventures is presented below:

**Rio de Janeiro Museum of Art (MAR)**

Occupying two buildings located at Mauá Square, the museum was inaugurated in March 1st, 2013. The Dom João XI Palace with its high historical value was
restored to hosts the exhibitions, and an art school was implemented in the neighbor building. The combination of historical and contemporary dimensions is represented in its architecture, by the connection of the two buildings through a sinuous cover structure. Furthermore, Rio de Janeiro Museum of Art became one of cultural anchors of Porto Maravilha.

Figure 41 - MAR. Source: www.fuiserviajante.com.

**Museum of Tomorrow**

In front of the Guanabara Bay and designed by the famous architect Santiago Calatrava, the Museum of Tomorrow was built on a pier previously used as a parking lot for vehicles. It features several concepts of sustainability, and became the newest tourist attraction in Rio de Janeiro. Considered the ‘Best Innovative Green Building’ from the MIPIM Awards, the Museum has an intelligent air conditioning system that uses and purifies water from Guanabara Bay, reuses rainwater in toilets’ flush, and has several solar panels positioned in the structure ‘wings’. The museum aims at questioning human behavior throughout history, its impact on environment, and explores different paths to a sustainable future. Inaugurated on December 2015, the museum became the most visited in the entire country the following year, Folha de São Paulo (2017).
AquaRio

Built from the renovation of an old abandoned warehouse, the 26,000 square meters of built area, and 4.5 million liters of water make AquaRio the largest marine aquarium in South America. It has the capacity to house 8 thousand animals of 350 different species, and besides being a tourist attraction, also hosts a marine fauna research center.
Gamboa Sheds

After decades of abandonment, the sheds that once served as a maneuvering yard and maintenance center for trains, were completely restored by Porto Maravilha. The sheds currently host cultural and educational events.

Figure 44 - Gamboa Sheds before and after Porto Maravilha. Source: Vitruvius and Muda-Arquitetura e Consultoria.
6 Part Three - Influence of PPP Framework in SUM Promotion

The PPP framework influence on Porto Maravilha outcomes was analyzed through interviewing main actors involved in the project. Their responses were contrasted with facts and findings from this study, which inspired greater discussion and analysis of each addressed topic.

6.1 Reasons for PPP

The reasons, that led Porto Maravilha project to be carried out by a PPP framework, are an important topic to start the analysis of its influence on project development and results. The interviewees highlighted key reasons that are discussed below:

“The complexity of works would not allow the contracting to be done by the traditional tender’s model” (Arraes). The size of Porto Maravilha project, with its magnitude and diversified urbanistic alterations, required great flexibility for the various design changes that would appear, as the projects were implemented. Many of the technical changes aroused due to unknown interferences at the start of the project, which were only identified during the deployment phase. The traditional contracting model is based on a quantity of services worksheet, which complicates the use of alternative constructive solutions that were not previously included. Even resulting in lower costs or more efficient solutions, the application of services, not provided in the service worksheet, depends on a new round of negotiations, making the whole process much less flexible and time consuming. Thus, traditional contracting framework would prevent the implementation of the project within the desired time frame.

Another reason raised concerns the "need to create a new paradigm in Brazil, in which those responsible for the works would also maintain it for a long period" (Arraes). Public works in Brazil suffer from an unfortunate historical context with large number of unfinished works, and low quality indexes. Part of the problem stems from traditional public works contracting model, which imposes the selection of lowest cost proposal. However, it does not necessarily represent the best solutions, as argued by Luiz that such a model “unfortunately obliges the public manager to always choose the lowest price. Hardly the lowest price is the best price, and also generates poor quality work”. Therefore, linking the operation and
maintenance, to the same company that made the implementation, would be a way of developing more efficient solutions, ensuring greater quality and durability levels.

The city of Rio de Janeiro did not have sufficient resources to carry out the entire project, and the creation of an urban operation consortium, with the issuance of CEPACs, was then an alternative way for providing necessary resources. Alberto emphasized the personal commitment of Mayor Eduardo Paes, and the favorable economic and political conjuncture, as a determining factor to make possible, both the adoption of PPP framework, as well as the execution of project itself. The political alignment of municipal, state, and federal spheres allowed "agility in the bureaucracy and good will in solving problems" (Arraes).

6.2 Main Challenges

Credibility

Almost all interviewees emphasized the creation of credibility among the population of Rio de Janeiro, as the most important factor for the entire project success. Citizens had great distrust of results that would be achieved by Porto Maravilha, as well as if the project would actually be accomplished. Chiavegatto highlighted that “the impression, for the external public, that these policies would be to benefit the private company” was an additional difficulty faced by the project. He also noted that, the greater flexibility in the use of PPP resources enabled CPN to create mass advertising campaigns, in order to raise public awareness on this issue.

Jose Renato explained that the provision of high quality services provided by CPN played a fundamental role in overcoming this challenge. He emphasizes that respectful treatment was given to citizens, in such way they had never witnessed before, which supported the promotion of credibility among citizens. In addition, another important factor was the implementation of a first phase (sector A) demonstrating which results could be expected for the entire project. "A first phase was executed with public resources demonstrating clearly that this time it was for real" (Arraes).
Short Time to Implementation

The short time for project implementation, due to the Rio de Janeiro Olympic Games 2016, intensified the inconveniences caused by works, and created numerous technical challenges during its implementation phase. According to Jose Renato it demanded activities to be carried out simultaneously, preventing an appropriate phasing that could minimize impacts to population. Gabriel highlighted situations where, for instance, "parking lots were being eliminated before offering public transportation alternatives". There were then less time of exposure to deployment phase inconveniences, but at a higher intensity. Furthermore, the complex urban transformations and short time, demanded integrated solutions with high interdependence and fast implementations, as exemplified by Luiz that "during the Perimetral demolition more than 20 changes in the traffic were made, within interval of little more than 1 year."

6.3 Perimetral Removal

Porto Maravilha most controversial urban alteration, the removal of Perimetral elevated highway, represented according to Alberto, the disruption with the urban development model based on road traffic. The demolition of its almost 5km was a fundamental condition for the entire project success, since it had direct impact both, on real estate valuation, as well as on expected urban mobility changing. "Without this it would not even be possible to think about the project" (José Renato)

A preponderant factor for its effective removal, according interviewees, was the political will and personal involvement of Mayor Eduardo Paes at this decision. There was great distrust of the population over the results that the removal would provide for the city. To illustrate the size of this challenge, José Renato cited an opinion poll conducted before the demolition, which indicated that almost 90% of Rio de Janeiro population was against the removal. There was a great politicization of the theme, which was intensely used during the electoral campaign by the mayor's opponents and which, according to Alberto, reached such an extreme point that “led, by incredible as it seems, environmentalists, urbanists and researchers to defend the elevated motorway permanence". (Alberto)

From the logistic point of view, Gabriel emphasized the inauguration of Binário
Urban Revitalization and SUM: An Analysis of PPP Framework Influence

Avenue, as well as the development of a wide-ranging mitigation plan and its innumerous actions, as important factors to enable the Perimetral removal. Luiz stressed that, the removal involved a joint effort of several secretariats of the City Hall, whose actions were positively influencing those directly and indirectly involved with the project.

According to Alberto, the PPP framework worked as a facilitator because "it promoted a permanent vision, on all intervention activities, by the two main responsible agents - CDURP and CPN, giving agility to the management process" (Alberto). Chiavegatto highlighted the greater flexibility, provided by the PPP model, as determinant for the Perimetral removal. According to him, without the PPP framework, the constructive solutions would have to be defined much earlier, and could not be changed without long and exhaustive contract’s renegotiations. In the specific case of Perimetral, several changes were necessary, both in the applied removal methodologies, as well as in the working periods constrains, not initially foreseen.

Ballassiano acknowledges that “it was a wise decision to remove from the region a volume of vehicles that, in addition to producing large congestion, contributed significantly to air and noise pollution.” He added that the Perimetral removal was already considered well before the choice of Rio de Janeiro city to host the Olympic Games, but the decision was always postponed based on the high costs of intervention. He suggested that, the PPP framework played a key role in allowing the Perimetral removal to be realized within port area revitalization project.

6.4 Conflict of Interests

Critics of PPP model argue that the involvement of a private partner creates an incompatibility of interests, where decisions could be influenced by the financial outcome rather than the product quality or efficiency. Such situation would then be highly detrimental to the public interest, by creating contradictory results regarding their effectiveness and value for money. Addressing this questioning, the interviewees reported:

Lobo refuted the hypothesis of conflict of interests by explaining that, the commitment with operation and maintenance, during the next 15 years, is what
guarantees the prevalence of quality over immediate profit. “Any future problem in the operation, although due to design or constructive defects, must be solved and supported by the Concessionaire” (Lobo). He further argues that in the case of Porto Maravilha, the provision of services required the execution of associated works to reach the minimum level of performance, which further increases the concessionaire's involvement and responsibility. “Thus, it becomes a short-term project financier, while is responsible for the excellence of its long-term operation” (Lobo).

Endorsing the PPP framework, Chiavegatto states that long-term private partner involvement encourages the development of better solutions for the project as a whole. To exemplify his argument, he mentioned some actions taken at Porto Maravilha project, whose solutions, despite requiring more initial investment, and aiming at future lower operating costs for CPN, have promoted important positive externalities for citizens. These actions commented were:

- Flexible road pavement structure designed for greater durability than originally planned;
- The decision to create an additional escape route at Rio-450 tunnel, through the excavation of an emergency gallery parallel to the tunnel, which arose due to operational and rescue concerns;
- Use of rigid pavement inside tunnels, allowing economy in lighting (as the concrete is lighter than asphalt) and future maintenance of tunnels;
- Alteration in the methodology of laying the granite pavement on sidewalks. Originally laid on sand, a concrete sub-base has been used as a way to increase floor durability and reduce maintenance costs.
- The implementation of LED luminaires for public lighting.

Balassiano stated that PPP model has the potential to generate good solutions over projects lifetime. However he pondered that, what happens in many cases in Brazil is that contracts are not well elaborated, thus hampering their development, and causing their downturn due to financial difficulties or problems not previously predicted. According to Alberto, a PPP contract like any other is subject to internal and external risks that depend fundamentally on how they are defined, and managed. "If there is no rigor and clarity in the definition of contract deliverables,
from a public interest point of view, the quality of the delivery can be compromised” (Alberto). He also warned that, even having clear rules, there is a need for active oversight by public partner, in order to guarantee public interests indeed.

6.5 Gentrification

Urban improvement projects generally promote an important discussion about gentrification processes, that can be originated from their actions. In the case of Porto Maravilha, where the instrument used to raise funds (CEPACs) was based on real estate valuation, this concern becomes even more pronounced. Analyzing this theme, Alberto first raised the question if it would be fair, from the city and local residents point of view, to allow the permanence of an urban degradation process, and the impoverishment of local population to continue. In the sequence, he stated that gentrification is not a price to be paid for the development of a region, and that “Porto Maravilha was taken as an opportunity for social and productive inclusion, and has shown that this path is fully possible” (Alberto). To support his argument, he exemplified some facts:

- The local population occupied a preservation area, which was maintained and strengthened by law;
- The benefits of public service provision improvement have been enjoyed by population since 2012, before even real estate expansion started to occur;
- Implementation of health, education and leisure facilities;
- Residents benefited from the project works, through jobs creation and opportunities for income generation;
- Implementation of Social Housing Interest Plan.

Balassiano affirms to be feasible the development of projects that promote the coexistence of low-income population and real state developments, but for this, it is required to design the area with a mixed occupation, aimed at serving populations with different income levels.

Regarding the influence of PPP framework on the gentrification theme, José Renato pondered that using municipal financial resources, having so many other severe demands in the rest of the city, would not be possible. He argued that, the PPP model, which services and works are paid through real estate valuation, was
the only feasible framework to provide all infrastructure improvements. He emphasized that gentrification process has only one way of being dealt: through the real valorization of local population. “The project must necessarily consider the people living there, and promote real improvements for their lives” (José Renato).

Questionnaires

The analysis of questionnaire answers allowed to make some inferences about the gentrification topic at Porto Maravilha. Therefore special attention was given to responses from AEIU residents (15% of entire sample) separating them into two subgroups to support the analysis:

- **Older Residents** (65% of resident’s sample): living within AEIU for more than 5 years. They are therefore the group that already resided in the area before Porto Maravilha main activities;
- **New Residents** (35% of resident’s sample): living within AEIU for less than 5 years. They are residents who settled within AEIU after Porto Maravilha activities had began.

The comparison of monthly incomes, between residents, and the whole sample indicates that AIEU residents have lower monthly incomes, as demonstrated at Graphic 27. The higher income profile among New Residents could suggest an ongoing process of gentrification, however, this assertion can not be made based only on this data. Up-to-date census data are needed to identify whether new residents are replacing the old ones or whether the AEIU population is increasing.
In addition, when questioning the impact of Porto Maravilha on life costs, a perception of worsening was more pronounced among the old residents, which contributes to the assumption that, a gentrification process is indeed in progress. Graphic 28.
The income profile of users, who indicated culture or leisure as reasons to access the AEIU (33% of respondents), shows higher monthly income than the entire sample. Being these voluntary activities, and considering the AEIU historical decadence, it is perceived that Porto Maravilha has attracted users with greater income: Graphic 29. This fact could then represent both a process of gentrification, or a process of economic improvement for the area. This fact can from one side generate more job opportunities, as well as induce prices increase.

**Income Profile - Leisure and Culture Users**

```
<table>
<thead>
<tr>
<th>Leisure/Culture</th>
<th>Entire Sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>I'd rather not answer</td>
<td>24%</td>
</tr>
<tr>
<td>&gt; 10,000</td>
<td>14%</td>
</tr>
<tr>
<td>5,001 to 10,000</td>
<td>20%</td>
</tr>
<tr>
<td>3,001 to 5,000</td>
<td>13%</td>
</tr>
<tr>
<td>1,501 to 3,000</td>
<td>13%</td>
</tr>
<tr>
<td>&lt; 1,500</td>
<td>6%</td>
</tr>
</tbody>
</table>
```

*Graphic 29 - Income profile leisure/culture users. Source: Questionnaires.*

The comparison of rental prices would be an interesting indicator to support this analysis, however it was not done due to the great technical difficulty to isolate the impacts promoted exclusively by Porto Maravilha. Furthermore, Rio de Janeiro had experienced a real estate boom between 2010 and 2016, with a sharp rise in rental prices throughout the entire city. Moreover, from the second half of 2016, the city has been experiencing a severe economic recession, which greatly influenced rental prices. According to Época Negócios report from June 2017, 14.4% of residential properties in Rio de Janeiro were vacant for lease, and emphasizes that property owners "accept a reduction of 30% to 33% from the value initially requested" Época Negócios (2017). A similar move also occurs in the area of commercial real estate, as evidenced by O Globo newspaper in August 2017, informing that office areas reached a vacancy of 41% in the first half of 2017. Thus, the comparison of real estate values, as an indicator for evaluating Porto Maravilha influence at a gentrification process, showed to be inadequate.
6.6 PPP Framework Enhancement

When asked about, what improvements could be made in PPP model, the interviewees addressed the following four aspects:

Financing Model

According to Arraes, financing models that use the capture of real estate valuation, such as CEPACs in Porto Maravilha project, need improvements on guarantees, in order to avoid its illiquidity during the contract lifetime. He also suggests that, contracts, for administrative concessions in the format of PPP, should have flexibility to be extended to the format of a sponsored PPP. In this model, user fees are not satisfactory to compensate the investments made by the private partner, and the public partner is then required to supplement the private partner's remuneration through regular contributions of resources.

José Renato stressed the importance of developing instruments that promote greater liquidity of CEPACs, as a way to ensure sufficient resources for the completion of the works. "It's not reasonable to start a tunnel excavation in one semester and stop in the other, due to lack of resources" (Jose Renato). In his view, the initial acquisition made by PMREIF was fundamental to ensure minimal resources sufficient to start the implementation phase in an adequate manner. He states that, the management of CEPACs should be more closely tied to the urban development master plan, thus promoting greater participation and responsibility of its holder in the process of urban revitalization. He points out that mechanisms need to be developed, in order to prevent the CEPAC instrument from being used only as a financial asset. It should play a role in inducing the urban revitalization process, whose development should not be so dependent on CEPAC's marketing strategy, developed by its investor.

Capacitation of Public Partner

Alberto warned that PPP models are not applicable for all cases, and that detailed studies are needed for its proper application. He points out the demand for a better qualification of public partner's teams, in modeling and managing PPP contracts, as a fundamental factor for improving the whole process. To support his statement, he commented that "of the 80 expressions of interest for PPP projects, launched after 2012, only four came to be tendered, but none have yet become an effective contract" (Alberto).
**Timeframes**

For Chiavegatto, urban revitalization projects have to be gradually implemented, especially in areas of extreme degradation, such as the case of Porto Maravilha. In his opinion, the revitalization should focus initially on areas of greater commercial appeal, which would consequently promote CEPAC's appreciation over time, thus enabling the revitalization of less attractive areas. On the other hand, Lobo argues that there should be no contractual mechanisms that allow flexibility of scheduled deadlines, which would reduce the possibility of delays due to physical or political interference.

**Contract**

A key aspect in the PPP framework, the contract was cited by all the interviewees. The main point highlighted was the importance of a clear definition of each partner's attributions, as well as a good balance in the distribution of risks. These should be imputed taking into account the capabilities and expertise of each partner, whose better allocation increases project's chances of success. It was point out that "this substantially reduces possible future requests, for contract financial rebalancing" (José Renato). However, Ballassiano warned that, in order to meet application deadlines for financing, provided by international banks, contracts are often signed hastily, with insufficient time spent on preliminary studies. In his opinion this is a factor that always tends to generate future problems, during the execution of the project. He emphasizes the importance of carrying out detailed impact studies, as well as the project proper elaboration, enabling their future developments to be visualized, and critical analyzed. Without such care "it is possible that inescapable problems arise, eliminating any advantage that a well-structured PPP can generate" (Ballassiano).
7 Overall Analysis and Conclusion

7.1 Porto Maravilha Impact on Walkability

The data analysis make it possible to affirm that, the assumption claiming that Porto Maravilha improved walkability standards within region, proved to be true. The local environment was improved in several ways, creating better conditions for walkability, with considerable increase in attention and care toward pedestrians, notably exemplified by Orla Conde boulevard construction. It increased 3.5 km of new and wide sidewalks exclusive to pedestrians, where Perimetral elevated motorway was before. Improvements at sidewalks design and infrastructure had significantly increased its attractiveness and effectiveness. Porto Maravilha activities promoted more efficient, and safe flows to pedestrians, as well as greater durability and aesthetical beauty for sidewalks. The investigative process and its findings indicated that major advances were achieved at Walkability aspects, with more noticeable improvements perceived on Convenience and Physical Conditions aspects, and lighter enhancements on Street Design and Safety.

The lack of data mainly regarding conditions prior to Porto Maravilha implementation, and the impossibility of measuring some variables, due to the Author's physical distance, made it impossible to apply one walkability evaluation model, such as those listed and analyzed by Maghelal et al. (2011). Therefore, it was not possible to generate a numerical score to support a mathematical overall comparison between previous and current conditions, however the answer to the question about to what extends has Porto Maravilha impacted walkability within Region was answered in a qualitative way. The research findings indicate that, urban alterations promoted by Porto Maravilha provided significant advances toward walkability promotion. This statement is based both on measured variables, as well as on users' perception, analyzed through questionnaires. Their expressive positive evaluation, regarding sidewalks conditions and its attractiveness, strongly indicates the improvements achieved.

The Land Use Mix was the aspect with lowest improvement among all analyzed ones. Despite the implementation of several urban equipment, especially at culture and leisure areas, Porto Maravilha showed minor advances in the increase of residences within AEIU. Its objectives regarding the increase of density, and encouraging land use mix demand more effective actions, in order to attract
indeed new residences. The implementation of a well-structured and active social housing program is needed, in order to provide residence increase within area, which development should not be left exclusively for market forces. Public actions must above all guarantee the availability of housing for low income profiles, as a way to prevent gentrification processes from occurring or being intensified, as the findings suggested being in progress. In addition, it is necessary to create real conditions so that local population can benefit from development, and effectively stay in region.

7.2 Disincentive of Private Motorized Transport

The data analysis showed that Porto Maravilha discouraged private motorized transport, confirming as true, the premise proposed by this study. The project promoted significant improvement on public transport, notably with the VLT implementation, and great advances on active transport infrastructure, especially on walkability aspects as previously mentioned. Investigation revealed that, activities were more focused on modal shift incentive than on MIT restriction measures, whose actions, although existing, had reduced impact.

The data limitation, regarding traffic indexes within AEIU, did not allow an overall numerical comparison between situations before and after project activities. However, questionnaires provided important data to answer the question regarding which progress has been made by Porto Maravilha in discouraging private motorized transport. It showed that 42% of respondents had changed the transport mode after Porto Maravilha implementation, and pointed out a reduction of 9 percentage points of cars and motorcycles frequent users.

Restrictive measures, such as reducing parking lots or creating exclusive lanes for buses, did not seem to have much effect on discouraging MIT users at Porto Maravilha context, as demonstrated by drivers’ low dissatisfaction with them. However, the questionnaire analysis points out factors that may improve restrictive actions efficiency. The shorter time spent with displacement was the main reason that motivated users to change transport mode, and this same factor was identified as having the greatest influence, among MIT users, to stop using cars or motorcycles. Therefore, reducing the maximum street speed for cars and motorcycles within AEIU could be a powerful measure in discouraging MIT users. Another factor, identified as having great influence at MIT users’ decision, was the
economic aspect. Lower prices for public transport did not appear as a motivating element for promoting modal shift, however costs related to private vehicles use presented great inconvenience among drivers. Such situation suggests therefore that, restrictive economic actions on the possession or transit of private vehicles could promote greater impact in the disincentive of MIT.

7.3 PPP Framework Influence on Results

The analyses performed by this study indicate that PPP framework had a positive impact on SUM promotion, mainly by providing the necessary conditions for such project to become reality. Therefore the main hypothesis that PPP framework impacts positively in SUM promotion proved to be true. The PPP framework played a fundamental role in providing financial resources, as well as promoting the necessary flexibility to deal with complex requirements faced during project deployment phase. As pointed out at interviews analysis, the realization of Porto Maravilha project would not be feasible through the use of traditional models for contracting public works. The constant changes in design, constructive methodologies and quantities, would lead to innumerous renegotiations causing significant delays, escalating costs, and consequently, project unfeasibility.

Regarding the principal research question, inquiring about a conflict between PPP framework and SUM promotion at urban revitalization projects, the analyses allow to affirm that this conflict do not necessarily exist. The findings showed that, there is room for developing solutions that aim to generate profit for private partner, while promoting positive externalities for public partner and citizens in general. However the PPP framework creates an environment, where additional care is needed to prevent immediate profits or individual interests from overriding project long term objectives. The absence of such special precautions could then negatively impact the results, especially at the promotion of sustainable urban mobility.
7.4 Porto Maravilha Current Situation

Porto Maravilha has been facing serious funding difficulties, in order to continue PPP’s implementation and provision of services. With the worsening of the economic crisis, in the second half of 2016, and consequently downturn of real estate market throughout the city, Porto Maravilha Real Estate Investment Fund (PMREIF), could not find buyers for CEPACs and declared bankruptcy. This compromised the transfer of funds to CDURP, causing the non-payments of works and services carried out by the concessionaire, which paralyzed activities on June 5th, 2017. Maintenance services of street pavements, public areas, drainage systems, public lighting as well as household garbage collection and urban cleaning, were no longer provided by CPN until November 15th, 2017 when the concessionaire restarted activities.

The return of activities was possible due to the purchase of certain amount of CEPACs by CDURDP and City Hall, which generated financial resources for PMREIF and consequent enabled the payment of CPN services. Therefore the city is acquiring CEPACs, at a higher price than the current market value, in order to maintain the services operation, thus assuming risks of CEPACs valuation that did not have before. During the standstill period, local population had services rendered by city hall in an emergency manner, which caused a great drop in its performance.

This fact evidences the project interdependency to real estate valuation, and shows that improvements are needed at its structure, in order to reduce the exposure to external factors. Many criticisms are made to PMREIF behavior that, even in periods of real estate high demand, and CEPACs’ appreciation, has performed a low pace of sales. It is perceived that the fund acted more like a speculative investor, aiming for greater profit margins, than as an agent of urban revitalization.

Porto Maravilha has experienced its first years of project life but still has several deployments to be carried out, and consequences to be experienced. Being the phenomenon and context at the same time, Porto Maravilha therefore requires a continuous monitoring of its future developments and consequences, thus allowing its results to be fully evaluated. It may happen that, the region regains its vigor after the economic crisis, whose CEPAC’s appreciation would allow the proper continuity of revitalization process, and further improvements on SUM. On the
other hand, if the resumption of investments does not occur at an adequate time frame, CEPAC’s liquidity problem will persist, compromising the success of the entire project.

7.5 Conclusion

The PPP model has proven to be an important tool for both financial and technical feasibility of large-scale urban revitalization project, and its framework showed to be capable of enabling significant improvements on sustainable urban mobility. However, improvements are needed at project financial guarantees, by the development of instruments that reduce its exposure to external factors, such as occurred in Porto Maravilha. The management of financial instruments, as CEPACs were to Porto Maravilha, needs to be closely tied to the urban revitalization objective, thus preventing them from being used only as a financial and speculative asset. Urban revitalizations involve complex processes whose unfolding occurs over the years, in a gradual and organic process, thus creating a context highly favorable for the development of PPPs. The greater responsibility of private partner with project performance, throughout its operational phase, enables the development of long term solutions, as well as promotes its greater commitment to results. Moreover, the great demand for urban infrastructure investment in developing countries, especially in Latin America, coupled with the lack of human and financial resources of their governments, makes the PPP model an important alternative solution for implementing urban revitalization projects.

The greater longevity of PPP framework tends to overcome political oscillations, and provide favorable conditions for the implementation of long-term and more efficient solutions. However it demands especial precautions for an appropriated application. Latin American countries suffer from the lack of long-term planning, and discontinuities of projects due to political alternations, where political opponents often do not give continuity to projects initiated by their predecessors. This context therefore, usually limits improvements to short-term solutions that are inadequate for urban revitalization projects. PPP framework could than enable long term action, through various mandates, however it demands greater responsibility from public administrators and politicians. Its framework involves risks for citizens, since the greater flexibility and proximity between partners,
facilitates the occurrence of harmful actions, such as misuse of inside information, market manipulation or corruption. Therefore, an appropriate way to mitigate this risk is promoting greater transparency at PPP frameworks, by ensuring and increasing popular participation at project development and decisions. Although it would bring greater complexity, and made the decision process more time consuming, it is an indispensable action, especially at Latin American context. In addition, PPP frameworks must have well-defined rules specified in contract, and constant supervision by exempt and capacitated public institutions, in order to ensure their compliance.

As identified in Porto Maravilha, mayors play a key role in urban transformations, both through directing city development, leading projects implementation, as well as ensuring public interests. Therefore a better capacitation of mayors and civil servants becomes essential for the improvement of urban areas. Public administrators need to focus on benefits that urban transformations can provide to population, even when their results are recognized only in the long run, and therefore do not generate immediate political gains. The city of Curitiba well exemplifies this importance, when Mayor Jaime Lerner, architect and urbanist, even under strong criticism, implemented concepts that were intensely contested at the time. Under his leadership, his team designed a new masterplan integrating land use and public transport, with the introduction of transportation corridors that would later evolve to the BRT system. His idea that transportation should be efficient, accessible and sustainable, inspired innovations throughout the city, and transformed Curitiba into a reference case.

Finally, it can be stated that this research achieved its objective of evaluating the impact of PPP framework on revitalization projects and SUM promotion, through the analysis of Porto Maravilha case study. It showed that the PPP model can be an adequate framework for implementing revitalization processes and allowing significant improvements in SUM. This study pointed out important aspects in the PPP structure that demand improvements, in order to guarantee the public interest and increase the chances of success in similar projects. Furthermore it identified Porto Maravilha achievements regarding urban mobility, and proposed complementary actions in order to achieve better results. Lastly, it serves as one reference for the development of future revitalization projects, at similar contexts, providing lessons learned, and thus enabling the development of more effective solutions both in PPP model and in SUM promotion.
8 List of references


Urban Revitalization and SUM: An Analysis of PPP Framework Influence

Psychology, 56 (6), 506-509.


Version 3


documents.net/wced-ocf.htm


9 Attachment

On Site Questionnaire

Example of applied version:

**9 - Na condição de motorista (carro/moto), como você avalia as condições atuais de trânsito na região do Porto Maravilha quanto a:**

- Disponibilidade de estacionamento.
- Velocidades máximas permitidas.
- Tempo de espera em semáforos.
- Exclusão para ônibus nas faixas do SRS.
- Tempo gasto em congestionamentos.
- Segurança no trânsito.
- Custos relacionados ao uso do carro/moto.

**10 - Como você avalia(s) meio(s) de transporte utilizado(s) atualmente para acessar a região do Porto Maravilha quanto a:**

- Conforto.
- Segurança.
- Proximidade do terminal/estação/destino.
- Frequência.
- Tempo gasto para chegar ao destino.
- Custo.

**11 - Enquanto pedestre na região do Porto Maravilha, qual seu nível de satisfação quanto ao:**

- Condição das calçadas.
- Disponibilidade de travessias para pedestres.
- Dist. de bancos, assentos para descanso.
- Disp./Proximidade de serviços cotidianos.
- Seg. quanto ao risco de atropelamentos.

**12 - Após conclusão das obras, qual foi o impacto do Porto Maravilha na região quanto a:**

- Facilidade de acesso à região.
- Atratividade das calçadas e praças públicas.
- Opções de lazer.
- Pecação sonora.
- Custo de vidas(plaguio/services/produtos etc).

---

**1 - Há quanto tempo você acessa a região do Porto Maravilha?**

- Menos de 1 ano
- Entre 1 a 3 anos
- Entre 5 a 9 anos
- Entre 9 a 10 anos
- Mais de 10 anos

**2 - Qual motivo(a) leva a acessar a região do Porto Maravilha atualmente?**

- [ ] Residência
- [ ] Trabalho
- [ ] Estudo
- [ ] Lazer e/ou cultura
- [ ] Acesso à serviços públicos
- [ ] Feirão Compras
- [ ] Transbordar/transferência
- [ ] Atravessa a região.
- [ ] Outro:

**5 - Você alterou o meio de transporte utilizado para acessar a região DEPOIS da conclusão das obras do Porto Maravilha?**

- [ ] SIM
- [ ] NÃO

**6 - Qual meio de transporte utilizada para acessar a região ANTES das obras do Porto Maravilha?**

- [ ] Ônibus
- [ ] Carro
- [ ] Trem
- [ ] Metrô
- [ ] Bicicleta
- [ ] Barcas
- [ ] A pé
- [ ] Taxi/Moto-táxi/Uber
- [ ] Moto/Scooter
- [ ] Outro:

**7 - Qual motivo(a) leva a alterar o meio de transporte utilizado?**

- [ ] Menos tempo para chegar ao destino.
- [ ] Maior proximidade do ponto/estação ao meu destino.
- [ ] Maior conforto.
- [ ] Maior segurança.
- [ ] Custo
- [ ] Preciso mudar contra a minha vontade.
- [ ] Outro:

---

**13 - Qual a sua renda mensal?**

- Até R$5.500
- Entre R$5.501 a R$10.000
- Entre R$10.001 a R$15.000
- Maior que R$15.000
- Prefiro não responder

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### Urban Revitalization and SUM: An Analysis of PPP Framework Influence

#### 1 - For how long did you access Porto Maraviha area?
- Less than 1 year
- Between 1 and 3 years
- Between 3 and 5 years
- Between 5 and 10 years
- More than 10 years

#### 2 - What is (are) the reason(s) for currently accessing Porto Maraviha area?
- Residence
- Work
- Study
- Leisure and/or Culture
- Access to public services
- Shopping
- Transshipment / transfer
- Cross through region
- Other: ____________________________

**8** - As a driver (car or motorcycle), you would use public transport instead of the car / motorcycle in case of:
- It was faster to reach the destination using public transport.
- The station / terminal was closer to my destination.
- Public transport were more comfortable.
- Public transport were safer.
- Public transport were cheaper.
- I was allowed to carry my bicycle inside public transport.
- I do not intend to stop using car / motorcycle to use public transport.
- Other: ____________________________

#### 3 - How often do you access Porto Maraviha area?
- Less than once per week.
- Once a week.
- 2 or 3 days a week.
- 4 or 5 days a week.
- Daily / almost daily.

**9** - As a driver (car / motorcycle), how do you evaluate the current traffic conditions in Porto Maraviha area regarding:
- Parking availability.
- Maximum allowed speeds.
- Waiting time at traffic lights.
- Exclusive lanes for BRT buses.
- Time spent on congestion.
- Traffic Safety.
- Costs related to car / motorcycle use (fuel / parking / maintenance / insurance / fees).  

#### 4 - Currently, which transport mode do you most frequently use to access Porto Maraviha area?
- Bus
- Subway
- Train
- VLT - Train (Tram)
- Ferry
- Taxi/Motorcycle-taxi/Uber
- Motorcycle / Scooter**
- Car (own/company)**
- Ride
- Bicycle/skate/rollerblade/etc.
- On foot
- Other: ____________________________

#### 10 - How do you evaluate the transport modes currently used to access Porto Maraviha area regarding:
- Comfort.
- Safety.
- Proximity of stations / terminals.
- Frequency.
- Time spent to reach destination.
- Costs.

#### 11 - As a pedestrian in the Porto Maraviha area, how satisfied are you with:
- Sidewalks conditions.
- Availability of pedestrian crossings.
- Availability of seats to rest.
- Proximity of important destinations.
- Safety against traffic accidents.

#### 12 - After the completion of works, what was the impact of Porto Maraviha regarding:
- Ease of access to the region.
- Attractiveness of sidewalk and public squares.
- Leisure options.
- Noise pollution.
- Cost of living (rent / services / products / etc.).
Online Questionnaire

Academic questionnaire on urban mobility in Porto Maravilha region.

This questionnaire has exclusively academic purpose, and its answers will be used in a master's thesis that evaluates the impacts of the Porto Maravilha project on sustainable urban mobility. It should be answered ONLY by those who access the area of Porto Maravilha.

For how long did you access Porto Maravilha area?

Area composed by neighborhoods: Santo Cristo, Gamboa, Saúde; avenues: Presidente Vargas, Rio Branco, Francisco Bicalho; squares: Maú, XV and surroundings.

- Less than 1 year
- Between 1 and 3 years
- Between 3 and 5 years
- Between 5 and 10 years
- More than 10 years

Próx.

What is (are) the reason(s) for currently accessing Porto Maravilha area?

Select more than one option if you have more than one frequent reason for accessing the area.

- Residence
- Work
- Study
- Leisure and / or Culture
- Access to public services
- Shopping
- Transshipment / transfer
- Cross through region
- Other: [ ]

Anter. Próx.

(Alterar)
Academic questionnaire on urban mobility in Porto Maravilha region.

How often do you access Porto Maravilha area?

- Less than once per week.
- Once a week.
- 2 or 3 days a week.
- 4 or 5 days a week.
- Daily/almost daily.

Academic questionnaire on urban mobility in Porto Maravilha region.

Currently, which transport mode do you most frequently use to access Porto Maravilha area?

Choose more than one option if you make frequent use of two or more transport modes. Examples: Train + Bus or Ferries + VLT, etc.

- Bus
- Subway
- Train
- VLT - (Tram)
- Ferry
- Taxi/Motorcycle-taxi/Uber
- Motorcycle / Scooter
- Car (own/company)
- Ride
- Bicycle/skate/rollerblade/etc
- On foot
- Other: 

[Previous][Next]
Did you change the transport mode to access the area AFTER the completion of Porto Maravilha works?

Works of Porto Maravilha:
Removal of Perimetral; Implementation of VLT, tunnels, Binary Avenue; Renovation of Maua square, Praça XV, Orla Prefeito Luiz Paulo Conde, etc.

- Yes
- No

Which transport mode did you use to access the area BEFORE Porto Maravilha?
Choose more than one option if you make frequent use of two or more transport modes. Examples: Train + Bus or Ferries + VLT, etc.

- Bus
- Subway
- Train
- Ferry
- Taxi/Motorcycle-taxi/Uber
- Motorcycle/Scooter
- Car (own/company)
- Ride
- Bicycle/skate/rollerblade/etc
- On foot
- Other: ________________________________
Academic questionnaire on urban mobility in Porto Maravilha region.

Which reason(s) led you to change the transport mode?

Possible to select more than one option.

- Shorter time to reach the destination.
- Greater proximity from stops / stations to my destination.
- Greater comfort.
- Greater security.
- Costs.
- Other: [blank]

Academic questionnaire on urban mobility in Porto Maravilha region.

As a driver (car or motorcycle), you would use public transport instead of the car / motorcycle in case of:

Possible to select more than one option.

- It was faster to reach the destination using public transport.
- The station / terminal was closer to my destination.
- Public transport were more comfortable.
- Public transport were safer.
- Public transport were cheaper.
- I was allowed to carry my bicycle inside public transport.
- I do not intend to stop using car / motorcycle to use public transport.
- Other: [blank]
### Academic questionnaire on urban mobility in Porto Maravilha region.

#### As a driver (car / motorcycle), how do you evaluate the current traffic conditions in Porto Maravilha region regarding:

<table>
<thead>
<tr>
<th></th>
<th>Very satisfied</th>
<th>Satisfied</th>
<th>Neutral</th>
<th>Dissatisfied</th>
<th>Very dissatisfied</th>
<th>Do not know to evaluate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parking availability.</td>
<td></td>
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<tr>
<td>Maximum allowed speeds.</td>
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<tr>
<td>Waiting time at traffic lights.</td>
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<tr>
<td>Exclusive lanes for BRT buses.</td>
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<tr>
<td>Time spent on congestion.</td>
<td></td>
<td></td>
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<tr>
<td>Traffic Safety.</td>
<td></td>
<td></td>
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<tr>
<td>Costs related to car/motorcycle use (fuel/parking/maintenance/insurance)</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

#### How do you evaluate the transport modes currently used to access Porto Maravilha area regarding:

<table>
<thead>
<tr>
<th></th>
<th>Very satisfied</th>
<th>Satisfied</th>
<th>Neutral</th>
<th>Dissatisfied</th>
<th>Very dissatisfied</th>
<th>Do not know to evaluate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comfort.</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Safety.</td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Proximity of stations / terminals</td>
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<td></td>
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<tr>
<td>Frequency.</td>
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<tr>
<td>Time spent to reach destination.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Costs.</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>
Academic questionnaire on urban mobility in Porto Maravilha region.

As a pedestrian in the Porto Maravilha area, how satisfied are you with:

<table>
<thead>
<tr>
<th>Condition</th>
<th>Very satisfied</th>
<th>Satisfied</th>
<th>Neutral</th>
<th>Dissatisfied</th>
<th>Very dissatisfied</th>
<th>Do not know how to evaluate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sidewalks conditions.</td>
<td></td>
<td></td>
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<tr>
<td>Availability of pedestrian crossings.</td>
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<tr>
<td>Availability of seats to rest.</td>
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<tr>
<td>Proximity of important destinations.</td>
<td></td>
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<tr>
<td>Safety against traffic accidents.</td>
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<td></td>
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</tr>
</tbody>
</table>

Anter.  Próx.
(Alternar)

Academic questionnaire on urban mobility in Porto Maravilha region.

After the completion of works, what was the impact of Porto Maravilha regarding:

<table>
<thead>
<tr>
<th>Factor</th>
<th>Much better</th>
<th>Improved a little</th>
<th>Same conditions</th>
<th>Worsened a little</th>
<th>Much worse</th>
<th>Do not know to evaluate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ease of access to the region.</td>
<td></td>
<td></td>
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<tr>
<td>Attractiveness of sidewalks and public squares.</td>
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<tr>
<td>Leisure options.</td>
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<tr>
<td>Noise pollution.</td>
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<td></td>
</tr>
<tr>
<td>Cost of living (rent / services / products / etc).</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Anter.  Próx.
(Alternar)
Academic questionnaire on urban mobility in Porto Maravilha region.

What is your monthly income?

- Up to R$1.500
- Between R$1.501 and R$3.000
- Between R$3.001 and R$5.000
- Between R$5.001 and R$10.000
- More than R$10.000
- Rather not answer
Example of form sent to interviewees

Prezado Sr. Jorge Arraes,

Esta tese de mestrado tem como objetivo principal avaliar os impactos do Projeto Porto Maravilha, na promoção de Mobilidade Urbana Sustentável na região Portuária. Sua análise se divide em três aspectos principais:

- Avaliação das transformações urbanísticas realizadas na região;
- Identificação da percepção e comportamento dos usuários diante dessas alterações;
- Análise da influência do modelo de Parceria Público-Privada nos resultados alcançados.

Desta maneira, para desenvolver o terceiro aspecto listado, foram elaboradas questões específicas para os principais envolvidos no projeto, tanto do parceiro privado como do parceiro público. Foram convidados também a participar pesquisadores do âmbito de mobilidade urbana, não envolvidos diretamente no projeto.

Ficaria muito grato com a sua participação, através das respostas ao breve questionário abaixo:

1. Desde a diminuição das atividades portuárias e redução de sua importância econômica, a região portuária do Rio de Janeiro vinha passando por um constante processo de degradação e piora das suas condições sociais. O desejo pela revitalização da área era antigo, entretanto tentativas de implantação não nunca se concretizaram. Na sua avaliação, quais fatores foram fundamentais para que o projeto Porto Maravilha virasse uma realidade? Neste cenário, quais os motivos que levaram a um modelo de PPP para sua implementação?

2. O projeto Porto Maravilha promoveu diversas alterações urbanísticas propostas um conceito de mobilidade urbana sustentável. Foram realizadas ações voltadas à promoção de: maior valorização do pedestre; uso misto do solo; e incentivo ao uso do transporte público. Por outro lado também foram implementadas medidas restritivas ao transporte motorizado individual (carro/moto) tendo como exemplo: a eliminação de vagas de estacionamento público; remoção da perimetral; e proibição de tráfego em locais específicos. Tais medidas impactaram diretamente na rotina de muitos cariocas, o que gerou muita polêmica e uma grande diversidade de opiniões. Neste contexto quais foram os principais desafios enfrentados para a implementação do Projeto Porto Maravilha? Na sua avaliação, o modelo de PPP influenciou na superação dos mesmos?

3. Na sua avaliação, quais foram os principais aspectos positivos e negativos promovidos pelo formato de Parceria Público-Privada na implementação do projeto Porto Maravilha? Poderia citar exemplos, em que tais aspectos tinham desempenho pape fundamental?

4. Segundo estudo do banco mundial o número de parcerias público-privadas em infraestrutura triplicaram nos últimos 10 anos na América Latina e no Caribe. Uma vez que o uso de PPPs tem se tornado uma realidade cada vez mais frequente, torna-se fundamental analisar seus resultados, bem como identificar oportunidades de desenvolvimento do modelo. Tendo olvidado a implementação do Porto Maravilha, na sua avaliação, quais aspectos podem ser desenvolvidos para aprimorar o modelo de PPP em futuros projetos de revitalização urbana?
Mr. Jorge Arraes,

This master's thesis has as main objective to evaluate the impacts of Porto Maravilha in the promotion of Sustainable Urban Mobility within project area. Its analysis is divided into three main aspects:

- Evaluation of urban transformations carried out within project area;
- Identification of user's perception and behavior in face of these changes;
- Analysis of Public Private Partnership influence on the results achieved.

In this way, to develop the third aspect aforementioned, specific questions were elaborated for the main actors involved in the project, both from the private partner and also from the public one. Researchers from the area of urban mobility, not directly involved with the project, were also invited to participate.

I would be very grateful for your participation, through the answers to the brief questionnaire below:

1. Since the reduction of port activities and decrease of their economic importance, the port area of Rio de Janeiro has been undergoing a constant process of degradation and worsening of its social conditions. The desire to revitalize the area was old, but attempts to implement it were never materialized. In your evaluation, which factors were fundamental to make the Porto Maravilha project a reality? In this scenario, what were the reasons that led to a PPP model for its implementation?

2. The Porto Maravilha project proposed several urban changes, proposing the implementation of sustainable urban mobility concepts. Actions were carried out to promote: greater pedestrian valorization; land use mix; and improvement of public transport. On the other hand, restrictive measures were also implemented to private motorized transport (car / motorcycle), for example: the elimination of public parking spaces; Perimetral removal; and prohibition of traffic in specific places. Such measures directly impacted the routine of many Cariocas, which generated much controversy and great diversity of opinions. In this context, what were the main challenges faced for the implementation of Porto Maravilha project? In your opinion, did the PPP Framework influence their overcoming?

3. In your evaluation, what were the main positive and negative aspects promoted by the Public Private Partnership framework in the implementation of the Porto Maravilha project? Could you cite examples where such aspects played a key role?

4. According to a World Bank study, the number of public-private partnerships in infrastructure has tripled in the last 10 years in Latin America and the Caribbean. Since the use of PPPs has become an increasingly frequent reality, it becomes fundamental to analyze their results, as well as to identify opportunities for model enhancement. Having experienced the implementation of Porto Maravilha, in your opinion, which aspects can be developed, in order to improve the PPP model in future urban revitalization projects?