057

Urban evolution of the Rio de Janeiro Port

Carolina Rodriguez Dias
Aflalo Gasperini Arquitetos
carolinamqrodriguez@gmail.com

Dr Maria Beatriz de Arruda Campos
Atkins Ltd.
beatriz.campos@atkinsglobal.com

Abstract

Driven by the events that will occur in the city, Rio de Janeiro signals a new economic dynamic. With a historic centre that remains attached to its original financial and commercial functions, the municipality seeks to regenerate the neighbourhoods around it. In that context, located adjacent to the historical centre, a new project was created with the intention to revitalize the Port of Rio de Janeiro and adjacent areas named 'Porto Maravilha'.

This paper presents a case study of the Port of Rio de Janeiro. Since the second half of the last century, the port has been losing its primary function. Composed of large industrial blocks and a fragmented urban grid, its built environment went through a process of deterioration and loss of functions, as part of its activities were gradually relocated and changes of its built environment occurred. By adopting the space syntax framework, this paper examines how the changes in the morphology of the port have affected its integration with the city. This paper also investigates the role that the Porto Maravilha project plays in improving the accessibility of the area.

Considering that part of the changes in accessibility have been defined by the new regeneration project of Porto Maravilha and part by the architects and stakeholders in their own developments, this study also raises the question of to what extent these localized interventions impact on the accessibility of an already highly fragmented area.

The analysis found that the fragmented urban fabric of the port street network affected its urban function, bringing decay to the area once the port was deactivated. The analysis showed that the Porto Maravilha proposal has a small role in increasing the accessibility of the local area. Conversely, architectural projects lead by the private sector were able to further integrate the proposed developments with their immediate urban fabric and at the same time increase the port accessibility to the surrounding areas, assisting with the creation of a new urban centre in this area of Rio de Janeiro.

Keywords

Space syntax methodology, urban regeneration, sustainability, Porto Maravilha.

1. Introduction

With a population of more than 12 million people (IBGE, 2013), Rio de Janeiro is the second largest metropolis in Brazil. The city, known for its impressive landscape, is the main tourist destination of the Southern Hemisphere and also has the second largest GPD in the country (IBGE, 2008). Nevertheless, as other Brazilian cities, Rio de Janeiro confronts sharp socio-economic inequalities.

In the XIX Century the city was the capital of the Portuguese kingdom and until 1960 the capital of Brazil. It inherited valuable historical neighbourhoods and buildings including the old royal residence (Quinta da Boa Vista) and the historical centre, both adjacent to the Port of Rio de Janeiro.

The Port of Rio de Janeiro started to be built in the beginning of the XX century. Its operations began to take place in a precarious way; new warehouses were constructed along the cove according to the needs. In 1910 a new, more adequate port infrastructure was created occupying the embankment (Figures 1 and 2). Warehouses occupied a large area and in the east side the passenger terminal was placed. Surrounded by the sea and mountains – where the first Brazilian shantytown emerged – and a historic neighbourhood, the new urban fabric had different morphological characteristics of its adjacent areas. It had large industrial blocks, wider roads and distinct single land use (Figure 3). Likewise in the beginning of the century other urban transformations happened in the city. Among them, a large number of derelict houses were expropriated in the city centre and the core had its land value increased. The population moved to the suburbs or to the informal settlements located in the mountains close to the centre (Dias, n.d.).

Figure 1: Overlap of historic map (1867) and current Google map highlighting the embankment area.

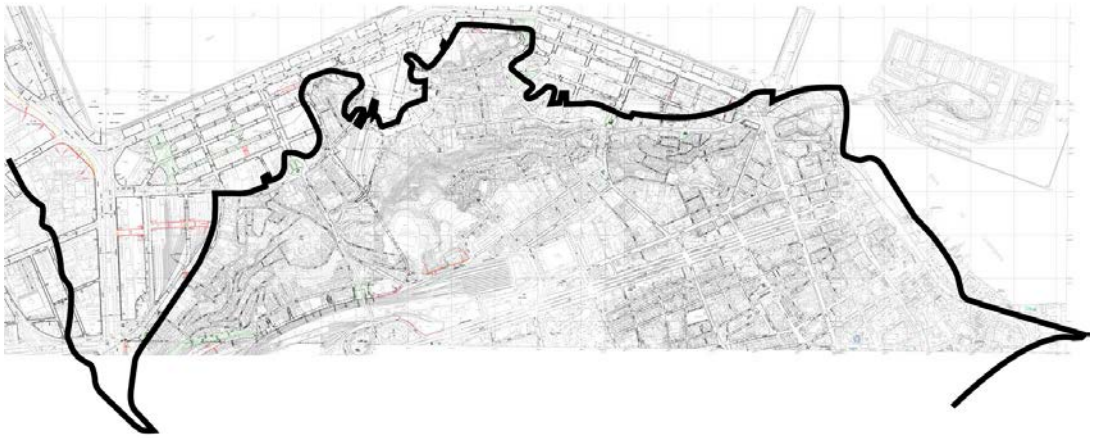

Figure 2: Current map highlighting the embankment line.

Figure 3: Photo showing the contrasting density between the port area and the neighbouring shantytown.

The port area remained virtually the same along the years. However, with the rise of a large number of new private developments and increase in population and density in the southern region of the city from the 1950's, and following a national tendency at the time for prioritizing private vehicles, highways, tunnels and flyovers were subsequently built. The intention was to link different regions of the city without passing through the main city centre. The streets in the Porto had heavy traffic caused by trucks and the alternative found by the local authority was to build new elevated expressways in the north and west sides of the port area. The construction started at the end of the 1950's and the opening occurred in the beginning of the 1970's. Additionally, a major coach station was also built in the area. Such changes had a negative impact on the surrounding consolidated neighbourhoods and on the urban fabric of the adjacent historic area. The small-scale streets and alleys were disrupted (Sinergia, 2013).

In the beginning of the 1980's, the port operations were partly moved to another port and only containers and roll-on/roll-off functions, that required large and empty areas, remained operational. Eventually, the dockyards became too small for the new set-up. Since the port could not expand as its warehouses were listed as architectural heritage, the remaining of its operation started to be deactivated and transferred to other areas. By the end of the 1990's, the dockyard area was fenced off and its warehouses were closed permanently (ibid).

All these historical changes created a situation where the port became an area surrounded by express roads, with large industrial blocks and a highly fragmented urban fabric. The configuration of the area prioritized the rapid vehicular flow and discourages pedestrian activity. These elements also worked as a barrier between the port and its surrounding neighbourhoods. Such situation brought decay to the area with degradation of its public space, abandoned and underused buildings, low pedestrian movement and crime (Figure 4).

Figure 4: Port area today[1].

Conversely, although the city's urban fabric went through rapid and radical physical transformations, the historic city centre remained alive. However, as it's main uses are commercial and retail, the centre remained active during the working hours but quiet during the night and weekends.

Due to the events happening in Rio de Janeiro such as 2014 FIFA World Cup, the 2016 Olympic and Paralympics Games and the recent economical growth of the country, the city finds itself in a need to improve its infrastructure. The port caught the attention of the government due to its strategic location: adjacent to the main city centre and surrounded by major roads - linking the centre of Rio de Janeiro to its outskirts (Figure 5). Acknowledging the importance of having residents close to the main centre of the city in order to reduce vehicular movement in the daily life of its inhabitants, the government proposed a new major regeneration project for the area named Porto Maravilha.

[1] Figure from http://portomaravilha.com.br/web/esq/summary.aspx

Figure 5: Main roads of the Port of Rio de Janeiro and surrounding areas.

2. Porto Maravilha Proposal

The Porto Maravilha regeneration project (Figure 6) aims to be implemented over 20 years. It aims to restructure the area, reviving and rearticulating its public spaces. It has an area of five million square meters and the project intends to increase the population from 22 thousand to 100 thousand people in 10 years.

Among other intentions, it proposes the demolition of one of the flyovers surrounding the dockyards, the Elevado da Perimetral, land use revision and a new concept for the city in terms of urban mobility with the introduction of new transport modals and priority to pedestrians. It also includes a few changes to its urban fabric, reducing the size of the large industrial blocks and connecting some streets.

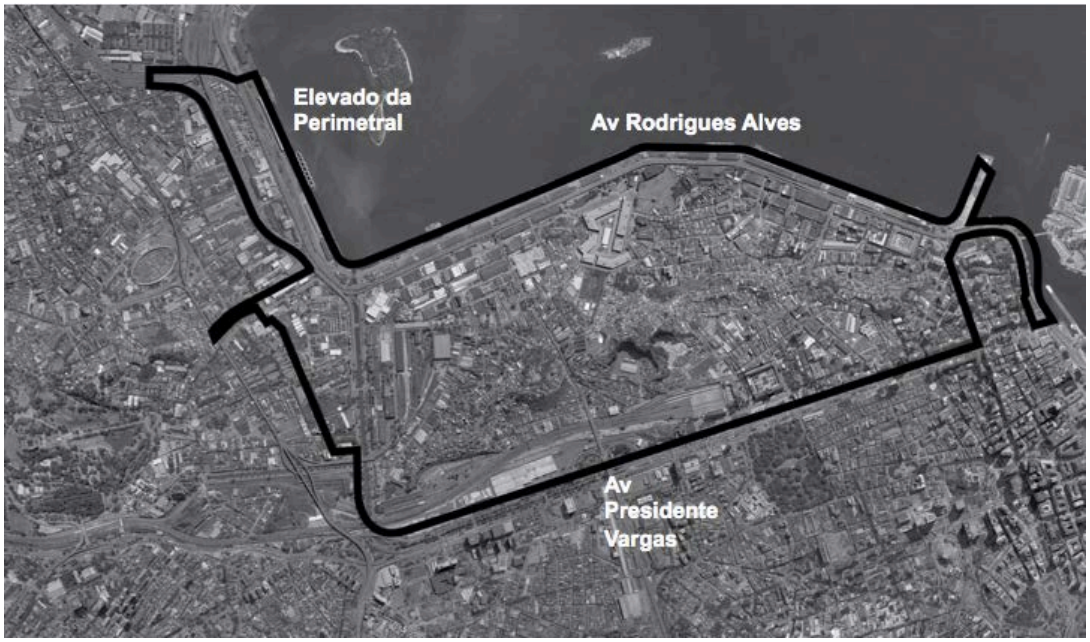

Figure 6: Urban area of Porto Maravilha.

3. Methodology and Analysis

In order to analyse the role of the spatial configuration in preventing the port to readapt to a new social and economical order after losing its primary function, the impact of the proposal for the regeneration of the Porto Maravilha and the influence of other architectural projects proposed for the area, a morphological analysis of the City of Rio de Janeiro was carried out.

As space syntax research shows that the spatial configuration of cities can be related with their social and economical conditions (Hillier and Hanson, 1984), the present study uses this theoretical and methodological framework. It draws on a range of data including cartographic, official land use and demographic data. The study includes spatial analysis using segment map performed in depthmapX. The boundary of the map used covers an area of around 3km from the Port of Rio de Janeiro and historic core. To calculate a syntactic measurement of space, the analysis applied the measures of integration and choice using different radii (global and local). For the global scale, radius n (infinity) is used, which measures each line in the system in relation to all other lines. For the local scale, the measurement of routes from any line is restricted to only those lines that are up to the metric distance specified; the used measures are choice and integration at different metric radii: 400m, 800m, 2000m, 5000m, 10000m. The spectrum global to local using different measures was chosen to understand possibilities afforded to vehicle and pedestrian movement at different scales.

As discussed, the city of Rio de Janeiro has a very distinctive topography, limited by the sea to the east and mountains to the west. These particularities to a certain degree have influenced its currently spatial configuration, however much of its complicated urban system has been a result of gentrification, real estate operators and Municipality strategies (Costa Braga, 2007).

Indeed, the morphological characteristics of the urban grid in the area of the Porto of Rio de Janeiro are not exclusive. Overall, the city of Rio de Janeiro has a fragmented urban grid with residential and commercial areas isolated from each other, only accessible by a complex vehicular network where rapid vehicular flows are prioritised over pedestrian mobility. This is clearly demonstrated by the analysis of the spatial accessibility (Figure 7). The measure of global integration highlights the vehicular network (the well known Av. Francisco Bicalho, Av. Rodrigues Alves, Linha Vermelha and Av. Presidente Vargas), which divides the area in approximately four sectors.

A subsequent analysis using the R400 metric measure further highlights this distinctive pattern with ‘integrated’ local areas but few routes interconnecting them. Interesting enough, the old city centre emerges as a very intelligible neighbourhood with high levels of global and local accessibility (highlighted by a circle). Analysis of existing land use and vehicular flows confirmed the authenticity of the spatial model. Qualitative data and site visits also confirmed the urban vitality of the old city centre during the week, an area with good levels of pedestrian flows and a viable economy, which acts as a link between the port area (to the west) and Gloria (to the south).

The maps also illustrate the area of the Port of Rio de Janeiro as a place designed for through movement but lacking spatial character that could support a local economy. This process helps to understand the decline of the Porto. By lacking local accessibility and with global accessibility predominantly on its banks, the morphology of the area could not support other types of land use after the relocation of the port activities.

The proposal for Porto Maravilha, amongst its merits, reduces the size of the urban blocks and advocates the demolition of the Elevado da Perimetral. There is a great concern to create public areas and to minimise vehicular through traffic. However, the level of intervention has a ‘cosmetic’ impact to the larger area. That can be noticed in Table 1; both global and local integration values increase slightly on the Porto Maravilha proposal. The proposal has also an effect on the city centre itself by increasing its local accessibility.

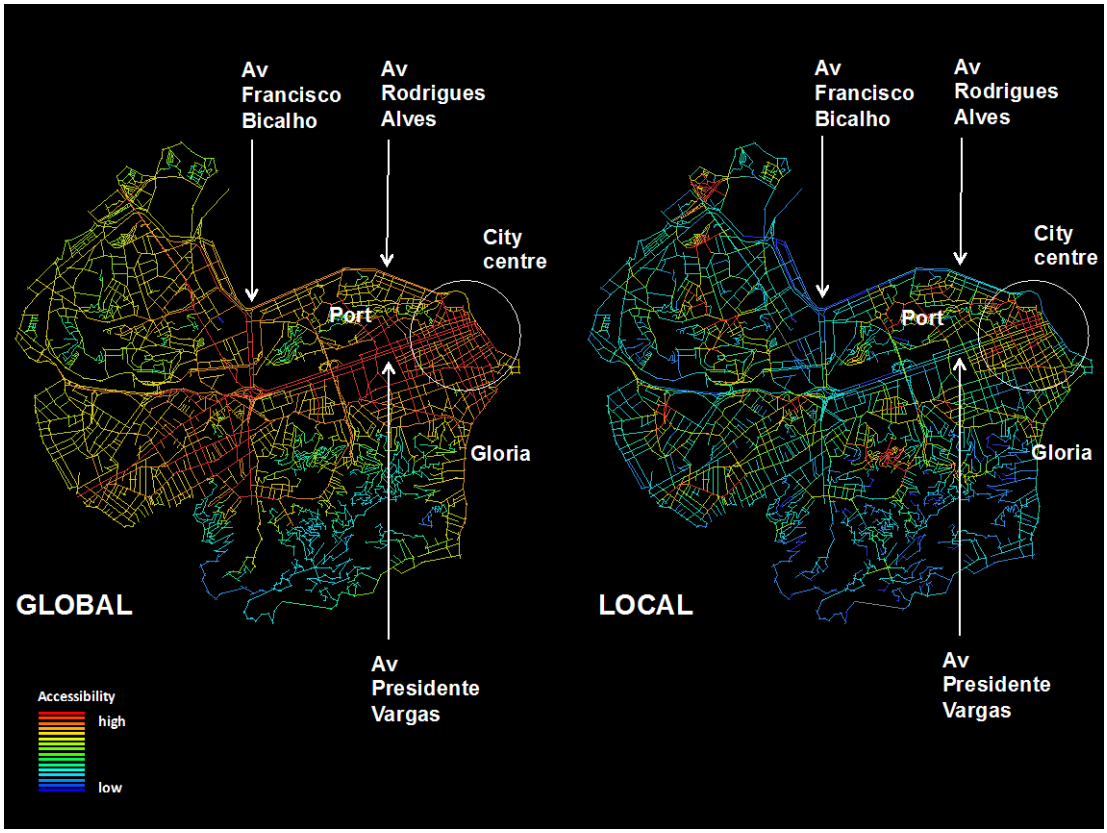

Figure 7: Integration segment map of study area as today: global measure (left) and local measure R400 metric (right). The old city emerges as a very intelligible area in the context of the city of Rio de Janeiro.

	Choice						Integration					
	5,000		2,000		400		5,000		2,000		400	
	value	%	value	%	value	%	value	%	value	%	value	%
Current Port	0.0421	0.97	0.0422	4.08	0.0385	-0.71	0.6338	2.07	0.4033	4.03	0.3180	4.39
Porto Maravilha	0.0426		0.0440		0.0382		0.6472		0.4202		0.3326	
Current Port	0.0522	-5.17	0.0416	-1.90	0.0092	7.39	0.7757	0.30	0.5575	-0.87	0.3546	4.21
Porto Maravilha	0.0496		0.0409		0.0099		0.7781		0.5527		0.3702	

Table 1: Current port and Porto Maravilha Choice and Integration measures – both global and local values.

When we analyse the morphology of the area after the implementation of Porto Maravilha, we notice a small increase in both global and local integration to the east and west of the port. Despite the increase of integration in some areas, the area of Porto Maravilha and the neighbourhood to the west (São Cristóvão) remain disconnected and fragmented, limiting the accessibility of pedestrians in the region. The northwest area of Porto remains with low accessibility values (Figure 8).

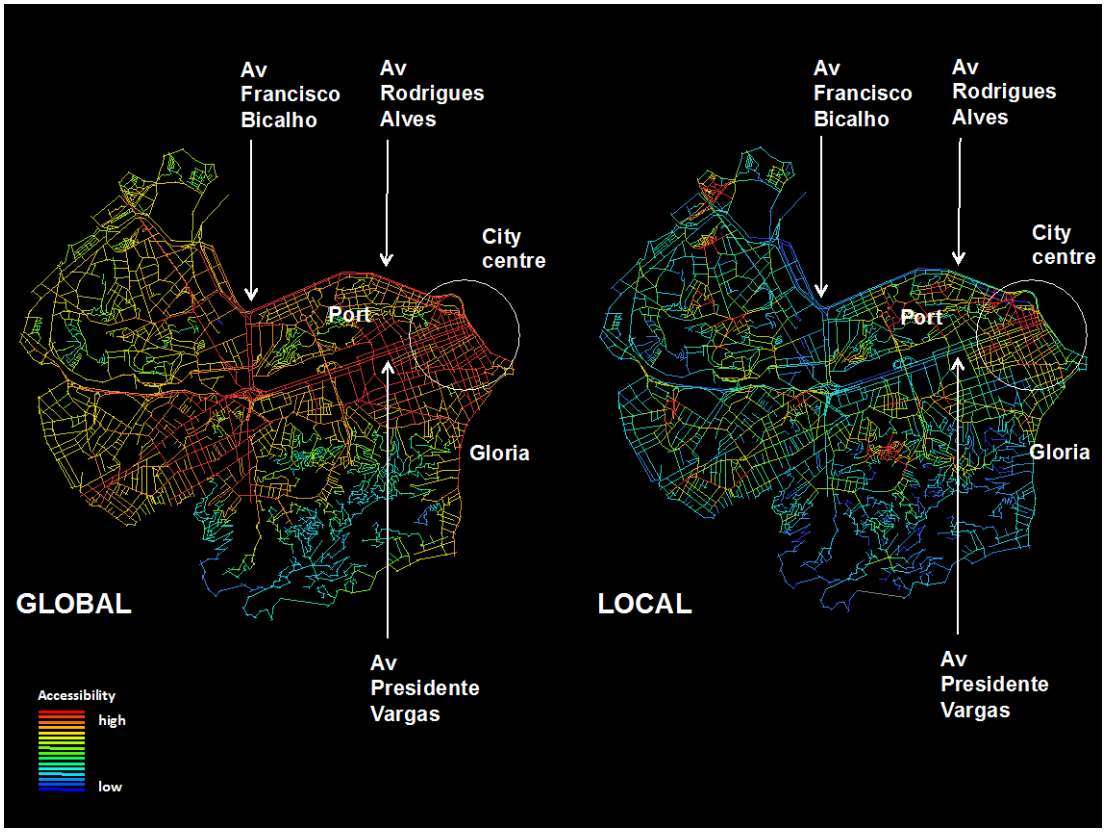

Figure 8: Integration segment map of study area with the regeneration of Porto Maravilha: global measure (left) and local measure R400 metric (right).

It is clear that, despite the improvements, the urbanization of the port area's impact will be localized and much of the sense of place and urban vitality, which the municipality was hoping to achieve, might not take place to the expected levels.

4. Further Projects

The Porto Maravilha masterplan caught the attention of private developers, which saw an opportunity to develop adjacent areas. Fortunately, the developers and designers understood that key to any project to be successful, the development would need to be connected to the port by improving the current urban system, i.e., somehow decrease the topological distance between the port and surrounding areas. The projects analysed in the present paper were developed by Aflalo Gasperini Architects (AG).

The connections of AG projects consist of new roads, pedestrian crossings, walkways and shopping arcades. Still, these connections took into account public squares and buildings in the vicinity of the development area.

The maps below (Figure 9 and Table 2) show a progressive increase in accessibility of the port area. The connections proposed by AG are increasing the 2000m distance integration values west of Porto (which is where they concentrate most of the office projects), turning the area into an integration focus similar to the central area of Rio de January. Although the urban fabric remains fragmented, there is an improvement in the relationship between the two sides of Av. Francisco Bicalho (the expressway surrounding the port to the west), which were interrupted by the expressway. Further, it can be seen that the addition of the connections of the new developments is increasing local integration of the Porto Maravilha project itself. Moreover, not only the Porto presents greater integration, but also the São Cristóvão neighbourhood, where there are located a series of cultural buildings including the Quinta da Boa Vista.

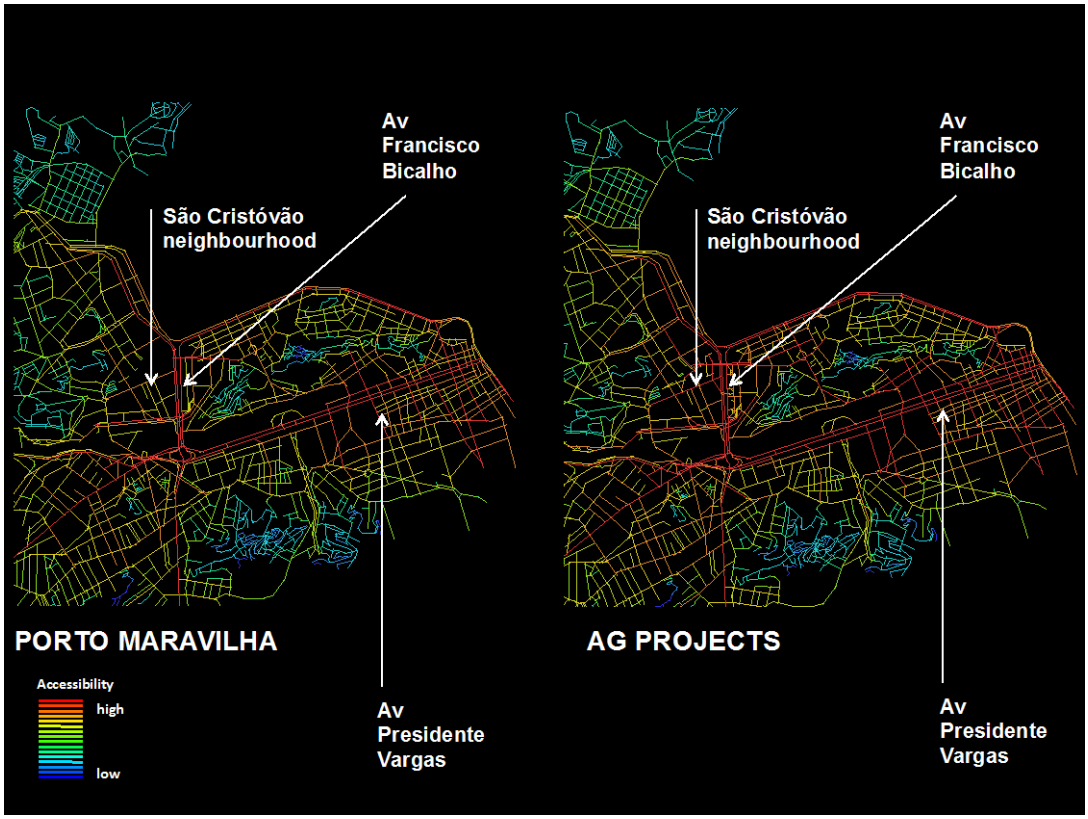

Figure 9: R2000 accessibility map of study area with the regeneration of Porto Maravilha (left) and AG projects (right).

	Choice						Integration					
	n		2,000		500		n		2,000		500	
	value	%	value	%	value	%	value	%	value	%	value	%
Porto Maravilha	0.0312	0.81	0.0831	3.94	0.0403	-2.07	0.6449	2.20	0.4971	0.59	0.3872	-5.96
New developments	0.0314		0.0866		0.0395		0.6594		0.5001		0.3655	
Porto Maravilha	0.0311	3.63	0.0544	-3.31	0.0110	1.40	0.7595	1.02	0.5626	-10.52	0.4051	-13.41
New developments	0.0323		0.0527		0.0111		0.7673		0.5090		0.3572	

Table 2: Comparison between Porto Maravilha proposal and New Developments including Choice and Integration measures – both global and local values.

Checking the overall integration of the area with the addition of connections proposals for projects one realizes that there is also an improvement in accessibility to the west of Porto, in particular between Porto Maravilha e São Cristóvão.

5. Findings

As discussed in previous research (Medeiros and Holanda, 2010), Brazilian cities are highly fragmented and have few roads connecting the centre to the edges. Usually this fragmentation is related to geographical characteristics of the site. The few lines crossing the system at a global scale produce a labyrinthine pattern. A study about the city of São Paulo (Rodriguez et al, 2012), a city with similar morphological features to Rio de Janeiro, found that the combination of areas better served with high-through movement streets linking the core to the edges and made up of orthogonal grids with a continuous and less fragmented urban fabric, imply in areas with a larger number of segments with great potential as routes and destinations with consequent more successful socio-economic conditions.

Additionally, as indicated by Hillier (2009) in his study on organic cities, the centres will appear where there is a co-presence of global and local factors. The global aspects indicate the potential locations, which will benefit from movement with respect to the system as a whole, and the local factors will select places with certain grid conditions that will allow easy movement inside the centre.

Bearing that in mind, the port area has potential to succeed socially and economically considering the number of structural roads surrounding and crossing the area. It lacks, however, continuity of its urban fabric and it presents two different scales of accessibility in its internal structure – that is the large-scale industrial blocks and the small-scale of the shantytown's urban fabric – which have a poor relation to the global structural roads. These local characteristics have been gradually improved from the old port to the Porto Maravilha proposal and through the area considering the AG projects.

Although the most significant local accessibility changes in the port of Rio de Janeiro have an incremental character rather than planned, the finding above presents a certain similarity to Karimi's (2007) study on the role of limited physical interventions in increasing the spatial integration of an area and of the whole city.

6. Conclusions

This study has examined the urban transformations of the Rio de Janeiro port and the impact of such changes in the socio-economic efficiency of the area. The aim was to understand through a configurational perspective why the area adjacent to the city core went through a process of deterioration and loss of functions. Additionally, it investigates the impact of the new regeneration project Porto Maravilha in improving the accessibility of the area. It also questions how the localized interventions of architectural projects in the port impact on the accessibility of an already highly fragmented area.

The analysis indicates that the current urban condition of the port is related to the decisions and events that took place in the past such as the construction of elevated roads around the port in order to separate private vehicles and trucks serving the dockyards and warehouses, followed by the loss of primary function of the port with warehouses being listed as architectural heritage and, therefore, limiting flexibility of land uses.

The evidence suggests that the current situation of the port is related to the way its internal structure is fragmented – it is divided into four parts and not married to the adjacent neighbourhoods – and has a weak relation to its global routes consisted of elevated expressways. The absence of a good relationship between its local and global parts helps us to understand the abandonment of the port.

The syntactic analysis of the Porto Maravilha proposal shows that, although there is an attempt to reduce the size of the urban blocks, the demolition of one of the elevated roads and the reconnection of some roads, their intervention has a limited impact on the general accessibility of the area.

Nevertheless, the architectural projects proposed by AG show a concern to reduce the topological distances and to reconnect the two sides of Av. Francisco Bicalho. The projects have a

complementary and positive impact, mainly in the west side of the port where most of them are located, in comparison to the Porto Maravilha. It assists the creation of the desired new financial centre along the global key route Av. Francisco Bicalho, where such a centre can not only attract more pedestrian movement, but also benefit the development of local streets.

The findings are indicating the importance of creating new minor connections in the port to the successful development of the area and any further development should enhance the connections to the Porto Maravilha area in order to further improve the overall accessibility of the city of Rio de Janeiro with the creation of successful urban areas.

Acknowledgements

I wish to acknowledge Aflalo Gasperini Arquitetos for having provided support and material for the development of this paper.

References

Arruda Campos, M. B. (2000), *Urban Public Spaces: A Study of the Relation Between Spatial Configuration and Use Patterns – PhD Thesis*, London: University of London.

Costa Braga, A. (2007), 'Morphology, Transformation and Co-Presence: Unveiling Four Centuries of Social Tension in Rio de Janeiro City Centre'. In: Kubat, A. S., Ertekin, Ö., Güney, Y. I. and Eyübolou, E. (eds.), *Proceedings of the Sixth International Space Syntax Symposium,* Istanbul: ITU Faculty of Architecture, p.111.1-111.8.

Dias, Max (n.d.), 'Transformações da Cidade do Rio de Janeiro no Início do Século XX', Rio de Janeiro: Universidade do Estado do Rio de Janeiro.

Hillier, B. (2009). 'Spatial Sustainability in Cities: Organic patterns and sustainable forms'. In:Koch,D.,Marcus, L. and Steen, J. (eds.), *Proceedings of the Seventh International Space Syntax Symposium*, Stockholm: Royal Institute of Technology, p. K01:1-K01:20

Hillier, B. (1996), *Space is the Machine*, Cambridge: Cambridge University Press.

Hillier, B. (1986), *Spatial Configuration and Use Density at Urban Level: Towards a Predictive Model*, Unit for Architectural Studies, Bartlett School of Architecture and Planning, London: University College London.

Hillier, B., Penn, A. (1991), 'Visible Colleges: Structure and Randomness in the Place of Discovery'. In *Science in Context*, Vol. 4, p.23-49.

Hillier, B., et al. (1993), 'Natural Movement: Or, Configuration and Attraction in Urban Pedestrian Movement'. In *Environment and Planning B*, Vol. 20 (1), p.29-66.

Hillier, B., et al. (1987), 'Creating Life: Or does Architecture Determine Anything', In *Architecture and Behaviour*, Vol. 3(3), p.233-50.

Hillier, B., Hanson (1984), *The Social Logic of Space*, Cambridge University Press, Cambridge.

IBGE, Brazilian Institute of Geography and Statistics (2008)

IBGE, Brazilian Institute of Geography and Statistics (2013)

Karimi, K., et al. (2007) 'Evidence-Based Spatial Intervention for Regeneration of Informal Settlement'. In: Kubat, A. S., Ertekin, Ö., Güney, Y. I. and Eyübolou, E. (eds.), *Proceedings of the Sixth International Space Syntax Symposium,* Istanbul: ITU Faculty of Architecture, p.034.1-034.14

Medeiros, V., Holanda, F. (2010), 'Brazilian cities: Fragmentary space, patchwork and oasis in the labyrinth'. In *Urban Design International*, Vol. 15, 73-89.

Rodriguez, C., et al (2012) 'The relationship of spatial configuration and socio-economic conditions in São Paulo, Brazil'. In: Greene, M., Reyes, J. and Castro, A. (eds.), *Proceedings of the Eighth International Space Syntax Symposium*, Santiago de Chile: PUC, p.8079:1-8079:24.

Sinergia (2013), *Relatório de Atualização do Estudo de Impacto de Vizinhança (EIV) da Operação Urbana Consorciada da Região do Porto do Rio de Janeiro,* Rio de Janeiro.

Turner, A. (2001), 'DepthMap: A Program to Perform Visibility Graph Analysis', In: Peponis, J., Wineman, J. and Bafna, S. (eds.), *Proceedings of the Third International Space Syntax Symposium,* Atlanta, U.S.A: Georgia Institute of Technology, p.31.1-31.9.

Turner, A., et al. (2001), 'From Isovists to Visibility Graphs: A Methodology for the Analysis of Architectural Space'. In *Environmental and Planning B: Planning and Design*, Vol. 28, no. 1, p.101-21.

Van Nes, A. (2013), 'How Space Syntax Can Be Applied in Regenerating Urban Areas, In: n: Kim, Y. O., Park, H. T. and Seo, K. W. (eds.), *Proceedings of the Ninth International Space Syntax Symposium,* Seoul: Sejong University, p.007.1-007-18.

E-sources:

http://www.portosrio.gov.br/node/show/99
http://portomaravilha.com.br/index.aspx
http://www.rio2016.org/en/news/news/rio-de-janeiro-is-the-main-tourist-destination-in-the-south-hemisphere