

THE RELATIONSHIP OF SPATIAL CONFIGURATION AND SOCIO-ECONOMIC CONDITIONS IN SÃO PAULO, BRAZIL

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Abstract

Brazilian cities have been the subject of a number of recent morphological and syntactical studies. The context is the recent socio-economic development of Brazil which has led to a period of rapid urbanization. This process of urbanization raises the question of how the changing built form of Brazilian cities has affected the socio-economic conditions and the livelihood of their inhabitants. This paper presents a case study of São Paulo, the largest city in South America and one of its most important financial centres. Since the 1950s the growth of the city has been characterized by a shift of the urban centre towards the southwest. This shift has had deleterious consequences on the historic centre, which has experienced both a deterioration of its built environment and an increase in socio-economic deprivation. This paper examines how the transformed morphology of twenty-first century São Paulo has affected the distribution of socio-economic activity and demographic diversity of the city. The case study will examine the finding of Medeiros and Holanda (2007 and 2010) that urbanizing Brazilian cities are characterized in general by increased fragmentation of the urban fabric and will enquire as to the extent this is accompanied by social and economic differentiation. The research draws on a range of data including cartographic, official land use and demographic data and land use collected through field work. Space syntax segment analysis of São Paulo was performed in Depthmap. The information was then integrated into a GIS platform for socio-spatial analysis. The analysis found that the morphology of São Paulo presents a particular case; neither a regular grid nor a deformed wheel but rather a 'patchwork' of offset grids which are morphologically differentiated by their scaled relationship to the larger urban structure. It is argued that the socio-economic consequences of this fragmentation have been to increase the differentiation of social classes consistent with their accessibility to concentrations of activity taking place at different urban scales.

1. INTRODUCTION AND BACKGROUND

With a population of approximately 19 million, the São Paulo Metropolitan Region is today the largest city in South America and the fifth largest city in the world. It has joined the global financial network and it has become one of the world's most important new economies (Sassen, S., 1999). However, at the same time that the city has gained a place in the global market, it faces sharp socio-economic inequalities. São Paulo has few areas which offer a better quality of life with better job opportunities, leisure and cultural facilities, and a better articulated transport system, and a majority of stigmatised areas with inadequate services, physical accessibility and mobility (Urban Age South America Research, 2008). Although it is difficult to measure quality of life, it is an essential aspect of the city's attractiveness. The liveability conditions of São Paulo have consequences not only in the daily life of its inhabitants, but also in the position of the city as a desired place when a global firm has to choose a location for its operations (Sassen, S. 2008).

The traditional image of the social dissimilarities in São Paulo separated by clear spatial distances – a rich and well-equipped centre and a poor and precarious periphery – has been increasingly challenged since the 1970s. With the improvement of the urban environment in peripheral areas and the displacement of the wealth from the centre, a new condition is presented in the city, and the poor and rich can be found side-by-side (Caldeira, T. 2011). Processes such as this have characterised the socio-economic scenario of the city - with the rapid urbanization resulting from accelerated population growth, São Paulo finds itself with complex relations between its space and socio-economic conditions.

In 1886 the city was a village with 47,697 inhabitants, and in 1950 it had 2 198,000 inhabitants within 420 km² (IBGE 2000). The intense expansion of the city from the mid-1940s onwards is mostly explained by the heavy industrialization, and by the opening of new roadways connecting major Brazilian cities – a parallel process that simultaneously stimulated remote demands for new production. São Paulo was by then both the most attractive market and the most propitious place for new industries. For instance, the intense and rapid growth was accompanied by radical physical transformations in the city's urban fabric.

Going back to 1911, the historic core of the city was still known as the financial, commercial and political centres as well as the area for articulation among different boroughs in the city. The road system composed of a set of routes which started in the old centre and linked the other neighbourhoods. At this time, São Paulo was passing for its first industrialization period and it received thousands of immigrants. The industry at this moment occupied the lowlands of the railway built in 1867, and the central neighbourhoods formed the first colonies of immigrants. Most of the southwest of the city was made up of small farms – the land subdivision was mainly made by private developers (Ponciano, L. 2002).

However, soon after, the number of cars in São Paulo was continually increasing and there was a search for better accessibility to the core. Prestes Maia proposed a new radio-centric plan called "Plano de Avenidas", which had the objective of avoiding vehicle flows inside the core. From 1930 this plan started to be implemented and important radials linking the core to the southwest were built or had their access improved. In 1945, the plan was almost totally implemented, with a few changes: a new important access from the core to the southwest was added, the Y System - which crosses in the centre, intensifying the transversal north-south axis of vehicular flow. However, an important street that was part of the original plan, linking the west to the east was not created.



Figure 1. Indicates the two major rivers of the city – Tietê and Pinheiros -, the railway track built in 1867, the historic core and the Y System formed by express ways crossing the historic core.

Following this spatial transformation, an important socio-economic change occurred in São Paulo in the 1950s and 1960s; many companies' headquarters and banks, which used to be concentrated in the historic core, moved to the region of Avenida Paulista – in the southwest. Not only did this street become a new major financial centre but also the whole region started being occupied by museums, cinemas, art galleries, bars, clubs, office buildings, shops and residences (Meyer, R., 2004, Rolnik, R. 2003) and for the first time the most expensive land in the city was no longer in the historic core (Meyer R. et al., 2004, Frúgoli Jr., H. 2006).

In parallel, the first underground was built in the city, and it had its two lines crossing in the historic core. Large bus terminals were placed in the city centre, conversely, while the automotive industry appeared in the country, leaving the public transport for those who could not afford a car. In addition, at this time, the most important streets of the city centre were closed for pedestrian use only. This set up a condition where the rich and the middle class abandoned the historic centre and it was, consecutively, popularized, attracting more the lower class population (Rolnik, R. 2003).

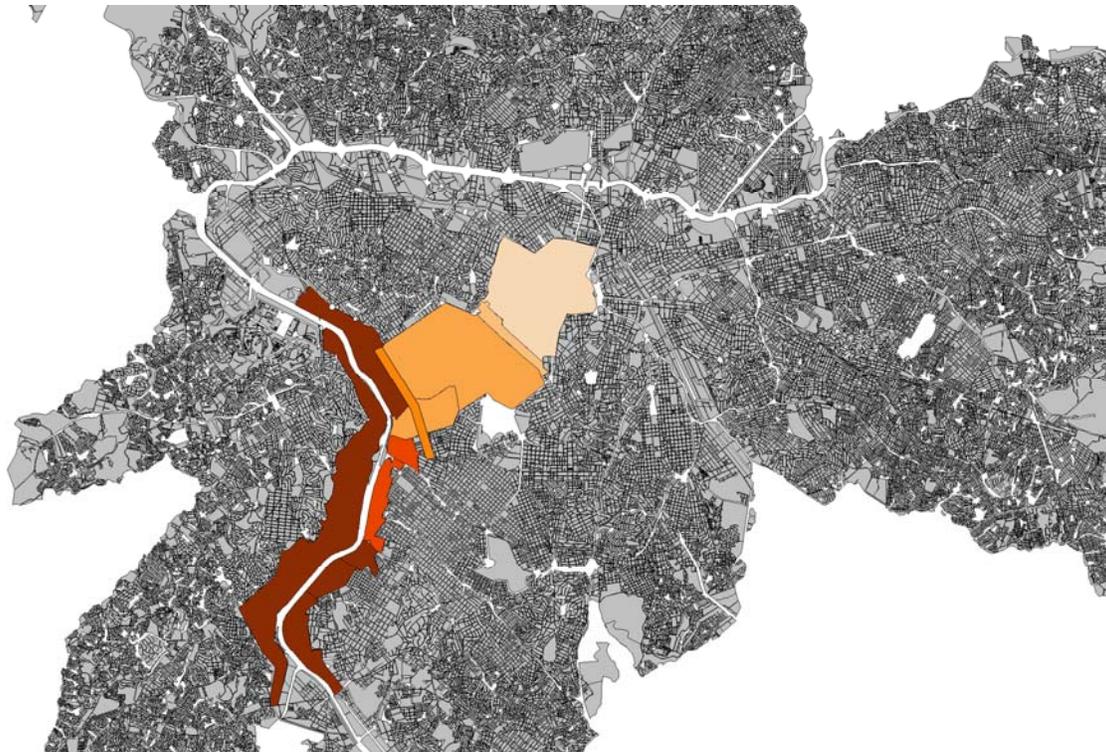
The consequences of this process for the central areas was mainly from the 1960s, they started to lose their population and gain slums (Meyer, R. and Grostein, M., 2010). They have also faced other problems, such as the physical deterioration of urban elements, an increase in crime and the loss of regular retail, replaced by the gain of clandestine and street retail. While the southwest areas were consolidated as the privileged

points of city elites – which concentrated the residences of the upper classes in the garden cities along with centers of retail and services (Rolnik, R. 2003).

Yet, the 1970s were marked by the total shift of the consumer centre of the elites, from the historic core towards Avenida Paulista, and the shift of financial activity towards Avenida Faria Lima – a region even further to the southwest. Figure 2 shows the focus of financial activity in different periods, which goes gradually through time towards the southwest. Conversely, the gain of function in this region does not correspond to the emergence of complementary centres of a main centre; it does signify a shift of centrality.

Although the centre has faced many problems, it has never lost its vitality. It has been popularized, but still relies on a significant reduction in number of middle and upper classes users, mainly those working in the remaining offices and public institutions within the core. It is also not the case that the government has abandoned the old centre. The large amount of investments in the area can clarify that. However, Meyer et al. (2010) suggest that the fact that the public investments have not achieved the desired results has two explanations: one economic, which is related to the logic of real estate investments; and the other, which is related to the renovation projects applied in the area which generally do not consider a more global scale. This paper suggests that there is a combination between the two factors and that one influences the other. They are actually part of the same spatial process which consolidated the southwest region as the main financial centre and that makes this region richer in a diverse range of activities. The new roads built in the city that crosses or are adjacent to the core - such as the ones forming the Y system - created a new pattern of physical mobility based on express roads, without considering its local impact. This new spatial configuration resulted from the rapid and radical growth, might mould the movement of people and vehicles on the space in a different way and influence the socio-economic conditions of the city.

Different studies have already found that spatial configuration plays a significant role in determining movement flows (Hillier, B. et al., 1993; Penn et al., 1998) and that this has influence on land use patterns (Hillier, B. et al., 1996) and centre formation (Hillier, B., 1999). Other research using the space syntax framework has found that the fate of historic cores is strongly dependent on how its spatial organization is transformed (Karimi, K., 1998 and 2000). Therefore, it is conjectured in this paper that the spatial-functional processes that have occurred in São Paulo comprehend the loss of mixed functions in its historical core and central neighbourhoods, the consolidation of centres in the southwest in the role of financial and cultural centres for the middle and upper classes. Thus, the outcome of the rapid transformation of the city's urban fabric is that its increased fragmentation is expected to be accompanied by social and economic differentiation.



KEY - CONCENTRATION OF OFFICES

- Historic core - until 1950
- Avenida Paulista - from 1950 to 1960
- Jardins and Itaim Bibi - from 1960 to 1970
- Avenida Brig. Faria Lima - from 1970
- Vila Olimpia and Av. Eng. Luis Carlos Berrini - from 1970 to 1990
- Marginal Pinheiros- from 1990

Figure 2. Concentration of offices in São Paulo from 1950 to present

Source: EMPLASA (2000) Por Dentro do Município de São Paulo 2000, historic data from: Meyer et al. (2004)

2. METHOD OF STUDY

The study employs theoretical and methodological space syntax theory. It also takes into consideration the findings of Medeiros and Holanda (2007 and 2010) that urbanizing Brazilian cities are characterized in general by increased fragmentation of the urban fabric and will enquire to what extent this is accompanied by social and economic differentiation. The research draws on a range of data including cartographic, official land use and demographic data and land use collected through field work.

The study includes the following methods: First, spatial analyses using segment map of São Paulo performed in *Depthmap*. The boundary of the strategic segment map used covers an area of 25km of São Paulo (around 10km from the core) rather than its total area within its administrative limits (Figure 3). According to Turner (2008) and Hillier and Iida (2005), to calculate a syntactic measurement of space there are three definitions

of distance to consider: metric, topological and angular (geometrical). The metric is the system of shortest mapped paths for integration and choice, the topological is the one of fewest turns, and the angular is the system of least angle changes. Within each definition it is possible to extract 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 explored measures are Choice ($\log CH+1$) and Integration (NC/MD) at different metric radii: 500m, 750m, 1000m, , 2000m, 3000m, , 5000m, , 10000m. Hillier (2009) proposes that integration is related to 'to movement' in a system. It follows that one might expect integration to reveal those streets that have greater potential as destinations. Using segment analysis, integration is calculated by the degree to which a line is closer to every other segment in the network, considering the simplest route (using minimum angular depth). "It is a measure of how accessible each segment is from all the others, and so how much potential it has as a destination for movement" (Hillier 2009). In parallel, the measure of choice is associated by Hillier with the theoretical notion of 'through movement', that is, with the potential of each segment to provide indications of movement flow. Choice measures the number of times one segment appears on a route between other pairs of segment in the system within a specific metric radius. Initial work of Hillier and Iida (2005) suggests this is related to pedestrian and vehicular movement patterns from all segments to all others. The spectrum global to local using different measures were chosen to understand possibilities afforded to vehicle and pedestrian movement at different scales. Second, land use and land value information was then integrated into a GIS platform for socio-spatial analysis. Third, socio-economic comparisons using the software JMP were adopted with the proposal to compare and describe the performance of some selected areas.

The aim of the spatial, syntactic and descriptive analyses is to investigate the possibility afforded to vehicular and pedestrian movement at different scales within the urban fabric, whether as a route or as a destination; and, furthermore, how this impacts on land use occupation and activities. Analysis helps to understand how the relationship between spatial properties and socio-economic characteristics work in specific areas of São Paulo, which includes the historic core, its peripheral settlements and the sub-centres that have emerged in the southwest in the last century. It examines which role the southwest centres play in affecting the performance of the historic core of the city and its peripheral area.

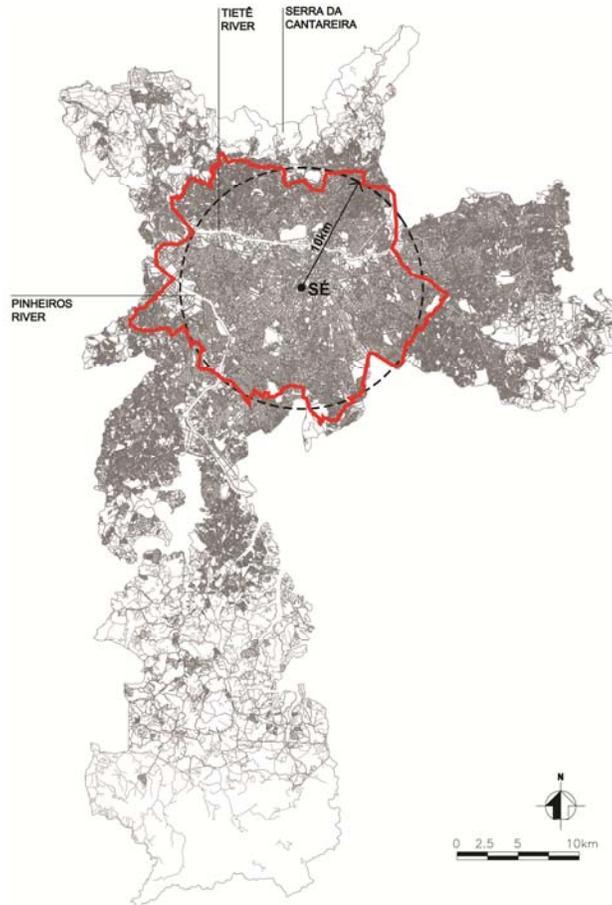


Figure 3. Map indicating 10km radius from Sé square and boundary of the area being analysed. The map used for the present study is within the São Paulo city. Source: Segment map boundary data by author; base map by DIPRO

3. THE MOST ACCESSIBLE DESTINATIONS IN THE SYSTEM

Looking at São Paulo's strategic global model, two aspects of its description are presented. One investigates the global structure of the city; identifying the routes with highest potentials for global routes and their relationship among different scales. The second is to compare the difference of grid structure revealed throughout the system.

São Paulo presents a structure which resembles two different systems (Figure 4). One is similar to a 'deformed wheel' - "a semigrad, or hub, of lines near the centre, strong integrators which link this semi-grid to the edges, like spokes, and some edge lines are also integrated, forming a partial rim" (Hillier, B., 1996, p.137). The other system is organised by Marginal Tietê – an express road running along the Tietê River. The presence of Marginal Tietê considerably affects the structure of the north part of the city. It looks like a labyrinth network, but it seems that there is logic in its formation. There are strong roads (similar to a tree's roots) which connect the expressway to the peripheral settlements - a distinct linear logic of integration-segregation is presented and especially affects the north side of the city, which presents higher values close to Marginal Tietê and lower when distant from it. The integration values in the north are more dependent on this road than its distance from the historic core. This second system is responsible for a very particular

way of urban organisation - the pattern found in English cities in which the integration values increase from the outside to inside, have a dramatic distortion in the case of São Paulo.

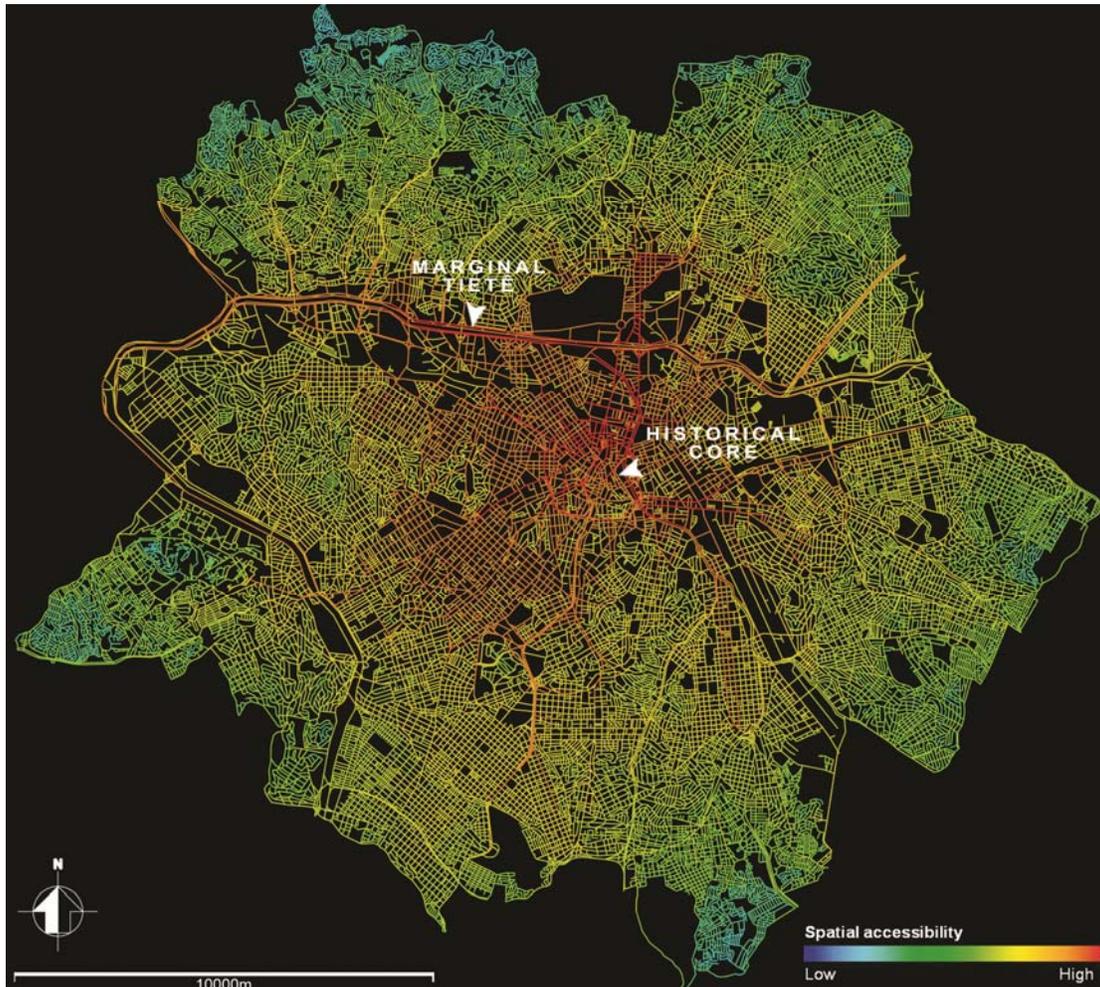


Figure 4. Segment angular integration radius n . Marginal Tietê draws the integration values towards itself for being extremely long and connected. The historic core still presents high integration lines as well as areas in the southwest region. The arrow in the historic core indicates the Dom Pedro II Park.

Although Marginal Tietê draws the integration values of the whole system toward itself for being extremely long and connected, the historic core still corresponds to the integration core, which can help explain its survival after the rapid growth and intense transformation of São Paulo, but yet, does not explain the shift of some central functions to other areas in the city.

Looking at the southwest region, we can notice that there are always areas as focus of integration at different radii (Figure 5 showing radii 10,000m; 5,000m; 2,000m). A phenomenon is occurring here, the focus of integration seems to shift gradually from the core to the south/southwest regions, with the decrease in radius given an allusion of a path, a feature not found anywhere else in the city. Furthermore, looking at those different radii we will see that there is always a well integrated area in the southwest and that the historic core loses integration at a few radii. Comparing this situation to London (Hillier, B. 1996) at both global and local levels, the most integrated line of the system is always the same, Oxford Street, which

corresponds to the main live centre. This implies that this street is not only the strongest global integrator of London, but also the strongest local integrator of its surrounding areas. However, it is important to notice that in the two cases, London and São Paulo, different types of maps were used. Axial Line Map to London and Segment Angular Map to São Paulo – the last being acquired from a road-centre line map. Nonetheless, Turner (2007) shows the possibility of deriving axial maps from road-line data - these are the fundamental street network 'objects' from which segment maps are derived. Although the numerical values of the maps are different, a visual comparison between them should be possible. Additionally, because of the distinct forms of representation, different radii were used.

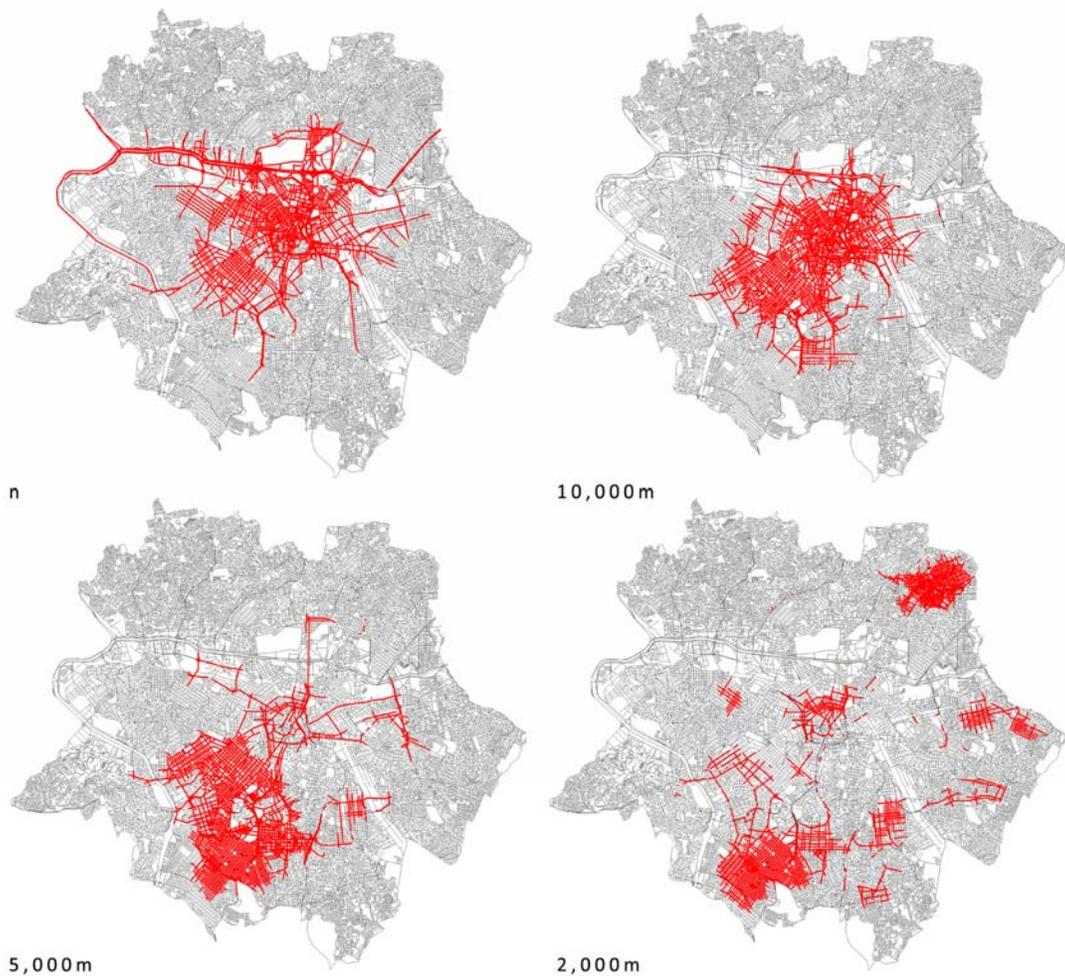


Figure 5. Segment angular integration radius n , 10000, 5000 and 2000 metres showing the 10% more integrated lines of the whole system.

Karimi's studies (1998 and 2000) also show that other English cities follow the same pattern, while those of Iran do not have the historic core as the focus of integration at different radii, resulting in several social and economical problems in the area. Absence of strong local and global relation such as São Paulo's core, in other words, a lack of part-whole structure, was pointed out by Karimi as a fundamental obstacle in the way

of urban conservation. Furthermore, considering the theoretical proposal that integration measures the to-movement and the potential for the area as a destination, the southwest will always have the more accessible destinations at a different radius. Considering that the middle and upper classes are the ones who inhabit or are in close proximity to these areas, they will have greater choices of destinations whenever they decide to travel by private vehicle to a closer or farther location. And it is said by private vehicles, because the higher radii correspond to the longest trips which are assumed to be executed using vehicles. Taking into consideration that the ones who had more conditions of purchasing a car – at the moment the areas being consolidated - are those belonging to the middle and upper classes, it is possible to suggest that the emergence of an intense functional activity in the southwest region for the middle and upper classes correspond to the way these social groups move in space.

Although a comparison was made through their respective maps, the numerical analysis allows quantifying the differences between the centres. Examining morphological factors (Table 1) in a comparison of five areas with centres in the southwest – located in the neighbourhoods of Pinheiros, Jardins, Itaim and Moema and also Augusta Road - and the historic core, the old centre reveals itself to have higher mean global integration values than the others. The same measure also shows that at a global level, the farther from the core, the lesser integrated the centre is. For instance, Moema centre – the farther centre from the core – has mean global integration of 5,686.46 – and Jardins centre and Rua Augusta – the closest to the core – have mean global integration of 6,561.79 and 6,603.56. This feature is found in different cities. Interestingly, when the radius is decreased, the historic core moves to a marginal position and becomes the most segregated of the centres being analysed, while Moema becomes the most integrated. Whatsoever, it gains integration at a local level. Once more, the figures are confirming that the old centre is not always the most integrated of the system; it does not maintain a consistent relation between local and global, and supports the suggestion that the partial shift of centrality is part of a configurational process.



Figure 6. Selected centres in the southwest.

| | Intn | | | Int5000 | | | Int2000 | | | Int500 | |
|----------------------|-----------------|-----------------|----------------------|-----------------|-----------------|----------------------|----------------|----------------|----------------------|----------------|----------------|
| | max. | mean | | max. | mean | | max. | mean | | max. | mean |
| Historic core | 7,676.33 | 6,671.09 | Moema | 2,233.86 | 1,951.69 | Moema | 749.734 | 605.053 | Moema | 86.6032 | 62.8523 |
| Augusta | 6,829.36 | 6,603.56 | Jardins | 2,158.87 | 1,932.46 | Pinheiros | 507.258 | 442.981 | Itaim | 76.8731 | 55.9714 |
| Jardins | 6,786.41 | 6,561.79 | Augusta | 2,158.87 | 1,849.79 | Augusta | 505.423 | 428.715 | Historic core | 89.8876 | 51.0196 |
| Pinheiros | 6,399.90 | 6,201.93 | Pinheiros | 1,913.66 | 1,739.90 | Itaim | 487.655 | 423.687 | Pinheiros | 74.9434 | 48.2431 |
| Itaim | 6,035.07 | 5,753.87 | Itaim | 1,798.43 | 1,642.69 | Jardins | 502.65 | 410.96 | Augusta | 66.716 | 47.2396 |
| Moema | 5,868.06 | 5,686.46 | Historic core | 1,834.06 | 1,439.88 | Historic core | 598.257 | 407.141 | Jardins | 51.492 | 41.0467 |
| WHOLE SETTLEMENT | 7,741.61 | 5,047.78 | WHOLE SETTLEMENT | 2,323.65 | 1,011.66 | WHOLE SETTLEMENT | 793.859 | 289.833 | WHOLE SETTLEMENT | 6,912 | 40.537 |

Table 1. The results of the segment angular integration comparing the historic core to the centres in the southwest. The areas are ranked accordingly to their mean values.

4. SÃO PAULO MORPHOLOGY, THE RELATION OF GLOBAL AND LOCAL STRUCTURE

The city presents very few lines starting in the historic core and crossing the system globally (Figure 7), as already noticed as a characteristic of Brazilian cities by Medeiros and Holanda (2010). They argue that this results in a “labyrinthine pattern associated to low integration values, that is, topological permeability and accessibility” with consequent limitation of the global perception - the understanding of the city is restricted to parts of the whole and therefore, a less intelligible and fragmented urban structure (*ibid*, p.80). However, a larger number of global lines link the core to the edges in the southwest and west regions of the city. The east and north sides are less connected by such lines.

A part from the way the city is organised globally, the arrangement of its local parts form a relatively fragmented spatial system. It is possible to see that the settlement has several clusters of regular and irregular grids; the regular being articulated by ‘X’ connections or offset grids’, which form a kind of ‘patchwork pattern’ as observed by Medeiros and Holanda (2007) as well as Ortiz-Chao (2008) and this being a characteristic of Latin American cities. This pattern is usually found where the topography contributes to it and as the city possesses a hilly topography, the more organic patterns of some areas are usually a response to this attribute. As also already observed by Medeiros and Holanda, the regular grid is better integrated than the irregular ones because of the predominance of ‘T’ connections of the organic pattern which increases the depth in the system (Figures 4, 7 and 8).

Following these arguments, the southwest and west regions of the city have a higher quantity of lines linking the edges to the centre together with the predominance of regular grids, resulting in more integrated areas than the rest of the settlement. The combination of the global properties (the radials linking the edge to the centre) and the local properties (the regular grid), have an effect on the synergy and intelligibility of the city; whenever there is a good relation between them, a less fragmented and less labyrinthine pattern is presented and, thus, the global integration increases. Additionally, the areas which present a more continuous and less fragmented urban fabric, that is, the areas not broken up by the railway and its adjacent large industrial plots, imply in areas with a large number of segments with great potential as routes and destinations at different radii (Figure 8).

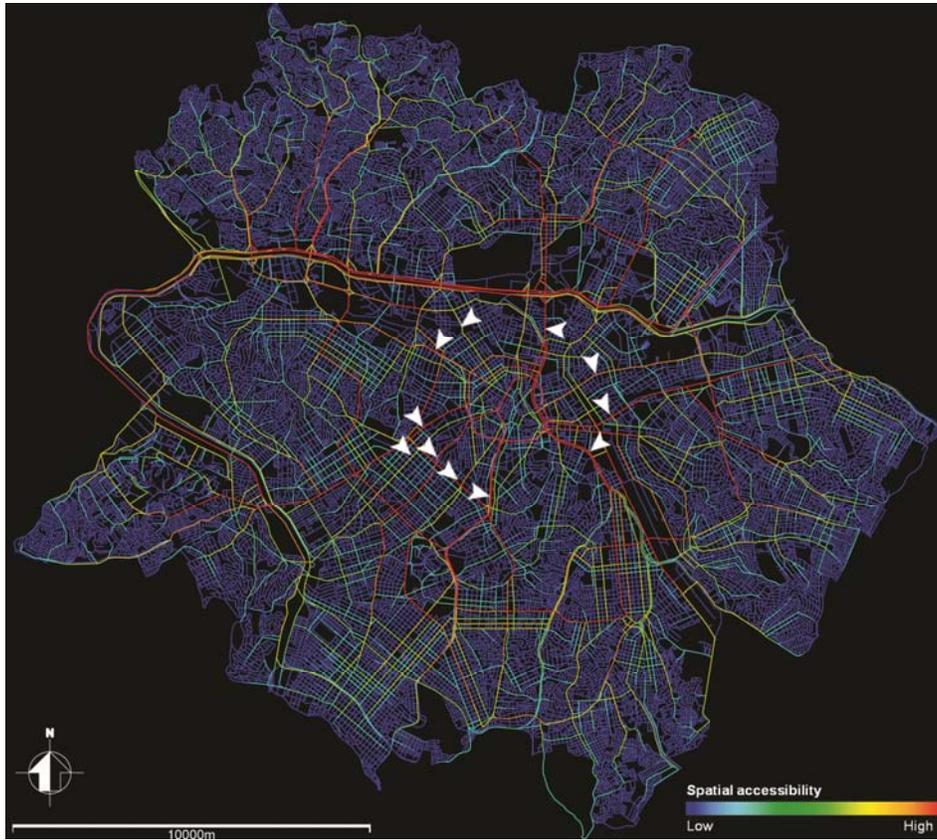


Figure 7. Segment angular choice radius n indicating global lines linking the historic core to the edges of the settlement.

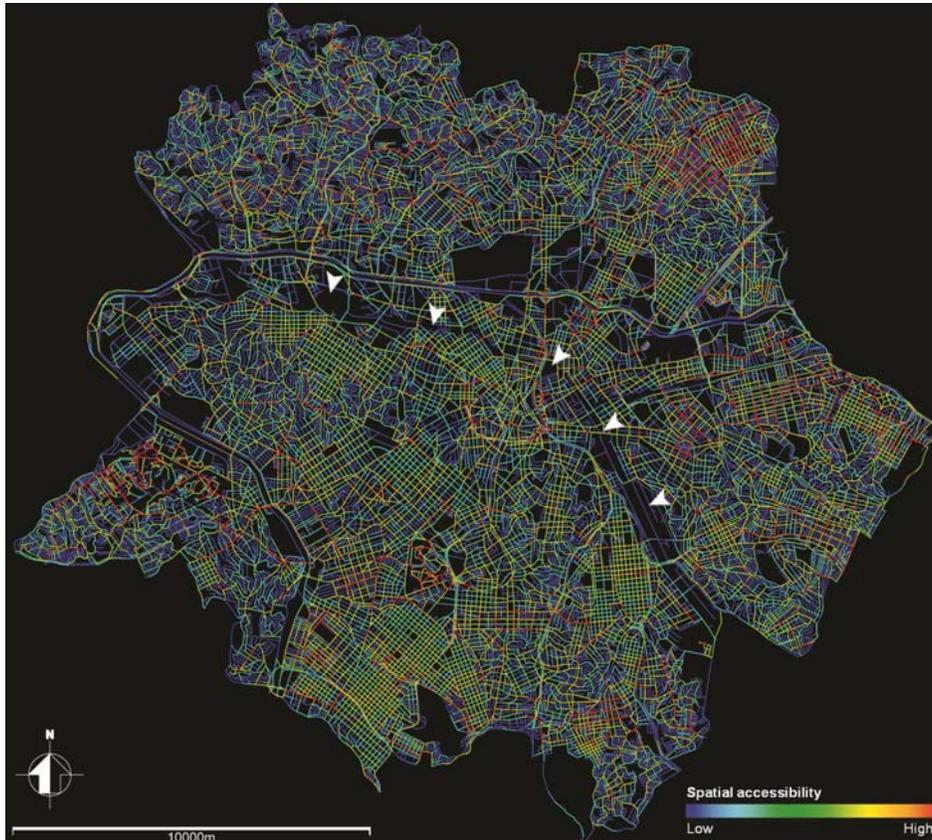


Figure 8. Segment angular choice radius 1000 indicating the industrial large plots along the railway and the low value segments adjacent to it.

5. SOCIO-ECONOMIC CONDITIONS AND SPATIAL CONFIGURATION

In the maps, it can be seen that the areas located immediately to the northeast and east of the historic core do not have concise structures. There are a few clusters of grid formations, but they become weak in the context – there is a lack of continuity. To verify the effect of the formerly explained spatial-functional properties in the city – the relation of global and local spatial attributes – analysis of some areas surrounding the historic core is presented. The intention is to investigate and describe how the continuity of the urban fabric, grid conditions and global connections are interfering in the socio-economic activities of the areas. The point is in relation to the descriptive aspect of their performance. Scatters were created in order to find the pattern among six areas, however, without discussing their absolute statistical output at this stage (their R^2 results). Analysis of six neighbourhoods surrounding the historic core – Santa Cecilia, Luz, Pari, Oriente, Gasómetro and Brás (Figure 9) – through the measures Integration, Choice, Synergy and Intelligibility at global and local radii found that the neighbourhood better embedded in its context - Santa Cecilia – (Table 5) is the one which presents the higher population density and has the higher proportion of high income and no income population, according to demographic census (Tables 2, 3). It has lower industrial and retail activities and higher service activity (Table 4).

A pattern can be identified looking at some scatters between the neighbourhoods. Regarding the relation between employed population and density (Figure 10), Santa Cecilia is the area with both higher density and

higher employed population. This indicates that this is a more socio-economically successful area since most of the central neighbourhoods have lost population and in particularly, middle and upper classes population. The comparison between density and industry, retail and service (Figures 11, 12 and 13), shows that Santa Cecília has not only the higher population density, but also the lower number of industries and retail and has the higher number of services. These numbers suggest that among the neighbourhoods being analysed, Santa Cecília is the one with a better socio-economic performance – it does not present the strong monofunctional economies if compared to the other areas.

Additionally, a pattern seems to appear when verifying the relation between some demographic data and syntactic measures. Comparing service with Integration (Figures 14 and 15), it is possible to notice that Santa Cecília is the area which presents the higher number of services and that these are located in the most integrated segments globally and locally. Thus, it is assumed that service is located on streets that have good potential as routes and destinations. Table 5 presents a comparison of local and global Integration and Choice measures, Santa Cecília is the one better embedded in the context of the whole city, locally and globally (Table 5) and the one better located in a regular grid, fed by global line and which presents a better continuity of the urban fabric.

It is clear that Santa Cecília is an outlier in the analyses, and it is a more western oriented neighbourhood with a better socio-spatial performance. Further research could adopt more than six areas, nevertheless the areas selected is a sample, enough to preliminarily understand the central area of Sao Paulo.



Figure 9. Neighbourhoods surrounding the historic core being analysed

| | Population 2000 (hab) | Area (km ²) | Housing 2000 | Demographic density (hab/km ²) |
|---------------|--------------------------|-------------------------|--------------|---|
| Brás | 9 626 | 1 095 | 3 476 | 8 791 |
| Gasômetro | 3 240 | 0.693 | 1 062 | 4 675 |
| Luz | 13 726 | 1 541 | 4 500 | 8 907 |
| Oriente | 4 150 | 1 085 | 1 278 | 3 825 |
| Pari | 11 415 | 1 398 | 3 654 | 8 165 |
| Santa Cecília | 33 305 | 1 441 | 14 204 | 23 112 |

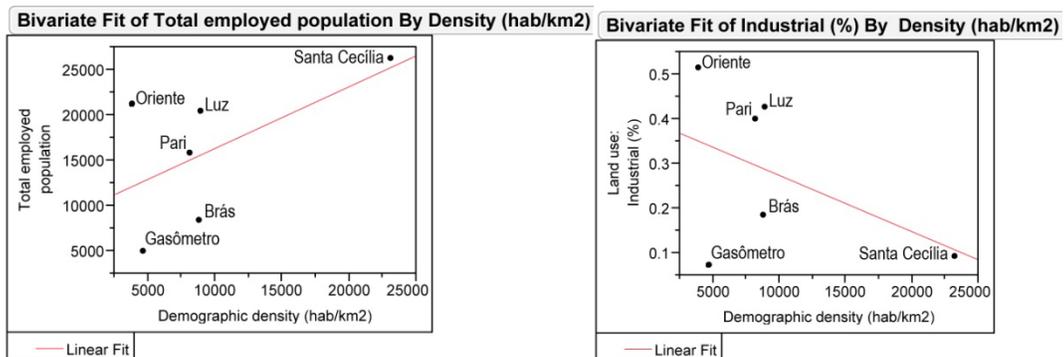
Table 2. General information of the surrounding neighbourhoods of the core.
 Source: IBGE, Demographic Census 2000 and IGC (Instituto Geografico e Cartografico) – from EMPLASA 2008

| | No income | % | 5 to 10 | % | More than 20 | % |
|---------------|-----------|------|---------|-------|--------------|------|
| Brás | 130 | 3.82 | 1,022 | 30.07 | 330 | 9.71 |
| Gasômetro | 63 | 6.1 | 288 | 27.88 | 34 | 3.29 |
| Luz | 204 | 4.78 | 1154 | 27.01 | 393 | 9.2 |
| Oriente | 67 | 5.36 | 348 | 27.82 | 40 | 3.2 |
| Pari | 210 | 5.91 | 968 | 27.23 | 281 | 7.9 |
| Santa Cecília | 702 | 5.54 | 4,232 | 33.4 | 1,201 | 9.48 |

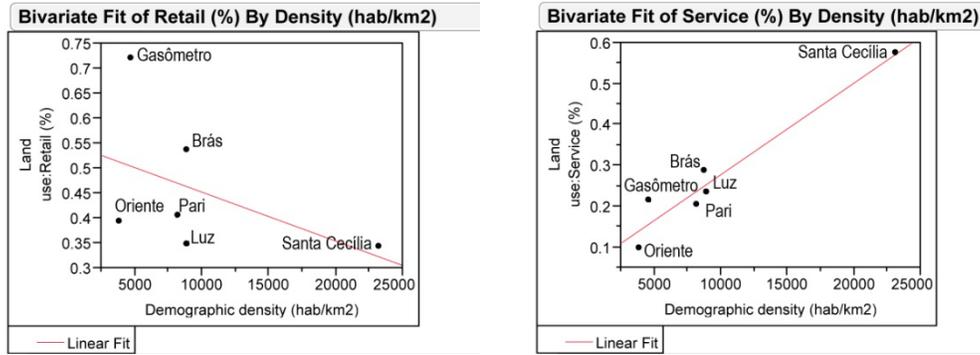
Table 3. Family average income indicating the minimum wage of each central neighbourhood
 Source: IBGE, Demographic Census 2000– from EMPLASA 2008

| | Industrial | % | Retail | % | Services | % | Total |
|---------------|------------|-------|--------|-------|----------|-------|-------|
| Brás | 105 | 17.95 | 313 | 53.50 | 167 | 28.55 | 585 |
| Gasômetro | 43 | 6.90 | 449 | 72.07 | 131 | 21.03 | 623 |
| Luz | 1,153 | 42.19 | 945 | 34.58 | 635 | 23.23 | 2,733 |
| Oriente | 1,431 | 51.25 | 1,089 | 39.00 | 272 | 9.74 | 2,792 |
| Pari | 547 | 39.72 | 552 | 40.09 | 278 | 20.19 | 1,377 |
| Santa Cecília | 147 | 8.91 | 562 | 34.08 | 940 | 57 | 1,649 |

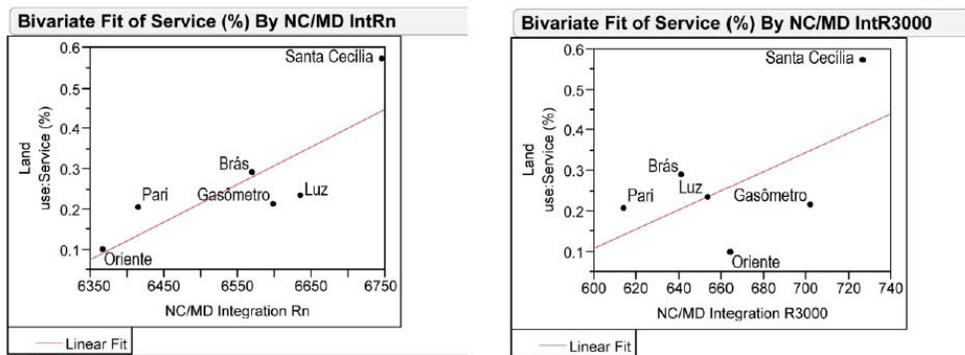
Table 4. Number of land use according to activities
 Source: Ministerio do Trabalho, Rais -Relacao Annual de Informacoes Sociais 2005



Figures 10 and 11. Scatter showing comparison between employed population and density, and between density and industrial use



Figures 12 and 13 Scatter showing comparison between density and retail, and between density and services



Figures 14 and 15. Scatter showing comparison between Service Use and Integration (global and R3000)

| | NC/MD int | | LogCH+1 | | |
|----------------------|------------|--------------|------------|--------------|--------|
| | Global (n) | Local (750m) | Global (n) | Local (750m) | |
| Brás | 6,570.72 | 65.169 | 6.066 | 2.473 | High |
| Gasómetro | 6,598.82 | 74.434 | 5.688 | 2.594 | Medium |
| Luz | 6,636.26 | 71.191 | 5.444 | 2.514 | Medium |
| Oriente | 6,366.28 | 78.926 | 5.535 | 2.613 | Low |
| Pari | 6,415.20 | 93.541 | 5.507 | 2.737 | High |
| Santa Cecilia | 6,748.55 | 90.545 | 5.873 | 2.614 | High |

Table 5. Relationship between integration (NC/MD) and choice (LogCH+1)

The impact of the discontinuity of the urban fabric is found in the settlements located along the railway track, from the southeast to the northwest. Locally, these are considered very segregated compared with the global scale. This reveals the effect of the large blocks from the industrial occupation on the area: fewer streets and less potential for through-movement within the streets. Similarly, this happens with segments of Estado Avenue located within Dom Pedro II Park (Figure 4). They have a high value at the global scale, but low at the local. The low potential for routes matches what was observed in the area: high vehicular movement, traffic in peak hours and very low pedestrian flow.

The land use map shows the predominant occupation of the block (Figure 16). A historical heritage of the industrial settlements implemented at the peripheral area - north and east - of the centre and spread out along the railway track and rivers Tietê and Pinheiros is the large blocks and lack of connections – which give the impression of dividing the city. Additionally, the map shows the lack of residences in the historic core and that it is highly occupied by retail, followed by cultural, educational institutions and services. While the financial centres Paulista, Brigadeiro Faria Lima and Berrini have along their segments not only extensive retail and services occupation but also they are surrounded by residential use.

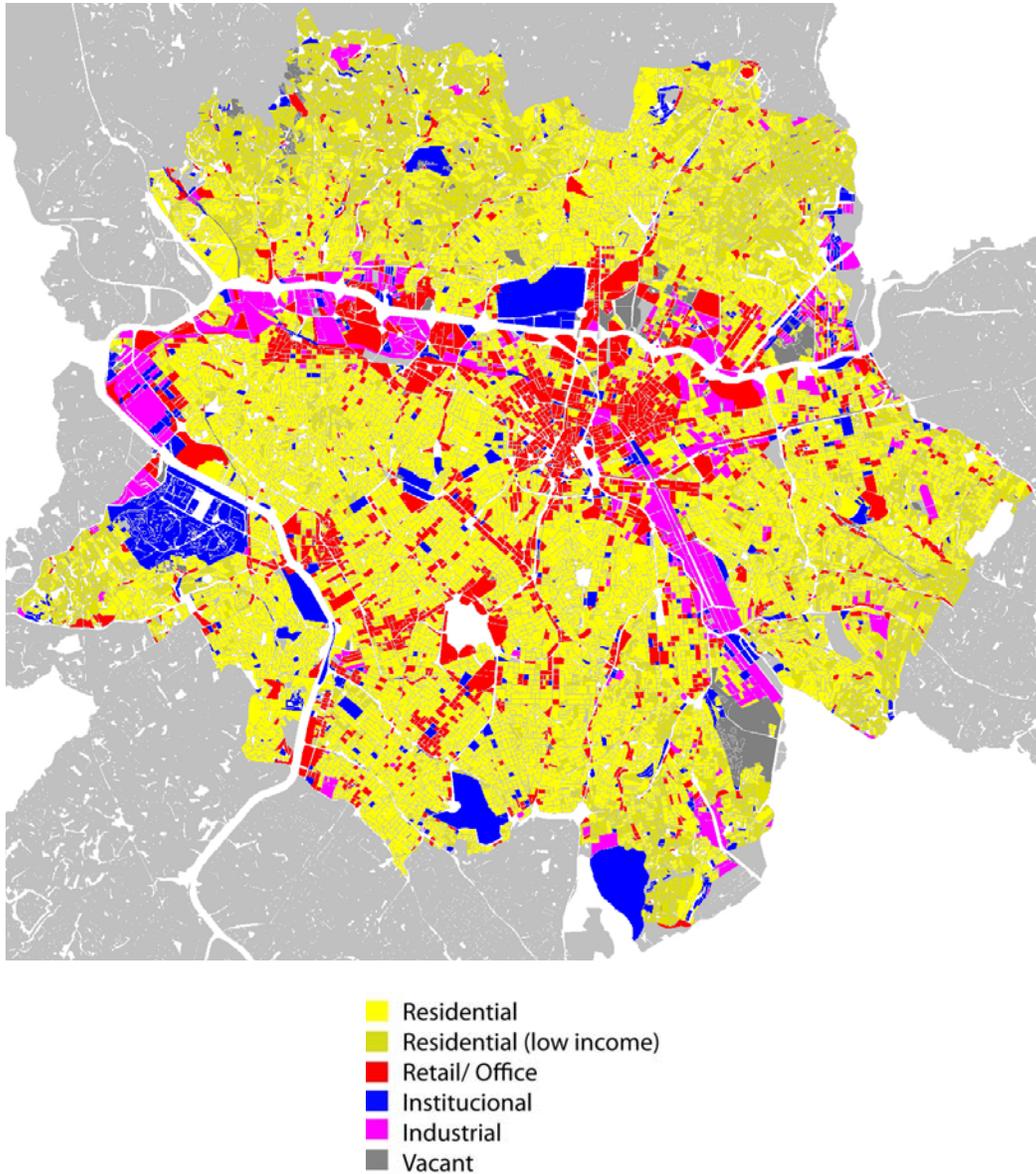
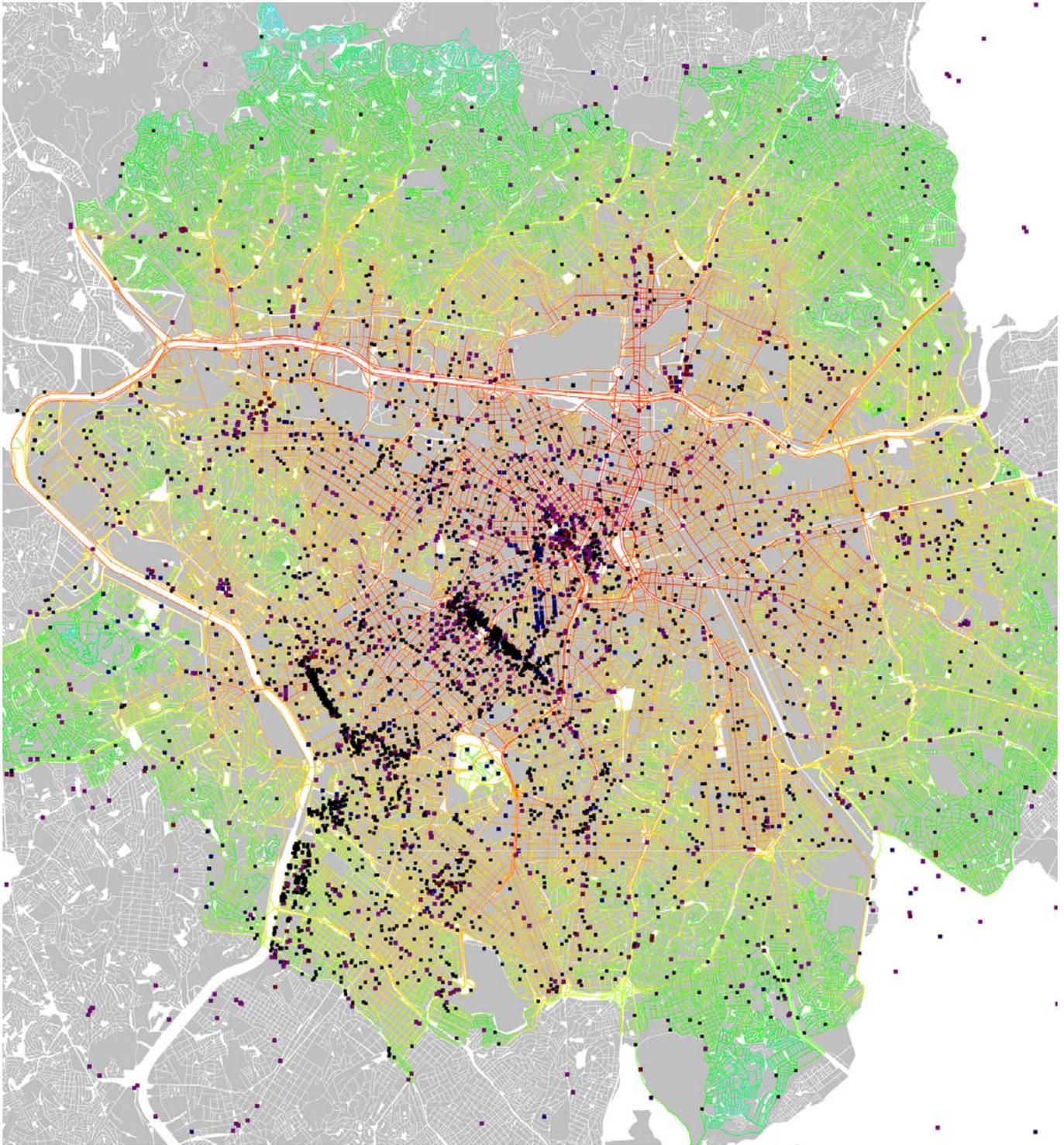


Figure 16. Predominant occupation of the block. Industrial plots along the old railway, predominance of retail activity in the historic core and its surrounding neighbourhoods.

Overlapping the segment angular integration map at global radius with some particular activities (Figure 17), it is possible to notice that there is a correspondence between the previous spatial analysis and the location of these non-residential uses. There is a concentration of activities in the most accessible destinations – the most integrated segments, which in general correspond to the regular grid and also to the areas more connected through global lines. Apart from the historic core where a mixture of non-residential uses is found, the southwest presents a vast mixture of activities – which helps to verify the consolidation of this region as a new centre. Notwithstanding, the activities are mainly located in its regular grids. The other areas which present intense function further down the southwest do not appear as one of the higher integrated areas at the global scale but they do appear at other global radii – 5,000 and 2,000 metres (Figure 5). Conversely, the north side of the city has very few segments with such land uses, being the majority of them concentrated in the most integrated lines – which are the tree's roots starting at Marginal Tietê.

To further understand the effect of the spatial properties on the function of São Paulo, the Global Integration Map and Value of Land Map (Figure 13) is compared. An outstanding correspondence can be identified between the most integrated areas and the most expensive lands of the city. The historic core, the immediate west of the core and the southwest region, which are the focus of integration, are the most expensive land of the city, while the more segregated areas, correspond to the cheapest land of the city, echoing previous studies using space syntax framework, which identify an almost perfect correlation between integration and high tax bands in London; thus indicating that the most advantaged people occupy the most strategic streets (Hillier, B. 2009). Moreover, the integration focus of radius 5,000 metres (Figure 5) corresponds to other high value areas in the south of the city. Also, it reveals the economic effect of the shift of the financial centre and higher income population to the southwest. Paulista Avenue and its surrounding area, Brigadeiro Faria Lima Avenue and Eng. Luis Carlos Berinni Avenue are shown to have very high values as destinations, while the areas to the north and east of the historic centre have low values, especially the streets located along the railway track.



KEY - LAND USE

- SERVICES
- OFFICES
- LEISURE AND CULTURE
- RETAIL

Figure 17. Non-residential activity and segment angular integration radius n . The more integrated areas generally present more activities than the most segregated ones. The most integrated areas are usually the ones with regular grid and which are linked to global lines. Source: see References

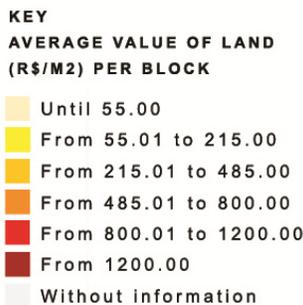
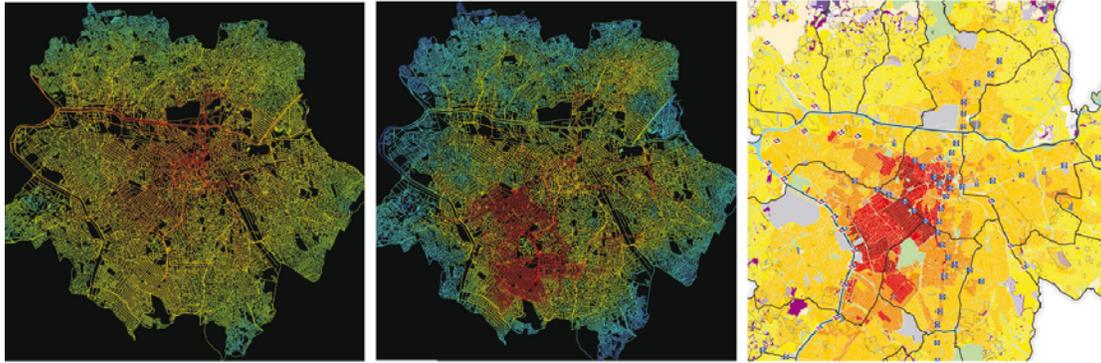


Figure 18. Segment angular integration radius n , segment angular integration radius 10,000 metres and Land Value Map
Source: SEMPLA, 2005

6. CONCLUSION

This study has examined the socio-economic and spatial characteristics of the city of São Paulo focusing mainly on its historic centre, its peripheral area and southwest region. The aim was to comprehend a spatial perspective of São Paulo in order to investigate if the southwest region of the city has spatial advantages over other areas, which can justify its larger diversity of activities, and if it can also help to understand the preference of the middle and upper classes towards the southwest centres, and the lower classes towards the historic core. The study also analysed if São Paulo's morphology has an impact on the land use distribution of some areas of the grid and how its morphology reflects on the land value.

It indicates that the series of top-down processes, composed of firstly private developers investing in an orthogonal pattern of land subdivision in some southwest neighbourhoods in the beginning of the twentieth century, and later by the public sector investing in radials linking those neighbourhoods to the historic core between 1930 and 1945, gave rise to a bottom-up process responsible for the emergence of centres with intense activities in the southwest region. The evidence suggested that not only retail, but also different centre activities are driven by the way the urban structure of the city is arranged, and its related patterns of integration and segregation.

The syntactic analysis of São Paulo in conjunction with the socio-economic data suggests that the absence of local and global relation in the historic core is related to the abandonment of some segments of society from this centre and the consequent physical deterioration, increase of crime and poverty in the old core. Additionally, São Paulo's particular urban structure is responsible for a distinctive property of the city

wherein whole areas are highlighted at different scales of integration / choice and this might relate via car ownership to the different socio-economic levels of its centres. It is suggested that the concentration of activities in the most accessible and intelligible locations is a by-product of the different size of journeys executed by middle and upper classes since those inhabit in close proximity to the mentioned areas.

It has also been found that areas better served with high-through movement streets linking the core to the edges tend to be more integrated than the areas which present a lack of such streets; and that the areas made up of offset of regular orthogonal grids are also better integrated than the areas which are made up of offset of irregular grids. The combination between the two – the radials and the regular offset grids –, mainly in those areas which present a more continuous and less fragmented urban fabric, that is, the areas not broken up by the railway and its adjacent large industrial plots, imply in areas with a large number of segments with great potential as routes and destinations.

In general, the processes responsible for the location of retail in São Paulo are similar to those indicated by Hillier (2009) that happen in organic cities, whereby the centres will appear where there is a co-incidence of global and local factors. The global factors 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.

Furthermore, the historic core of São Paulo has not preserved a good relation between global and local patterns, pointed out by Karimi (1998 and 2000) as an important property in order to maintain a good variety of activities in the old core as it becomes economically viable and increases the chances of private investments inside it. The core does not sustain good levels of diversity capable of attracting these kinds of investments. Similarly, the settlements in its periphery have a strong local economy with a highly specialised retail; however, this impedes the diversification of activities. Among the six central areas analysed, the one which presents more diversity of uses and better socio-economic conditions is also the one better embedded in the context of the whole city, locally and globally and the one better located in a regular grid, fed by global line and which presents a better continuity of the urban fabric.

This study has shown a relation between the form of the city and the way it functions; although this relation is still not as clear as found in organic cities, it is an important step towards an understanding of the mechanisms that make up one of the largest cities in the world, and that also presents sharp social inequalities which are embodied in the city's space.

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Sources image 12:

| Land use description | Updated in | Reference date | Source |
|--|------------|----------------|---|
| SERVICES | | | |
| bank branches | 1997 | | Guia dos Negócios RMSP (1997) |
| location of Blockbuster video stores | 2005 | 2005 | Blockbuster website |
| location of the following hipermarkets: Extra, Carrefour, Makro, Sam's Club, Walmart, Big | 2005 | 2005 | website of the companies |
| location of the following pharmacies: Antares, Droga Raia, Drogão, Drogaria São Paulo, Drogasil, Onofre | 2005 | 2004 | website of the companies |
| location of the following supermarkets: Barateiro, D'Avó, Lojas Americanas, Pão de Açúcar, Pastorinho, Sonda | 2005 | 2005 | website of the companies |
| OFFICES | | | |
| release of office buildings | 2001 | 1999 | Embraesp |
| company headquarters | 1994 | | Balanço Anual Gazeta Mercantil - CD-Rom version (1995) |
| convention centres no município de São Paulo | 2002 | 2001 | Guia Mapograf - 2001 |
| LEISURE AND CULTURE | | | |
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| RETAIL | | | |
| location of shopping centres inside of buildings in the historic core | 2001 | | Listagem Mapa Viva o Centro made from field survey |
| location of the following eletronic shops : Casas Bahia, Extra Eletro, Ponto Frio, Fast Shop | 2005 | 2005 | website of the companies |
| shopping centres | 2005 | 2005 | abrasce, guia mapograph, internet search |

Source of the data: LUME (Laboratório de Urbanismo da Metrópole)