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Brazilian Medium-Sized cities:

Richness and Poverty Paradox

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ABSTRACT

This paper focuses on evaluating Brazilian mid-sized cities and how their morphological attributes, expressed by the centrality and the accessibility of the transportation infrastructure, are related with its inhabitants, implying limitations and potentials for improvements in their urban network. The sample is composed by nine Brazilian cities investigated by the ReCiMe: Uberlândia/MG, Londrina/PR, Passo Fundo/RS, Chapecó/SC, Dourados/MS, Marília/SP, Marabá/PA, Campina Grande/PB and Mossoró/RN. These municipalities are distributed across the country, in several states, and to some extent represent the diversity of the national urban scenario. The theoretical, methodological, and technical approach is based on Space Syntax Theory associated with non-configurational variables – geopolitical, economic, and socio-spatial data made available by ReCiMe. The study database was structured in a Geographic Information System and cities were explored comparatively, according to the present-day panorama and their historical evolution: axial and segment maps were developed along time from the cities' foundation to 2017. Findings suggest these cities present social and spatial inequality patterns in fragmented systems, implying a general sensation of public unsafety. There are great differences among different social strata, creating an ambiguous scenario of richness and poverty, representing, to some extent, Brazilian social reality at large. Findings point to the existence of, if not a type, at least a similar pattern of socioeconomic structures, urban expansion processes, and socio-spatial inequality.

KEYWORDS

Brazilian Mid-Sized Cities, Urban Morphology, Space Syntax Theory, Sociospatial Patterns, Configuration, Diachronic Analysis

1 INTRODUCTION

This article is dedicated to the investigation of Brazilian medium-sized cities through a morphological approach, according to the Space Syntax Theory (henceforth SST), in order to analyze the urban dynamics of their spatial structures, to identify a possible urban “type” of the set. The intention is to explore the relations between socioeconomic and configurational aspects, from the scrutiny of a selection of variables capable of expressing spatial characteristics and quality of life. To this end, a georeferenced database is used (in Geographic Information System) with axial and segmental maps developed from the foundation of the urban centers up to 2017 – the cities are compared in a diachronic perspective. It has been suggested that Brazilian medium-sized cities are places where people live better, with more quality of life, given the characteristics of small territorial extensions and rather balanced social strata. There is low complexity in the flows and supply of goods and capital, trade and services tend to be improved to keep up with the pace of the modern and globalized world. Santos states that [...] "intermediary cities or medium-sized cities are increasingly the locus of intellectual work and where the information necessary for economic activity is obtained" (Santos 1993, p. 123, our translation).

The IBGE (Brazilian Institute of Geography and Statistics) classifies cities based on the number of inhabitants and considers medium-sized cities to be those with a population between 100,000 and 500,000 inhabitants (IBGE 2010). The Instituto de Pesquisas Econômicas Aplicadas – IPEA (2000) considers aspects such as the spatial impact of the transformations of regional economies, evolution of the urban network profile, hierarchy of the system, typology of cities and characterization of the urban functions of the main centers and agglomerations in their respective regional subsystems in order to rank these municipalities. Although attributes that show precise data about Brazilian intermediary cities are not easily obtainable, specialists point out the complexity of defining them as in Santos (1993), Souza (2003), Arroyo (2006), Sposito (2016), Correa (2007), Castelo Branco (2007) and Oliveira Júnior (2008).

In varied literature concerning the taxonomy of Brazilian urban centers, the expression "medium-sized cities" seems to correspond in a more comprehensive way to the phenomenon of demographic growth of spatial structures that do not fit in the categories of large cities or metropolises. The most appropriate concept for this research is the one adopted by the Network of Researchers on Medium-sized Cities (ReCiMe), based at the Paulista State University (UNESP).

The network brings together researchers in urban studies from multidisciplinary areas at several public and private Brazilian universities, and foreign institutions from Argentina and Chile, with the elaboration, until 2016, of an analysis of twelve medium-sized cities, among them nine Brazilian and three foreign ones. The network has developed its own research methodology for these cities, which are considered urban spaces in transition. In the theoretical framework developed by ReCiMe, since its operation in 2005, methodological principles were adopted such

as a) diffusion of scientific agriculture and agrobusiness; b) deconcentration of industrial production; c) diffusion of trade and specialized services and d) deepening of socio-spatial inequalities for the differentiation of terminology (medium-sized city; intermediate city; medium city).

"[...] when naming medium-sized cities, the population level is used to simply recognize the size of the cities; for intermediate cities, the definition considers their relative and intermediate position (between small cities and regional metropolises), regardless of their political and economic expressiveness in the hierarchical context of an urban network. The condition of medium city, in its turn, considers the sub-regional importance presented by a given intermediate city, ipso facto, the strong centralities that are materialized there through flows, to the point of contributing significantly to the regional spatial planning in which they are inserted" (Oliveira Júnior *et al.*, 2016 *apud* Sposito *et al.*, 2016).

Given the difficulty of selecting a sample, both due to the complexity of its definition and the scarcity of studies consolidated in a pattern for these cities, the selection already made by ReCiMe was considered for this study. The result was the selection of the following settlements: Passo Fundo/RS, Mossoró/RS, Campina Grande/PB, Londrina/PR, Marília/SP, Uberlândia/MG, Marabá/PA, Chapecó/SC and Dourados/MS. Distributed all over Brazil, in several states, the group covers the five macro-regions of the country - North, Northeast, Southeast, South and Midwest – and, to some extent, represents the diversity of the national urban scenario (Figures 1 and 2).

Figure 1: Map of Brazil and indication of the medium-sized cities in the sample (Source: adapted from IBGE 2010.)

Figure 2: Linear representation of the nine cities in the sample (same scale).

2 THEORETICAL, METHODOLOGICAL AND TECHNICAL ASPECTS

We start from the material made available by ReCiMe about this sample, but our focus comes from the discipline of Architecture while studying their structure. The theoretical foundation comes from Space Syntax Theory (Hillier and Hanson 1984). The analysis considers socio-spatial relations involved in the flow of people, goods and capital in the investigated spatial structures; for the spatial representation and interpretation of the potential urban dynamics, models of SST are adopted. Medium-sized cities are investigated from the point of view of the existing articulations in their urban fabric – their configuration. The main aspects at stake are the deepening of socio-spatial inequalities in the cities of the sample.

The city is understood in its sociological dimension, so that the social effects of spatial organization in its arrangements need to be better explored, in the relationship between space and society. The city as an object is treated in the light of the notions of structure, patterns, hierarchy, and relations, which imply that settlements as interrelated systems in which changes in parts will imply changes in the whole. That is, the city is composed of a network of interdependent

relationships, so that it is necessary to understand how these relationships affect the dynamics (and quality) of urban life.

The nine cities in the sample are interpreted from three perspectives, each associated with specific variables: 1) configurational, 2) diachronic configurational, and 3) socioeconomic. The socioeconomic group of variables was selected to allow the evaluation of social concepts and specific data, interpreting phenomena from the perception of the group of cities researched by ReCiMe.

For the configurational discussion regarding the most recent modeling of each of the 9 cities (2017), the following measures were analyzed for this paper: a) compactness, b) overall integration (Rn), c) synergy, d) intelligibility, e) NAIN and f) NACH (Figure 3 and Figure 4). The results were confronted with those obtained by Medeiros (2013) for Brazilian cities.

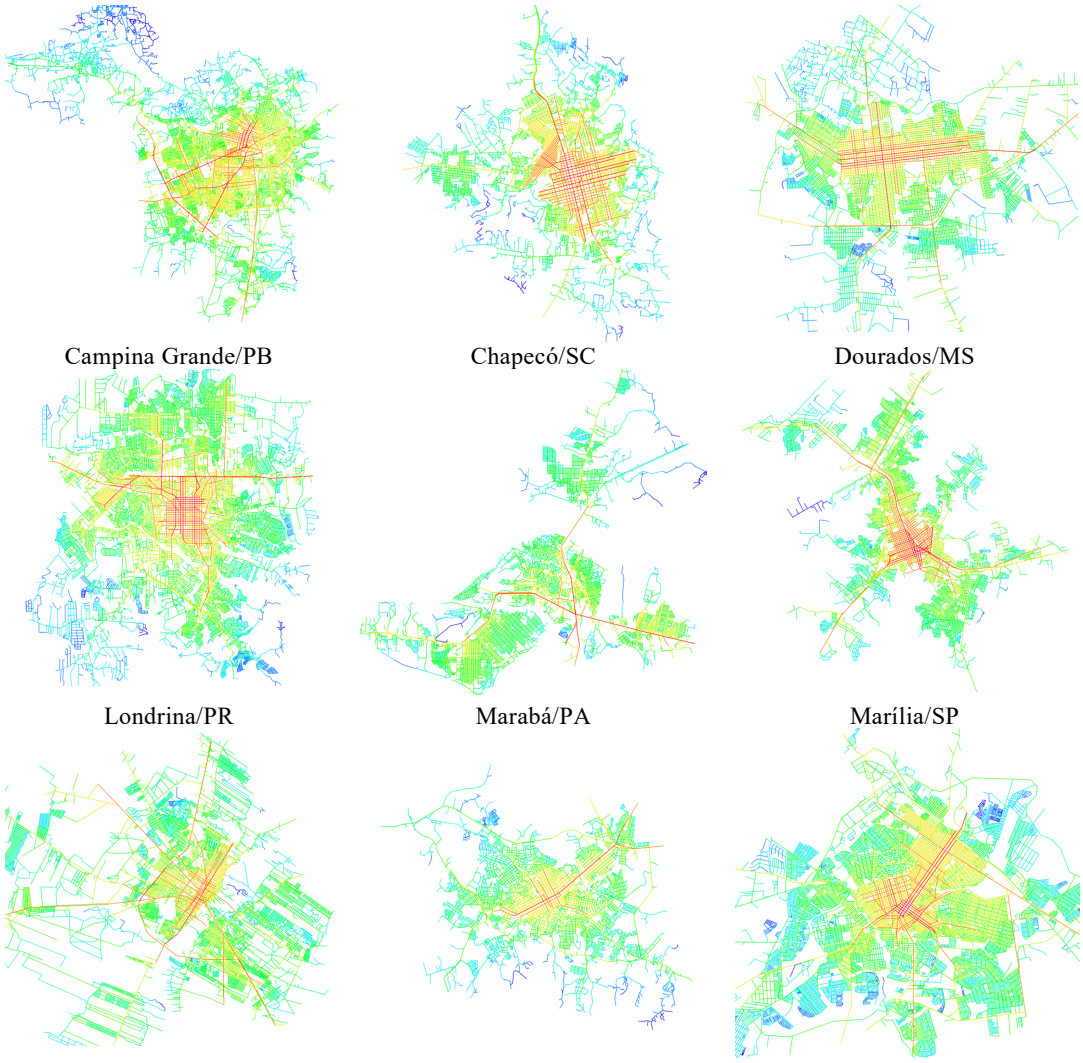

Figure 3: Segment map (NAIN) for the sample (same scale). (Source: the Authors.)

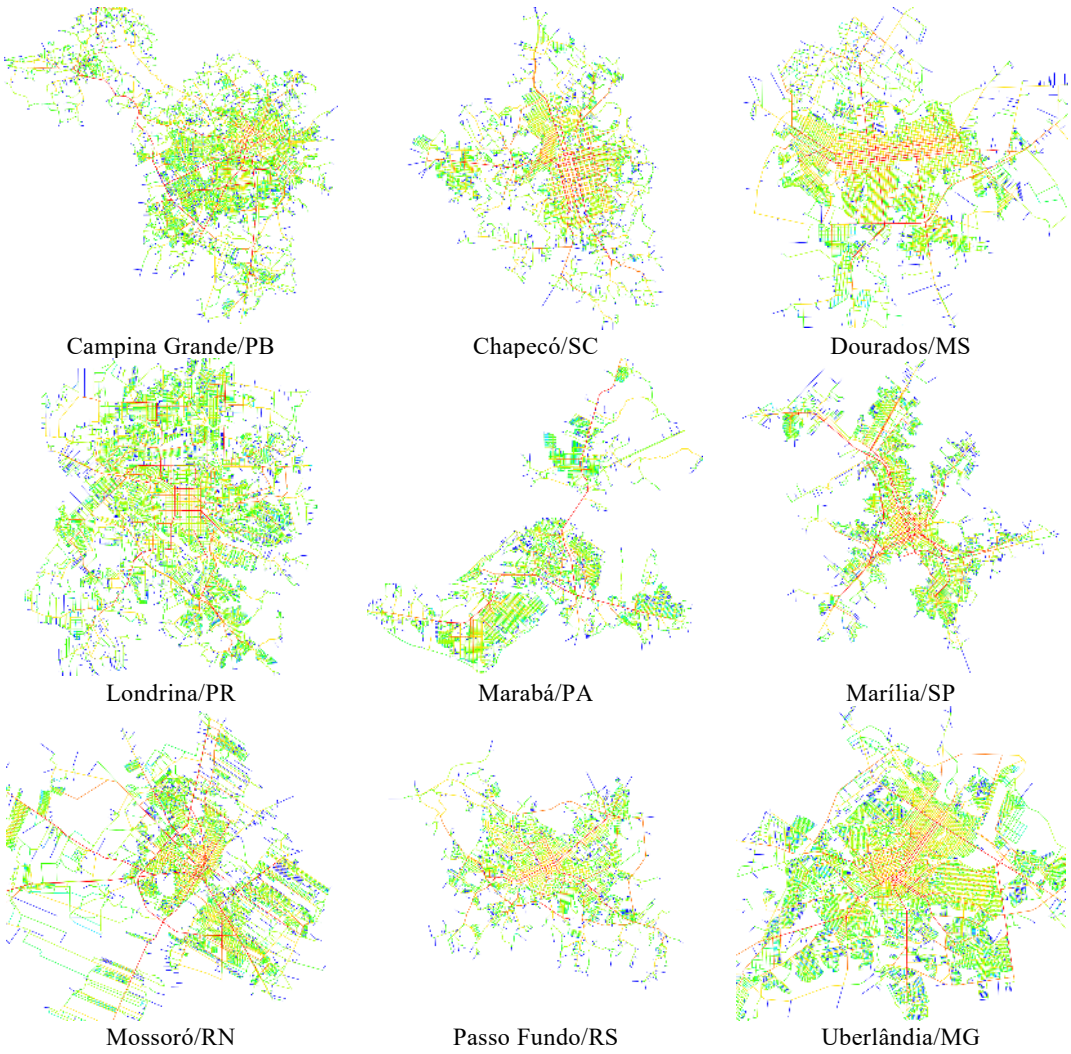

Figure 4: Segment map (NACH) for the sample (same scale). (Source: the Authors.)

For the variables referring to the diachronic configurational reading, 58 configurational models were produced, in the form of axial and segment maps: Campina Grande (1864, 1907, 1918, 1943, 1980 and 2017), Chapecó (1957, 1965, 1979, 1988, 1996, 2009 and 2017), Dourados (1934, 1949, 1959, 1969, 1979, 1989, 2001 and 2017) Londrina (1957, 1970, 1980, 1990 and 2017), Marabá (1920, 1947, 1954, 1970, 1981, 2004 and 2017) Marília (1927, 1946, 1973 and 2017), Mossoró (1857, 1926, 1966, 1982, 1994, 2002 and 2017), Passo Fundo (1853, 1888, 1902, 1918, 1953, 1980, 2011 and 2017), Uberlândia (1851, 1891, 1940, 1960, 1990 and 2017). From the processed maps, the measures a) average length of the axes (AX LEN), b) average length of the segments (SG LEN), c) connectivity (CONN), d) global (INT Rn) and local (INT R3) integration, e) legibility (synergy – SYNER and intelligibility – INTELL) and f) normalized angular choice (NACH) were analyzed.

For the socioeconomic discussion and correlation with configurational variables, quantitative data made available by the IBGE (Portal @Cidades) platform (from "a" to "d", below) and qualitative data from the survey conducted by ReCiMe about each municipality (from "e" to "r", below) are adopted:

a) Municipal human development index – HDI. As pointed out by the UNDP (Brazil), the HDI is a measure composed of indicators from three dimensions of human development – longevity, education, and income. The index ranges from 0 to 1, and the closer to 1, the higher the human development. The HDI adapts the global methodology to the context of Brazilian municipalities (UNDP, IPEA/Brazil).

b) Occupied population – POC. This comprises the percentage of people who had a job in the week prior to the week of the interview, i.e., individuals who had an employer, those who operated their own business, and those who worked unpaid helping family members.

c) Adequate sanitation. The percentage of the municipality's territory with good management of rainwater and solid waste.

d) Infant mortality. Number of deaths per thousand of living born babies.

e) Type of layout of the urban network. Classification of the layout into regular, mixed and organic grids.

f) Dynamism in the old center. Degree of vitality of the urban center under the evaluation of strong, medium, weak or shared, for cities that present more than one centrality.

g) Copresence in central areas. Potential co-presence in centres and sub-centres, measured from the uses and activities (strong, medium or weak).

h) Presence of gated communities. Existing gated communities, evaluating it as strong, medium or weak presence.

i) Presence of "shopping malls". Quantity of existing shopping malls, evaluated as "consolidated" for more than three, "expanding" for up to two, with one under project or construction, and "beginning" for those cities with up to one under construction.

j) Location of verticalized areas. Apparent location of vertical buildings, if located in the old center, central category, if located in the center and tending to move to new sub-centers or neighborhoods, shared category.

k) Economic vocation to agrobusiness. Presence of agrobusiness and its chain of flows, involving industry, commerce and services – strong, medium, weak categories.

l) Industrial economic vocation. Economic strength generated by the diversification of the industry as a productive chain of "agroindustries" and other types of product processing – strong, medium, weak categories.

m) Vocation for business tourism and events. Intensity of people and business flows in fairs and business events – strong, medium, weak or in project categories.

n) Presence of hypermarkets and supermarkets. Presence of large supermarkets and hypermarkets in the territory – strong, medium, weak categories.

o) Technological development center. Existence of a technological center that develops and exports technology – strong, medium, weak categories.

p) Influence of local capital in the economy and influence of national and international capital in the economy. Evaluation of the capital that moves economic flows - strong, medium or weak categories.

q) Urban transportation network. Urban mobility by public transportation – good, regular and bad categories.

r) Rail network. Freight transport by rail; few cities still have it, since most rail lines and stations have been deactivated – active and deactivated categories.

3. RESULTS

This section discusses the results obtained from three perspectives – configurational, diachronic configurational, and socioeconomic (Tables 1 and 2) – according to the following structure.

Table 1: Configurational variables obtained for the modeling set of the sample cities. (Source: the Authors.)

	AX LEN (m)	SG LEN (m)	CONN	INT Rn	INT R3	INTELL	SYNERGY	NACH	NAIN
Londrina/PR									
1957	520,49	109,15	5,000	1,548	2,187	0,392	0,832	1,039	1,534
1970	287,70	88,32	3,772	0,868	1,907	0,096	0,405	0,929	1,045
1980	297,11	91,61	3,746	0,812	1,900	0,064	0,319	0,899	0,948
1990	263,74	85,34	3,637	0,663	1,839	0,049	0,27	0,884	0,889
2017	242,49	83,64	3,467	0,556	1,737	0,660	0,321	0,872	0,818
Chapecó/SC									
1957	370,82	118,06	3,459	1,293	1,567	0,489	1,000	0,916	1,335
1965	339,02	103,15	3,674	1,135	1,902	0,172	0,597	0,916	1,063
1979	324,95	94,68	3,92	0,793	1,848	0,098	0,592	0,939	1,079
1988	317,10	93,05	3,924	0,934	1,827	0,124	0,628	1,012	1,190
1996	331,89	93,27	4,077	0,937	1,905	0,137	0,614	0,930	1,181
2009	311,53	92,48	3,908	0,738	1,878	0,066	0,362	0,912	0,973
2017	248,81	92,99	3,284	0,582	1,586	0,114	0,539	0,916	1,016
Passo Fundo/RS									
1853	245,84	100,16	2,000	1,537	1,536	0,966	1,000	0,623	1,269
1888	528,15	142,35	3,888	2,074	2,153	0,733	0,973	0,875	1,519
1902	490,77	118,91	4,553	1,342	1,858	0,777	0,947	1,000	1,535
1918	427,27	108,28	4,133	1,545	1,901	0,634	0,964	0,988	1,619
1953	353,31	89,48	4,289	1,304	1,984	0,404	0,741	0,977	1,392
1980	338,92	93,02	4,087	0,792	1,884	0,151	0,323	0,908	0,982
2011	309,95	91,31	3,888	0,743	1,825	0,132	0,322	0,904	1,026
2017	298,95	96,15	3,589	0,662	1,698	0,171	0,439	0,910	1,050
Dourados/MS									
1934	1980,47	298,92	6,250	2,321	2,792	0,438	0,883	1,053	1,722
1949	2321,19	202,53	9,959	2,538	3,034	0,661	0,912	1,158	2,253
1959	1465,59	139,60	10,02	2,221	2,801	0,702	0,867	1,133	2,058
1969	1299,90	139,09	9,241	2,115	2,720	0,583	0,877	1,116	1,992
1979	872,17	128,42	7,107	1,655	2,483	0,329	0,795	1,063	1,732
1989	786,03	122,37	6,812	1,630	2,490	0,297	0,766	1,052	1,676

2001	693,52	116,50	6,456	1,533	2,454	0,286	0,707	1,041	1,618
2017	559,31	124,60	5,118	1,144	2,115	0,240	0,678	0,995	1,412
Marília/SP									
1927	940,38	118,25	7,586	2,186	2,473	0,881	0,946	1,120	1,978
1946	759,70	109,05	7,170	1,806	2,542	0,509	0,682	1,092	1,770
1973	534,61	96,13	5,839	1,521	2,287	0,300	0,731	1,049	1,532
2017	349,59	99,04	4,125	0,732	1,916	0,128	0,290	0,904	0,961
Uberlândia/MG									
1851	543,85	93,24	5,259	2,370	2,422	0,834	0,993	1,034	1,688
1891	562,43	102,79	5,160	1,961	2,197	0,685	0,930	1,049	1,722
1940	891,51	110,92	7,827	1,830	2,613	0,380	0,841	1,118	1,909
1960	645,97	105,40	6,545	1,382	2,553	0,220	0,531	1,051	1,577
1990	521,27	106,75	5,478	1,056	2,367	0,140	0,429	0,977	1,329
2017	484,69	109,03	5,031	1,021	2,248	0,171	0,464	0,960	1,327
Campina Grande/PB									
1864	107,28	41,55	2,480	0,822	1,193	0,376	0,861	0,766	1,044
1907	124,35	48,37	2,647	0,794	1,337	0,369	0,681	0,793	0,814
1918	182,17	58,21	3,503	1,049	1,657	0,319	0,866	0,958	1,134
1943	199,47	60,12	3,652	1,024	1,767	0,182	0,752	0,936	1,094
1980	235,27	67,78	3,959	0,835	1,936	0,097	0,427	0,924	1,043
2017	221,01	69,83	3,697	0,723	1,830	0,088	0,423	0,899	0,967
Mossoró/RN									
1857	213,57	56,19	4,127	1,582	1,930	0,687	0,888	1,008	1,322
1926	360,11	79,45	5,019	1,637	2,264	0,484	0,774	1,053	1,584
1966	316,06	81,24	4,422	1,282	2,113	0,287	0,664	0,981	1,375
1982	290,90	83,00	4,050	1,057	2,021	0,151	0,487	0,914	1,165
1994	295,60	85,77	4,002	0,984	2,026	0,120	0,407	0,910	1,138
2002	296,56	84,59	4,087	1,041	2,052	0,123	0,420	0,919	1,199
2017	368,46	100,50	4,189	0,984	2,063	0,063	0,291	0,903	1,170
Marabá/PA									
1920	191,15	73,11	2,609	1,210	1,348	0,733	0,933	0,806	1,068
1947	216,91	74,82	3,116	1,380	1,662	0,630	0,915	0,839	1,179
1954	248,35	87,35	3,219	0,972	1,652	0,311	0,576	0,838	0,983
1970	329,19	118,22	3,269	0,518	1,589	0,148	0,449	0,910	0,754
1981	175,41	71,60	3,076	0,717	1,555	0,024	0,109	0,871	0,773
2004	245,30	81,55	3,597	0,640	1,703	0,000	0,014	0,886	0,718
2017	275,27	88,91	3,705	0,599	1,784	0,008	0,056	0,878	0,849

Table 2: Socioeconomic variables for the sample of cities. (Source: the Authors.)

	Londrina	Chapecó	Passo Fundo	Dourados	Marília	Uberlândia	Campina Grande	Mossoró	Marabá
Municipal HDI (2010)	0,778	0,790	0,776	0,747	0,798	0,789	0,720	0,720	0,668
Occupied Population (2015)	38,60%	42,70%	36,20%	32,70%	31,40%	37,20%	27,60%	25,20%	18,60%
Infant Mortality (2014)	8,68	6,43	9,59	15,86	13,74	10,03	12,71	12,91	11,12
Adequate Sanitation (2010)	85,20%	61,80%	54,10%	50,70%	96,80%	98,20%	84,10%	64,60%	31,80%
Type of Urban Layout	mixed	regular	irregular	regular	mixed	mixed	irregular	irregular	mixed
Dynamism in the Old Center	medium	medium	strong	strong	strong	strong	strong	medium	medium
Copresence in Central Areas	medium	medium	strong	strong	strong	strong	strong	strong	medium
Presence of Gated Communities	strong	weak	weak	strong	strong	strong	strong	strong	medium
Presence of "Shopping Malls"	consolidated	beginning	expanding	expanding	expanding	consolidated	expanding	expanding	expanding
Location of Verticalized Areas	central	central	central	central	central	central	central	central	central
Economic Vocation to Agrobusiness	medium	strong	strong	strong	weak	medium	weak	strong	medium
Industrial Economic Vocation	strong	medium	strong	strong	strong	medium	strong	medium	strong
Vocation for Business, Tourism and Events	strong	medium	in project	strong	weak	strong	medium	strong	in project

Presence of Hypermarkets and Supermarkets	strong	medium	strong	strong	medium	strong	medium	strong	medium
Influence of Local, National and International Capital in the Economy	strong	medium	strong	strong	strong	strong	strong	strong	strong
Urban Transportation Network	good	regular	good	regular	regular	good	regular	regular	good
Rail Network	active	deactivated	deactivated	deactivated	deactivated	active	deactivated	deactivated	active

3.1 Configurational perspective

Compactness

Compactness is measured by the total length of the network (in km) divided by the area of the system (in km²). In a neighborhood or a city the greater the compactness the greater the length of axes or streets it has in relation to its surface, which implies more space for meetings at a certain radius. The cities present a varied compactness, reaching an average of 18.10km/km² for the sample. Chapecó and Dourados have similar compactness (29.01km/km²), while Campina Grande reaches the highest offer of paths per unit area (74.38km/km²) and Mossoró, the lowest (7.24km/km²).

When the measure is correlated with the other variables, it is observed that the most compact cities tend to have livelier urban dynamics, with more accessibility, greater co-presence in the central areas and dynamism in the center, possibly with diverse uses and activities. There is also greater influence of local, national, and international capital, more industries, consumption, and technological development, tending to concentrate more flows of people and goods, and more wealth.

On the other hand, the urban dynamics of less compact fabrics tend to present greater segregation and less dynamism in central areas. The trend towards greater concentration of activities in agrobusiness is identified here, with, however, a caveat: the wealth produced does not seem to be distributed with equity and social justice. Patterns of socio-spatial concentration are evident, generating involuntary segregation or exclusion.

Global Integration (Rn)

The Integration measure indicate the inter-parts accessibility potential of the urban structure. At the global level, the measure refers to the entire system, but it can also be sought at the local, neighborhood scale, referring to the potential for accessibility related to the surroundings of each axis. Low values of integration reveal spaces that are difficult to access or are segregated, leading to more labyrinthine structures, as Loureiro (2017) points out.

Among the cities of the sample, six have integration degrees below the Brazilian average (0.764), analyzed by Medeiros (2013). Three of them, however – Uberlândia (1.021), Dourados (1.144), and Mossoró (0.984) – present configurational accessibility above the country's average, which is related to their predominantly regular grids.

The associations identified among the variables point out that the systems of higher global integration are those that present a) greater dynamism of the center, b) more influence of local, national, and international capitals, and c) greater vocation for industry, agrobusiness, services, and tourism business, resulting in greater growth. Broadly speaking, it seems that wealth tends to be more easily identified in more permeable and accessible spaces, attracting people for consumption, for tourism, for unplanned meetings, generating vitality for the city in several aspects. The issue, however, lies in inequality: despite the positive performance, more accessible and richer cities are also those that concentrate greater inequality, resulting in socioeconomic segregation of the less favored.

Synergy

Synergy comprises the degree of correlation between global and local properties of integration, meaning that their parts have similar performance as the whole. The surveyed cities present significant variations, but it is worth mentioning that five of them are above the Brazilian average (0.36) (Medeiros 2013): Dourados (0.68), Chapecó (0.54), Uberlândia (0.46), Passo Fundo (0.44) and Campina Grande (0.42). The most critical performance is Marabá's (0.06), whose municipal seat of government is tripartite (Marabá Pioneira, Nova Marabá and Cidade Nova) and multinucleated, a result of the accentuated fragmentation of its urban expansion.

The confrontation between variables draws attention to the fact that less synergy is linked to places with greater strength of the circulation of large capitals in the economy (wealth) and with a strong presence of gated communities (spatial fragmentation). On one hand, one can infer that the effect of gated communities is the fragmentation of the city, and, on the other, the fact that industries and large conglomerates of local, national or international capital prefer to locate at the periphery and in fragmented parts of the city, where the cost of urban land is low and therefore close to cheaper labor.

Intelligibility

Intelligibility is the measure that reveals the degree of system readability by the correlation between integration and connectivity measures. A more intelligible system is one in which the most globally integrated roads are also the most locally connected. Above the Brazilian average (0.15) (Medeiros 2013), are Londrina (0.66), Dourados (0.24), Passo Fundo (0.17), and Uberlândia (0.17). The critical situation is Marabá's, with a practically null result (0.01), which is in large part a result of its fragmentation, as commented above.

The correlation among the variables reveals greater intelligibility with trends associated with a) the regular urban transportation network, b) the influence of local, national and international capitals, c) economic vocation for industry and agrobusiness, d) more consumption and e) technological development, pointing out that more intelligible cities favor exchanges, flows of people, goods and capital. However, those with unfavorable levels of intelligibility, which are also the richest, indicate segregation and socio-spatial inequality.

Normalized Angular Integration (NAIN)

While all the previous measures originate from the axial map, NAIN and NACH are the product of the segment map. The normalized angular integration expresses the configurational accessibility potential calculated from the angles between segments. The results obtained tend to be understood as more refined in relation to the identification of the accessibility potential per road section (Medeiros 2013). Of the sample, five cities have accessibility levels above 1.00; two are close to 0.90 and another two to 0.80. The values roughly indicate a favorable tendency towards better accessibility, good orientability and openness to the various alternatives of growth flows and socioeconomic development. The resulting correlation of the measure with the others, therefore, indicates that the higher the NAIN value, the greater the relationship of the urban system with industrial vocation, agrobusiness, tourism business, consumption and free circulation of goods and capital. In this situation, the old center maintains its vitality in relation to the structure and social relations are intensified.

Normalized Angular Choice (NACH)

This measure relates to the potential of trough-movement along the street segments of the urban fabric, in contrast with integration values, which represent the potential of to-movement (Coelho, 2017, p. 185). All cities present choice values very close to each other (c. 0.90). One can infer a relative homogeneity, so that all offer good choices for displacements in paths or routes, facilitating the predictability of the "critical path" or of options more favorable to the implementation of improvements, for example, of the urban transportation system. On the other hand, one can interpret that the measure is not able to provide significant differences, given the degree of normalization.

3.2 Diachronic Configurational Perspective

The analyses in this section comprise the reading of the diachronic configurational transformation of the cities analyzed, from their foundation to 2017. The cartographic research covered the largest number of available historical maps that could express the transformation of the settlements, which allowed for the production of the configurational modeling for each period of analysis, in axial and segment maps and respective variables.

Average Axis Size

The average size of the axes can be associated with the average size of the streets in the settlements, whose average length in Brazilian cities is 290 m (Medeiros 2013). From the cities at the beginning of their processes of consolidation and urbanization, five present axes with an average higher than the national average, and in four the streets are lower, which indicates diversity. Over the years, the five cities with longer streets have been reduced, progressively approaching the national average. For both situations, a possible cause is the densification of paths and the filling of gaps in the pre-existing structure, or the lengthening of streets toward the periphery during urbanization.

The scenario becomes clearer if confronted with the macroeconomic dynamics of the country around the end of the 1970s, when the process of implementing government policies to encourage the modernization of farming and cattle raising and the growth of industry, especially in the North and Northeast regions, began to stabilize due to the Brazilian economic crisis that was being announced. What seems common to the process of transformation of the cities is a kind of homogenization: originally differentiated, the performance of the settlements started to get closer in the last decades.

Average Segment Size

The average size of the segments can be associated with the average size of the blocks, and this allows us to understand the transformation of the macro-partitions in the settlements. Like the previous variable, there seems to be a movement from heterogeneity to progressive homogenization. Initially, Dourados had the largest average segment size (298.91m) and Campina Grande, the smallest (41.55m). Over time, the segment sizes of the cities in the sample, tending to 90m, approached the Brazilian average (71.67m). Dourados, in this movement, experienced a reduction to 124.60m, while Campina Grande grew to 69.83m, both maintaining their position as extremes. Uberlândia presented a pattern with the most regular performance over time, alternating values around 100m and 110m. Changes and approximations in the variable suggest massive presence of housing developments and gated communities in the interstices of the city and periphery, in a process that seems to be constant in Brazilian cities, regardless of their size.

Connectivity

Connectivity expresses the number of average connections per axis in the system, which is related to the possibilities of routes and paths in the modeled network (Medeiros 2013; Loureiro 2017). More connected cities tend to be more accessible, due to a greater supply of routes, which can lead to greater urban vitality, while low values refer to more labyrinthine structures. The connectivity values of the cities and the comparative graphs show a stable trend between 4 and 6, however with relative decline for some of the cities like Uberlândia, Dourados and Marilia, characterized by strong regularities. The most recent averages for Dourados (5.12), Uberlândia (5.03), Mossoró (4.19) and Marília (4.13) are higher than the national one, at 3.90 (Medeiros,

2013), the others ranking lower. As it is a general trend of the sample to regularity, this performance seems to be related to the impact of urban fringes, usually more fragmented and discontinuous, which reduces the average connectivity.

Integration (Global/Rn and Local/R3)

Integration, as pointed out earlier, is a measure of centrality that allows identifying the areas that are easier to reach from a) the whole system (if global) or b) part of it (if local, up to the third level of connections). The variable assists in the identification of "more" or "less" "central" sectors, which is especially useful when relating to land use and activity data (Loureiro 2017; Coelho 2017).

Regarding overall integration, the measures obtained for the sample indicate that, over time, there are two clear movements: decline and homogeneity. If on the one hand the progressive reduction of values for all cities is evident, to a greater or lesser degree, on the other hand, it is noticeable how much the spectrum of values tends to be reduced diachronically, so that the poles get closer: would this be the path to the emergence, in fact, of an urban type? Local integration, in turn, repeats the global performance, although in a more subtle way, without such a sharp decline, and with a homogenization that seems to be previously processed, with its first steps since the 1950s.

Legibility (Synergy and Intelligibility)

With regard to the measures that assess legibility aspects, both in the association between global and local properties (synergy) and in the expectation that the most connected axes (locally) are also the most integrated (globally), there is an evident diachronic decline. However, it is possible to observe that for both measures there is a stabilization in the last decades, perhaps because the lowest possible level has already been reached. On the other hand, for synergy, the sharp decline that occurred between the 1980s and 2000s seems to indicate a reversal of the trend, with higher values for the last moment of analysis (2017). It is believed that the scenario points to a progressive filling the gaps of the urban fabric, as well as a reduction in the growth speed of the cities in the sample, which is related to the peculiarities of Brazilian demographic growth.

Normalized Angular Choice (NACH)

The diachronic data of NACH reinforce the previous findings, both in the way of there being a progressive homogenization in the performance of the cities in the sample, as for the indication that perhaps the measure, due to the normalization process, excessively approximate the values, making them not very relevant for comparative studies. From the beginning of the 20th century, the values are always oscillating between 0.8 and 1.15, with some diminishing distances in 2017, when the gap is limited to values between 0.85 and 1.00.

3.3 Socioeconomic Perspective

For the discussion of the socioeconomic perspective, the four quantitative group variables are analyzed in isolation in separate sections, accompanied by association with the other investigated measures.

Municipal Human Development Index (HDI)

The sample presents a higher HDI than the Brazilian one (0.699), except for Marabá (0.668). The correlation demonstrates relative coherence between HDI indexes and urban development, in such a way that the cities with the highest values present: functioning urban transportation, dynamism of the center, co-presence, network expanding to new neighborhoods and consumption increase. What stands out is the influence of capital of local, national, and international origin. The wealth accumulated by the economic flows of goods, products and services seems to be managed separately from urban quality. The context of verticalization of center-district indicates a possible growth of activities and land use towards sub-centers, so that mixed urban form may result from interstices and discontinuities in the network, inducing the existence of segregated spaces. The trend suggests a chain of flows generating significant growth, but when related to previous findings, it seems that wealth is not distributed in the form of income, work remuneration, benefits and social rights that enable equity in the right to the city. This situation suggests signs of socioeconomic and socio-spatial segregation.

Occupied Population (POC)

An employed population generates growth and development, not only from the point of view of remuneration for the work done, but also of occupation in the sense of belonging, of being part of, of feeling a sense of belonging to the place, to the city. An employed population, in the current view, corresponds to less crime and diseases. In relation to the values obtained, the analyzed cities present percentages of occupied population around 30% for five of them, and close to 20% for two. In extreme poles are the level of occupation in Chapecó (42%) and in Marabá (18%).

If it was speculated about greater walkability and co-presence, strength in the center, for the confrontation of this variable with the others it is identified that a high percentage of POC corresponds to the reduction of centrality dynamism, associated with low frequency of shopping centers, vocation to agrobusiness and routine movement in urban transportation. What can the reduction in values for these variables mean when occupancy rates are higher? Don't capitals induce flows of people and goods? An occupied population may consume more, although it circulates less, but what about regular urban transportation? Commuting? It is not clear whether the presence of large industries encourages collective transportation restricted to workers, not affecting, for example, urban transportation. On the other hand, wealth understood in its broad sense does not seem to correspond to a better quality of urban space. The findings continue to point out that if the occupied population generates wealth, on the other hand, other performances

point to the existence of inequalities in income, labor supply, access to labor qualification, among others, which compromises the quality of life.

The sanitary sewage index obtained expresses that most cities only reach close to the range between 50% and 60% of the territory covered by solid waste collection and treatment and rainwater management: Dourados and Passo Fundo are surpassed by Chapecó and Mossoró. Some municipalities with higher demographic densities have rates above 80%: Londrina, Uberlândia, Campina Grande and Marília. The exception is Marabá, reaching just over 30%. By associating the measures, the number of sanitary sewage systems suggests social inequality that permeates streets that are not paved, do not have a rainwater collection system, do not have electricity, do not have potable water, do not have individual toilets, and have rudimentary cesspools. In the correlation of variables, the influence of internal and external capitals and their economic flows tend to relate to higher rates of sanitary sewage. The economic flows of agrobusiness and agroindustry tend to act independently of the quality of the urban territory. This distance can mean companies installed in peripheral areas, where the low-cost labor is, conforming the space of the excluded. On the other hand, the positive sign for consumption in large supermarkets, technological development, co-presence and dynamism in the center signals economic growth and wealth. The mixed urban form is linked to discontinuous growth with probable high infrastructure costs.

Differences among cities diminish as to infrastructure. The trend points to the existence of socioeconomic inequality and socio-spatial segregation, for all cities in the sample. Implicit throughout the sample is a residual of housing without basic sanitation, susceptible to flooding and other misfortunes common to the urban fringes.

Infant Mortality

According to UNICEF (2006), the decline in child mortality in Brazil is associated with several improvements in living conditions and basic child health care, such as food and nutrition security, basic sanitation, and vaccination. For the sample, the mortality data is varied: it approaches 10 to 12 deaths per thousand live births for most of the sample. Better statistics for Chapecó (6.43) and more critical situation in Dourados (15), surpassing in deaths the index of Brazil, which fell to 13.82 deaths per thousand live births *(IBGE, Portal @Cidades, 2015)*. The infant mortality rate is related to the sanitary sewerage rate, because the absence of basic sanitation can generate fragility and diseases in children. The correlation between variables reveals a growing negative influence of capitals, consumption strength, more industries and business tourism, growth of gated communities, good social relations, and vitality of the center. Therefore, a picture of contradictions is evident.

Urban configuration in irregular patterns suggests a fragmentation of the fabric, disperse urbanization, and spatial discontinuities. The increase in infant mortality when associated with

the presence of these characteristics may indicate possible socioeconomic and socio-spatial inequality. Table 2 reveals a lack, even residual, of adequate sanitary sewage. The current one shows an increase in mortality, indicating the same trend: that of wealth that generates growth, but remains accumulated to the detriment of equal rights and income distribution.

4 CONCLUSION

The article sought to investigate a group of nine Brazilian medium-sized cities from a morphological approach. To this end, based on the assumptions of Space Syntax Theory, three perspectives were analyzed: configurational, diachronic configurational and socioeconomic profile, their respective variables having been correlated.

Brazil is a large territory with multiple natural resources and is essentially agricultural. Almost all Brazilian cities, from small ones to the metropolises, keep in their evolutionary patterns strong traces of agriculture, and this is still a current base for their development. For the cities in the sample, this is the first point of contact that marks similarities among them. In all of them, the origin of the settlement, the planned or organic urban core, stems from rudimentary farming. The expansion of the territory occurs concomitantly with the economic development of agriculture and cattle breeding, the intermediation of the surplus, the processing of raw materials, and the diversification of basic products. With the mechanization of agriculture and modernization of the field, development culminates in the spread of scientific agriculture and agrobusiness, which reaches levels of specialization and diversification in a production chain.

Most Brazilian medium-sized cities specialize and diversify in the exchange of goods and services, linked to the production chain of agrobusiness and the agricultural industry. The exception is Campina Grande, which in this development path became a pole of technological development, services, and commerce in large scale. However, marks of its origin can be noticed when identifying a lower network of commerce and small agricultural producers that make the cities' street market places of thriving co-presence.

Another similarity among the cities in the sample is the strong presence of governmental investments, which promoted industrialization and economic development during the 1960's and 1990's, because of programs, strategies, and national development plans, which aggregated to the territory opportunities for business flows and production of goods, distributed and received by railroads and new regional/national highways. It is a characteristic of the entire sample to be well served by road networks, inter-regional, interstate and airway circulation – all of them have an airport to transport passengers and cargo. Londrina stands out in the scale of this service for being considered an intermodal transport hub (rail, road, and air) connected to another Paraná city (Cambé), whose reception and distribution of cargo on a national level is connected to the Paranaguá Port.

Configurationally-wise, a relative homogeneity of the sample was identified. These are predominantly cities with regular layouts, with streets between 240m and 350m, and the average size of the block face is close to 90m. Nevertheless, the more peripheral they are to the morphological centers, the more fragmented the fabrics tend to become. These aspects favor accessibility and legibility, due to a greater supply of routes and paths, as well as highlight the hierarchy of the systems. However, socioeconomic riches resulting from the wealth generated by agrobusiness and the intense flows of people, goods and capital are not distributed with equity, and thus do not contribute to the full appropriation of the city by its population. Given income inequality and the need of migrant or excluded populations to live, circulate, and work, even if in minimal conditions, what seems to be left to them in the city is the space of the discontinuous and fragmented urban tissue, urban voids, ghettos that confine and deepen socio-spatial inequality among classes.

Broadly speaking, due to the characteristics of the network, the potentials of integration, connectivity, synergy, intelligibility, NACH and NAIN express, together, good levels of configurational accessibility. On the other hand, fragmentation and discontinuity of the networks are revealed when a closer look at the settlements is made, a product of the presence of low-income housing developments in the periphery, and gated communities in important areas, which tend to jeopardize potentials of accessibility and weaken the vitality of the urban center. Moreover, differences among various social strata in this group of cities – between wealth and poverty – is responsible for the deep socio-spatial inequality that ends up affecting, in some way, all citizens. In the end, what we conclude is that there is indeed, if not a "type", at least a characteristic profile of these Brazilian medium-sized cities, with close similarities in patterns of socioeconomic structuring and in the reasons that led to the urban expansion and the deepening of socio-spatial inequalities in Brazil. Quoting Sposito (2007), in medium-sized cities, "[...] one notices the tendency towards socio-spatial fragmentation without yet reaching the political weaving of social relations, as seen in metropolises". There is still time for a qualitative intervention in the urban planning of these cities to extend the right to the city to most of its inhabitants.

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