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SCHOOL-PLACE AS A COLLECTIVE URBAN ENTITY

The case study of Lisbon

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ABSTRACT

This paper is part of a wider on-going research project, which intends to contribute with new and comprehensive knowledge about school buildings in Portugal for secondary and middle education under the framework of educational urbanism. With a specific focus on the spatial distribution of secondary schools in the city of Lisbon, it investigates the relationships between the evolution of the city's urban layout and the functional transformations that occurred along the 20th century. The purpose is to understand how far these schools are incorporated into the urban grid and to explore their potential to perform as a neighbourhood-based institution.

A syntactical-morphological history of Lisbon provides the basis for interpreting the urban evolution of the city along the 20th century and to capture the relationships with its functional structure. As Hillier (1996) suggests, spatial configuration plays a key role in connecting physical form with functions, in that space is an intrinsic feature of urban dynamics. The urban network became the favoured instrument for organizing the urban layout, with a double function: to support the settlement of basic services including mobility and facilities, such as schools, and to organize and control the built environment. Topological properties of the urban network are explored on a global and local scale, such as integration and choice variables.

The paper is organized in two parts. It starts by outlining the evolution of secondary school provision and location in Lisbon with reference to the Western countries context and its main trends. Particular attention is given to the rationale behind both the urban and educational planning and theories, which have run parallel with the construction of school buildings and the conditions that facilitated the development of the city's school provision and location. The second part focuses on syntactical-morphological features by exploring the spatial distribution patterns of school buildings at both global and local scales. A macro level analysis is followed to understand the relationship between the distribution of secondary schools and the architecture of the urban network. Integration patterns of both global and local scales are numerically and visually compared with the distribution pattern of school buildings at the correspondent periods. Synergy and intelligibility parameters in the scoped timespan are sequentially compared.

It is concluded that the present urban condition of secondary schools shows the juxtaposition of global and local factors, i.e. the presence of a strong relationship with the city's local and global parts.

KEYWORDS

School-place, city-based institution, neighbourhood-based institution

1. INTRODUCTION

This paper is part of a wider on-going research project – “Atlas of School Architecture in Portugal: Education, Heritage and Challenges” - which intends to contribute with new and comprehensive knowledge about school buildings in Portugal for secondary and middle education. It adopts a dialectic relationship between education, urban planning and architecture disciplines. Educational visions, together with emerging concepts in urban planning and architecture theories and practices at the time school buildings were built, outline the research framework. This approach is consistent with a growing body of research showing the potential of school architecture not only to enhance education but also to catalyse urban development while benefiting their social and economical milieu (OECD, 2011, 2014). Educators, urban planners and architects agree: schools are day-to-day facilities and their location, spatial design, physical conditions and resources are important determinants of educational achievement and urban quality of life. Moreover, as urban entities, schools have significant impacts on urban dynamics including mobility patterns, residential choices and real estate development.

This paper focuses specifically on the spatial distribution of secondary schools (regular and technical schools) in the city of Lisbon. The purpose is to understand the associations between the structure of the urban network and the spatial distribution of these schools, both at the global and at the local scales, potentially enabling them to perform also as neighborhood-based institutions thus intertwining learning with live, work and play.

The theoretical premise is that ‘school-place’, defined as the condition that gives meaning to the educational experience, is correlated to the degree to which the school is embedded in its urban context. This includes special features of the school’s physical environment related to the urban built fabric and to the community and also special social, cultural and educational influences. Detailed consideration of school buildings of any period tends to reveal this underlying complexity (Woolner et al., 2005).

It is argued that while schools are important carriers of meanings and values, they help to create and reinforce individual and community identity, as they serve as centres of learning and they connect neighbours with one another. Whereas this function can to some degree be influenced by the design of the school building and its relationship to the surrounding area, the more a school is embedded into the urban context, the greater will be its potential to support a variety of school and community related activities.

The study is organized in two parts. It starts with a review of the secondary school building construction in Lisbon from a historical perspective, pursuing an extensive survey on educational and municipal archives and inventories. It draws on a range of technical data, records and publications on the topic. The mission and the role of secondary schools have played in various periods have also been investigated as a source of historical and social evidences for the spatial analysis through existing literature and photograph collections. Particular attention was given to the rationale behind the educational and urban planning theories, which have run parallel with the construction of school buildings and the conditions that facilitated the development of the city’s school mapping.

The second part explores the spatial distribution of secondary school buildings in Lisbon based on a detailed spatial analysis drawing on longitudinal syntactic data at both global and local scales. A number of studies on urban evolution carried out with the primary intention of understanding the contemporary built environment can be found in Space Syntax literature (Griffiths, 2012),

whether comparing the evolution of spatial patterns at different times or investigating relationships between changing functional pattern and its spatial structure in the urban transformation process. The present study encompasses the theoretical and methodological framework applied in spatial-locational studies. It has involved the 'cartographic redrawing' of each period and the combined use of axial and segment angular analysis.

2. A BRIEF REVIEW OF THE SCHOOL BUILDING CONSTRUCTION PROCESS

The first public programme of secondary school building construction in Lisbon goes back to the end of the 19th century. At the time, in most European cities school buildings, in particular those for secondary education, were used as tacit structural elements to shape new expansion areas developed according to 'regularists' guidelines (Choay, 1969: 15-26) as illustrated by the French model of lycées. They composed the design and promoted the legibility of the main streets, contributing to the settlement of new inhabitants with important social and economical benefits for the specific areas where they were placed. The hygienic concerns of the time, which had a major influence in urban planning theories, placed emphasis on comfort and health, and consequently in the selection of the location of school buildings within the urban fabric (Frago, 1993-94:29).

Comparing with other European experiences and in particular with the French one, which was of paramount importance in Portugal at the time, Lisbon was a singular case. The urban principles applied in the reconstruction of the city centre, after the 1755 earthquake, restricted the inclusion of this new type of educational facilities as created in the 19th century. Thus, the first two purpose-built secondary schools – a regular school, the so called lyceum, and a technical school - were planned to be located in the Western periphery of the city core: the former in the interior of a large block within the 16th century compact urban fabric, on the West side of the downtown area, and the latter near the harbour industrial sector in a new developed residential area for working-classes families.

Through out the 20th century, the urban locations of the new schools followed different criteria, according to different urban and educational theories, as well as changing demographics and evolution in the enrolment of school-age population.

In the first two decades of the 20th century, several arteries were efficiently planned and built that intended to be the structural support for the entire Northern urban expansion of the city. Two new lycées and one technical school were built to serve as co-educational schools. The demands of health and hygienic theories required schools to be located in vacant lots within the limits of the new urban expansion area. Similar to the French experience, they occupied large plots near the main avenues, as a prominent-singular entity, a city landmark expressing the image of monumentality that would signal an institution of modern urban life. They took advantage of the plot main frontage to reflect their civic character and foster their presence within the urban fabric. Their configuration varied according to their location within the block in order to solve problems of light and air as required by the hygienic theories, as well as to offer external space for physical activities as claimed by the new educational premises.

Along the next three decades more four single-sex lycées and ten technical schools were built encompassing the urban evolution both to the North and to the West of the city limits. These schools were built as part of state-funded public secondary school construction programs. According to the programs rationale, schools were placed close to main axis in reference places in new or existing residential areas, thus assuming a prominent position and imposing their presence by dominating their surroundings as landmark buildings.

At the time, the emergent process of democratization of education taking place in most Western countries, led modern theories of urban planning to recognize the school building as a place-based institution, a day-to-day facility in close relationship with the neighbourhood. From the Ebenezer Howard's idea of "social cites" to the principles set out by Unwin, as well as by Perry in the 1920's or in the German and Dutch experiences of the late 1920's and 30's, school premises became a key element of the neighbourhood structure, having an important role in

the settlement of inhabitants. The loss of the monumentally through the reduction of building scale together with the opening of school spaces to the community and the improvement of pedestrian accessibility led to a close relationship between the school and local inhabitants and to the strengthening of social links.

The process of democratization of education in Portugal did not follow the trend observed in other European countries, but the new urban expansion areas promoted by the Lisbon city council along the 1940's and 50's, were deeply influenced by these experiences. They correspond to the first large-scale urban operation planned to expand Lisbon by public initiative in order to respond to the lack of affordable housing and to decentralize services and activities to the periphery of downtown, i.e. the traditional city core. Their planning was based on the concept of neighbourhood unit. Implicit in this new model was the vision of a compact, multifunctional and socially diversified city with urban environments that were more attractive and vibrant, capable of promoting a closer community with a greater sense of neighbourliness. More three secondary single-sex schools were built at this time. A female lycée and a technical male school were located in the centre of the new neighbourhood while the male lycée was placed around the edge of the neighbourhood, serving two or more neighbouring groups of dwellings that were within in walking distance. In accordance with the modern thinking, school building design was focused on less formal plan organizations and massing arrangements, looking for a deinstitutionalized character.

The period immediately following the Second World War was one of wide-sweeping social and economic reforms and innovations in the urban and educational fields. It was marked by a shift in planning theory away from a localized design focus and project orientation toward a concern with large scale, multi-community and multi-faceted problems (Llewellyn-Davies 1972: 104). The right to education and its democratization in most of the European countries was the first condition for the school construction program to become an integral part of urban planning decision-making (Roth 1957:11). The rise in school-age population and the demand for school facilities created intense competition for land and other resources, especially with other community needs, such as affordable housing, parks, and community centres.

Late in the 1950's and throughout the next two decades, another large-scale planning operation promoted by the Lisbon city council was initiated, corresponding approximately to 1/10 of the total area of the city. The experiments that were being made at that time in the development of new towns in various European countries represented an additional motivation for Portuguese planners. It was not a question of breaking away from the functional principles of housing, work, recreation and circulation, from the Athens Charter, but rather amplifying them and adapting them to new situations with more elaborate proposals. The adopted strategies had made it possible to ensure an effective link between the housing units and their immediate services and educational infrastructures. Outside these planned areas, new developments were promoted by public initiative on a speculative basis. Along this period two more lycées and three technical schools were built. By the end of the 1960's the growth of secondary schooling challenged the ideological tenets of single-sex schooling and gender segregation was abolished from public schools. Early in the 1970's a new education act altered the structure and organization of secondary education and regular and technical education were merged since 1976, being offered in the same school.

The increasing demand for school places during the decades of 1970's and 80's as a result of the country's democratization process and new educational policies, implied a transition to singular design solutions for widespread implementation, which has strongly impacted on the appearance of schools as well as on the aesthetic character of the area where such schools are placed. The exigencies of school finance together with larger site area requirements often resulted in school location and design decisions that were aligned with neither educational needs nor urban development needs, but instead were driven by land costs. Moreover, the rejection of urban planning models based on defined catchment areas, in favour of widely overlapping areas of service, led to the construction of new schools in outlying areas. This period is marked by the construction of a set of six secondary schools.

Since the 1980's the city started losing population to its metropolitan area. The total number of residents at the end of the 20th century was approximately 550.000 inhabitants, similar to that of 1930. From the early 1990's, the existent secondary school buildings became a focus within the agenda of policies for urban and social revitalization. Secondary school facilities are now being re-examined so as to maximize their public use and to support greater opportunities for community interaction. An effort is being made to transform schools into hubs for community activities, where people of all ages can access education, community services, recreation and culture. This approach has particular interest in the context of an ageing population and declining school enrolments.

3. DEPICTING THE ARCHITECTURE OF THE URBAN NETWORK

Previous studies on the Lisbon syntactic morphological evolution (Kruger; Heitor and Tostões, 1996; Heitor and Pinelo, 2014) have shown how Lisbon's topological centrality evolved after the 18th century earthquake from a regular grid pattern to a more linear structure and deformed grid. This occurred in the last quarter of the 19th century and was due to the opening of two large avenues perpendicular to the river, following the city's two main valleys, thus reinforcing the expansion of the urban fabric towards the Northern periphery in detriment to the East-West borders. Following the strategic character of political and administrative interventions over the organization of the city as a means of controlling urban life, these avenues had a role both as a landmark in the Lisbon urban transformation process and a support for the new city expansions developed along the 20th century. This included the opening of several arteries and the construction of modern infrastructures, housing and other facilities promoted by real estate developers and private builders as well as large-scale public operations, carried out from the 1940's up to 70's.

A macro level analysis was carried out to understand the relationship between the distribution of secondary schools and the structure of the urban spatial network. Six historical cartographic maps of Lisbon published respectively in 1855, 1911, 1948, 1970, 1997 and 2005, are decomposed into axial and segment maps thus allowing a spatial-temporal analysis of the evolution of the urban network with a time interval of 150 years.

Space Syntax Toolkit (Gil 2015) a front end to Depthmap (Turner 2004) is used to calculate integration and choice patterns at local (radius 5) and global (radius n) scales and to obtain a general picture of the spatial centrality condition. Global and local intelligibility and synergy analyses were also produced to give a further trace of the morphological changes occurred.

Global analysis is used to represent the degree of convergence and dispersion of axial lines and other types of space in the whole system, while local analysis is applied to grasp local grid structures, which can be indicative for the "living centre" at the neighbourhood scale. The objective is to identify the dominant foreground network, marked by linear continuity and the background network with less linear continuity (Hillier, 2009: 8). The understanding of the dual structure of the city provides a more clear impression of the school location.

Then, integration patterns of both global and local scales are visually compared with the distribution pattern of school buildings at the corresponding period. This allows detecting if the (top-down) centralized school planning and location process was sensitive to the actual centrality structure of the network.

Scatter plots showing intelligibility and synergy at the six different periods are sequentially compared. Functional changes are revealed from a syntactical-morphological perspective by highlighting the distribution of schools.

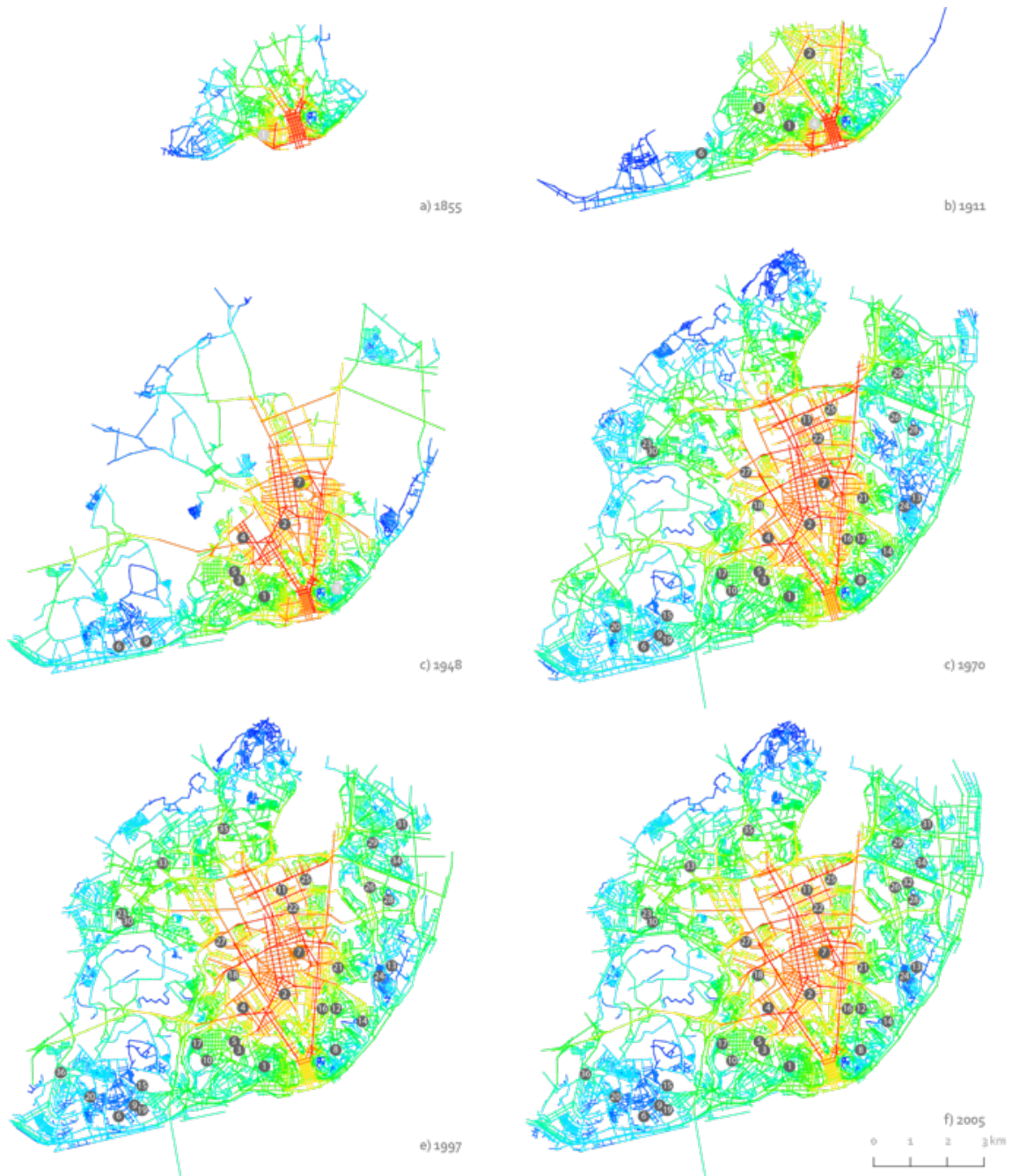


Figure 1 - Axial Integration - Local Integration from 1855 until 2005 a)1855; b)1911; c)1948; d)1970; e)1997; f)2005. All the six axial maps are displayed at the same scale and each dot corresponds to the location of a school.

A visual inspection of both maps (Figure 1 and Figure 2) seems to reveal that the strategic centrality of the urban network dates back to the end of the 19th century, due to deeper hinterland penetration of the South-North axis. Ever since, the geographical expansion of the integration core around these two structuring axes is further emphasized, pushing the “new” integration core towards the North, as observed in the 1911 map and further consolidated in the following periods (1948 and 1970 maps). The integration core has grown to spread out along the main axis, with strong links to the outside. Also it has developed as to become more compact and shaping an emergent deformed grid.

The densification of the deformed grid entails the construction of new residential areas and is accompanied by the extension of the grid towards the Northern and Northeast periphery of the city. The expansion of the urban fabric to the West maintains a peripheral character, also translated by low values of integration, not creating distinct impacts on the spatial configuration at that time. This densification process also reduces the segregation of the peripheral areas, while increasing the levels of integration in the central core, as it is reflected in the 1997 and 2005 maps. Although marginally, the integration core increases and solidifies its structure, shifting slightly to North and substantially reducing the centrality of downtown area. However, this central core is somehow dissociated from the rest of the city, due to the absence of continuity axes supported by local structures, which could join the city as an articulated continuum. The pressure of private investors influenced urban expansion, in particular those scattered developments built between the 50’s and the 80’s, which were developed without the strict control of the city council over the organization of the city.

In 2010, the expansion of the city to the Northeast, following the renewal of part of the riverbank, has an insignificant contribution to the spatial structure of the city as a whole. It does not entail any displacement or growth of the centre as already established since 1948. Despite the new development areas, to a large extent Lisbon’s basic spatial structure has remained the same. It seems that from the last quarter of the 19th century onwards, the city has evolved into a unique collage of various urban grids. This confirms the strategic character assumed by the planned interventions of the late of the 19th century. Besides representing the icons of urban life at the time, i.e. the modernization blueprint, they were also efficient instruments for organizing the urban layout and controlling the city expansion since then.

4. RESULTS

Table 1 provides a synthesis of the axial analysis of this historical process. The analysis includes global (radius n) and local (radius 5) integration, connectivity, intelligibility and synergy at the different evolving stages. It also characterizes the structuring traces of the system, providing a syntactical evaluation of its 150 years timespan evolution.

Date	Number of lines	Line length	Global integration (radius n)	Local Integration (radius 5)	Connectivity	Intelligibility factor r^2	Synergy factor r^2
1855	1449	117,695	0,625	1,434	3,573	0,150	0,345
1911	2226	163,112	0,692	1,545	3,846	0,127	0,356
1948	3459	187,610	0,619	1,523	3,802	0,108	0,309
1970	7846	170,160	0,616	1,476	3,561	0,084	0,293
1997	7600	176,951	0,652	1,498	3,626	0,088	0,306
2005	7813	178,698	0,656	1,504	3,634	0,084	0,295

Table 1 - Lisbon metric and axial parameters

The 1855 axial system comprises 1449 lines with an average length of 117m and a global integration of 0,62. By 1948 the system has practically doubled in size (3459 lines) to further doubled again by 2005 (7813 lines). Also an increase in all integration values along the 150 years timespan evolution was observed.

The connectivity value, peaked somewhere by 1948, decreasing smoothly afterwards by 2005, showing that the overall structure of the city has become shallower while the street layout has become better connected. This is mainly due to the combination of areas better served by high through-movement streets linking the core to the edges, made up of orthogonal grids with a continuous and less fragmented urban fabric. An ascending trend for the global integration of the urban layout from 1948 to 2005 is observed, together with a clear demarcation of the integration core. Since the 1948 map, the key integrators are shaped rather like the rims of a deformed wheel pattern. However due to the city topography, the long radials linking to those rims do not fully converge inward at a focal point to create a strong internal hub. The global

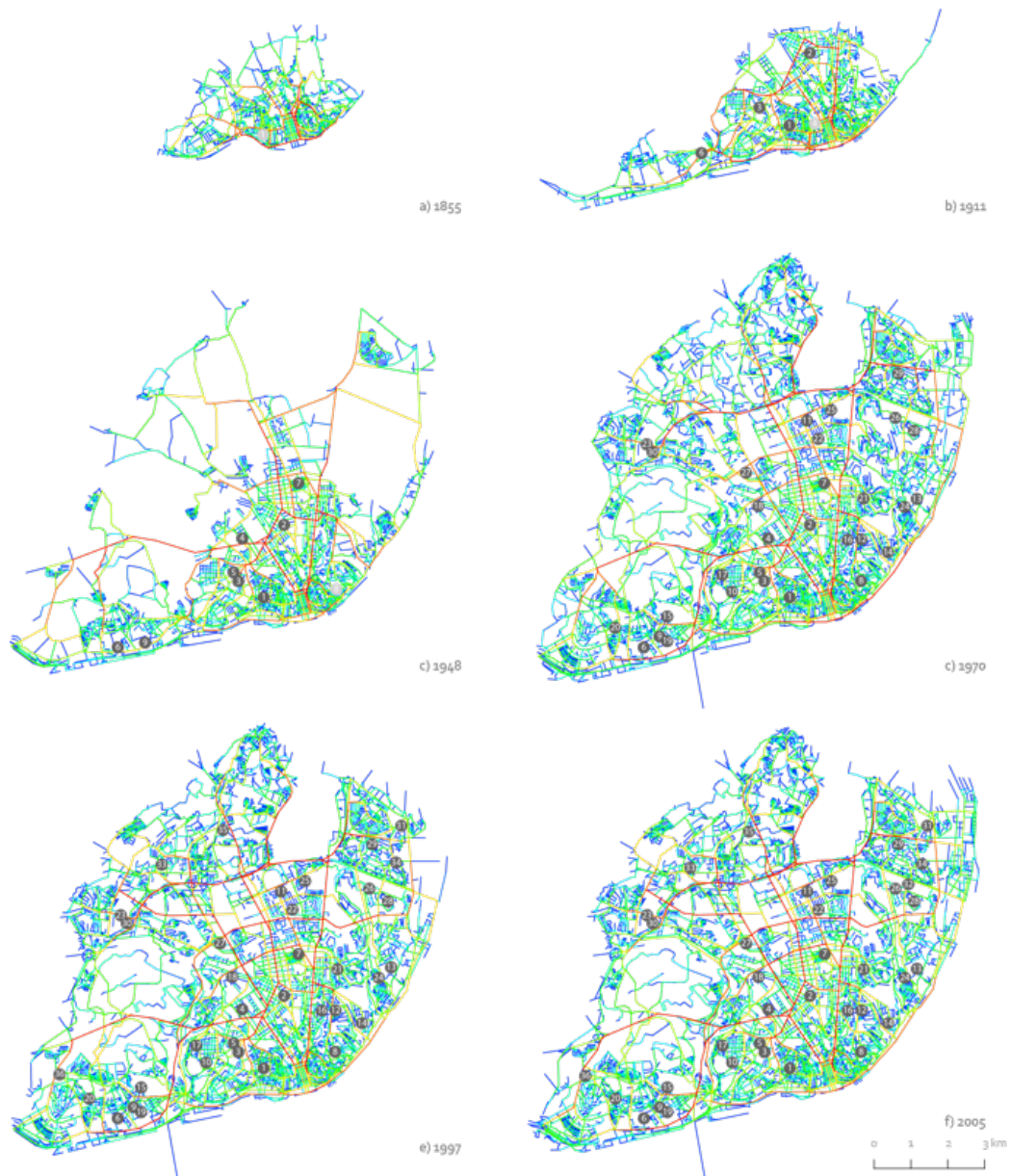


Figure 2 - Segment Map - Foreground and Background Network a)1855; b)1911; c)1948; d)1970; e)1997; f)2005.

integration core has shifted first towards the North, then marginally floated to West and East sides and further towards the Northeast. This pattern of expansion and relocation corresponds to 'the paradox of centrality' as described by Hillier (1996). The possibility of forming certain edge-to-centerlines effect is minimized by the presence of natural barriers. Besides the increasing size and the diversity of the new urban grids, there is a general evolving trend for both the mean local integration and connectivity values.

Nevertheless a decrease is also detected in the synergy values of the whole urban network, suggesting a loss of synchronization between the local street structure and the wider urban context, i.e. a drop on the symbiotic relation between the local and global structures.

The axial analysis was complemented by the segment analysis so as to identify both the foreground and background networks at each analysis period (Hillier, 2009: 8). Grasping this duality allows a deeper understanding of the school location and relative position within the city. The analysis (Figure 3) confirms the previous findings, which have shown that the foreground network gains its high centrality at the cost of creating a segregated background, and reinforces the potential of the foreground network to structure the urban network by creating rings that help integrate the background.

Table 2 summarizes the axial analysis, featuring both global and local integration, as well as global and local choice values. All values are qualitatively displayed according to the featured quartile. Also, schools are characterized according to their type, i.e. Lyceum, Technical School, Industrial Institute, 2nd cycle school or Secondary School, original gender and type of building i.e. provisory or specifically built for purpose.

School #1 is the only present in the 1855 map (although in its provisory building) and its global integration value is slightly above Q₃, placing it in the integration core. In the 1911 map four lyceums were located in the most integrated areas within the system as part of the integration core while two technical schools (#5, #6) occupied less integrated sites, i.e. either the 1st quartile (the IEast integrated 25 %) or the 2nd quartile.

By 1948, another three schools were built, totalizing nine schools: seven lyceums and two technical schools (#5, #6). Global integration values range from the 1st to the 4th quartile, and both provisory lyceum buildings (#8, #9) and a technical school (#6) feature low integration values (1st and 2nd quartile). All the lyceums show high local integration values, but the technical schools feature either in the 1st or 2nd quartile. Moreover seven schools are located within the integration core of local choice and the remaining (#1 and #5) is in the 3rd quartile. Conversely global choice values are slightly lower, ranging from the 2nd quartile (#2) to the Integration core (#3, #4, #8, #9). Also, it is observed that school #2 has global choice values represented in the 2nd quartile, while the global integration is in the 4th quartile. Conversely, school #9 is in the integration core regarding global choice values while its global integration is in the 1st quartile.

Along the next two decades (1970 map), another 20 new schools were built. The majority are located within the global integration core, which, as previously referred, has moved North to embrace the new commercial and business areas. Schools (#6, #8, #15, #19, #20), which are located in the Western part of the city, feature the lowest global integration values. At this time 21 of the total of 29 existing schools are located within the local integration core, assuming a prominent local position. Choice values, both at global and local scale feature high outcomes, mostly in the integration core.

Between 1970 and 1997 more seven school were built. The global integration analysis features fifteen schools located within the integration core and four schools in the least integrated quartile. A total of twelve schools (located in South-Western and Eastern part of the city) are in 1st and 2nd quartile; however, most of these schools feature high local integration values. Technical schools #20 and #24 both have the least integrated global integration values and the highest local integration values.

In terms of global and local choice values, schools show a consistent pattern showing high values.

School Type	Gender	School #	Global Integration (radius n)					Local Integration (radius 5)					Global Choice (radius n)					Local Choice (radius 5)									
			1855	1911	1948	1970	1997	2005	1855	1911	1948	1970	1997	2005	1855	1911	1948	1970	1997	2005	1855	1911	1948	1970	1997	2005	
L	M	1	4	3	3	3	3	3	3	4	4	4	4	4	4	3	3	3	2	2	2	4	3	3	3	3	3
L	M	2		4	4	4	4	4		4	4	4	4	4		3	2	2	2	3		4	4	4	4	4	4
L	M	3		4	4	4	4	4		4	4	4	4	4		4	4	4	4	4		4	4	4	4	4	4
L	F	4		4	4	4	4	4		4	4	4	4	4		4	4	4	4	4		4	4	4	4	4	4
TS	M	5		3	3	3	3	3		2	2	3	3	3		3	3	3	3	3		3	3	4	3	3	3
TS	M	6		1	1	1	1	1		4	1	3	2	2		3	4	3	3	3		3	4	3	3	3	3
L	F	7			4	4	4	4			4	4	4	4			3	4	4	4			4	4	4	4	4
L	M	8			2	3	2	3			4	4	2	3			4	4	2	4			4	4	2	4	4
L	M	9			1	2	2	2			4	4	4	4			4	4	4	4			4	4	4	4	4
TS	F	10				3	3	3				4	4	4				4	4	4				4	4	4	4
TS	M	11				4	3	4				4	4	4				3	3	3				4	4	4	4
TS	M	12				4	4	4				4	4	4				4	4	4				4	4	4	4
TS	M	13				1	1	1				2	3	1				4	4	2				3	4	2	2
TS	M	14				4	3	3				2	3	3				4	4	4				3	4	4	4
TS	M	15				2	2	2				3	3	3				3	3	3				3	3	3	3
TS	F	16				4	4	4				4	4	4				3	3	3				4	4	4	4
TS	M	17				3	3	3				4	4	4				3	3	3				4	4	4	4
TS	F	18				4	4	4				4	4	4				4	4	4				4	4	4	4
TS	M	19				2	2	2				4	4	4				4	4	4				4	4	4	4
TS	F	20				1	1	1				4	4	4				4	4	4				4	4	4	4
TS	M	21				4	4	4				4	4	4				4	4	4				4	4	4	4
L	F	22				4	4	4				4	4	4				3	4	4				4	4	4	4
TS	M	23				2	3	3				4	4	4				4	4	4				4	4	4	4
TS	M	24				1	1	1				4	4	2				4	4	4				4	4	4	4
L	M	25				4	4	4				3	4	3				2	4	2				2	4	3	3
Inst	M	26				2	4	4				4	4	4				4	4	4				4	4	4	4
L	M	27				4	4	4				4	4	4				4	4	4				4	4	4	4
L	M	28				1	2	2				2	2	2				4	4	4				3	3	3	3
2C	MF	29				2	2	1				1	1	1				1	1	3				1	2	2	2
L	MF	30											4	4					4	4					4	4	4
ES	MF	31											4	4					4	4					4	4	4
ES	MF	32											4	4					4	4					4	4	4
ES	MF	33											4	4					4	4					4	4	4
ES	MF	34											2	1					3	3					2	2	2
ES	MF	35											4	4					3	3					3	3	3
ES	MF	36											2	2					4	4					4	4	4

Table 2 - Axial Analysis Global Integration (radius n), Local Integration (radius 5), Global Choice (radius n) and Local Choice (radius 5) comparative representation, according to the Quartile (1 to 4) in the 1855, 1911, 1948, 1970, 1997 and 2005 maps for schools #1 to #36. Framed cells represent provisory buildings. Legend: L- Lyceum; TS – Technical School; Inst – Industrial Institute; 2C – 2nd cycle school and ES – Secondary School; M- Male; F- Female; MF – Male and Female.

In 2005 the city of Lisbon comprised a total of 36 schools. The global integration analysis features six schools in the 1st quartile and five schools in the 2nd quartile. Similarly to the 1997 analysis, the least integrated schools are located to the Southwestern and Eastern periphery of the city. The local integration analysis features only six schools in the 1st or 2nd quartile and 24 schools in the integration core. Along the urban development (Figure 6 c) and d)) and consolidation process former female lyceums and technical schools became in the most integrated axis of the system, thus becoming more visible and integrated than the first male lyceums built in the first quarter of the 20th century.

Regarding the choice analysis, local choice values are greater than global choice values.

Throughout the six periods under analyses schools are typically located within the background network. This reinforces the concept of background network, and its residential vocation, which also restrains and structures movement through a distinct geometry, thus conferring each background network a new spatiality and feeling (Hillier 2007, 2010). Nevertheless, most schools are located relatively close to the foreground structure, which makes them highly accessible within the city (Hillier 2007, 2010).

In terms of axial synergy, as observed in Table 3, schools (represented with blue dots) tend to lie above the main regression line of synergy and distribute within the top- right zone of these plots, which indicate that they are more integrated than the average level of the whole city. Also it is observed that schools shape a rather linear pattern, which may be interpreted as a kind of hierarchy when treating schools as part of the city school mapping.

In terms of axial intelligibility, as observed in Table 4, schools (represented with blue dots) tend to lie above the main regression line. But to the exception of some outliers, the distribution is typically in the lower zone of these plots.

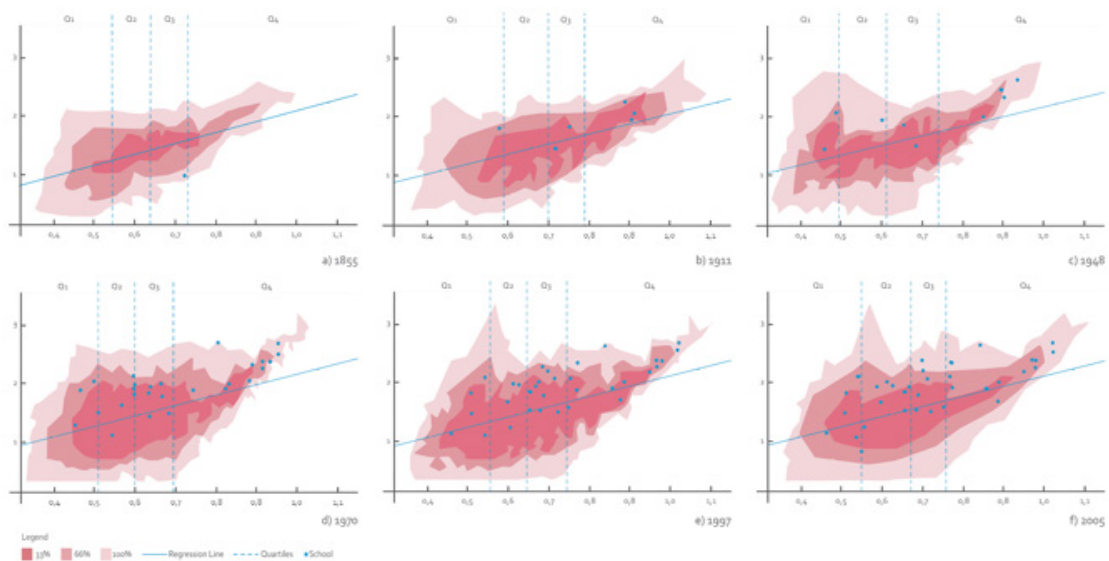


Figure 3 - Axial Synergy along the 150 years timespan. x-Axis: Axial global integration; y-Axis: Axial local integration. This graphic is a simplification of a scatterplot: each area represents the density of occurrences (from 33% to 100%).

Furthermore, a 150-timespan synergy and intelligibility analysis was drawn in Figure 4. The regression lines have minor divergences and schools are cohesively distributed throughout the timespan.

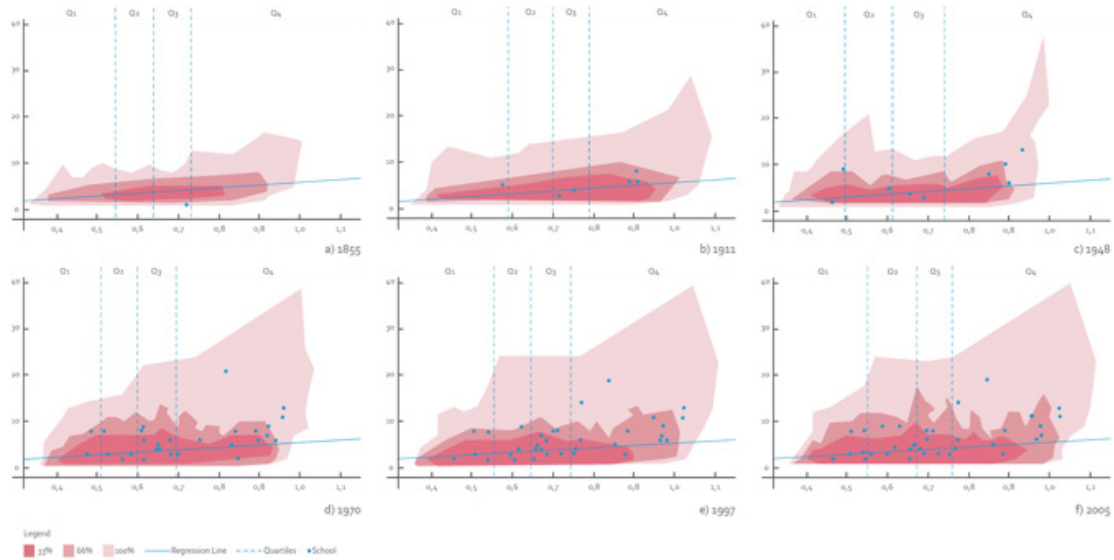


Figure 4 - Axial Intelligibility. x-Axis: Axial global integration; y-Axis: Axial Connectivity. Legend: This graphic is a simplification of a scatterplot: each area represents the density of occurrences (from 33 to 100%).

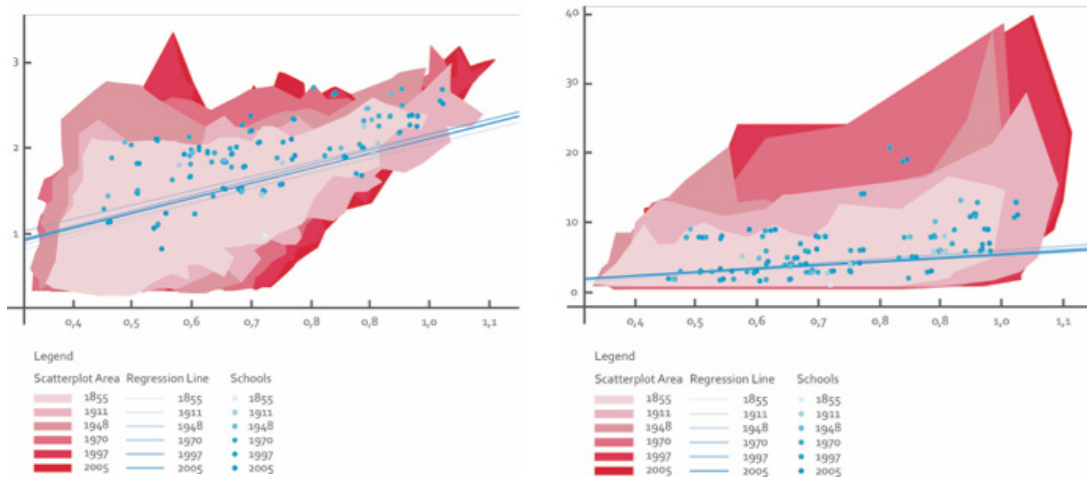


Figure 5 - Axial Synergy and Intelligibility comparison

Figure 6 characterizes the axial integration according to the typology of the school (Lyceum; Technical School; Industrial Institute; 2nd cycle school or Secondary School). In the late 19th and early 20th century the focus was given to the construction of male schools. With urban growth and the democratization of education (from 1912 to 1970: Figure 6 c) and d)) a significant number of new female lyceums and technical schools were built. Later on, these schools become more integrated in the global system and than the first wave of lyceums (Figure 6 a) and b)).

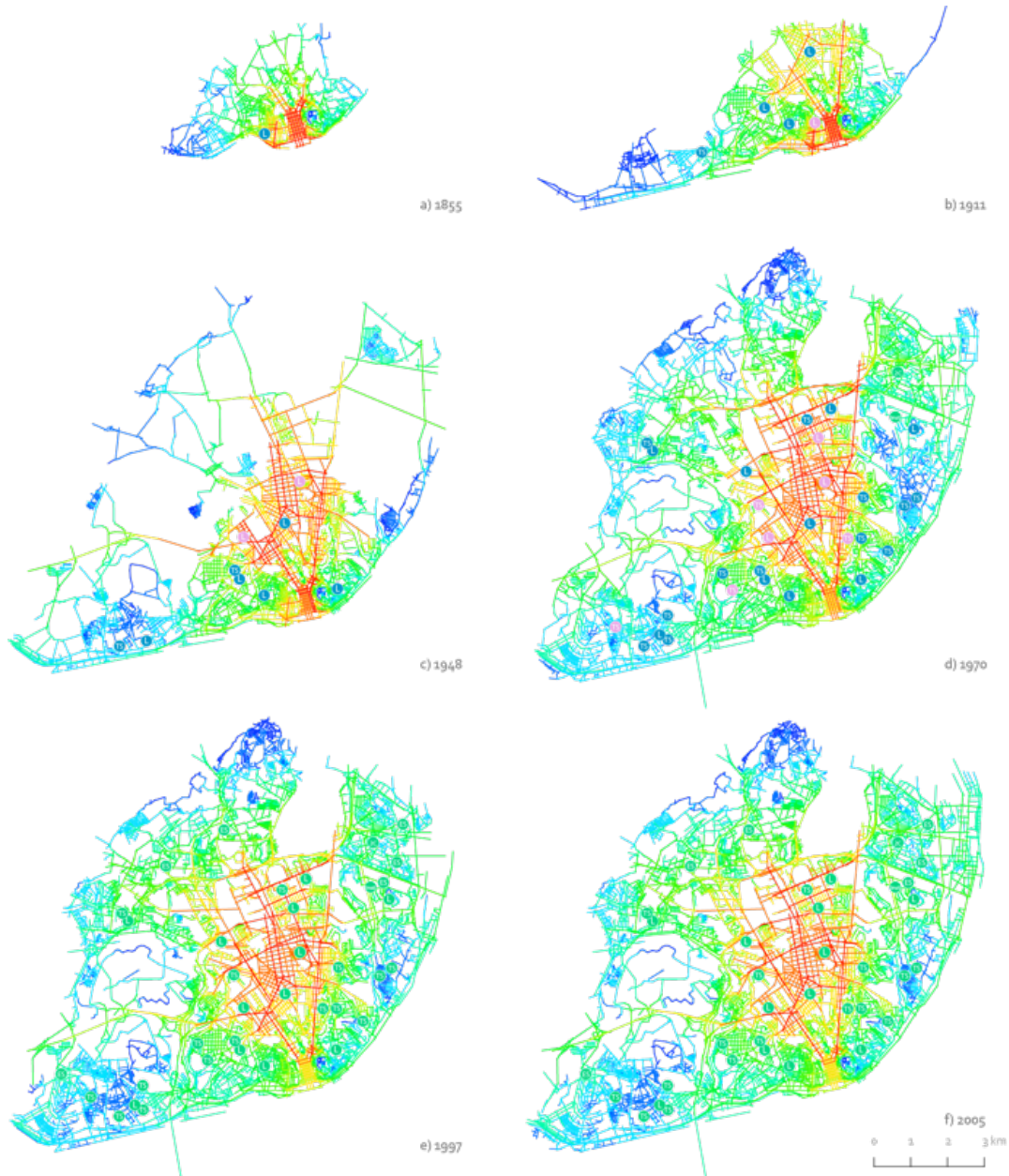


Figure 6 - Axial Analysis - Global Integration - Schools represented by gender a)1855; b)1911; c)1948; d)1970; e)1997; f)2005. Legend: L- Lyceum; TS – Technical School; Inst – Industrial Institute; 2C – 2nd cycle school and ES – Secondary School; Blue- Male; Pink- Female; Green – Male and Female.

5. CONCLUSIONS

The analysis shows that throughout the period under consideration 'school-place' in Lisbon has evolved from a prominent-singular entity, a city landmark portraying the image of monumentality, to a more neutral-commonplace entity. This loss of monumentality led to the reduction of the building scale enabling it to operate as a neighbourhood-based institution. This shift occurred from 1940's onwards in line with the state-funded programs rationale, when school buildings were placed in prominent places within new or existing residential areas.

The present urban condition of secondary schools is supported on the juxtaposition of global and local factors, i.e. the presence of a good relationship between its local and global parts.

Many schools feature a favourable location regarding its global and local axial integration values. This is a reflection of a careful school planning process (based on top-down decisions) in that schools usually have both a strategic position at the city- wide scale and a compact and inter- accessible local structure. Moreover the shift of monumental to local, transformed the perception of the school building, while revealing a joint strategy towards a new significance of education, which combines modern educational, urban planning and architectural theories and practices. This trend acknowledges the important role of the school as a shared public resource and gives meaning to school-place.

Finally, it is important to mention the limitations of this study. When examining the average integration value each school holds both at the global and local level in the six axial maps some variances in their functional aspect are revealed from a spatial perspective. Hence, a more detailed analysis focused on the best and least-served school locations is needed. In particular the relationship established between the local spatial characteristics of these schools and their potential to perform as shared public resources and neighbourhood base institutions should be questioned. Connections that can be made between learning, living, working and leisure remain to answer. Up till now, since the work of both Perry (1929) and Stein (1928) on planning for the neighbourhood unit, insufficiently empirical data exists on sitting new school facilities within the context of an all-integrated and responsive city.

ACKNOWLEDGEMENTS

This paper was developed in the scope of the ATLAS of School Architecture in Portugal_ Education, Heritage, and Challenges (ASAP_EHC) Research Project, funded by FCT - Fundação para a Ciência e a Tecnologia.

Lisbon Axial Maps of 1875, 1991, 1948, 1997 and 2005 were withdrawn from Pinelo and Heitor (2015).

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