The Spatial Roots of Urban Growth: Modelling Urban Dynamics with Space Syntax

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Abstract. The intricate interplay among urban sub-systems poses significant challenges in comprehensively interpreting urban dynamics and assessing the efficacy of urban planning strategies. Spatial modelling stands out as a crucial tool for analysis and decision-making in this context. This paper investigates the potential of Space Syntax in extracting intrinsic characteristics vital for understanding urban growth dynamics and spatial phenomena. Specifically, the study explores the inherently multiscale nature of Space Syntax, which offers a diverse array of techniques and measures for analysing urban systems, spanning from regional to architectural scales. In particular, the investigation focuses on the capability of Space Syntax to estimate vehicular and pedestrian flows and their correlation with the distribution of commercial activities, both at urban and neighbourhood scales, with a specific emphasis on the case study of Pisa, Italy, leveraging *Angular Segment Analysis*. In addition to the analytical exploration, the paper provides a concise historical overview, highlighting the transformations and peculiarities of Pisa's current urban form. The findings underscore the potential of the proposed methodology and Space Syntax multiscale approach for analysing urban settlements. Notably, the research reveals a correlation between heavily traversed streets and the localisation of commercial activities. These insights contribute to a deeper understanding of urban dynamics and offer valuable implications for urban planning and design.

Keywords: Spatial Modelling · Space Syntax · Multiscalarity · Urban Dynamics · Vehicular Flow · Pedestrian Flow

1 Introduction

The United Nations, through the Sustainable Development Goals (SDGs), has established the key objectives to be achieved in order to create sustainable and liveable urban environments. In particular, urban planning plays a crucial role in achieving SDG 11: Sustainable Cities and Communities, while also being closely interconnected with all other SDGs. However, pinpointing the precise mechanisms regulating different urban phenomena is highly complex. These are in fact the results of intricate interactions among the subsystems comprising city systems [1], which are inherently complex and interconnected organisms in continuous growth.

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In the quest to understand the short and long-term impacts of urban policies and interventions, or to evaluate alternative design scenarios, spatial modelling and digital twins play a central role [2]. In particular, models capable of simulating human behaviour and movement in cities are essential, serving as valuable decision support systems. Unlike Mara and Cutini [3], who highlighted the dichotomy of top-down and bottom-up tools in addressing modelling issues, this paper aims to closely analyse the theme of multiscalarity in configurational approaches, highlighting its natural predisposition, capabilities, and importance in urban planning.

Indeed, Space Syntax, both a theory and a set of analyses and measures capable of interpreting the urban networks hierarchy and extracting intrinsic spatial characteristics, is inherently multiscalar. Space Syntax modelling can be applied across various scales of analysis – from the regional to the architectural one – while maintaining its effectiveness [4]; it offers a wide array of analyses to choose from based on the scale of analysis and specific modelling requirements; it allows qualitative interpretation but also quantitative analysis (due to its analytical framework based on graph theory) of urban phenomena related to movement and the resulting social dynamics [5].

Moreover, the configurational approach has fundamentally overturned the spatial interaction model by revaluating the importance of urban form. While initially space was considered a scenic backdrop just marginally influential for urban dynamics, with the configurational approach, urban form becomes the protagonist of urban scenarios, capable of determining urban flows and consequently land use [6, 7] (see Fig. 1). Only through topological-visual and positional analysis of the various elements composing the urban environment is it possible to determine *a priori* the preferred vehicular and pedestrian movement pathways [7, 8], and simultaneously, the land use distribution [7, 9] of the urban environment.

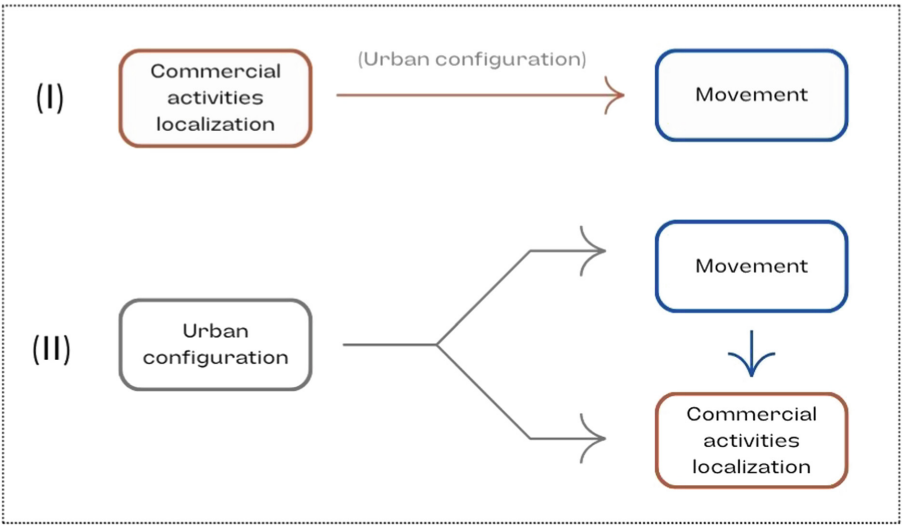


Fig. 1. Interactional (I) vs configurational (II) approach to urban planning.

In this perspective, this paper demonstrates the utility of the configurational approach at both urban and neighbourhood scales, highlighting the hierarchical logic of the historic urban settlement of Pisa, estimating the hierarchy of vehicular and pedestrian flows, and showing the correlation between centrality and the natural positioning of activities.

The paper is structured as follows: in Sect. 2, the case study and methodology are presented, describing the datasets and measures employed both for configurational analysis and for the extraction of commercial activities. Section 3 is divided into three parts: it first presents the study at the urban scale (Sect. 3.1), briefly tracing historical evolution, analysing the distribution of vehicular and pedestrian traffic, and discussing the correlation between flows and commercial activities distribution. Subsequently, it presents the same study at the neighbourhood scale (Sect. 3.2). Section 3.3 briefly discusses the results and highlight some aspects to be further explored. Finally, Sect. 4 summarizes the main findings.

2 Concepts, Datasets and Methods

2.1 Case Study

The historical city centre of Pisa, located in Italy's Tuscany region (Fig. 2), have been selected for this case study. Specifically, the area comprising the historic centre within the medieval walls, along with the adjacent neighbourhood extending towards the central train station (Fig. 3). According to this framework, a total of 5 neighbourhoods can be identified: *Santa Maria*, *San Francesco*, *Sant'Antonio*, *San Martino*, and the *Stazione* neighbourhood. For the neighbourhood-scale analysis, Santa Maria has been selected.

The city of Pisa is characterized by two distinctive features: it is a diffuse university city characterized by university facilities diffused all over the historical nucleus and a high number of students. Simultaneously, it is a tourist hub, primarily due to the historical landmark of *Piazza dei Miracoli*, the presence of the international airport

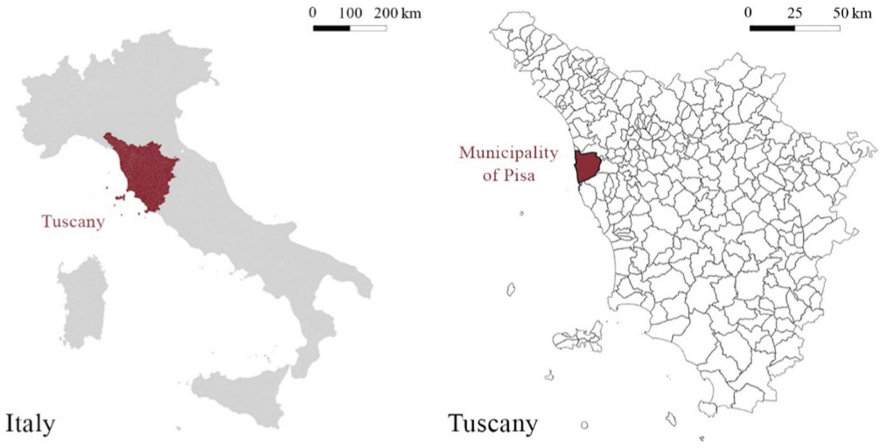


Fig. 2. Localization of Tuscany and Municipality of Pisa.

of the Tuscany region, and its proximity to Florence. This attractiveness results in the historical core being marked by a high concentration of dining commercial activities. Furthermore, because of the historical nature of the urban settlement, the central area is predominantly pedestrian and characterized by restricted traffic zones.

2.2 Datasets and Methodology

To conduct this study, three datasets were utilized. The spatial modelling of the urban grid (Road Centre Line) was achieved using data from Open Street Map [11]. The urban and neighbourhood grid was created with data provided by Geoscopio Toscana [12], from which the urban base map (Regional Technical Map 2K) was also extracted. The



Fig. 3. Pisa historical centre. Districts subdivision and landmarks

modelling of activities within the area was conducted by extracting functions' locations from the Open Street Map [9] geodata repository, then modelled using the QGIS suite [13].

From a methodological perspective, the study comprised three successive steps. Firstly, a historical-evolutionary analysis of the urban settlement through a semi-systematic bibliographic analysis [14] was conducted. This entailed tracing the transformations that the historic centre has undergone since the Middle Ages (10th century), considering the major changes in the built environment and the evolving use of urban spaces over the centuries.

Subsequently, spatial analyses were conducted at both levels. Drawing from Turner's studies [9], the Road Centre Line (RCL) was chosen as the base map for conducting Angular Segment Analysis to estimate both vehicular and pedestrian flow hierarchies at urban and neighbourhood scales. Specifically, the network was extended by 200 and 50 m respectively at urban and neighbourhood scale to mitigate edge effects. The measure adopted for flow analysis was the Normalized Angular Choice (Betweenness), considered its high correlation with vehicular and pedestrian flows [9, 10].

Concurrently, the functions within the study area were extracted from OpenStreetMap and categorized following the classification by Pezzica et al. [15]. Both point and polygon data were taken into account, by merging them into a single point layer. Unclassified data weren't considered. Therefore, a qualitative and quantitative evaluation of commercial activities distribution in relation to the centrality values of network segments was done. Specifically, regarding the quantitative analysis, activities were associated with the road on which they are located, and the percentage of activities located on network segments with the highest NACH values (10, 20, 30%) was calculated both at the urban and local scales.

3 Results and Discussion

3.1 Urban Scale Analysis

Historical Analysis. During the 10th century, the historical centre of Pisa was enclosed within a very small circle of walls. The first expansion occurred around the year 1000, dividing the city into four main districts: "Ponte" in today's Santa Maria neighbourhood, "Mezzo" further north, "Foriporta" (San Francesco), and "Chinzica" south of the Arno River. The current configuration of the city walls was established around 1150 by the consul Cocco Griffi, incorporating the borough area, the Cathedral Square, and Chinzica [16].

From the Late Middle Ages (11th century) onward, Pisa declined under Florentine dominance, with the city confined to the Santa Maria neighbourhood. An economic and demographic recovery began in the 16th century, marked by numerous architectural and artistic endeavours, land reclamation works throughout the countryside, and the restoration of Pisa's *terziario*, namely the transformation of the city in a commercial hub, an artisanal and mercantile centre, as well as a noble and university town under the governance of Cosimo de' Medici. Notable constructions during this period include *Piazza dei Cavalieri*, *la Sapienza*, which was the main university hub, *Piazza delle Vettovaglie*, la *Loggia dei Mercanti*, *l'Arsenale della Cittadella Vecchia*, l'*Orto Botanico* (please refer

to Fig. 3); the *Lungarni* flourished with the construction of several aristocratic palaces, becoming the most prestigious streets of the era. The most densely populated residential area remained the Santa Maria district, which retained its commercial nature [17].

Unlike other Tuscan cities, Pisa has historically comprised several economically and socially significant nuclei without a true central core. The city's heart shifted over the centuries from *Piazza dell'Arcivescovado* in Roman times to *Piazza della Pescheria* in the early Middle Ages (now *Piazza delle Vettovaglie*), and then to *Piazza dei Cavalieri* during *Medici* rule. Some scholars argue that the city has experienced a shift away from the traditional squares towards the *Borghi-Corso Italia* axis [17]; *Piazza Santa Caterina*, for example, is located in a central position, but actually marginal in the city's community life. Pisa's ancient road network is a mixture of narrow, winding medieval streets and a grid echoing the 19th century patterns [18], with frequent intersections between narrow and wide streets: a main road crossing the Arno River (today's *Corso Italia* and *Borgo*) and others parallel to it, connecting to the city gates, interlinked by alleys.

In the 19th century, there was a surge in public works focusing on demolition and saturation to introduce new roads, occupying most of the green areas within the walls. The limits of Cocco Griffi's walls were exceeded in the post-war period, creating a series of radial nuclei around the medieval city. Urban development, however, witnessed disorderly growth, characterized by rampant construction speculation, in particular along Lungarno Mediceo, and saturation of areas adjacent to the walls. Over the years, the university continued to expand, facing challenges in introducing new campuses and coexisting with the local population, who have been displaced by the conversion of residences into student apartments.

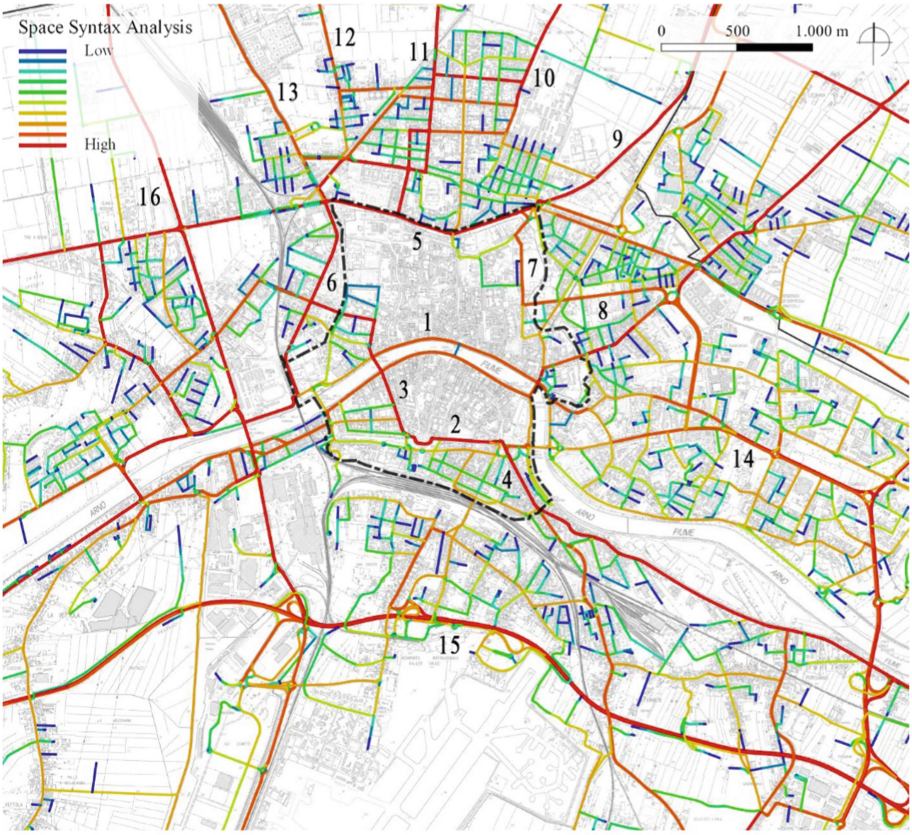
Vehicular Flow Analysis. The inter-municipal road network, comprising the municipality of Pisa and adjacent municipalities, was analysed to highlight the traffic roads in the suburb of Pisa as well as in the historical center, largely characterized by Limited Traffic Zones, excluded from the analysis. The ASA RCL (NACH Rn) (Fig. 4) shows two main axes crossing the historical centre, *Lungarni* and an axis near the ancient walls in the South, *Via Benedetto Croce*, (separating the station district from *San Martino*), which continues westward to *Via Crispi-Ponte Solferino-Via Roma-Via Risorgimento* and eastward to *Via Cattaneo*, then *Via Fiorentina* and *Via Emilia.* From the outside, vehicular flows distribute along the walls to the north (*Via Contessa Matilde*), reconnecting to the *Lungarni* via *Via Bonanno Pisano* to the west and crossing the walls through *Via Buonarroti* and *Via San Francesco*/*Via San G. Bosco* to the East. Moreover, among the main axes departing from the center emerges *Via del Brennero* to Lucca, then *Via di Gello*, *Via XXIV Maggio*, *Via San Jacopo* and *Via Pietrasantina* to the north, and *Via Matteotti*/*Matteucci* leading to *Cisanello* to the east. Among the main suburban axes, becomes evident either the Fi-Pi-Li highway in the southern area, or the Aurelia state road running vertically in the western area. The ASA RCL analysis proves the city of Pisa to be an attractive/diffusing hub in all directions, characterized by radial axes with NACH high values, from the historical center to the many adjacent nuclei.

Pedestrian Flow Analysis. The ASA RCL (NACH Rn) calculated on the historical centre road network, highlights the preferred pedestrian routes (Fig. 5). Particularly, the hierarchy reveals several aspects emphasized in the historical-evolutionary reconstruction. The presence of a single preferential vertical axis that continuously traverses

the entire centre from south to north (*Corso Italia-Ponte di Mezzo-Borgo*), supports the shift in centrality from squares to the central urban axis described by [17]. However, additional vertical axes characterized by significant centrality emerge. In the southern portion, *Via Sant'Antonio* emerges, while in the northern portion, from west to east, *Via Roma*, *Via Santa Maria*, and *Via Buonarroti* (please refer to Fig. 5) come out. As the main transversal axes, *Via Battisti - Viale Bonaini*, the two *Lungarni*, and the axis *Via Contessa Matilde - Via del Brennero* arise – this last one despite its marginality in the system, as it was constructed. Then, a series of transversal segments connecting these primary axes to the surrounding areas, emerge: *Via Cottolengo-Manzoni*, *Via Turati*, *Via San Martino*, *Via Giusti-Palestro*, *Via San Francesco*, *Via San Lorenzo*, and *Via Pietro Maffi*.

Curiously, all the paths that identify the boundary between adjacent neighbourhoods are configurationally strong, echoing Lynch's analysis [19], according to whom paths can represent boundaries of urban tissue, and thus act as elements of segregation between adjacent neighbourhoods. The axis *Corso Italia-Borgo*, the *Lungarni*, and, to the south – with a slight shift from the actual 'boundary' between the Stazione and Sant'Antonio and San Martino neighbourhoods – the transversal axis *Via Battisti-Viale Bonaini*, are clear examples of this concept. Also noteworthy is the presence, among the 20% of the most integrated axes, of the streets that give their names to the 4 historical neighbourhoods: *Sant'Antonio* and *Santa Maria* are the vertical ones, *San Martino* and *San Francesco* are the transversal ones. Moreover, *Piazza dei Miracoli*, despite being in a position far from central, is naturally characterized by pedestrian flow.

Commercial Activities Distribution. After assessing the hierarchy of the road network, the distribution of commercial activities was analysed. As outlined in Sect. 2, functions were extracted from OSM and categorized into the 6 macro-categories highlighted in Table 1. Specifically, to examine the spontaneous distribution of commercial activities, the macro categories of commerce and entertainment (in red) were considered (Fig. 6). In the background, only the road network categorized according to Urban ASA RCL measures (NACH Rn) in 10 classes is represented. A preliminary qualitative analysis reveals that a significant portion of commercial functions is distributed along the central axis of *Corso Italia-Borgo*, with a more substantial presence of commercial functions in the northern portion compared to the southern portion of Pisa, thus reflecting the area's historical commercial prominence. However, a basic quantitative analysis was conducted to assess potential correlations between commercial activities distribution and pedestrian flows. Specifically, the number of activities located in high-betweenness streets, and therefore characterized by great through-movement potential, was examined. In particular, the number of commercial activities located in the top 10, 20, and 30% of streets with the highest NACH values was calculated (see Table 2). It emerged that 30% of the commercial activities in the historic centre are concentrated on streets with the highest 10% NACH values, and furthermore, 60% of the activities concentrate on streets with the highest 20% NACH values. Remarkably, almost 70% of the activities concentrate on streets with the highest 30% NACH values. This proves the configurational logic, wherein the urban network determines areas of greater centrality and high flows, thus attracting commercial activities localization and confirming Hillier's theory [20] (please refer to Fig. 5).



MAIN AXES

1 Lungarni	7 Via Buonarroti	13 Via Pietrasantina
2 Via Benedetto Croce	8 Via San Francesco-Via San G. Bosco	14 Via Matteotti-Via Matteucci
3 Via Crispi	9 Via del Brennero	15 Fi-Pi-Li highway
4 Via Cattaneo	10 Via di Gello	16 Via Aurelia
5 Via Contessa Matilde	11 Via XXIV Maggio	
6 Via Bonanno Pisano	12 Via San Jacopo	

Fig. 4. Municipality RCL Angular Segment Analysis, NACH Rn (Equal Count). Analysis of the vehicular flow through the urban and periurban areas.

3.2 Neighbourhood Scale Analysis: Santa Maria

Historical Analysis. The Santa Maria neighbourhood encompasses the ancient city area within the first wall. Throughout the history of the city, it always held a significant role. It hosts *Piazza dei Cavalieri* (please refer to Fig. 3), which in Roman times represented the city centre, hosting the forum of the Republic, and during the communal era was the site of the traditional *Gioco della Mazza Scudo* – named *Gioco del Ponte* after its relocation over *Ponte di Mezzo* [21]. It is also remembered for the tower of the Dantean Count Ugolino in the Gherardesca palace. The new layout of the square, however, dates back

Table 1. Categorization of activities extracted by Open Street Map (OSM) repository. In bold the functions selected for the investigation.

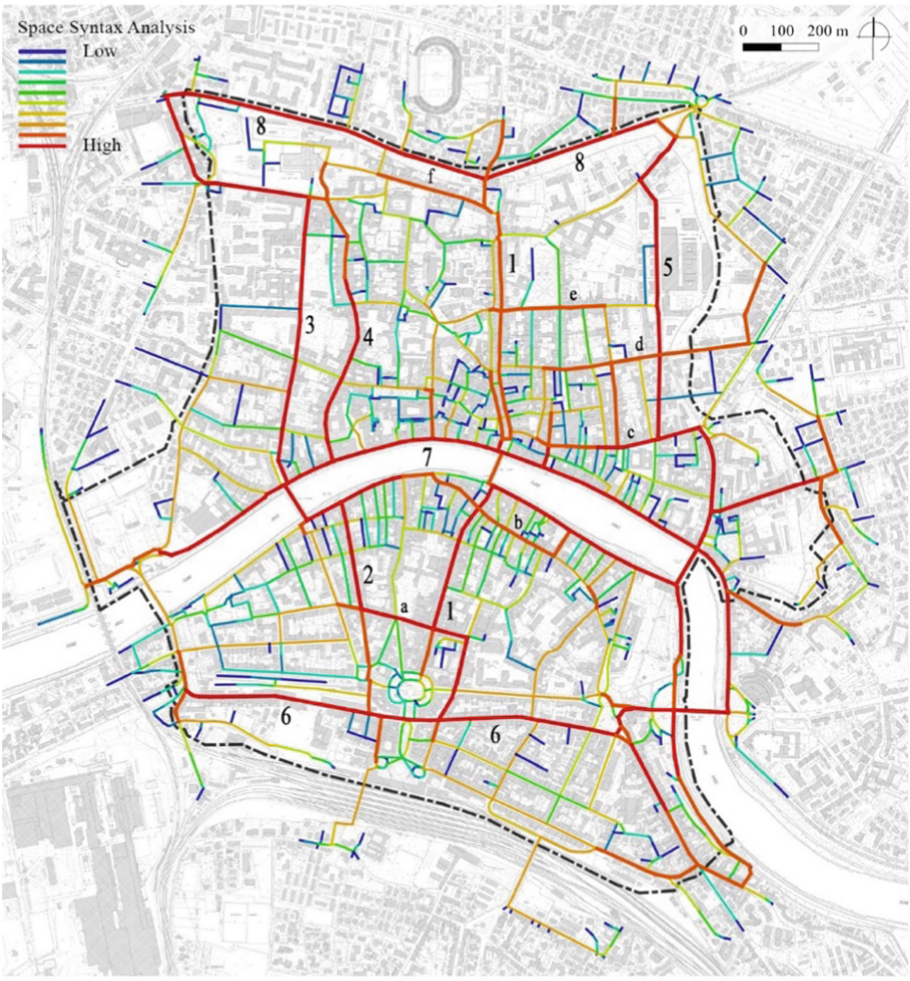
Function	Key	OSMCategorization
Commerce	**Shop**	**Shop**
	Amenity	**Sustenance**
	Amenity	**Financial**
Healthcare	Amenity	Healthcare
Education	Amenity	Education
Entertainment	**Amenity**	**Entertainment, arts & culture**
Other services	Amenity	Public Service
		Facilities
		Waste Menagement
Transportation	Amenity	Transportation

Table 2. Quantitative analysis: correlation between NACH and commercial activities distribution.

% NACH	OSM Commerce		% OSM
	Total	% NACH	
10	853	268	31
20	853	509	60
30	853	585	69

to the mid-19th century. Already in the 11th century, the neighbourhood's location had strong urbanistic importance in relation to the monumental *Piazza dei Miracoli*, hosting the Cathedral, the Baptistery, the Bell Tower, and the Cemetery, built after the inclusion of the area within the city walls. Moreover, the neighbourhood included the *Sapienza* building, the *Rossi* Theatre, the Botanical Garden, the Archbishop's Palace [21]. *Piazza delle Vettovaglie* represents another key element of the neighbourhood, built between 1494 and 1553 after the excavation of a part of Pisa's ancient nucleus in order to establish the market there; it has always maintained its commercial vocation, formerly home to numerous butcher shops and now to the roaming fruit and vegetable market, as well as the vital centre of Pisa's evening entertainment scene.

The Santa Maria neighbourhood appears heterogeneous, historically characterized by high population density, with buildings prevailing over the green areas. The area was further densified, like many others in the historic centre, between the 17th and 18th centuries. In particular, the Vettovaglie area and the area adjacent to the western walls were densified in consequence of the Solferino bridge construction (1875) which directly connected Santa Maria to Sant'Antonio [16].



MAIN VERTICAL AXES	MAIN TRANSVERSAL AXES	SECONDARY TRANSVERSAL AXES
1 Corso Italia-Borgo	6 Via Battisti-Viale Bonaini	a Via Cottolengo-Manzoni
2 Via Sant'Antonio	7 Lungarni	b Via San Martino
3 Via Roma	8 Via Contessa Matilde-del Brennero	c Via Giusti-Palestro
4 Via Santa Maria		d Via San Francesco
5 Via Buonarroti		e Via San Lorenzo
		f Via Pietro Maffi

Fig. 5. Urban RCL Angular Segment Analysis: NACH Rn (Equal Count). Analysis of the pedestrian flow through the urban historical centre.

Pedestrian Flow Analysis. Analyses at the neighbourhood scale highlight more prominently the main local axes, which nevertheless confirm the hierarchy observed at the urban scale (Fig. 7). The axe of *Via Santa Maria* and *Via Roma* emerge, this last one maintaining high values despite the disconnection with the bridge and the southern area.



Fig. 6. Commercial activities distribution over the 10 classes equal count categorization of the urban RCL ASA (NACH Rn) network.

Additionally, despite their marginal position and the edge effects, the axis of Borgo to the east and Lungarno Pacinotti to the south arise. Compared to the urban scale, the axes leading to Piazza dei Cavalieri (*Via Consoli del Mare* and *Via San Frediano*) are more prominent, underscoring the centrality of this square. The dominant entrance across the walls from the outside seems to be in *Piazza del Duomo*, actually the main tourist hub, strongly predominant in comparison with the other parallel streets in the western area.

Commercial Activities Distribution. As for the historical center, the macro categories of commerce and entertainment (in red) were considered (please refer to Table 1) to show the distribution of commercial activities (Fig. 8). From a preliminary qualitative analysis, an activities' agglomeration is revealed in the south-eastern portion of the district, along

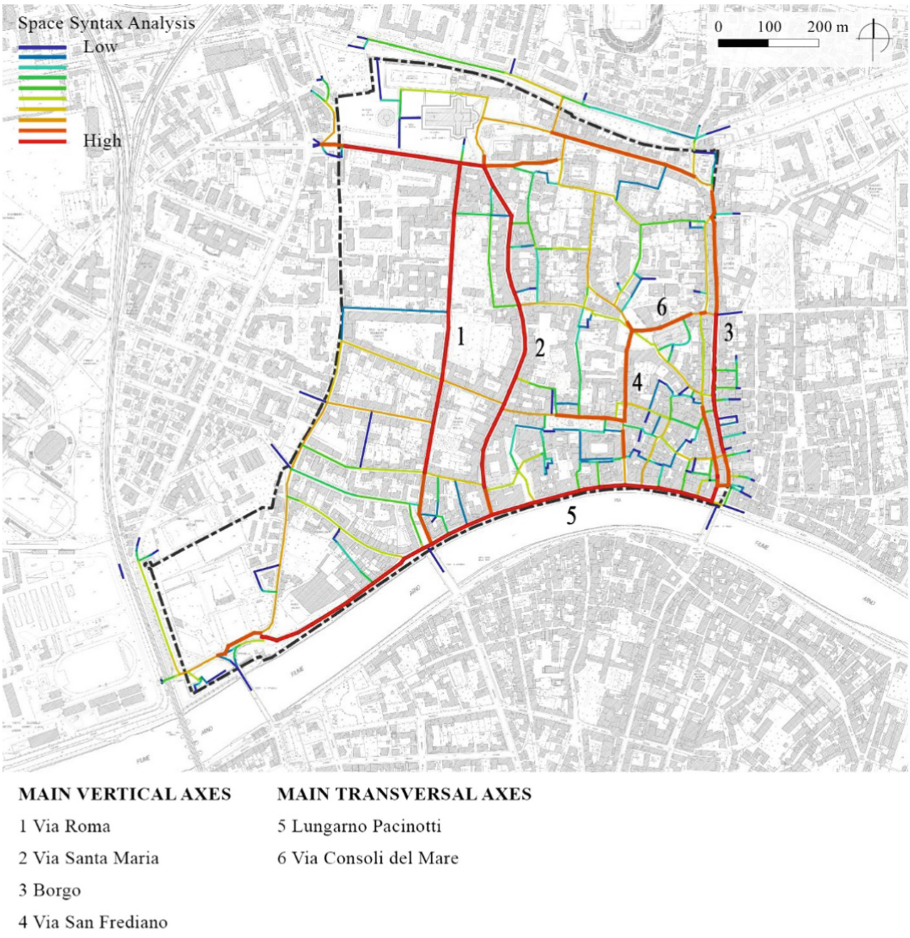


Fig. 7. Urban RCL Angular Segment Analysis: NACH Rn (Equal Count). Analysis of the pedestrian flow through the Santa Maria neighbourhood.

Borgo Stretto and the axis of *Via l'Arancio-Via Cavalca,* but is also displayed a concentration in the central area of *Via Santa Maria* and *Via dei Mille*, to *Piazza dei Cavalieri. Piazza delle Vettovaglie* confirms its historical commercial vocation. A basic quantitative analysis shows the potential correlations between the activities and the pedestrian flow in the road network, categorized according to Urban ASA RCL measures (NACH Rn) in 10 classes. Differently from the urban scale, there is a notable rise of the rate of the activities concentrates on the street with the highest NACH values, particularly within the top 10% NACH values where it reaches 45% (Table 3). There is no homogeneous concentration of activities on roads with higher NACH values; some of these axes, in fact, host a small number of commercial activities (e.g., *Via Roma*).



Fig. 8. Commercial activities distribution over the 10 classes equal count categorization of the neighbourhood RCL ASA (NACH Rn) network.

Table 3. Quantitative analysis: correlation between NACH and commercial activities distribution.

% NACH	OSM Commerce		% OSM
	Total	% NACH	
10	329	149	45
20	329	222	67
30	329	241	73

3.3 Urban vs Neighbourhood Scale: A Brief Comparison

The multiscalar analysis has proven useful in investigating various aspects, despite the slight dimensional difference between the two systems, with Santa Maria being approximately a quarter of the historical centre of Pisa. Firstly, the RCL ASA NACH analysis at the inter-municipal scale – performed after eliminating the area forbidden to vehicular flow from the system – highlighted the vehicular movement patterns [9]. The same measure, calculated on the complete urban system and referred to as 'urban RCL', has highlighted pedestrian preference routes instead. This analysis has essentially shown

how the major flows concentrate on the axes separating historical neighbourhoods and in the ancient cores of each neighbourhood, providing the input to further explore this correlation, which could prove useful in intercepting the primary historical axes of historical cities. A similar analysis has been developed at the neighbourhood scale in the Santa Maria neighbourhood, where the logic identified at the urban scale was confirmed but supplemented by the to-movement potential represented by Piazza dei Cavalieri and the streets leading to it.

Examining the second-order indices [7], further peculiarities of urban settlement are highlighted. Second-order indices derive from primary configurational indices and are capable of describing the configurational characteristics of the entire system rather than just its individual elements, thus proving to be significant indicators of the overall characteristics of the analysed settlement. Specifically, the Synergy index – a correlation index R^2 between global integration index and local integration index – reveals how the local relational and spatial organization of the settlement is well grounded in its global organization, both at the urban scale ($R^2 = 0.73$) and even more so at the neighbourhood scale ($R^2 = 0.81$), indicating coherent spatial relationships across various scales. Indeed, where the strong global integrators are also strong local integrators, it means that the network of dominant relationships within portions of the settlement coherently ties into the network of spatial relationships of the entire system [7]. Conversely, both the urban and the neighbourhood systems are characterized by a low Intelligibility index – a correlation index R^2 between global integration index and connectivity index –, thus indicating a weak correlation between the global integration index and the connectivity index. Essentially, the two systems are not easily interpretable by an external visitor, who will have difficulty orienting themselves in the urban grid due to the lack of correspondence between integration and the number of prospective connections. Indeed, where the main hubs do not correspond to a high number of visual openings onto adjacent paths, orientation for a visitor will be more difficult compared to the opposite situation where main hubs correspond to a high number of connections on nearby paths. Nevertheless, the network of Santa Maria neighbourhood emerges as more easily understandable ($R^2 = 0.46$) than the historical centre ($R^2 = 0.33$) Table 4.

Table 4. Sinergy index and Intelligibility index of the urban and neighbourhood systems.

Second order indices	Urban scale [R^2]	Neighbourhood scale [R^2]
Sinergy value	0.73	0.81
Intelligibility value	0.33	0.46

Furthermore, on both scales, RCL NACH has demonstrated a strong correlation with the distribution of commercial activities, indicating a significant clustering of these businesses along streets characterized by high-NACH values.

Several potential improvements to the methodology have been identified. Particularly, it would be valuable to assess the differences between the use of RCL ASA, isovist-based ASA, and Visibility Graph Analysis (VGA) in both estimating flows and

exploring correlations with the distribution of activities. However, in the case of line-based analysis and VGA, a more refined methodology would be necessary to accurately associate commercial activity's location with isovists, considering the increased segmentation/granularity of those analysis. Additionally, for neighbourhood analysis or any micro-scale analysis, conducting on-field verification of OSM data concerning the existence and location of commercial activities may be necessary to improve the accuracy of the research. Finally, further quantitative analysis methodologies could be tested.

4 Concluding Remarks

This study highlighted the natural ability of the configurational approach to interpret urban dynamics across multiple scales. More than this, Space Syntax has proven capable of interpreting the spatial roots of urban growth by intercepting dynamics that, by their very nature, develop at different scales, contingent upon distinct sub-systems. Specifically, it has been demonstrated the capability of the Space Syntax technique to interpret vehicular and pedestrian movement at the urban and neighbourhood scales, as well as to illustrate how the natural distribution of commercial activities in the territory follows configurational logics. Moreover, given the analytical framework of this approach, it is possible to combine qualitative analyses of network hierarchy with quantitative analyses that, using appropriate techniques, allow for comparisons between different urban grids.

Future studies should work in two directions. On one hand, to deepen the multiscale potential of the configurational approach, evaluating the various information that can be extracted from the urban network from the regional scale to the micro-urban scale, through the testing of various metrics and analysis techniques: Axial Analysis, Angular Segment Analysis, Visibility Graph Analysis. On the other hand, test the effectiveness of Space Syntax in investigating sub-systems related to urban dynamics that it is able to detect, such as the investigation of the location of commercial activities, the functioning logics of multimodal transportation, criminal dynamics, and urban sprawl phenomena, still through a multiscale and multi-techniques comparative approach.

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