

The morphology of mixed-uses

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Abstract

In the fields of urban planning and architecture, it is often difficult to articulate with rigour the interaction of the form and use of spaces that gives social life to cities. A layperson's attraction towards a particular urban location offers testimony to the important role that spatial configuration plays in shaping our cities. Perhaps more important, it is how individuals' 'local knowledge' create place-making within their locality. This paper proposes the general question of how the physical configuration of cities affects social life. It outlines the relationship between urban form and the activities it accommodates, arguing that a city must be addressed in its social, economic and spatial environments, in its architectural and urban design scales.

This work presents an interdisciplinary research that combines morphological and urban economic methods. Firstly, it examines competing locations of different activities, identifying places of mixed-use development. Different urban locations within a city are studied according to the urban spatial network using 'space syntax', a technique that informs how the urban geometry of spaces play a role in distributing activities. Secondly, the morphology of the location of mixed-use developments is addressed at a local scale –in the building, the plot and the street. The results of this work showed that competing land users searching to pay for good access for a location depends on the architectural flexibility of a building to accommodate different uses, offering different possibilities for adaptability depending on their urban location. It is also shown that fostering mixing of uses within a same location becomes a product of the knowledge and skills of individuals.

Keywords: urban form, Jacobs, mixed-use, knowledge economy, space syntax

INTRODUCTION

The relationship between urban economy and urban morphology relates to a general idea of what makes cities grow. This idea is grounded on the understanding that a city is essentially a social phenomenon. What makes economic expansion happen in the first place is an issue that has been addressed in a variety of disciplines, ranging from economics, sociology and geography to urban planning and urban design. However, the root of the problem is not only what makes it happen, but also the scale in which it occurs. Urbanisation can be said to be a reflection of individual decisions on how land and built forms are structured in order to shape a city's development and growth. Whether these decisions are of an economic or social nature, they are decisions materialised as actions in space, taking effect in multiple ways in an urban settlement, from the building form to an entire city. In this sense, one of the major challenges in urban planning and urban economics is how to understand the relationship between the spatial configuration of cities and its influence on the social life of their inhabitants.

The field of urban design has gradually acknowledged the importance of social life in cities, offering different views of accounting the social value of design (Alexander et al, 1977; Doxiadis, 1968; Lynch, 1984). Accordingly, the theoretical foundations of the spatial geometry of the built environment became relevant amongst scholars who offered a view of how diverse actors affect the spatial structure of cities (Martin and March, 1972; March and Steadman, 1971; Hillier and Hanson, 1984; Marshall, 2005). Taken together, the inception of urban design as social process became a condensed praxis that allowed an analysis of urban form in relation to a wider field of knowledge (Cuthbert, 2006). While cities continue to grow physically, the real knowledge of their social organisation distinguishes the relevance of economic processes in cities. Max Weber's *Economy and Society* (1968) expressed this consideration arguing that urban life in its full complexity could only be explained through the invisible web of economic and social processes.

In *The Death and Life of Great American Cities* (1961), Jacobs argued that the order present in well-functioning urban areas emerges as a result of human action and not in design. One of Jacobs' major contributions in urban planning is her conception of cities as "problems of organized complexities" which entail "dealing simultaneously with a sizeable number of factors which are interrelated into an organic whole" (1961:564-565). Indeed, the challenge is not only to account for the large number of factors to be taken into consideration, but the interrelationships between the factors. Therefore, a form-process dialectic cannot be explained in one single component, but in the combination of one component to another. The notion of complexity evoked by Jacobs suggests that any particular interaction between form and use could take shape in many ways depending on additional factors.

Jacobs' readings of cities extended to a distillation of an economic framework (ibid: 1969a, 1969b, 1980, 1984, 1992, 2000). Her economic writings represent a logical extension of her micro-based approach to understanding the social order of cities and also testify to the importance of economic development and expansion, which have served as a starting point for empirical research amongst economists (Lucas, 1988; Romer, 1986; Glaeser, 2011; Ikeda, 2011). In *The Economy of Cities* (1969a), Jacobs defines a 'city' as "a settlement that consistently generates its economic growth from its own local economy" (ibid: 262). She explains that cities develop by adding new kinds of work to their existing economies, then develop these new types of work into export businesses serving other cities and use the imports gained from this export work to develop still more kinds of businesses¹, in a repeating cycle (1969a pp.3-38). In Jacobs' terms, trade of animals was necessary to the discovery of agriculture and husbandry implied also that these discoveries had to move out of the city due to land competition.

Within Jacobs' economic theory, one of the key issues she successfully contributes is the process of exchange, first and foremost a social process that creates economic situations. Key factors such as trade, location and the production of markets, all implicit in Jacobs' observations, have been addressed from early spatial descriptions of urban settlements in the attempt to explain their economic growth and the importance of a central location. These descriptions were represented in urban land models that initially focused on the principles of agricultural land (Von Thünen, 1826), to describe how socio-economic forces act upon urban spatial structures addressed by sociologists (Burgess, 1925) and economists (Hoyt, 1933), and the central locations of markets in urban settlements (Christaller, 1933). However, the study of economic processes relating to spatial form increased the level of complexity by adding other environmental factors. Addressing the spatial organisation strongly influenced by concepts of location and distance, the gradual analysis of urban settlements introduced more normative models that linked transportation and land uses

¹ This referred to the role of small businesses in creating new lines of work as opposed to the large businesses that can lead to stagnant company towns.

(Lowry, 1964; Echenique and Williams, 1980; Putman, 1998).

The analysis of city growth traces back to Jacobs' arguments about the complexities of social orders and exchange as the economic value of social life. There is little consensus, however, over the significance of urban-architectural form in urban economic theory. It is argued that the holistic view in urban planning and urban economics is that despite the acknowledgment that urbanisation is influenced by social and economic processes, they fail to recognise how these processes are both part of the resulting landscape of a city and the architecture that organises its geography. Therefore, the question of whether the physical configuration of a city has any significance in social and economic processes remains contested. This paper brings to the fore several considerations of why this view should be addressed in different aspects.

First, the change and growth of cities demands more attention to understanding how the activities of city dwellers are affected by the design of the built form. The use of space in cities has been rapidly taken by urban localities, even increasing faster than the urban population itself (UNFPA, 2007). Yet, where and how land is incorporated in cities has social and environmental implications for future populations. Thus, the urban growth and sustainable use of space in cities has become increasingly important to the understanding of how the spatial configuration of the built form affects the way people live in it. 'Spatial configuration' is a term originally expressed by Hillier and Hanson (1984) in order to explain how buildings and settlements constitute a system of spatial relations, defining the concept as 'relations that account other relations'.

Configuration refers to the spatial relations that make up buildings and cities (rooms in buildings, streets in cities) that take a certain size and form (Hillier, 1996a). In this sense, spatially speaking, buildings and cities are configurations that describe the connectivity and adjacency of spaces that result from their geometry. Therefore, spatial configuration is not only about connections, but also how the position of each space is related to all others. In a word, *association*. The physical structure of cities is understood in the geometric layout of buildings and streets, and the circulation of routes that connect them. The way these urban elements are laid out results in spatial patterns of access and generation of land uses. Implicitly, this accounts for the relation between space and human activity taking place therein. These aspects require further empirical research. If the physical configuration of the built environment is neglected it would be disregarding the qualities that imply the economy and social life of cities.

Second, the complexities of city form begin with ordinary people forming informal relations with one another in neighbourhoods in which they live or work. Community networks emerge and thrive when people are able to have different forms of exchange and encounters with acquaintances or strangers in streets, sidewalks and other public spaces. These forms of exchange within a neighbourhood or district are what we commonly acknowledge as 'mixed-uses' (Rowley, 1996). Schools, places of worship, shops, offices, residences, theatres, restaurants located in the same vicinity help make it interesting and attract more people who are likely to encourage still more diverse uses (Hillier, 1996b, 1999), influencing the economic development in a city. The dynamics of economic expansion and contraction trace the emergence and changes over time in urban institutions and community networks of trust to the decisions of individual agents (Jacobs, 1961). Indeed, this issue has been raised in the management of spontaneous order (Webster and Lawrence, 2003), in which institutional analysis of cities and their planning, using transactions costs and property rights, have described how urban order evolves as individuals cooperate in cities for mutual gain. Cities and their economies work at the micro level and the relevance of trade in urban economic theory should acquire more attention also at the local city scale and not only as an urban scale process.

Third, the former mention follows the relevance of architecture in social and economic processes.

Activities of individuals, which have been historically accommodated by cities, are constrained by the geometry of the built form; this issue has been raised by Davis (2012), expressing that within a building different activities are adapted over time, allowing its functional and design flexibility to respond to locational contexts. Indeed, buildings accommodate the socio-economic needs of individuals, which makes them important in two main characteristics: They are potential locations for local production and they are potential generators of creating central urban places. These two aspects of architecture take their relevance within a wider system of economic factors, such as the role of prices or rents. This calls for a better understanding of how spatial geometry plays an important role in defining location, and its potential of being a central place within a city, by distinguishing the distance shaped in the urban street network. Changes in the built form, such as adaptable building types, respond to the pathway configuration of their urban location.

In this paper we investigate the spatial configuration of city form and its relationship with socio-economic processes within the context of mixed-uses. The focus on mixed-uses is based on variables which seemed to be contained in Jacobs' theories (1961; 1969a). First, in 'testing Jacobs hypothesis' correlating diversity of land uses and the morphology of blocks. This is approached in terms of pedestrian accessibility within a network of streets, and on the local scale of architectural morphology of mixed-uses. And second, to explore what mixed-uses implicate in terms of the effects of urban morphology over economic diversity in the wider context of the city.

The next section discusses the methodology. The next section shows an analysis of mixed-uses at a city scale. Following an urban analysis, an example of a local architectural scale is presented, showing how the mixing of uses is developed under certain conditions of spatial location. Finally, the last section opens a discussion.

METHODOLOGY

The study of the spatial configuration of city form and its relationship with urban economic theory has given some attention to the way these two fields can be correlated through different approaches. On the one hand, location and its economic properties have been studied through the concept of centrality in terms of attractiveness (Losch, 1952; Isard, 1956; Alonso, 1964). Methodologically, these approaches to centrality do not account for the factors of what causes the location of activities to be more favourable in one place than the other. On the other hand, research in configurational studies has addressed centrality as a 'spatial process' using spatial analysis (Hillier, 1999; Cutini, 2001; Crucitti et al, 2006; Porta et al, 2006; Krafft et al, 2011), in which the street network (representing the streets as segment lines in a map) is the main component. Centrality is approached in terms of its accessibility mainly in how places are closer to other places and how a place can be a potential location to be traversed.

Amongst the many traditional land models in urban economic theory, the principle of the bid rent theory by Alonso (1964) is taken as a basis to analyse the morphology of mixed-uses. The theory focuses on the notion of location and centrality. It gives a good understanding of the way urban areas are likely to grow, representing essentially how land users, whether they be retail, residential or office, are able to compete to pay for good access to the city centre. The amount they are willing to pay is called 'bid rent'. The analysis model uses rent values and location according to the distance from the city centre: as distance from the city centre increases, rent values will decrease. Conversely, the closer to the city centre, the higher the rent value. Put alternatively, it assumes that accessibility increases with centrality.

The principle of the bid rent theory is coupled with the analytical study of the street network

configuration. The method of space syntax is used to calculate attributes of urban space. The analysis examines spatial configurations by defining cities as a collection of buildings held together as a continuous network of spaces: the street network. The spatial configuration of the city is represented by a least line map, that is, the representation of the street network as a set of fewest lines that cover their structure. The techniques of space syntax identify the configurational structure of the urban street network, through a computer model called 'UCL Depthmap' (Turner, 2008-2011), in which the unit of analysis is the street segment between junctions. The analysis focuses on the way the street segment is related to all other segments in the urban system. Thus, each street segment is studied according to how accessible it is from all other spaces in the system. The street segments analysed by Depthmap describe the urban system according to the distribution of accessibility (Hillier and Vaughan, 2007), which is a way of calculating the degree of centrality in spatial configurations.

In order to compare the principle of the bid rent theory with a pedestrian accessibility of the street network configuration, centrality is measured as depth distance –distance from a selected street to all other streets in the urban network (Penn et al, 1998). Previous study involved using different types of distances in order to compare different characteristics of urban centrality and urban morphology (Narvaez et al, 2015, 2014). The types of distances included topological (fewest number of turns in the street network) and least angle change of directions apart from metric distance. For the purpose of this paper, we use metric distance to exemplify the principle of the bid rent theory as well as to examine the local design scale of patterns of mixed-uses. In space syntax analysis, metric distance is calculated as the distance in metres between a street segment and all other segments in the urban street configuration.

LOCATION AND DISTRIBUTION OF MIXED-USES

The analysis of mixed-uses is based on the distribution of property rent values of three types of land uses: retail, manufacturing and residential using the city of Cardiff, UK. Every point in the map represents each property rent value plotted against distance from the city centre. The unit of analysis for property values is rent per square metre. We acknowledge that bid rents from the empirical data in the analyses are not bid rents in the strict sense. Therefore, we present a variant of Alonso's bid rent theory proposing *pseudo bid rent curves* (hereafter PBRC). PBRCs are the resulting curves plotted in a graph that correlates distances from the city centre with different types of uses and their rent values. Since the empirical data is formed by property rent values, the PBRCs refer to the constructed-land value at specific locations in the city. Therefore, PBRCs indicate land-use patterns that bring about mixed-use profiles of the built form at certain locations rather than the actual competition between land uses at a particular location.

The result of plotting each type of property rent value against distance from the city centre (expressed in kilometres) is represented in Figure 1, which shows the first part of our analysis. The graph presents the PBRCs of Cardiff for the three types of uses. However, while the graph illustrates retail as apparently dominating the other two uses and residential mostly dominating manufacturing, it is argued that this underlies mixed-use patterns at certain locations in the city. The maps in Figure 1 show the observed locations of rent values ranked by their distance from the city centre, which accord with the PBRCs in the graph. In other words, the map traces each pseudo bid rent curve, representing them in the spatial form of the city. Figure 3 shows the points in the graph in which different land uses overlap. These points represent use-mix profiles in the city.

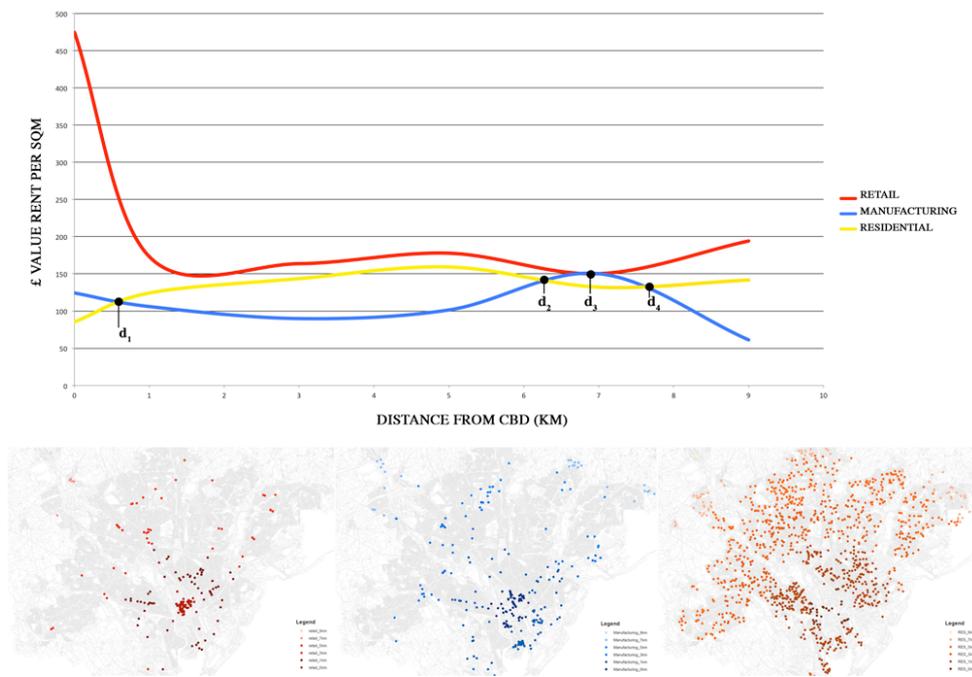


Figure 1. Pseudo bid rent curves representing types of land uses and their rent values according to their distance from the city centre.

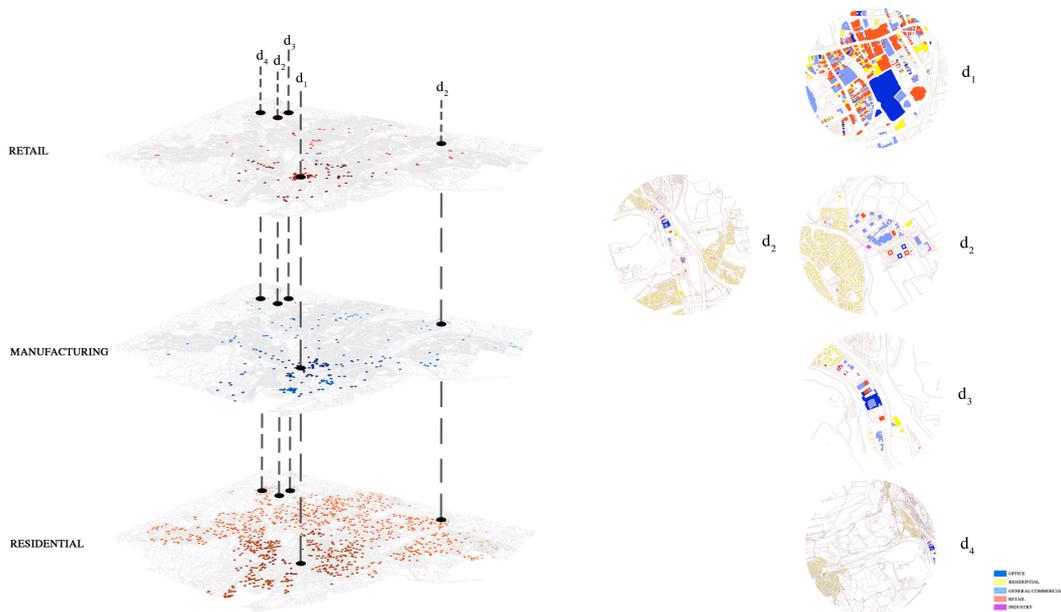


Figure 2. Map representing each land use ranked by their distance according to the graph in Figure 2. The points in the graph indicate the location of mix-use profiles at different distances in the city.

The PBRC graph in Figure 1 describes the mixes of use within the various distance ranges. The intersections of the graph define land-use mix profiles across the city. In order to see any similarities or differences between the curves, each of them are statistically compared using an ANOVA test. This test allows comparison of different means between the PBRCs. Table 1 shows the variations between and within the groups of rent values in the sum of squares. The difference between groups is greater than within groups. Therefore, it is suggested that residential and manufacturing use does

significantly differ (residential $p= 0.01$, manufacturing $p=0.047$) between the three groups of rent values, while retail does not represent a significant difference amongst the groups ($p=0.110$). This means that the curves of residential and manufacturing are different, while retail is not in comparison to the other two curves.

		ANOVA				
		Sum of Squares	df	Mean Square	F	Sig.
Residential_Rents	Between Groups	455835.981	5	91167.196	4.113	.001
	Within Groups	32409580.619	1462	22167.976		
	Total	32865416.600	1467			
Manufacturing_Rents	Between Groups	81338.201	3	27112.734	2.658	.047
	Within Groups	13647107.286	1338	10199.632		
	Total	13728445.487	1341			
Retail_Rents	Between Groups	45119.223	1	45119.223	2.568	.110
	Within Groups	8872708.300	505	17569.719		
	Total	8917827.523	506			

Table 1. One-way ANOVA for each property market

An interesting characteristic of measuring different types of uses and their rent values based on the bid rent theory is that the distribution of every type of use is scattered throughout the city. For example, retail use bids highly in locations scattered at all distances from the city centre, yet only in certain locations; these locations are in urban areas within a distance range of 0km (city centre area) to 9km from the centre. Manufacturing uses appears on the ground at certain locations due to its historical position in the city and the costs of relocating it or reusing the land for a more profitable use. Residential pseudo bid rent curve differs from that of retail and manufacturing in that, theoretically, satisfaction rather than transaction cost is the relevant criterion for optimal location. A city dweller will tend to seek a balance between the cost of commuting and the advantage of having more land at a given location. This is why it is argued that in residential bid price, satisfaction can weight more than profit.

MIXING USES BY STREET CONNECTIVITY

The second part of our analysis is applying the same logic as we did before using the street network configuration. The street network serves as a means to measure distance from the city centre according to the distance depth from a central location to all other locations throughout the city. The purpose is to test where and how mixed-uses are found and shaped according to the spatial configuration of the city. In this case, we present the use of metric distance. The underlying analysis that serves to measure metric distance is by the topology of the street network². Taking the main shopping street in the city centre as a starting point³, we quantify the number of 'steps' within a certain number of metres from one street to all other streets. The graph in Figure 3 shows the location of every types of land use and their rent value with 500m between them. Research has shown that a 500m interval would imply an estimated 5-minute walking distance (Mehaffy et al,

² We have also used separately topological distance and a least angle change distance (known as angular distance) to test the same analysis, which is presented in previous work (Narvaez et al, 2015). However, we only present a sample of one of the types of distances used in space syntax analysis. New results have shown that there is a difference of how mixed-uses concentrate in relation to the different types of distances in the street configuration (Narvaez, forthcoming).

³ The factors for which the main shopping street, called Queen Street, is taking as a point (street) of origin to make the analysis are based on historical background; in parallel, the street is considered as one of the highest accessible streets within the whole urban network (Narvaez, forthcoming).

2010), which would imply that distances are more associated with pedestrian movement patterns and therefore find locations based on that parameter.

On several occasions, retail, office and residential markets overlap (points A, C, K and N). The commonality between these points is the presence of mixed commercial and residential uses at the edges of the neighbourhoods. These are not local cores of retail or businesses within a neighbourhood, but are located on the outer edges of purely residential blocks and linked to main roads that inter-connect the city.

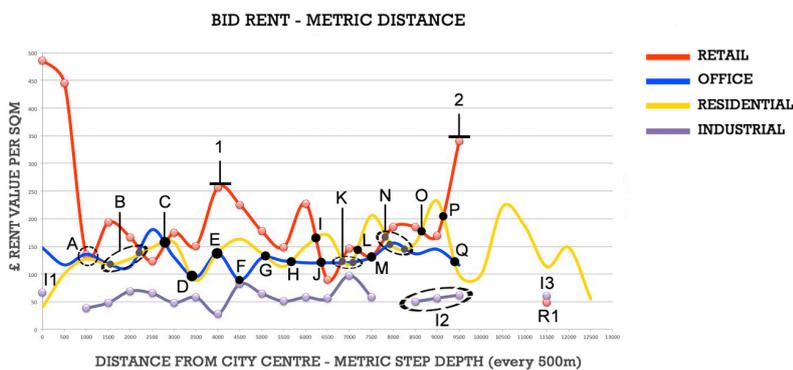


Figure 3. Location of mix-use profiles throughout the city within metric distance in the street configuration at every 500m.

Following the same methodology as the traditional distance from the city centre in the first analysis, an extract of use mix profiles that resulted from measuring PBRCs with metric distance is shown in Figure 4. The difference in the metric profiles from the traditional ones is that streets at every 500m measured from the city centre is presented. This is indicated in the column of 'intervals' in which metric step depths mark the street network in a similar concentric fashion, with the difference that instead of delimiting a zone, metric distances are captured in the street segments of the network. The methodology using the street network as a basis also informs about the pedestrian accessibility of each mix-use profile. For example, point A in Figure 4 highlights the city centre area; it shows the a high dense urban area composed by large urban blocks (form), with advantage in accessibility of main roads crossing from west to east of the city (accessibility), the diversity of land uses within and around the centre (Use) and the streets most immediate within 500m from the central area.

TABLE/GRAPH		METRIC DISTANCE - CITY CENTRE				
Symbology	ID POINT	Step Depth	URBAN LAYOUT FORM	STREET MORPHOLOGY ACCESSIBILITY	FUNCTION USE	INTERVALS Streets at every 500m from Centre
	A	1000-1500				
	B	1500-3000				
	C	2500-3500				

Figure 4. Sample of mix-use profiles: ID point refers to each location identified in the graph (Figure 3); step depth refers to the distance in metres at every 500m from the city centre; the symbology in colours represent the types of uses that overlap at a corresponding distance location.

THE LOCAL ARCHITECTURAL SCALE

This section presents an example of how mixed-uses are formed at the locale scale of the city. We show an example of how within metric distances we can find typologies of mixed-uses, particularly within local urban districts. We quantify the depth distance from a local high street of four urban districts. These were selected by several factors: by the planning proposals of the local council authorities that define which areas are considered urban districts; by their mixture of land uses; and by the accessibility metrics captured within a global radius –comprehending the entire city - and at a local radius, that is, spatial accessibility within an 800m radius (Figure 5).

From the four urban districts selected in the city of Cardiff, a number of typologies of mixed-uses were found, which mainly included corner shop locations that included mainly local businesses, such as shops, bars, takeaway food and some specialised businesses like surgery or hairdressers (Figure 6). Metrically, at less than 500m from the main street, we find these kinds of activities. This suggests that at one single turn of direction from a block that is possibly less than 500m away from the high street we are able to find a CRB at a corner that is likely to combine residential use with a general commercial use or a retail shop.

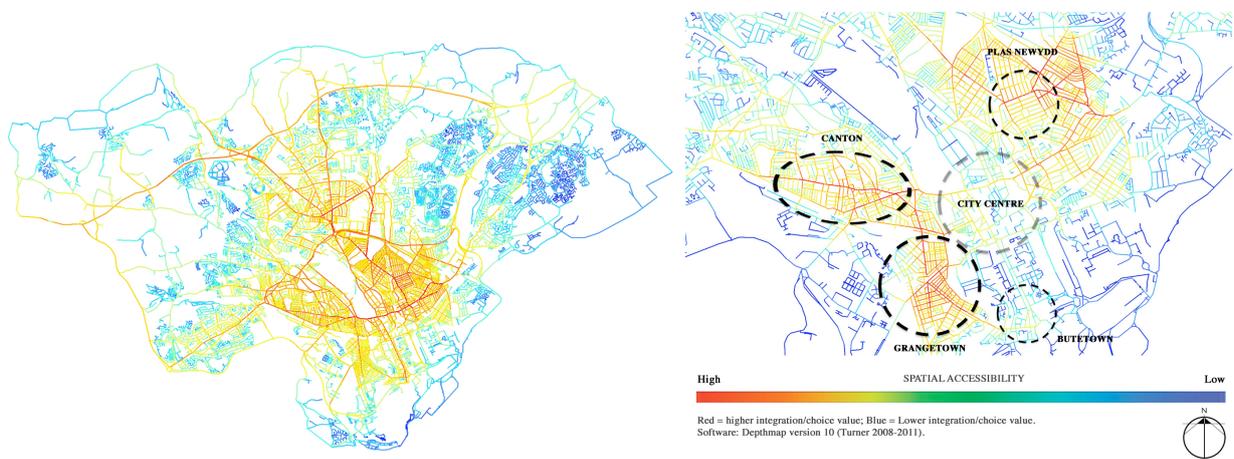


Figure 5. (Left) Cardiff's street network showing integration accessibility (potential movement to get to from one street to all other streets) at a global radius (whole city). (Right) Spatial accessibility within an 800m radius in the network highlighting local urban districts and the city centre.

From an urban scale analysis of mixed-uses, based on competing land uses (bid rent theory), to an architectural analysis of how mixed-uses are contained we simply the analysis of architectural form through an examples of a corner shop in comparison to middle block mixed-use building. In both cases, we are not considering high-rise building of mixed-uses. Rather the mixing of uses on corner shops and middle blocks refer to either family-owned shops who live in the residential space over the store, or the case of having separate functions that can be either renting a shop or a residential dwelling.

What the metrics of distance and rent values showed us is that mixed-uses is a bottom up process that reveals global patterns of distribution and organisation of the use of land (economic) and also the social factors that involve reconverting uses or creating one's business within a same property. This is shown as an example in Figure 6 where a mixed-use building containing a shop on the ground floor and two upper floors as residential use. First, in a middle block along a main high street, the owner of the building owns the shop and rents the two upper floors as separate rooms. This, in parallel, is typical in retail fronts where two door entrances are part of the façade. In contrast, the second example is a corner shop, which offers more possibilities to be architecturally adaptable to accommodate other uses. The corner shop is a family-owned business in which the

shop at ground level functions daily until late hours and a separate entrance on the rear side is for the family's residential space.

Whether it is the first or second example that mixed-uses can be formed, it raises questions about knowledge work. Knowledge and skills of individuals that creates businesses, and therefore, being part of organising diversity of land uses that we acknowledge often only at an urban scale. Little attention is given how resilient architectural morphologies and typologies have in local economies.

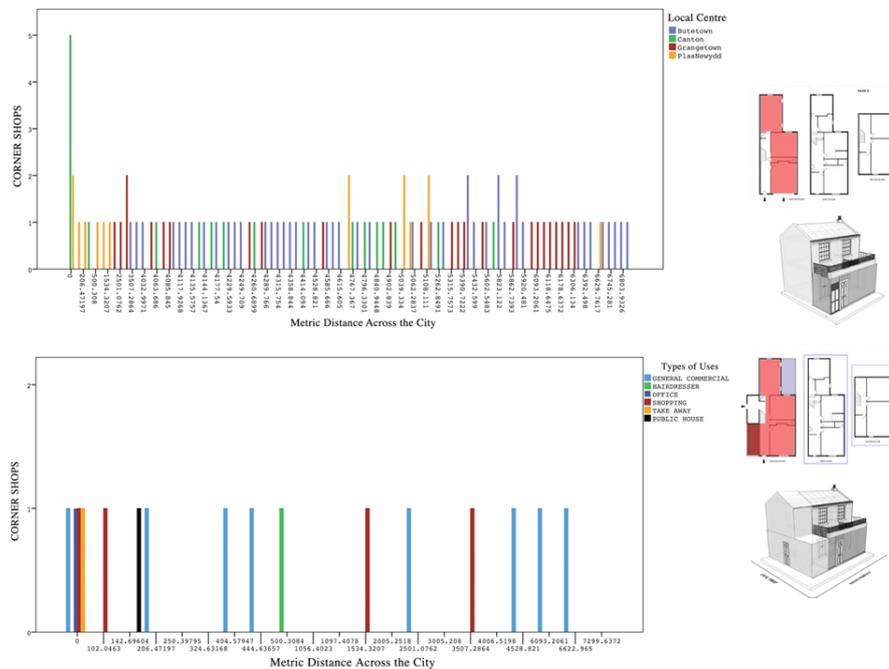


Figure 6. Metric distances from local urban districts of mixed-use building as corner shops; two examples of mixed-use buildings are shown in the right.

DISCUSSION

The results of this study are, we believe, initial steps to understand the morphology of mixed-uses and how they distributed and how they are developed morphologically, both globally and locally in the built environment. In this paper we present evidence of how mix-use profiles throughout the city can be identified combining two methodologies: one, is taking the principle of bid rent theory and using the street network configuration as a measurement of distances in the city. We proposed a variant of Alonso's bid rent model by using constructed-land value, which in turn proposes pseudo bid rents. The pseudo bid curves illustrated the locations of mixed-use profiles across the city, which then informs the morphological conditions of every location –their urban location, the relation to historical path dependency, what kinds of mixtures of uses occur and under what specific areas, such as high streets, residential area, central area, or the large mixed-use complex areas in the suburbs. What this evidence showed is that mixed-uses occurring throughout the city brings about the spontaneous city order that happens when mixed-uses are analysed at the local scale.

The methodology of combining spatial and economic variable not only proved to be effective addressing the city, but also to use it in the local design scale, bringing fundamental urban design parameters. One of them is the architectural morphology of mixed-uses depending on their location. And, on a second note, the nature of activities that mixed-use buildings contain in local urban districts, which are mostly common to the concept of a 'shop/house' (Davis 2012).

Again, in this light, Jacobs emphasis on the microfoundations of cities (1961) parallels to the ideas of Hayek (1945) in respect to how the use of 'old buildings' to create 'new work' (1969a) emerge spontaneously to handle local knowledge, that is, the use of information and skills to create innovation. The mixing of uses takes part of a competitive market that occurs at the heart of cities in which entrepreneurs establish new social ties, and sustaining the old ones, creating new knowledge work, or effectively, knowledge economy. This paper has tried to take a step forward to better understand the effects of urban morphology over such factors embedding economic diversity. For example, the case of a family-owned corner shop fosters resilience for change over time. The resilience to change is partly a result of individual decisions that respond to locational contexts which embed dynamics of pathway configuration, land value, and, ultimately, urban centeredness. All in all, the spatial configuration of mixed-uses forms part of the practices of place-making; it is multidimensional and multiscalar. The dimensions are, but not limited to, social, economic and spatial, which are inter-related and applied on different scales –the building, the street, the neighbourhood and the city.

Further work is needed in order to better understand what exactly brings about these mixed-use patterns in which the diffusion and the use of local knowledge emerge spatially. This paper, however, provides insights regarding the differences between what kind of architectural morphologies and typologies are formed according to their types of activities. We acknowledge that a more complete understanding of the interaction between how these activities took place and how they were developed over time is needed that could refine the results presented here. This paper has highlighted the importance of addressing both spatial and economic processes, emphasising in the morphological effects and the implications of knowledge economy over the development of mixed-uses.

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