# **DESIGNING DIFFERENCE:**

# Interpreting and testing Jane Jacobs' criteria for urban diversity in space syntax terms

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#### Abstract

The most influential contribution to the discussion about the relation between the urban fabric and the generation of diversity, was put forth fifty years ago by Jane Jacobs (Jacobs 1961). More specifically, she pointed out four major criteria that, according to her, were necessary for the development of diverse urban public spaces: small blocks, mix of primary uses, aged buildings and concentration of people. All these variables have since then been ubiquitous in debates on urban planning and design and have also been applied in design of concrete projects. At the same time, it is quite obvious how they all are quite vague and lack rigorous definitions, why, even though they have become popular truths, we know very little about their actual effects.

In this paper we therefore redefine Jacobs' criteria in the analytically more rigorous concepts and measures developed in space syntax research and its extensions. We interpret Jacobs' criterion 'small blocks' into measures of relative distance in the street network more particularly the measurements integration and choice, applied at different radii, argued to represent analysis at different scales. The criterion 'concentration of people' is interpreted as urban density. More precisely, this is measured using attraction accessibility analysis of night and day populations developed in the Place Syntax Tool (Ståhle, Marcus, and Karlström 2005), once again at different radii. 'Mix of primary functions' is partly covered by analysis of day and night populations but here we have also added accessibility to commercial activities, furthermore, an important difference is that we focus, the degree of mix and balance between these activities and not only their size. The final criterion 'aged buildings' is analysed as degree of land-division into discreet plots and parcels, which in earlier studies has proven to correlate well with diversity in urban uses (Marcus 2010).

These measures are applied in an extensive empirical investigation of retail distribution in Stockholm comparing the intensity (amount of shops) and diversity (variation of shops) in both local suburban centres and between the inner city and the outer city, as a substantial test of Jacobs' criteria in this form of space syntax interpretation. The results in general clearly support Jacobs' argument but also give rise to further discussion. In extension, this study also contributes empirical support to the principally vital question, not least for space syntax research, about how spatial form not only play an important part in generating variations in size of co-presence throughout urban space, but also how it is part in generating variations of the constitution of co-presence, that is, the diversity of co-presence.

Keywords: local markets, retail studies, urban diversity, spatial capital, urban design

Theme: Green Urbanism and Sustainable Developments

#### 1. Introduction: diversity and spatial form

Diversity is a central but elusive notion in urban design, where concepts like mixed-use, multi-functionality and diversity partly overlap and partly contradict each other, which can lead to rather indistinct debates (Talen 2008). The problem is, on the one hand, that what is meant by urban diversity often is ill defined and, on the other hand, that we lack common methodologies when it comes to measuring diversity in cities, which makes it difficult to compare urban areas. Together, this means that arguments for or against concepts like 'mixed-use' often are conducted without a proper basis in empirical data. To develop useful measurements that can remedy this situation, we need to be precise about, firstly, what category of urban phenomena we are investigating, that is, we need to answer the question: diversity of what? Secondly, we need to be clear on what scale we measure diversity, since cities can be diverse on one scale but can prove to be quite homogeneous on another, that is, we need to answer the question: diversity on what scale? Therefore, distinct definitions of scale and choice of categorical system, as more or less always in urban modelling (Wilson 2000), is essential for the development of precise analysis and measurement of urban diversity.

Apart from the final aim of this paper, which is to develop a deeper understanding of how spatial form, here defined as spatial configuration structured and shaper by built form, can support, develop and sustain varieties in intensity and diversity in local economic markets, it will need to also address the particular methodological difficulties of measuring diversity. There are two sides to this. On the one hand, we need to develop means by which we can measure diversity in an economic context, and, on the other hand, we need to develop variables of spatial form that can be shown to influence such diversity. This will more precisely take the form of a thorough investigation of Jacobs' four criteria for diversity introduced in the 'Death and Life of Great American Cities' (1961), with the double intention of both developing better knowledge on spatial form in this regard and empirically test the criteria of Jacobs, so often referred to by far less often critically scrutinised. The more general aim is to contribute to a more informed discussion on methods and ideas about how spatial form, structured and shaped by urban planning and design, acts as a means to develop spatial structures in our cities adequate for our contemporary and complex knowledge economy.

More precisely, this paper will report from an extensive study of retail distribution in local markets over a large area of Stockholm, comprising both centrally located and suburban markets, following Jacobs' suggestion of retail as an indicator of more general diversity in the economy. As touched upon, any such analysis rests on distinct definitions of both categories, in this case categories of retail, and scales, where we are especially keen to analyse the overlap and interaction between scales. However, we also want to stress that we clearly recognise the complexity of the causes of urban diversity, and that it includes many parameters apart from urban form.

# 2. Operationalization of Jacobs' criteria

The aim of the study that this paper is based upon, was to investigate how *spatial form*, defined as spatial configuration as structured and shaped by built form, can influence the creation of *local markets* both when it comes to their size, or as we have chosen to refer to it, *intensity*, but also and more originally, when it comes to their constitution or *diversity*. As returned to many times, the most influential contribution concerning the relation between the urban fabric and the generation of diversity, was put forth fifty years ago by Jane Jacobs. More specifically, she pointed out four major criteria that, according to her, were necessary for the development of diverse urban public space: *small blocks, mix of primary uses, aged buildings* and *concentration* 

of people. All these variables have since then been ubiquitous in debates on urban planning and design and have also been applied in design of concrete project (Talen 2006). At the same time, it is quite obvious how they all are quite vague and lack rigorous definitions, why they have been interpreted freely so that, notwithstanding that they have become popular truths, the fact is that we know very little about their actual effect. In the present study we aim to be more rigorous in tying these criteria to concrete effects on local markets. We will therefore redefine Jacobs' criteria using the modelling concepts and developed measurements found in space syntax (Hillier and Hanson 1984; Hillier 1996), in an effort to operationalize them for our current analytical aims. What we, more precisely, need to do is to give these criteria formal definitions that make them possible to quantify and thereby, in extension, possible to correlate with quantified values of both intensity and diversity, as descriptions of size and constitution in local markets.

Before moving on to the actual analysis we will therefore go through each criterion, first restating Jacobs' presentations of them and thereafter briefly discuss how they will be technically formalised and redefined and further explored in the following study. It is obvious how Jacobs uses popular rather than professional terms, such as 'streets' and 'blocks', to describe the urban fabric. These are clearly not only imprecise but also invoke certain urban models and even ideals, which is another reason to aim for more rigorous definitions. However, we will keep Jacobs' terms for now as a means to make the transition into more analytical terms possible to follow.

The first criterion to be studied is the importance of 'short blocks':

"Most blocks must be short; that is, streets and opportunities to turn corners must be frequent [...] Frequent streets and short blocks are valuable because of the fabric of intricate cross-use that they permit among the users of a city neighbourhood. [...] Frequent streets are effective in helping to generate diversity only because of the way they perform." (Jacobs 1961, 186)

That the form and size of blocks shape street patterns and in turn, as noted by Jacobs, has a fundamental influence on how we move in cities, is absolutely central to urban design. Analysis of spatial form, and more specifically its configuration, influences the distribution of accessibility in cities, either from particular locations to other locations (accessibility to), or from other locations to particular locations (accessibility from), is a fundamental form of analysis in spatial analysis in general and in space syntax in particular. More precisely, we will transform Jacobs' criterion 'small blocks' into measures of relative distance developed in space syntax. The measurements chosen, *centrality* and *betweenness*, are fundamental and well established in spatial analysis in general as well as in space syntax analysis, where they are more commonly known as *integration* and *choice* respectively. We will also, following the discussion on scales, apply these analyses within a set of different radii from chosen market cores, which here is argued to represent analysis of different scales. Both as a means to compare what goes on at different scales, but also to see if there are noteworthy interferences between scales.

The next criterion is 'concentration of people':

"The district must have a sufficiently dense concentration of people, for whatever reason they may be there." (Jacobs 1961, 200) [...] "To be sure, the dwellings of a district need to be supplemented by other primary uses so people on the streets will be well spread through the hours of the day." (ibid, 201)

It is easy to interpret this as the ubiquitous idea of urban density, but density is a far more complicated concept than normally recognised. First, there is the limitation of equating this with

residential density, recognised by Jacobs, why she stresses the need of a mix of primary uses in city districts that bring people not resident there to them. This primarily concerns the local working population but also people visiting shops, public agencies or other institutions. All this is recognised by Jacobs. However, a chief contribution to concentration of people in public space is people simply passing through. This is where the street network, as an extended idea of 'short blocks', does its principal work, which is extensively studied in space syntax research. The idea that co-presence, informal encounter and even the whole notion of urban buzz in cities primarily is a by-product of other more intentional processes, is central here and not least how it creates all kinds of synergetic effects, such as the feeling of safety in Jacobs' case and the 'theory of movement economy' in Hillier's case (Hillier 1997).

Even so, the really tricky thing is to measure density, whether population density or something else. This is generally well recognised in spatial analysis and it all has its basis in the fact that one has to choose a spatial unit on which to represent whatever sectorial data one has. Whatever unit chosen will have decisive influence on the data itself, as eloquently demonstrated by Pont and Haupt (Pont and Haupt 2010), for instance, that similar density values could be achieved with greatly varying spatial form. Here, we propose a way out of this, that is, to measure any form of concentration not as density, that is, an amount divided by the size of the chosen spatial unit, but as a form of accessibility, that is, as the amount of something within a radius following the street network. This could also be argued, as has been done above, to be a form of representation that comes closer to an actually experienced density or concentration of people, that is, it more decisively becomes an integral part of local co-presence, or better put, the local IR-market. Moreover, this extended co-presence can also be analysed both as intensity and diversity, creating a detailed description of not only the size and composition of the local market place but also the local market area also in strictly economic terms.

More precisely, this is measured using attraction accessibility analysis (Karlström et al. 2009), including data on both residential and working population calculated within different radii, once again made to represent different scales as discussed above. The possibilities of measures here are extensive, since the accessibility to all kinds of attractions from each market place is in principle possible. One of prime concern for the current study is the accessibility from market places, or even individual shops, to other shops as a form of cluster analysis and will therefore be consistently performed for all analysed market places.

The third criterion is 'mix of primary functions', whereby Jacobs invokes urban activities at the top of the classification hierarchy, such as residences, offices and commercial activities:

"The district, and indeed as many of its internal parts as possible, must serve more than one primary function; preferably more than two. These must insure the presence of people who go outdoors on different schedules and are in place for different purposes, but who are able to use many facilities in common." (Jacobs 1961, 153)

Jacobs argues for a combination of residential with major economic activities such as offices and even some forms of industry, to assure a consistent urban life during different hours of the day. As is well known, this idea represented a fundamental criticism in reaction to the ideas about zoning that were widely applied in urban planning at her time and still are. In addition to the group of primary functions or uses, she noted the importance of complementary activities, such as local services, shops, and restaurants, which are intrinsically dependent on the primary functions, while these certainly, if not dependent, clearly draw great benefits from them.

Clearly this whole discussion is closely related to the notion of mixed use, once again a vague concept used in all kinds of ways. We find it important to stick to Jacobs' original intention here, since it is easy to otherwise slip into the general discussion of diversity, which Jacobs exactly

aimed to tackle by formulating some primary analytical concepts. What she discusses here is primary functions, why it is these we need to choose more rigorous analytical tools for, within the limits of our proposed model. What we will analyse will come close to what was addressed concerning concentration of people – obviously all these criteria are interrelated – that is, accessibility to residents and accessibility to work places. Additionally, we will also look at the accessibility to other economic activities, as a form of complementary or secondary function. The important difference here compared to the similar analyses concerning 'concentration of people' is that we will here rather focus the degree of mix and balance between these functions than their sheer size.

The final criterion is probably the most obscure and least analytical, that is the criterion 'aged buildings':

"Cities need a mingling of old buildings to cultivate primary diversity mixture, as well as secondary diversity. In particular they need old buildings to incubate new primary diversity." (Jacobs 1961, 195)

With this factor, Jacobs underlines the need to retain both old and newly constructed building in one area to generate room for the presence and development of both large and small enterprises with different economic outputs. Despite all the descriptions Jacobs gives for considering the need for different enterprises or, in a similar vein, for facilitating the created spaces' wider flexibility to correspond to a variety of uses, still her suggestion is in need of refinement. Because, present-day urban planners and designers deal with a large variety of daily planning tasks, including both totally new development projects and infill projects, we need to have a broader definition of this factor in order to make it to be applicable in different conditions.

We have elsewhere developed what we call 'spatial capacity', which actually exactly addresses this criterion (Marcus 2000; Marcus 2001; Marcus 2007; Marcus 2010). The idea is that rather than trying to do some kind of inventory of building ages, ask what it is that creates a variety in building age, a more precisely what it is in spatial terms that create such variety. The proposed answer here is that it must be the spatial structure that over time organises and structures building activity, that is, the structure of land-division into plots or parcels for building, which, moreover, often but certainly not always, prove to have a longevity that exceeds the longevity of buildings. The idea then is that by analysing the spatial structure that see individual buildings come and go we can capture an essential structure for the presence of buildings of varying age and not least aged buildings.

More precisely, the suggestion is to shift the focus from spatial form defined by physical buildings and other material objects to spatial form defined by institutions such as property right, that is, the privately and publicly owned domains called plots or parcels. From this standpoint, each plot or property can be regarded as the extension of its legal owner or disposer, that is, a particular actor designated to a particular space in the city and as such develop a particular strategy of maintenance for this space, where not having a strategy also is a strategy. "An area with comparatively many plots seems to have the potential to carry a higher amount of such actors and thereby a higher amount of strategies for action; in turn, it seems likely that this would produce a larger amount of diversity among these strategies" (Marcus 2010). Such a 'diversity of strategies' can in extension be said to represent a capacity to accommodate various contents and uses. Earlier studies have repeatedly demonstrated such a correlation between fine scale land division generating many plots or parcels, what we call a high spatial capacity with high diversity in both residents and work places (Marcus 2001). More specifically then, Jacobs' criterion 'aged buildings' will here be formalised as what we call spatial capacity, that is, accessible plots or parcels.

Jacobs' criteria	Redefinitions	Tools
Short blocks	Centrality and Betweenness	Configurative network
		analysis
Concentration of people	Accessible population	Accessible attraction analysis
Aged buildings	Accessible plots	Accessible attraction analysis
Mix of primary uses	Accessible night and day population	Accessible attraction analysis

**Table 1:** Redefinition of Jane Jacobs' criteria for urban diversity and the tools used to measure them.

# 3. Case study: Identifying market cores

Applying these measures in a particular study we need to decide what will comprise a good study area and on what scale we should apply these measures. When talking about diversity, which is a relational concept, we may consider the varieties of diversity throughout the city as a whole; a large-scale perspective covering a large geographical unit, or we may aim to explore diversity between or within different neighbourhoods; a small-scale analysis. The resolution could be even higher and concern diversity along particular streets. The following study follows both trajectories in a study on both aggregated and detailed levels. For the larger unit, the chosen area covers the inner city of Stockholm and in addition all of the southern part of the municipality. The study area comprises well over half of the total area of the municipality of Stockholm (Figure 1). The primary aim here is to capture the distinct difference between the spatial form of the inner and the outer city in Stockholm and their potential implications for retail diversity, as one token of general diversity. While high density and centrality are well recognized as principal characteristics of the inner city, the southern area has the characteristics of a later development period with low density and accessibility reliant on public transport. The distinct physical differences between these two urban areas help in discovering the crucial dissimilarities between two diverse perspectives in urban design - compact and dispersed cities - that may have led to various levels of functional diversity in these areas. For the smaller scale analyses, a group of neighbourhoods in the southern part of the city is selected, in which their retail centres are later identified for the detailed analyses. These analyses attempt to investigate the influential factors on the location choice of urban activities and the variety among the activities. Therefore, the precise selection of the retail cores containing all activities in each area is considered to be fundamental in the final results.



Figure 1: Larger studied unit (grey), and fifteen selected areas in the south of central Stockholm

To determine the neighbourhood centres and their locations, which accommodate various urban activities: narrowed down to retail, services and restaurants, we can begin by locating the most distinguishable cores in each area according to the existence of high intensity of activities. This method relies on exploring the geographical concentration or cluster of activities in accordance with the most recent available geo-coded data rather than their planned location to define the centres. This type of identified centre is, more particularly, referred to as a market cores in this research project. One of the major characteristics of these areas planned as 'neighbourhood units' is their access to a planned neighbourhood centre. Many of these centres have gone through great transformations in their activity levels, and many have lost their planned functional level. In the latest comprehensive plan for Stockholm (City of Stockholm 2010) greater attention to the critical situation of some of these centres and the need for changes that may help them to maintain their activity within the municipality. It should be noted that by examining an assortment of areas with the neighbourhood unit foundations, we do not expect to find extremely high correlations between diversity and intensity of activities and the urban factors. Rather, the similarities among the identified market cores will assist in the exploration of the differences between the spatial structures of these cores that may have caused the later changes in them. Consequently, the main questions of the analysis can be stated. First: What aspects of spatial form influence the intensity, in terms of amount of retail activities, in the market places? Second: What aspects of spatial form influence the diversity, in terms of variety in retail activities, in the market places?

In this project, the analyses are continued with the selection of segments as origins, which is suggested to be more suitable for investigating the configured intensity and diversity, that is, the number of accessible activities for those users who move along the segments (Figure 2). Looking at the intensity values we see that 95% of the segment in the entire Stockholm area has access to less than 10 retail activities within a walking distance of 150m and among the remaining segments, less than 2% have access to more than 25 activities with top notations of 190 in the inner city.



**Figure 2:** Market cores (red segment) defined as the 5% of segments with highest accessible retail values within a radius of 150m walking distance.

To identify the market cores, the first step was an accessible intensity analysis. Next the group of segments with the highest accessible intensity values within each neighbourhood was selected to represent the market core of each neighbourhood.

# 4. Case study: measuring diversity of retail activity

Like measuring intensity, measuring diversity raises various questions. First, should we examine the diversity between the market cores or the diversity within the market cores? Second, for measuring, there is a series of rather complicated measurements and indices that can be used, which are introduced below. Furthermore, for the quantification of diversity, unlike intensity, the categories have been narrowed down to retail, which the sectorial data is divided into six categories (Table 2).

Retail groups	Amount of shops
Large and small food shops	2329
Clothing shops & department stores	2221
Culture & leisure shops	986
IT-equipment shops	629
Household & department stores	1401
Other household goods	1588
Total	9154

Table 2: Six categories of retail shops and their number in Stockholm

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In the current project, we attempt to measure the accessible diversity for the retail sector with the use of two indices: Shannon Entropy Index<sup>1</sup> and the Neighbourhood Diversity Index<sup>2</sup>. The use of these two measures will facilitate the test of two different ways of evaluating diversity. Whereas the first one assists in measuring diversity within the studied area, the second one will help compare the areas with a larger set, which in this project is the entire city of Stockholm.

As discussed above, the intention in the current study is to analyse and measure diversity from the point of view of an experiencing individual in the street, what we have called the cognitive level, why we will measure accessible diversity rather than distributed diversity. Attraction accessibility analyses are therefore conducted for each category within a particular radius following the street network. All values for the six categories are then inserted into the formula to generate the final diversity value. It is important to note that such a definition of diversity differs distinctly from more common methods, where, for instance, the area analysed is defined by a metric straight-line distance boundary. In the current analyses, these measurements are done for data covering the whole city of Stockholm in order to be able to examine the variety in the city as a whole.

The accessible diversity is, moreover, measured by selecting the segments as origins and both the six values from the attraction accessibility analyses and the final diversity values, that is, the accessible diversity of retail shops within 150m from each street segment, are represented on the segments as variations in colour (Figure 3). The highest accessible diversity in retail shops is found in the inner city of Stockholm, while in the southern area there are a few nodes that have a relatively high access to diversity. Noteworthy is that the central shopping area in the inner city has a relatively low accessible diversity. This is due to the particular scale the current measure concerns. On a finer scale of retail categorisation we will see that this area is extremely diverse within the clothes and fashion segment, proving the point that choice of scale and categorical resolution is critical in analysis of diversity.



Figure 3: Accessible retail diversity within 150m walking distance, measured as entropy.

 $Mixed-use \ entropy = -1 \times \left( \frac{\left( \sum_{i=1}^{k} p_i \times \ln(p_i) \right)}{\ln(k)} \right)$ 

<sup>&</sup>lt;sup>2</sup> NDI= ½ (|Ca-Ta|+|Cb-Tb|+|Cc-Tc|) S Sardari Sayyar and L Marcus : Designing difference

#### 5. Case study: measuring spatial form

We continue by representing the results from spatial analyses. We will start with the integration and choice analyses that depict the pure spatial structure of the areas and their potential movement pattern, which is affected by urban form. In this project, we use the Place Syntax Tool to run both types of analyses; instead of choice analyses, we measure the betweenness of the segments. The results from the latter analysis resemble the choice measurement where the differences are not noticeable at a comprehensive level. These variables, in addition to redefined four criteria form all independent values that finally are correlated with the accessible intensity/diversity values.

#### 5.1 Centrality and betweenness of market cores (short blocks)

Integration is measured within different radii on the axial map of Stockholm. The map is drawn according to the major pedestrian routes in line with the main interest of the project, pedestrian accessibility, and therefore does not include the roads with merely car access and no pedestrian routes. Results from the local integration analysis within 3 axial steps (Figure 4), illustrate the significant difference between the spatial structure of the inner city and the suburban areas.

The visual comparison of the integration maps overlaid with the accessible intensity maps can be highly informative for gaining a preliminary knowledge about the possible interrelation between spatial factors and the location of retail activities. A visual comparison shows little overlap in the southern area but significant overlap in the inner city (Figure 4). This can be interpreted as a distinct sign of the inner city as a self-organising (market driven) retail systems, that partly can be explained by variations in pedestrian accessibility, and the outer city as a planned (publicly or privately) retail system, that rather can be explained by infrastructural investments and marketing. To be interpreted in terms of good and bad, such basic observations needs to be set in a larger theoretical framework of discursive theory for instance, in terms of sustainability or social justice.



**Figure 4:** Overlap of integration analysis within 7 axial steps (red lines: high, blue lines: low) and accessible urban activities within 250m (dark pixels: high, light pixels: low)

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**Figure 5:** Overlap of betweenness analysis within 5 km (red lines: high, blue lines: low) and intensity of urban activities within 250 m (dark pixels: high, light pixels: low)

Similar to integration, betweenness also is explored within various distances 500m, 1000m, 2000m, 3000m, 5000m representing different scales from local to global. Figure 5 illustrates the routes with highest betweenness values within 5000m (colour range from red to blue). With a preliminary comparison of the selected areas, which is done by overlapping the produced maps, the results illustrate that in some areas the indicated routes with highest betweenness value go around the areas and their market cores rather than through them. At this scale we also find some distinct patterns of correlation that are pointed out in Figure 5. In the inner city, such overlap is less significant while a stronger overlap was found for integration values. For the selected areas in the outer city, there is little correlation found, which is a distinctly different result than found in similar studies in London(Griffiths et al. 2008; Chiaradia et al. 2009; Vaughan et al. 2010). A tentative interpretation is the fundamentally different spatial form of the Stockholm outer city, potentially representing a distinct type, which will be further discussed below.

#### 5.2 Accessible night and day populations (concentration of people)

As earlier discussed, population density measures are more tricky than they seem. First, there is the question what population we actually mean, where there is increasing recognition that night population needs to be augmented by day populations when it comes to explaining such things as urban buzz and more specifically retail intensity (Teller 2008). Second, there is the MAUP-problem<sup>3</sup> based in the fact that whatever area unit we select to calculate densities on, this will always bring inherent imprecision, necessary to reckon with. Third, whatever the density, its actual effect must be related to accessibility, which normally, if considered at all, is predominantly calculated for car-accessibility rather than, for instance walking or biking. In this study, accessibility to populations rather than density per area unit is calculated and, furthermore, for both day and night populations. These analyses are, moreover, conducted at different radii as representations of different scales of the potential market areas. Analysis within short walking distances aims to detect the local market area, while longer radii help

<sup>&</sup>lt;sup>3</sup> Modifiable areal unit problem.

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reach a larger population, comparable to district scale. Figure 6 illustrates the results for accessible residential population as well as total population (within 500m walking distance) from the urban market cores. There is a significant difference in potential size of local markets for retail activities located in the inner city and in the southern area in terms of accessible night and day populations. While most retail activities in the southern area have access to fewer than 5000 residents (green, blue, dark blue), most retail activities in the southern part of the inner city (*Södermalm*) have access to more than 7500 residents.



Figure 6: Accessible night and day population within 500 m walking distance (red: high, blue: low).

#### 5.3 Capacity and accessible plots (aged buildings)

In this section, the idea of spatial capacity is more investigated by measuring the number of accessible plots within walking distances. The analysis, once again and similar to the previous series of analyses, is run from segments as origins to plots as destinations and the number of accessible plots calculated. An issue here is whether to measure amount of accessible plots or variation in size of plots, something we will return to. According to this analysis, we can say, for instance, that Vårberg and Kärrtorp have a higher spatial capacity compared to Sätra, while there is no distinct pattern in relation to retail activity.

#### 5.4 Access to other economic activities (mix of primary functions)

The hypothesis for the last tested variable is that the proximity to a larger number of other economic activities will affect the intensity and diversity of the retail activities in the market cores. This variable can also be interpreted to depict the presence of other primary functions in the proximity of the studied market cores. Attraction accessibility analyses are used within various distances (500m, 2000m, and 5000m) on data for all economic activities in the entire Stockholm region ("PAR" 2006). According to the results, Gullmarsplan has access to the largest number of other economic activities (323, 7316, 39702), which according to hypothesis would have a positive effect on retail intensity and diversity. It should be noted that the significant increase in access to other economic activities in this area is because the larger radii reach the inner city.

# 6. Correlation analysis

Correlation analyses are run between values of diversity in economic activity at the different market cores and four redefined criteria measures of spatial form based on Jacobs' criteria. All measures are also calculated for different radii, representing different scales. All values are extracted from the segments. These analyses are done for both the larger study unit and selected areas.

#### 6.1 Comparing correlations with retail diversity for the inner and outer city

Turning to retail diversity, the highest correlations in the inner city are found, similar to intensity, for accessible population and accessibility to other economic activities (Figure 7). We can note a higher significance for residential population in the outer city, while both prove equally important for the inner city. Unlike intensity, where we identified a greater importance for shorter distances when it comes to accessible population, especially true for the outer city, for diversity longer distances prove more important for the inner city, where both accessible residential population (r=0.60) and working population (r=0.58) have their top notation for a walking distance of 2000 m. This might reflect that such diversity work as a clustering attraction drawing people form larger distances. In this respect, however, the inner city differs from the outer city, which still has the highest correlations with 500m walking distance: residential population (r=0.27) and working population (r=0.22).

Access to other economic activities within 500m has in the inner city a high influence on diversity (r=0.73), while the effect in the southern area is far lower (r=0.33). Finally, the access to a higher number of plots has in the inner city an even great influence on diversity (r=0.70).



Figure 7: Correlation values between Entropy diversity values within 150m and all tested variables

#### 6.2 Correlations for fifteen market cores

The following section presents the results from the correlation analysis of the fifteen market cores. We here deal with fifteen planned commercial centres in typologically quite similar neighbourhoods where the aim is to explore the effects of differences in spatial form in this homogenous group on the intensity and diversity of their retail activities. It should be noted that all analyses are run for the mean values of the segments representing the different market cores.

Figure 8 sums up the correlations between the spatial variables and retail diversity, where the higher correlation values for betweenness is the most notable difference from what was found for the analyses in the larger unit. Similar increase of correlation with integration is found here (r=0.38), while betweenness continues to have a high importance at walking distance 500 and 1000 m (r=0.50). Access to working population as well as total population, which was highly influential on intensity, seems to be less influential on diversity. Spatial capacity or accessibility to plots did not show any significance in this part of the study.

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Figure 8: Correlation values between retail diversity and spatial variables for 15 selected market cores.

#### 7. Findings and conclusions

First, the outcomes of the correlation studies, generally speaking, confirm the essential role of all of Jacobs' criteria as interpreted in our specific terms, which is a finding of principal and general importance. Among these factors the accessible population and proximity to other economic activities have repeatedly been found to be the most important factors for both intensity and diversity. Concerning other factors, integration and betweenness appear to have different degrees of influence on the two parts of the study. While, integration has a larger effect in inner city on diversity in the larger survey, betweenness is found to be more influential for the fifteen selected areas. On the other hand, when the factors are tested for diversity, even though integration gains a larger importance compared to the correlation analysis for intensity, betweenness continues to be more influential. Another highly interesting finding in the study is the importance of the intermediate scales rather than the most local or global, which can mirror the importance of interplay between scales. Equally interesting is the distinct influence of spatial capacity identified in the inner city while not in the outer city. This reflects the generally most distinct patterns that identify the inner and outer city of Stockholm as inherently different conceptions of cities as relations of form and function, which we find of great principal interest and calls for further studies.

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