The Medieval Urban 'Movement Economy'

Ref 019

Using Space Syntax in the Study of Medieval Towns as Exemplified by the Town of 's-Hertogenbosch, the Netherlands

Marlous Craane
Tilburg University, Faculty of Social and Behavioural Sciences, Tilburg, Netherlands
m.l.craane@uvt.nl

Keywords
urban morphology; middle ages; urban history

Abstract
An early ascertainment of space syntax is that it establishes the correlation areas with a high to-movement potential (a high integration value) and urban economic space. Because of this feature, Hillier called the city 'a movement economy' in his 1996 publication Cities as Movement Economies. It is my hypothesis that the correlation between integration values and economic space (part. markets) is not just a characteristic of modern towns but also of medieval towns. This paper will build on the findings of previously published research in 2007, which explored this issue and showed that this correlation already existed in medieval settlements. In addition, this paper fixes the methodology for using space syntax in a medieval context and correlates particular trades, crafts and markets with particular levels of integration in order to illuminate our perceptions of the occupational division in a medieval town.

However, space syntax can only be used when one has a complete street pattern as van Nes argues in her paper on Pompeii to be presented at this symposium. To obtain these for the medieval period is a significant problem for most towns as reliable plans are usually not available before the seventeenth century and as large-scale archaeological excavations can hardly take place because of economic or structural constraints. To overcome this problem, Keith Lilley's town-plan analysis methodology (published in Urban History in 2000) based upon Conzenian morphology is used, which enables us to recreate medieval town plans from the first cadastral plans of the nineteenth century by combining them with historical, archaeological, architectural and cartographic evidence. These reconstructed plans allow the use of space syntax in the analysis of a historic environment. The case-study for this paper is the town of 's-Hertogenbosch (the Netherlands) because of the town's importance during the medieval period and because of the large amount of archival and archaeological evidence available.

This paper in essence synthesizes Conzenian morphology and space syntax. This method has not been applied by other researchers, even though Larkham has highlighted in the journal Urban Morphology in 2006 "the great opportunity for exploring the potential complementarities of space syntax and Conzenian morphology". Moreover, at the 6th International Space Syntax Symposium in 2007, Whitehand presented an invited paper on Conzenian Urban Morphology and Urban Landscapes. Both urban morphologists and spatial analysts have realized the potential for a methodology combining both. This combination builds upon the strengths of both, that is the historical element of Conzenian Morphology and the detailed level of analysis of space syntax. This new methodology provides the starting point for this paper on the analysis of the medieval urban movement economy.

This paper is part of ongoing research on the urbanisation and spatial patterns of production and consumption in the Bailiwick of 's-Hertogenbosch between 1180 and 1568.

Introduction

Medieval towns are not just about the buildings within them but also about the open spaces that define them. Medieval towns are not organic in nature and their development has a clear logic behind them. Medieval life was not just about the architecture, the artefacts and the rules and regulations, it was about how people used and experienced them in the space around them, and the topology which defined the medieval urban environment. It is, however, in the nature of history and archaeology to study the physical remains of the past and not those remains that are immaterial and invisible. In order to study the essence of urban construction and development and the strong economic focus of urban settlements, it is therefore essential to find techniques from other disciplines to aid us. Space syntax is all about topology and the analysis of natural movement, which is the proportion of movement that is determined by the configuration of space itself, rather than by the presence of specific attractors or magnets (Hillier et al. 1993, 32). One of the main findings of space syntax has been that in modern cities the location of economic space correlates strongly with those spaces with high natural movement, or in space syntax terms, high integration levels (Hillier et al. 1993, Hillier 1996a, 1998, 1999).

"Well functioning cities can therefore, it will be suggested, be thought of as 'movement economies'. By this it is meant that the reciprocal effects of space and movement on each other (and not, for example, aesthetic or symbolic intentions), and the multiplier effects on both that arise from patterns of land use and building densities, which are themselves influenced by the space-movement relation , that give cities their characteristic structures, and give rise to the sense that everything is working together to create the special kinds of well-being and excitement that we associate with cities at their best." (Hillier 1996b, 113-114)

This technique of space syntax has, however, always been cast aside by archaeologists by its inapplicability to the historic environment, as previous authors and sceptics always stated that space syntax could only be used on historic towns when one has a reconstruction of a town's street pattern (van Nes 2009, 12). For most towns this is a significant problem, unless the town is a greenfield site, i.e. when there is no modern town upon the older town, as is the case in for instance Pompeii and Silchester. Moreover, reliable plans are not available for most towns before the seventeenth century, and if they are they are usually of the grandest cities and not of small hamlets and thus create a distorted view of our past.

At the 6th International Space Syntax Symposium in Istanbul in 2007, space syntax itself hinted at a solution to this problem when Jeremy Whitehand gave an invited paper on Conzenian Urban Morphology and Urban Landscapes (Whitehand 2007). It is this Conzenian morphology, which provides the starting point for my use of space syntax in the analysis of medieval urban space and medieval economic urban space in particular. Keith Lilley (2000) has created a methodology based upon Conzenian morphology, which enables one to recreate medieval town plans from the first cadastral plans of the nineteenth century by combining them with historical, archaeological, architectural and cartographic evidence. These created plans gives one the opportunity to use space syntax in the analysis of a historic environment. Using space syntax in a historic environment is advantageous because it enables the analysis of the location of particular buildings or trades. I think this analysis is important because I think there is a logical explanation behind the location of economic buildings and trades.

Returning to Hillier's quote highlighting the focus of this paper and explaining the choice of the title, the central hypothesis of this paper is that 'movement economy' is not only a feature of a modern town but of a medieval town as well. Previous research has provided early indications that this is the case. This paper, however, is able to test this hypothesis on many more levels than any previous research (Craane 2007).

In order to achieve this, this paper will first introduce the Conzenian morphology and the Space Syntax methodologies in order to discuss how we can analyse the medieval urban topology and its relevance for studying the medieval urban economy. Secondly, the medieval geography of 's-Hertogenbosch shall be reconstructed using the first part of this methodology. This will highlight

the transformations that have taken place within 's-Hertogenbosch and it will highlight the need to study archaeological artefacts and historical documents within their correct topological context. Thirdly, the historical and archaeological evidence of the medieval economy shall briefly be presented. This will provide an insight in the information already available in the archives about the medieval urban economy. Finally, the space syntax maps of 's-Hertogenbosch shall be presented and compared to the evidence from the archival records in order to illustrate the importance of topology in the location of medieval economic spaces. The conclusion will bring together all of these findings and discuss the way in which medieval economic space manifested itself within the medieval town, how space syntax can help to analyse it and whether the medieval urban 'movement economy' does exist.

This paper forms part of a chapter on the medieval economy in my thesis on 'Urbanisation and Spatial Patterns of Production and Consumption in the Bailiwick of 's-Hertogenbosch 1180-1568'. The chapter will discuss at length any other evidence available for the economic spaces in the town of 's-Hertogenbosch. Due to the conference focus and length restrictions, this paper will mainly focus upon the tax register of 1552 and the comparison to the space syntax results as well as the new methodology of using space syntax in the medieval urban environment.

The Methodology

Conzenian Morphology

The introduction highlighted the lack of accurate medieval maps and town-plans. If these maps did exist they would provide an important framework for the of urban spaces and urban economic spaces in particular. Conzen (1960) realised the potential of these medieval town-plans and he pioneered a new methodology entitled town-plan analysis in his study of the medieval burgh Alnwick. This and his subsequent publications stood at the basis of what is currently referred to as Conzenian Morphology (Whitehand 2001). Conzen's techniques have since been developed and improved by various scholars of whom Lilley has achieved the greatest advancement by providing a step-by-step methodology for performing town-plan analysis (Lilley 2000), which will be detailed in the following paragraphs.

Firstly, this methodology is based upon the premise that British Ordnance Survey maps published between 1843 and 1893 on a scale of 1:2500 or 1:5000 can be used as a basis for the derivation of medieval town plans (Lilley 2000, 11). For the Bailiwick of 's-Hertogenbosch similar evidence is available in the Historische Topografische Atlas Noord-Brabant 1836-1843 (Stam 2008) Moreover, there is plenty additional cartographic material available in the form of the maps of for instance Van Deventer, Blaeu, and Drossaers. The underlying reason behind not using the most recent plans as the basis for the derivation of medieval town plans is because many towns have changed substantially since the end of the nineteenth century which makes town plan analysis much more difficult if not impossible. In 's-Hertogenbosch this can be seen in the creation of the Arena shopping centre (1997) (Janssen and Thelen 2007, 9), the erection and later demolition of the military barracks (1744 until 1960s) (Vos 2007, 29) and the disappearance of the monasteries (+/- 1911) (Vos 2007, 28).

Secondly, these early cadastral plans need to be transformed into vector drawings[1] using computer-aided design programmes such as Adobe Illustrator or AutoCAD. This choice only really depends on the affinity of the user, and the original format of the cadastral plans, as both programmes produce drawings comparable in use and quality. For this thesis Adobe Illustrator has been chosen, since it is the more user friendly package and since it can more easily cope with the analogue cadastral plans. These vector drawings should only show the insulae, streets, waterways and town walls, thus erasing any other features the original map might show, and which could obscure the important spatial developments. These drawings will form the base-maps from which to start the town-plan analysis.

Thirdly, on these base-maps various forms of evidence, such as archaeological, archival and cartographic evidence, secondary sources, antiquarian histories and standing buildings, will be

plotted in order to gain an insight into how the street-grid of the town has changed over the centuries.[2] Because of their inaccuracy with regards to scale, antiquarian cartographic evidence should only be used with caution and only in comparison with the base town-plan on an insula to insula basis.

Finally, having incorporated this evidence on the base town-plan, more maps will be created which show's-Hertogenbosch at earlier stages in its history. It is envisaged that it will be possible to create maps, at least for the town of 's-Hertogenbosch, at 50 year intervals, and thus at 1650, 1600, 1550, 1500, 1450, 1400, 1350, 1300, 1250 and 1200. However, it will be the case that the further back in time one goes the less detailed the maps will become.

As will be evident from these paragraphs, the technique of map regression is very time-consuming. This technique has therefore mainly been applied to villages or small towns (Conzen 1968, Lilley 2000, Lilley et al. 2005). However, more recently papers have been published seeing its application to larger towns (Conzen 2004, 108-115, Craane 2007).

To summarise, town-plan analysis has enabled the reconstruction of the medieval townscape. As a result, these reconstructions can be used as evidence in the analysis of town urban and economic development and morphology. Moreover, these maps can also be used as the basis for space syntax. This technique will be explored in a the following section.

Space Syntax and the Medieval Town.

Larkham (2006, 130) realised the great potential of using Conzenian Morphology with Space Syntax by stating that "a great opportunity clearly exists for exploring the potential complementarities of the different traditions of space syntax and Conzenian morphology."

Space syntax is based upon the idea that human societies use and configure space. Space can therefore be analysed to tell us something about society. Even though this technique has mainly been used in modern cities it would be very advantageous to use it in the analysis of historic cities as it will enable us to shed some light upon the way in which historic society functioned. Griffiths (2005) and Craane (2007), have already produced the first results which indicate that space syntax can indeed be successfully applied to a historic urban environment. However, much more research is needed to show the possibilities and limitations of using space syntax within history and archaeology.

The vector drawn reconstructions created in the previous stage are the ideal format to progress with the spatial analysis. Since, as Bafna (2003, 18-19) states, "it is essential in any analytical study of the configured space to re-describe it in an abstracted format focusing on its topology". Through all of the open spaces an axial map is created. "Axial maps are the representation of an urban area in terms of the longest and fewest lines it takes to pass through all the space" (Griffiths 2005, 657). Axiality reflects the way in which people experience space visually, namely by means of line-of-sight.

The quickest and easiest way to draw an axial map is to use a specially designed software package, such as Confeego or Depthmap both of which are developed at the Space Syntax Laboratory at UCL, and are available as a free download to genuine researchers. I have chosen to use Depthmap because it also features other forms of spatial analysis and since it is a standalone program for PC.

To generate a fewest-line axial map, which is the one generally used in space syntax, Depthmap first draws an all line axial map. An all line comprises "every line that connects two corners in open space, and extend it until it hits a solid object" (Turner 2005, 58). This all line map is then reduced to the fewest-line map using a technique called subset elimination. " A line whose connections are the subset of another line may be deleted, until only the core lines remain, bearing in mind two guidelines. Firstly, ensure that all open space may be observed by the combination of lines and secondly that all topological loops are completed, i.e. that all islands of built form are cut off from all other islands of built form" (Turner 2005, 58). This fewest-line map is equivalent to a hand-

drawn axial map drawn in the method specified in the social logic of space (Hillier and Hanson 1984, 91-92, Turner et al. 2005).

The creation of axial maps seems a very subjective task for historic maps since street width can in most case not be determined with complete certainty, due to the lack of sufficient evidence. However, research has pointed out that, provided there is not a significantly large discrepancy (e.g. from a single track to a dual carriage way) between the plans and the actual historic street width, the results of the axial line analysis are hardly affected. This is due to the fact that the axial map which is used in the analysis is the fewest-line axial map and only shows the fewest number of lines which cover all of the open space and links with other axial lines and not the all-line axial map which simply shows all axial lines that can be drawn in the open space.

The fewest-line axial map is analysed by Depthmap by first calculating "the number of steps it takes to get from one line to all other lines in the system. If this number is low, then the line is considered integrated if this number his high the line is segregated. The most integrated lines correlate with high levels of movement." (Turner 2005, 59). Integration calculates to-movement potential of a line. Secondly, Depthmap calculates the number of times that a line is on the route between all pairs of other lines. This is called choice value and calculates the through-movement potential of a line.

Depthmap can calculate both integration and choice on a global and local level. Global levels correlates with the natural movement of people from outside the areas analysed, whereas local levels correlate with the natural movement of local people doing local trips (Penn 2003, 39).

Depthmap shades the lines from the highest to the lowest to- and through-movement potential from red via orange, yellow, green and blue to indigo.

The integration and choice values both reflect a part of the decision process of humans before moving anywhere in a system. Firstly a human decides on an origin and a destination for his or her movement. This destination is the to-movement, and destinations which are more accessible are more likely to feature as a destination and as a result are the most integrated, whereas very inaccessible destinations are less likely to feature as such and are therefore the least integrated. Secondly before a human can start moving he/she needs to select the streets (lines) that must be passed through to go from origin to destination, or the through-movement. The line which is on the largest number of shortest routes between origin and destination has the highest choice value whereas the line which is on the least or none of the shortest routes between origin and destination has the lowest choice value. Like the choice of destination the choice of route to that destination is highly dependable upon the network. The ratio of through-movement lines to origin/destination lines will become higher when the length of trip increases and therefore in those cases the choice value will be more accurately reflected (Hillier and Iida 2005, 6).

Settlement analysis started in 1984 with this axial line analysis. However, since space syntax is constantly evolving a new method has been discovered which correlates more strongly with natural movement levels. Segment angular analysis, as this new method is called, makes use of the fewest-line axial maps and also analyses the to- and through-movement potential of lines. To create a segment map from a fewest-line axial map the axial lines are divided into segments from crossroads to crossroads. A segment with high to-movement potential is one that is 'closest' to all others in terms of the angle one must turn through to get to each other line. Segments with a high through-movement potential are those segments which are on the most least angle routes between all pairs of other segments (Hillier and Iida 2005).

Segment analysis has got the added benefit that its connections can be weighed. This is important due to the fact that one long straight street with high visibility will probably be composed of various small segment and the weighing of these connections will preserve this high visibility in contrast to the those occasion in which segments are connect at right angles and have very poor visibility. Connections between segments can be weighed for metric distance, complexity distance and angle of change. Especially the latter is a useful value, since it will still take into account, the ex-

ample just given, long streets, which are straight or nearly straight, and will still receive the high integration value which most of the longest axial lines receive. Therefore, the least angle value correlates best with real movement.[3] This is because people move across town in the most logical way possible, which might not necessarily be the shortest, a way which might have a large number of turns. People read the urban network in geometrical and topological rather than metric terms. Even though people always try to take the shortest routes to their destination, their concept of distance is shaped more by the geometric and topological properties of the network than by the ability to calculate metric distances (Hillier and Iida 2005, 15). This discovery has profound implications since it proves, as space syntax has always argued, that

"the geometric and topological architecture of the large scale urban grid is the most powerful shaper in urban movement. Secondly that axial graphs are in most circumstances a good approximation of the impact of spatial configuration on movement and thirdly that the architecture of the street network in geometrical and topological sense through its effect on movement flows influences the evolution of land use patterns and consequently the whole pattern of life in the city" (Hillier and Iida 2005, 15)

As was stated earlier in this section, high integration and choice values correlate strongly, both in the modern and historic urban environment, with the presence of economic spaces along that segment or line. This is because integration measures movement potential and movement, or footfall, is the main contributor to a successful business (Hillier et al. 1993, Hillier 1996a, 1998, 1999). This is one of the main reasons why space syntax has been chosen as a method for analysis in this publication. Space syntax can shed an objective light upon the functioning of economic spaces, relationships and networks in the medieval period. The following section will explore the situation of the various trades and shops/markets in the medieval town of 's-Hertogenbosch by making use of the methods outlined in this section of the paper. Space syntax will be used to deepen our understanding of the choice of location by particular crafts and tradesmen.

The historic topology of 's-Hertogenbosch

Figure 1 displays the spatial transformation of 's-Hertogenbosch between 1000 and 2003 as achieved by using Conzenian morphology.

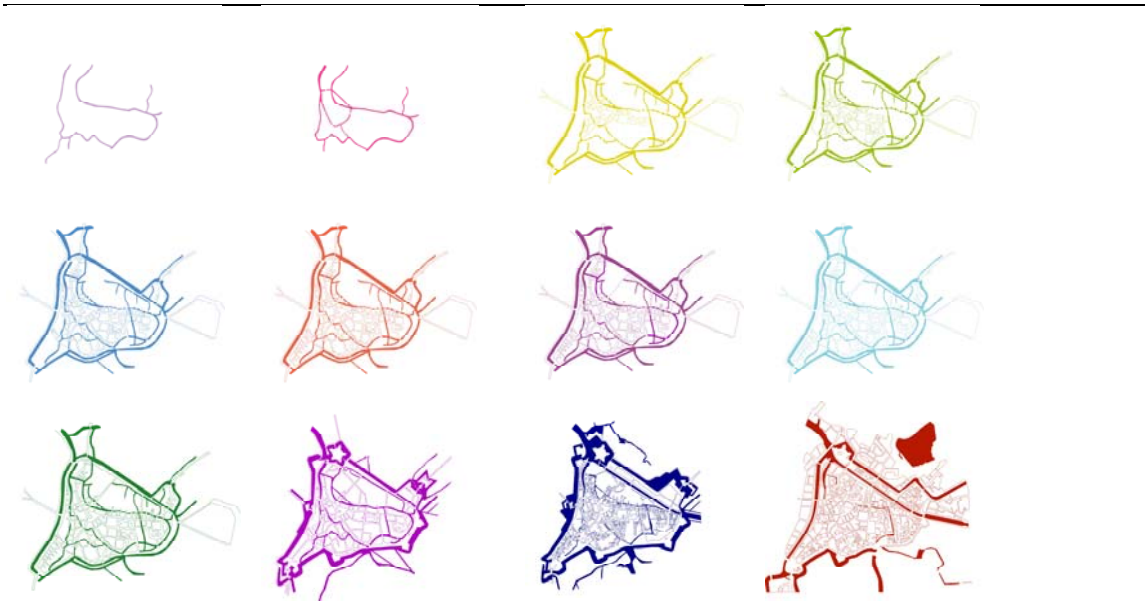


Figure 1:
's-Hertogenbosch in 1000, 1200, 1250, 1300, 1350, 1400, 1450 1500, 1550, 1650, 1830 and 2003 (from top left to bottom right)

In order to use spatial analysis we need a reconstruction of 's-Hertogenbosch' topological past. This reconstruction can be created by starting with the 1830 map by Drossaers. Blaeu's map of 1645 was subsequently combined with Drossaers map and some historical and archaeological information to derive the map of 1650. A similar process took place to derive the map of 1550 by using Van Deventer. The earlier maps were solely derived from archaeological and historical evidence about the expansion of 's-Hertogenbosch mainly from publication by Janssen, Verhees, Van Drunen, and Kuijer (Janssen 1983, Boekwijt and Janssen 1988, 1997, Verhagen and Kerckhoffs 1998, Kuijer 2000, Kuyer 2001, Verhees and Vos 2005, van Drunen 2006).

Historical and archaeological evidence of the medieval economy

In a next step we would like to plot the distribution of professions on the reconstructed map of 's-Hertogenbosch. In order to be able to do that we need evidence about where these professions were situated and what products were bought and sold in 's-Hertogenbosch. Evidence for this are, for instance, archaeological finds of workshops and products, or archival records in which professsions occur, such as charters and tax registers.

Charters were issued to a particular professional guild and contained all of the rules and regulations relating to that particular guild. Rules and regulations, for instance, relating to where and when they could sell their produce, when they could work, when you could become a master etc. These charters are available from the early fourteenth century.

Tax-registers were compiled in 1502, 1505, 1511, 1547, and 1552. A tax collector visited all of the houses in 's-Hertogenbosch and his route through the town is traceable. It therefore becomes possible to link a particular property to a particular person in the register and to his profession. For the purpose of this research I have mainly used the tax register of 1552 in order to trace the location of particular professions. The other tax-registers have only been used for quantitative comparison to check that there are no significant increase or decrease in particular professions during the first half of the sixteenth century. This quantitative comparison safeguards the data of the 1552 count and ensures the reliability of the outcomes of my research. Fortunately, for the tax-register of 1552 I am able to rely on the research of Jord Hanus [4], who has kindly compiled maps of the professions I requested.

Before this paper discusses where particular trades were located and when they first appeared within 's-Hertogenbosch, it is first of all important to check whether there indeed was no significant change in the overall professional make-up changed during the first half of the sixteenth century. For this period it is possible to rely on Blondé's (1987) contribution on the social structures and economic dynamism of 's-Hertogenbosch. Blondé (1987, 39) has, however, argued that the tax registers he uses (those listed in the previous paragraph) are an unreliable source for research into the spread of occupations in 's-Hertogenbosch. He argues that the different professional categories should be equally represented in the sample of the tax registers as in the total population of 's-Hertogenbosch. He uses an example of the linen weavers (which only number about 17-22 in the registers) to state that they cannot be correct as one knows that 's-Hertogenbosch had a booming linen-industry. If one, however, adds up all those professions involved in the linen-industry they total about 25% of all professions mentioned in the registers and is the largest group of professions. Moreover, it has been argued that when the tax collector asked one's profession, it was perceived more important to stress the membership of a trade rather than one's actual place in the production process, master, apprentice or servant. The tax registers are therefore a useful source for research into the trades of 's-Hertogenbosch as long as on asks the correct questions of the evidence available.

The rich were less identified by their jobs than the poor (Blondé 1987, 40). This is not because rich people did not want to give their profession but because poor people were usually known by a profession rather than a surname, the latter being more common for the rich. For the purpose of the register everyone had to be identified as exactly as possible. Without national insurance numbers or BSNs, using one's profession was the best way to do this. Moreover some rich people did not have a profession and simply lived of their fortune. These criticisms do not create significant problems for their use as a source for the occupational make-up of 's-Hertogenbosch. It is evident from the registers that people across all classes have been asked for their profession, and would state 'gentleman' if one was too rich to have a profession. The occupations in the tax

register account for about twenty percent of the households which for all intense and purposes is a representative sample.

Table 1 summarises the main data concerning the tax registers of 1502, 1505, 1511 1547, and 1552. It shows an approximation of the number of households of 's-Hertogenbosch (as derived from the Hearth Taxes [5]), the total number of people in the register, the number of people listed with a profession and the appropriate percentages. I have listed the number of households rather than the number of inhabitants as there is likely only one profession per household (as not many married women were in employment outside of the house, and population would also include any children too young to work).

Gemene Zetting	n households	n taxed	n trades	% trades/ households	% trades/ taxed
1502/1503	3500	2759	645	18%	23%
1505/1506	3520	2395	518	15%	22%
1511/1512	3550	2898	820	23%	28%
1547	3780	2902	425	11%	15%
1552b	3800	3081	1111	29%	36%
1552j	3800	4088	1778	47%	43%

Table 1
Main data concerning the tax registers

	1502	1505	1511	1547	1552
administration	1.2%	1.2%	1.8%	1.8%	1.7%
clergy	0.3%	0.6%	4.6%	4.6%	1.4%
culture	1.4%	2.3%	1.2%	1.2%	2.5%
drink	1.1%	1.0%	0.7%	0.7%	3.1%
food	13.0%	13.9%	11.0%	11.0%	10.2%
health	3.6%	2.1%	3.4%	3.4%	2.2%
household goods	4.8%	5.6%	4.1%	4.1%	5.9%
leather	5.9%	5.0%	5.5%	5.5%	6.5%
metal	16.6%	17.4%	17.1%	17.1%	20.7%
services	5.7%	5.2%	4.4%	4.4%	3.0%
stone	4.2%	4.4%	2.4%	2.4%	4.4%
textile	25.0%	21.4%	27.3%	27.3%	25.6%
unspecified	0.6%	0.4%	0.9%	0.9%	1.4%
wood	16.6%	19.5%	15.5%	15.5%	11.7%

Table 2
Percentage of taxpayers employed in the various occupational categories

Table 2 show the percentage of taxpayers employed in the various different occupational categories. This table follows the historical assumption about the prominence of the textile (cloth) and metal (pins, nails and knives) trade in 's-Hertogenbosch

The Medieval Urban Movement Economy

As stated earlier in this paper, as a result of the research of Jord Hanus it is possible to use the tax register of 1552 to locate exactly the residence of each tax payer in the register and it is therefore also possible to link a residence to an occupation. The following maps shows the location of all occupations within one occupational group. One map for instance shows the residence of all people involved in the metal trade, whereas another shows those of all people in the drinks trade. Each particular colour identifies a particular occupation within the occupational group. These maps visualise the spread of those occupations. In order to gain an insight into the location various trades present in 's-Hertogenbosch. The main hypothesis is that there is a identifiable pattern in the distribution of pro-

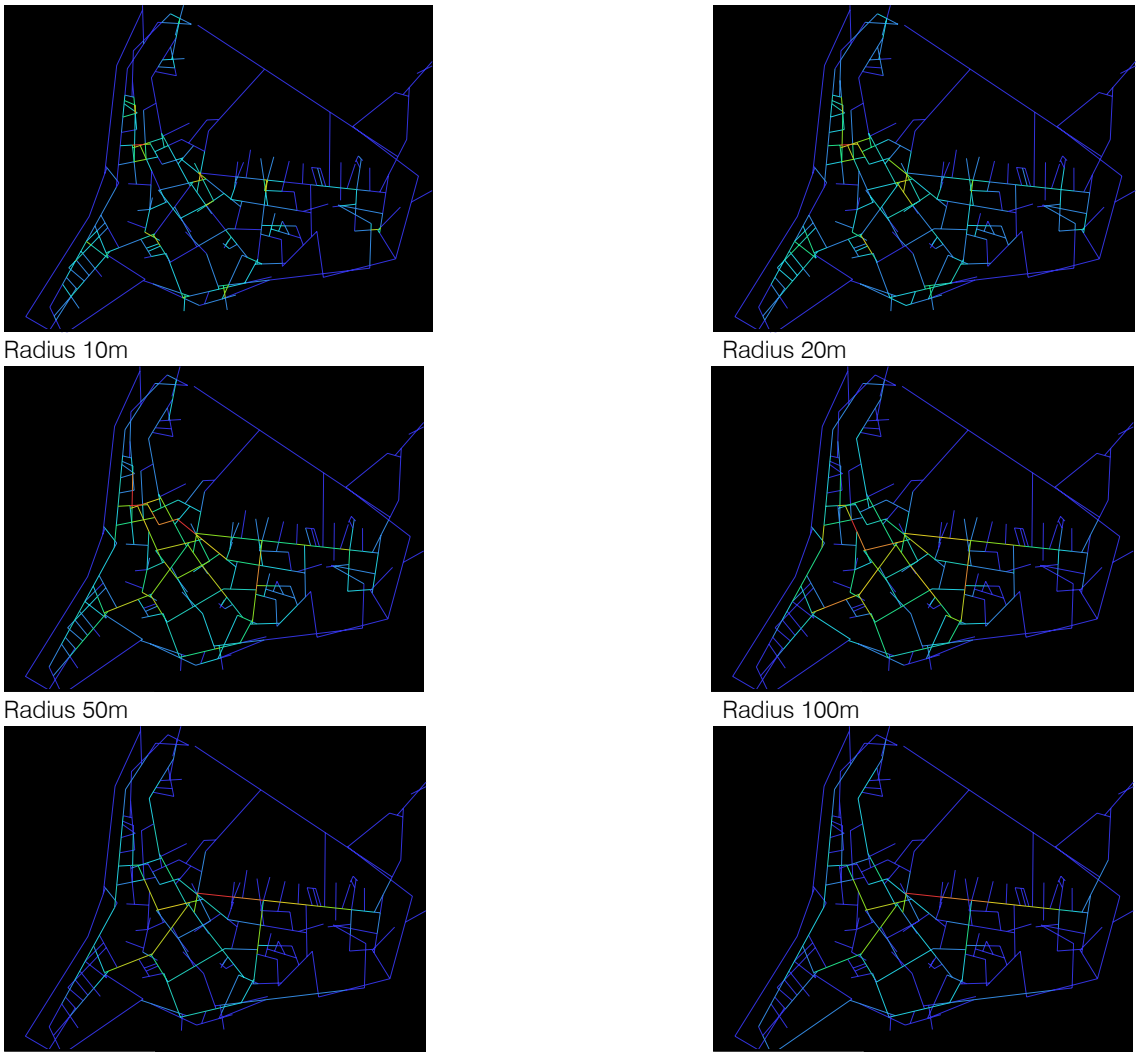
fessions and crafts and that they do not arrange themselves randomly within a city plan. This pattern can be caused by geographical concerns, such as the proximity to water, topological concerns, such as the needed for passing traffic or social concerns such as the proximity of guild-members to one another.

In order to be able to discuss the spatial distribution of the various occupations, the results of the spatial analysis shall be presented first.

's-Hertogenbosch 1550: Norm. Mean Depth Radius n

's-Hertogenbosch 1550: Norm Choice Radius n

Figure 2:
1Space Syntax maps of 's-Hertogenbosch in 1550



Radius 10m

Radius 20m

Radius 50m

Radius 100m

Radius 200m

Radius 300m

Figure 3:
Topologic Choice with metric radius 10, 20, 50, 100, 200 & 300 metres

These maps show the results of the segment analysis of ‘s-Hertogenbosch in 1550 with radius n.

The results of the spatial analysis as presented in figure 3 shall be used in explaining the spatial distribution of the occupations shown in figures 4 until 7. These figures shows those occupational groups which have a high correlation with the topological framework of ‘s-Hertogenbosch. Maps of the other occupational groups have been produced. However, confirming a previous assumption, occupations without a significant economic component do not correlate highly with the topological framework of a town. These occupational categories are administration, clergy, culture, health and service.

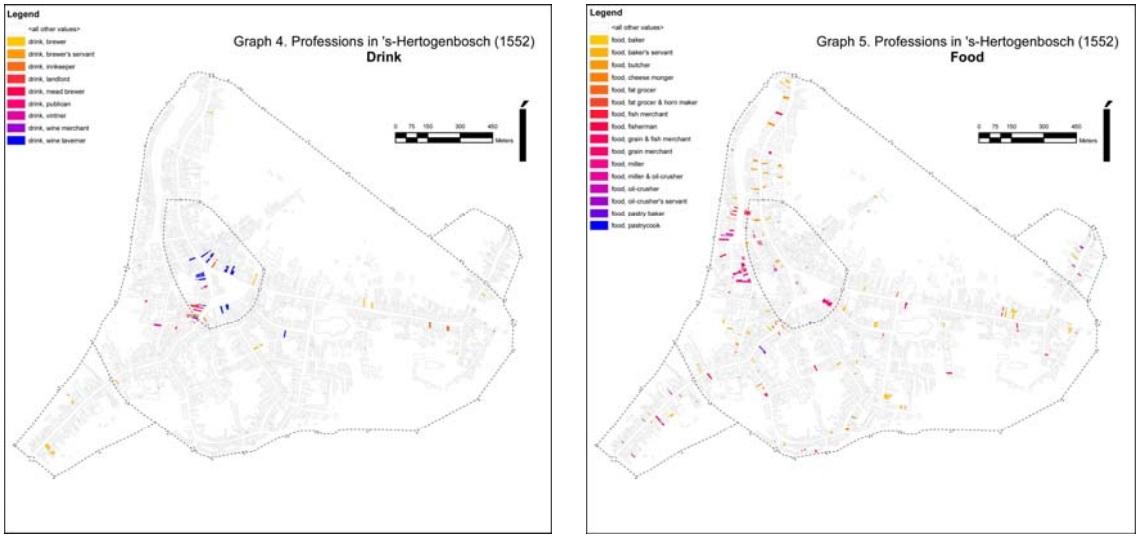


Figure 4:
Occupational Maps of the Food and Drink Professions

The food and drink maps show entirely different topological patterns. Most of the drink occupations are centred on the market square (taverns etc.) and near the gates. Drink establishments had to be easy to find for visitors not familiar with a town’s layout. This is why they are located near the gate, so visitors would see them right away on entering the town, or on the market-square, which is where the topology of a town leads the visitor towards.

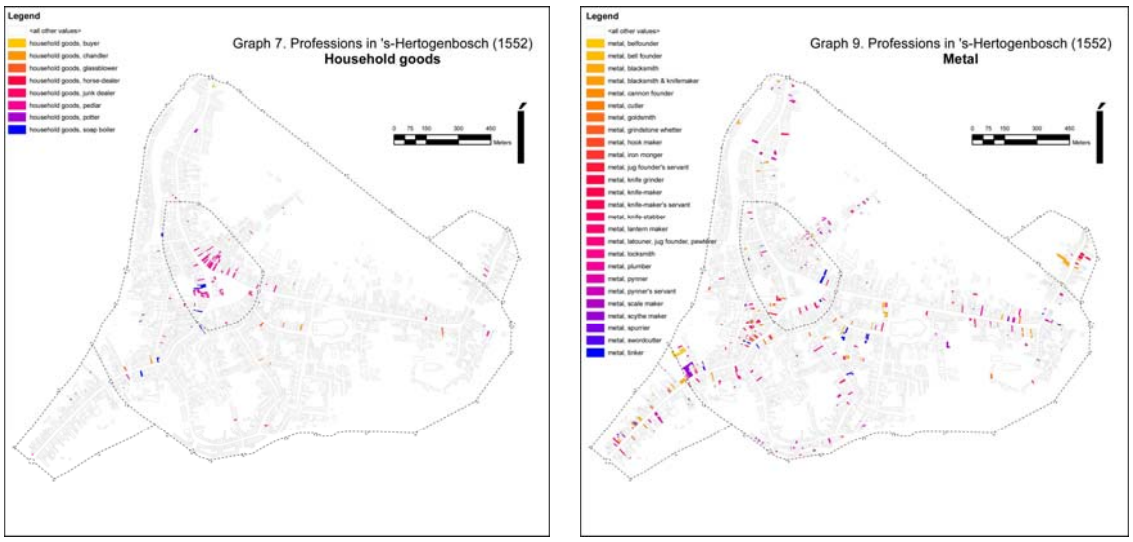


Figure 5:
Occupational Map of the Household Goods and Metal Professions

The food occupations are not centred around the market square, as one would expect but around the harbour and the fish markets, both to the east and north of the market square. Some other food occupations are spread around the town. This was especially true for the bakers, one of which was located in every neighbourhood as bread was an everyday purchase, having a baker just round the corner would be a great advantage. Their location on a segregated or integrated street will not make a difference as the locals will be able to find them either way. While the location of the drink category has a high correlation with the topological choice maps of radii 100, 200 and 300 metres, the location of the food category correlates with all radius levels. The drink category services the visitor more than the local. Whereas food is needed by locals and visitors alike and therefore corresponds with all radii.

Almost all the sellers of household goods, the pedlars and related occupations, are centred around the markets square, and some of them along the three main routes radiating out from it. The household category correlates highest with radii 100, 200 and 300. Pedlars relied of course on footfall and for that reason they can be found in the most integrated locations within the town.

Most of the metal professions seem to be centred on the main three roads radiating outwards from the central market square. However, the pynners are traditionally (van Drunen 2006) centred around the Tolbrugstraat (in the northwest of the town). Pins were usually manufactured as part-product in a home environment. Moreover, there is a concentration of pynners around the south side of the town. The metal category correlate on all radii with the topological choice values. Despite the fire risk of the metal profession they do not seem to be located in segregated areas but rather in the streets with the highest integration.

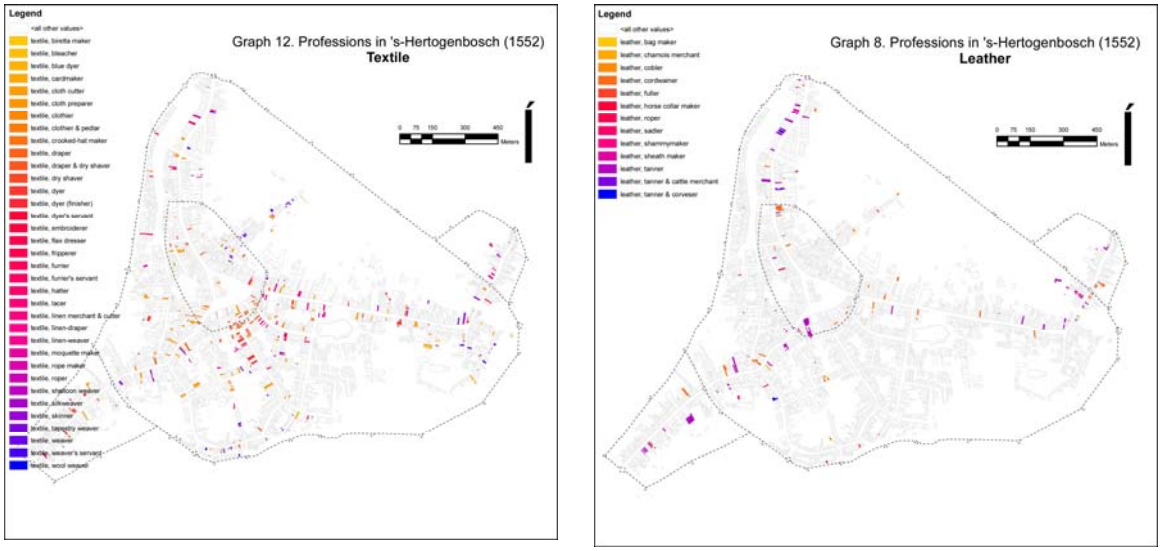


Figure 6:
Occupational Maps of the Textile and Leather Professions

The spatial distribution of the people employed in the textile trade or manufacture also shows a particular pattern. Many of them were centred around the weaver's alley (just to the south of the market square), which was the economic heart of the textile trade. Most of the textile professions were located on the integrated streets probably because they very much depended on footfall and the ability to advertise their wares. In the frame-alley, linen-frames were positioned in the court near the St. Barbara-chapel in 1471. On these frames the pieces which had been shrunk during preparation would be stretched to their proper sizes. These frames also allowed for checking for flaws. Van den Heuvel (1946, 54) argues that a 'trade'-street [6] also functioned as labour market for that same trade as it was a logical location for supply and demand to meet one another. Such as the Weversplaats (weavers square) for the weaver. Usually the time at which this should happen

was also regulated (van den Heuvel 1946, 75). The textile trade correlates on all radii with the topological choice values.

The distribution of people employed in a leather profession shows an entire different pattern. They are mostly located on one of the three main roads radiating from 's-Hertogenbosch market square, and correlate with the topological choice maps on radii 100, 200 and 300. These are the busiest streets and it seems surprising that the leather professions are located along these streets because of the bad smell involved in the tanning of the hides.

Conclusion

The main aim of this paper was to analyse the location of particular crafts and trades and see how those results have confirmed or contradicted our understanding of the economic organisation and topology of the medieval town. The occupational maps have shown that there is a clear pattern in the location of especially the economic occupations. Simply noting the information available from archival records, archaeological evidence and street names these patterns are at first sight maybe not very surprising, however, when one compares these patterns to the space syntax results some interesting remarks can be made.

Comparing the various occupational categories with topological choice maps of different radii indicate which customer – local or visitor – the profession focussed upon. Whereas the food category correlates with all scale levels, and therefore serves the local as well as the visitor, the drink category seems to be more aimed at the visitor. The same distinction can be made between the textile and the leather categories. Whereas the former was aimed at locals and visitors, the later was mostly aimed at visitors. This is also true for the metal and household goods categories. Especially this later distinction seems surprising because most metal items seemed to have been produced for the export. However, the pins might have been overlooked in this assumption, as they might have been produced for the flourishing local textile production as well as for the export.

Other observations can also be made. The food profession was situated in a very segregated part of the town and located more near to the point of arrival of goods (the harbour), rather than the main point of sale (the market square). The other interesting discovery is the spread of the metal profession across nearly all of the integrated streets in the town of 's-Hertogenbosch. Due to fire risks the metal profession has always been perceived as one that would be located in segregated, out-of-the-way, locations. The leather profession is also located on the integrated streets, which is surprising because of the smell involved in the tanning of hides. However, the metal and leather profession like any other 'retail'-establishment did rely to some degree on footfall and therefore focuses upon integrated streets.

My previous article (Craane 2007) has shown a strong correlation between market space and integration levels. This paper has tried to investigated whether it is possible to explain the location of particular professions by using space syntax. Since this is the first research into this topic more research does of course need to occur in order to create a complete picture of this relationship. However, I do hope that this paper has provided some interesting proposals and I hope that it will stimulate a fruitful discussion on the applicability of space syntax in the analysis of the medieval urban economy.

Notes

Notes

1 A vector drawing is simply a drawing made up of geometrical primitives, such as points, lines, curves and polygons, which are all based upon mathematical equations. This is in contrast to raster graphics, which is the representation of images as a collection of pixels (dots)
2 For more details on this technique see: (Lilley 2000)
3 Segment analysis is therefore also referred to as ASA (angular segment analysis)
4 Jord Hanus is a PhD student at the University of Antwerp, Centre for Urban History http://www.ua.ac.be/main.aspx?c=jord.hanus

5 The heart taxes are lists of the number of hearths (households) within a town, which determined the amount of taxes a town had to pay. This way the taxes were divided in equal proportions among the towns and villages These hearth taxes were compiled in various years 1374, 1438, 1464, 1472, 1480, 1496 and 1526. Many authors (Hermans 1845, van de Hammen and Sassen 1894, Cuvelier 1912, Schuttelaars 1998) have compiled lists of these hearth taxes, and some transcriptions are also available in the archives (BHIC 307- 41, 42, 45, 46, BHIC 8 – 381, 383, 384).

6 By 'trade'-street I mean a street which has been named after a particular trade such as Mandenmakersstraat (Basketman's street), Sadelstraat (Sadle street) and Volderstraatje (Fullers alley)

Abbreviations

BHIC Brabant Historisch Informatie Centrum (Brabant Historic Information Centre)
ONB Oorkondeboek Noord-Brabant (Camps et al. 1979) (Chartulary Noord-Brabant)
RHCE Regionaal Historisch Centrum Eindhoven (Regional Historic Information Centre Eindhoven)
RHCT Regionaal Historisch Centrum Tilburg (Regional Historic Information Centre Tilburg)
SAH Stadsarchief 's-Hertogenbosch (Municipal Archives 's-Hertogenbosch)
UvT Universiteit van Tilburg (+library code) (Tilburg University Library)

References

Bafna, S. 2003. 'Space Syntax; a Brief Introduction to its Logic and Analytical Techniques', *Environment and Behavior*, 35(1), 17-29.

Blonde, B. 1987. *De Sociale Structuren en Economische Dynamiek van 's-Hertogenbosch 1500-1550*, Tilburg: Stichting Zuidelijk Historisch Contact.

Boekwijt, H W and H L Janssen. 1988. *Kroniek van Bouwhistorisch en Archeologisch Onderzoek 's-Hertogenbosch*, 's-Hertogenbosch: Kring Vrienden van 's-Hertogenbosch.

Bowkwijt H W and H L Janssen. 1997. *Bouwen & Wonen in de Schaduw van de Sint Jan*, 's-Hertogenbosch: Kring Vrienden van 's-Hertogenbosch.

Camps, H P H, M Dillo, G van Synghel and E T van der Vlist. 1979. *Oorkondeboek Noord-Brabant*, http://www.inghist.nl/Onderzoek/Projecten/OorkondenVanNoord-brabant694-1312 (Page Consulted: 14/10/2008).

Conzen, M R G. 1960. *Alnwick, Northumberland; A Study in Town-Plan Analysis*, London: George Philip & Son, ltd.

Conzen, M R G. 1968. 'The Use of Town Plans in the Study of Urban History' in H J Dyos (Ed.) *The Study of Urban History,* 113-130. London: Edward Arnold.

Conzen, M R G. 2004. *Thinking about Urban Form; Papers on Urban Morphology 1932-1998 (edited by Michael P Conzen)*, Oxford: Peter Lang.

Craane, M L. 2007. 'Analysing Medieval Urban Space; a Methodology', *Internet Archaeology*, 21, http://intarch.ac.uk/journal/issue21/craane_index.html (Page consulted: 14/08/07)).

Cuvelier, J. 1912. *Les Dénombrements de Foyers en Brabant (X1V-XVI siècle)*, *1*, Brussels: Académie Royale des Sciences, des Lettres et des Beaux-Arts de Belgique, Commission Royale d'Histoire.

Van Drunen, A. 2006. *'s-Hertogenbosch; van Straet tot Stroom*, Zwolle: Waanders Uitgevers.

Griffiths, S. 2005. 'Historical Space and the Practice of 'Spatial History''. in A van Nes (ed.) *5th International Space Syntax Symposium,* Delft, The Netherlands. 655-668.

Van de Hammen, J and A Sassen. 1894. *Telling der Huizen en Haardsteden in de Stad en de Meierij van 's-Hertogenbosch gedaan in het jaar 1526 (Overdruk uit de Handelingen van het Provinciaal Genootschap van Kunsten en Wetenschappen in Noord-Brabant 1891-1893)*, 's-Hertogenbosch: Gebroeders Muller.

Hermans, C R. 1845. *Bijdragen tot de Geschiedenis, Oudheden, Letteren, Statistiek en Beeldende Kunsten der Provincie Noord-Braband*, *2*, 's-Hertogenbosch: Gebroeders Muller.

Van den Heuvel, N H L. 1946. *De Ambachtsgilden van 's-Hertogenbosch vóór 1629*, 's-Hertogenbosch: Boekhandel Adr. Heinen.

Hillier, B. 1996a. 'Cities as Movement Economies', *Urban Design International*, 1(1), 41-60.

Hillier, B. 1996b. *Space is the Machine*, Cambridge: Cambridge University Press.

Hillier, B. 1998. 'The Common Language of Space: a Way of Looking at the Social, Economic and Environmental Functioning of Cities on a Common Basis', www.spacesyntax.org/publications/commonlang.html (Page consulted: 16/07/05).
Hillier, B. 1999. 'Centrality as a Process: Accounting for Attraction Inequalities in Deformed Grids', *Urban Design International*, 4(3 & 4), 107-127.
Hillier, B and J Hanson. 1984. *The Social Logic of Space*, Cambridge: Cambridge University Press.
Hillier, B and S Iida. 2005. 'Network and Psychological Effects in Urban Movement'. in A G Cohn and D M MARK *Spatial Information Theory: International Conference, Cosit 2005,* Ellicottsville, N.Y., USA. 475-490.
Hillier, B, A Penn, J Hanson, T Grajewski, and J Xu. 1993. 'Natural Movement: or, configuration and attraction in urban pedestrian movement', *Environment and Planning B: Planning and Design*, 20, 29-66.
Janssen, H L (Ed.). 1983. *Van Bos tot Stad; Opgravingen in 's-Hertogenbosch.* 's-Hertogenbosch: Dienst van Gemeentewerken.
Janssen, H L and A A J THELEN (Eds.). 2007. *Tekens van Leven; Opgravingen en Vondsten in het Tolbrugkwartier in 's-Hertogenbosch.* Utrecht: Uitgeverij Matrijs.
Kuijer, P T J. 2000. *'s-Hertogenbosch; Stad in het Hertogdom Brabant ca. 1185-1629*, Zwolle & Den Bosch: Waanders Uitgevers, Stadsarchief 's-Hertogenbosch & Adr. Heinen.
Kuyer, I. 2001. *'s-Hertogenbosch Cartografisch Bekeken*, 's-Hertogenbosch: Het Bossche Prentenmuseum.
Larkham, P J. 2006. 'The study of urban form in Britain', *Urban Morphology*, 10(2), 117-141.
Lilley, K D. 2000. 'Mapping the Medieval City: Plan Analysis and Urban History', *Urban History*, 27(1), 5-30.
Lilley, K D, C Lloyd and S Trick. 2005. 'Mapping Medieval Townscapes: a digital atlas of the new towns of Edward I' http://ads.ahds.ac.uk/catalogue/specColl/atlas_ahrb_2005/ (Page consulted: 16/11/06)
van Nes, A. 2009. 'Measuring Spatial Visibility, Adjacency, Permeability and Degrees of Street Life in Excavated Towns'. Proposal for the 7th International Space Syntax Symposium.
Penn, A. 2003. 'Space Syntax and Spatial Cognition; Or why the Axial Line?' *Environment and Behavior*, 35(1), 30-65.
Schuttelaars, A H. 1998. *Heren van de Raad; bestuurlijke elite van 's-Hertogenbosch in de stedelijke samenleving 1500-1580*, Nijmegen: Nijmegen University Press.
Stam, H. 2008. *Historische Topografische Atlas Noord-Brabant schaal 1:25.000*, Tilburg: Uitgeverij Nieuwland.
Turner, A. 2005. 'Being in Space and Space in Being'. in a van Nes (ed.) *5th International Space Syntax Symposium,* Delft, The Netherlands. 57-65.
Turner, A, A Penn and B Hillier. 2005. 'An Algorithmic Definition of the Axial Map', *Environment and Planning B: Planning and Design*, 32, 425-444.
Verhagen, P And A Kerckhoffs. 1998. *De Binnendieze van 's-Hertogenbosch: 800 jaar geschiedenis, 25 jaar restauratie*, Zwolle; 's-Hertogenbosch: Waanders Uitgevers; Adr. Heinen.
Verhees, E and A Vos. 2005. *Historische Atlas van 's-Hertogenbosch*, Amsterdam: Sun.
Vos, A. 2007. 'Leven rond de Tolbrugstraat' in H L JANSSEN and A A J THELEN (Eds.) *Tekens van Leven; OPgravingen en Vondsten in het Tolbrugkwartier in 's-Hertogenbosch,* 22-33. Utrecht: Uitgeverij Matrijs.
Whitehand, J W R. 2001. 'British Urban Morphology: the Conzenian Tradition', *Urban Morphology*, 5(2), 103-109.
Whitehand, J W R. 2007. 'Conzenian Urban Morphology and Urban Landscapes'. in *6th International Space Syntax Symposium,* Istanbul. ii.1-ii.9.