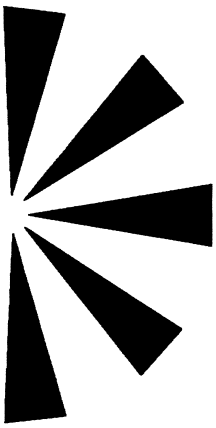

VIEWPOINTS

Discussion of topical issues
in urban morphology

Urban morphology and computers 10 years on

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In the last decade there has been a growing interest in the use of GIS in the field of urban morphology. Ten years ago, I wrote in this journal that the potential of the computer is demonstrated, 'not only for the comparison of historical plans but also for visualization and analysis' (Koster, 1998, p. 7). Both in recent issues of *Urban Morphology* and in papers on urban morphology and computers at the Fourteenth International Seminar on Urban Form there have been examples of the use of information and communication technology in this field. Here I should like to refer to a few aspects relating to my current research on 'Paper and virtual cities'.

This is a joint project of the Virtual Knowledge Studio of the Dutch Royal Academy of Sciences and Groningen University. The central purpose of the project is to develop and integrate methodologies that (a) permit researchers to use historical documents more accurately in creating virtual reconstructions, and (b) help users to recognize technical manipulations and distortions of truth used in the process. In a sense the project focuses on the necessary initial processing of source materials that can subsequently be used in GIS research. It accords with the recent shift of focus in GIS from analysis to data sharing.

Computerized techniques, for example in the field of GIS, have created many opportunities to visualize the townscape. According to M. R. G. Conzen (1976), maps such as those prepared in the Historic Towns Atlas programme are a useful basis for further research on built form and socio-economic development. However, reliability is a key issue and is dependent on not only scale but also the measuring techniques used in surveying and the purpose for which the map was produced.

Research on Dutch cities illustrates this. The earliest maps of Dutch cities are from the early-seventeenth century and show the mathematical design of the fortification works as they were laid out by the engineers designing them. These maps represent the new fortification structures accurately, but are less reliable on the rest of the depicted structures (for example, roads and buildings in the city core). In some cases these structures are not even shown. Other maps, such as the cadastral maps, which in the Netherlands date from the 1830s, are accurate in depicting streets and buildings, but in the case of the fortified area only the main structures are shown. Still other maps show both plot structures as well as the bulwarks in great detail but, nevertheless, are very inaccurate.

In the Paper and Virtual Cities project we have created a specialized viewer that shows the Root Mean Square (RMS) error on a map based on the pairs of co-ordinates that are generated in the process of geo-referencing. Visualizing this error is useful in those cases where maps of a city are used at a later stage to produce a visualization of the townscape, for example using three-dimensional techniques. When creating a historical three-dimensional model we are dependent on the precise location of a built-up structure being mapped in order to make it fit with earlier or later periods. Using the RMS error viewer we can tell for each map, or even parts of a map, how accurate it is and how much a chosen point will deviate from its real co-ordinates. Knowing this the researcher can

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decide either to adapt the model or repeat the process of geo-rectification on a specific area on the map. This kind of information is already available in modern GIS but is rarely used owing to the difficulties of visualizing the error.

In the project we have created a toolbox that enables the researcher to annotate maps in a visual way. The user can load a digitized, preferably geo-referenced, map and use the toolbox to draw a separate layer on top of the map. The user can mark points that can be used for geo-rectification. Areas can also be indicated that have a specific characteristic (for example, a plan unit). These data are stored separately from the map and if the map is geo-referenced the data from one map can be compared to those of other geo-referenced maps of the same area. The output layers from this application can be stored on a server so that other researchers can benefit from the annotations. If any GIS connection is required, the application offers an export function to GIS using the Geography Mark-up Language (GML) export format.

In addition to the use of maps and GIS there is a growing interest in the use and application of three-dimensional city models. This type of application is a good way to reconstruct townscapes from the past. The main advantage of this kind of reconstruction is that the user can walk through the scene as if it were a real town, but is able to switch structures (for example, buildings) on and off. In our work on the Renaissance square in Pienza, designed by Bernardo Rossellino between 1459 and 1462, we reconstructed the relevant part of the town centre in order to examine the square from different viewpoints (Koster, 2006a). In the real world of today the view from one of these points is impossible since the town hall is blocking the view. In the digital reconstruction, this building can be 'switched off' and we can clearly see how Rossellino originally saw the connection between the façade of the cathedral and the square in front of it.

Since the sources used have varying degrees of accuracy, the end user needs to be able to assess the veracity of the final model. Different colours and hatchings can be used to indicate levels of accuracy. One of the earliest historical models in which this system is used is the NuME project showing a reconstruction of the medieval centre of the city of Bologna (Bocchi, 1999). Depending on the available sources, each object receives a colour and a texture. Buildings or objects that look brownish are those that do not have specific or reliable data available. Another type of presentation was introduced by Harrison Eiteljorg (2000): in some cases only the contour of the building can be seen and the walls are almost translucent.

Such a system can be complemented by a technique that offers a kind of labelling in which each element in the model receives a label that indicates the source. The advantage of such a labelling system is that it can also be used for other purposes. For example, labels can contain dates such as the date of construction or the date of demolition or structural alteration. The software can use these labels to show or hide objects for a certain period chosen by the user.

In the project a step-by-step model was run showing the transformative process of part of Alnwick. This was based on the surveys of Alnwick carried out by Conzen in the 1950s and 1960s and a modern survey by the author in 2004 (Koster, 2006b). Similar models have been used by Polidori and Bachilli (2007) using specialized software.

The labelling of objects within a three-dimensional model can be done using extensible mark-up language (XML). GML is an XML application with a close connection to GIS technology that offers the possibility of describing geographic objects. Using GML we can describe not only plan elements (streets, plots and building block plans), but also the building fabric and land use.

Based on Conzen's surveys of Alnwick in 1953 and 1964 and my own in 2004, a specific XML application has been developed that enables the user to describe the town plan. Elements to describe the geometry of the objects are taken from the GML specification – for example, those elements that describe a plot by its real-world co-ordinates. However, the plot itself and the properties that are used to describe such a feature have to be defined in a separate language. We can describe the plot in a number of different ways. One description is based on its historical development and contains the succession of owners and their properties over time. It contains different types of information on the owner, such as name and occupation, the buildings and the use of the plot. The historical description will also contain the sources in which the information was found. Another description is concerned with the spatial component of the plot. This includes its area, the building coverage, and the perimeter of the plot and its buildings.

The combination of these data blocks may be imported into the GIS and can be presented in different ways. By presenting a simulation over a given period of time the changing townscape can be visualized. These changes may not be visible from

the street. Some kinds of change may be evident only on maps and in building records. Visualization of elements that are only found in written records tends to be difficult, but again GIS can play a role. In a field like urban morphology, in which many different disciplines are involved, each discipline tends to treat the data differently. Whitehand (2006, p. 87) has pointed out that 'greater attention is needed to the building up of conceptual frameworks and the connecting of individual studies to those frameworks'. In order to establish such frameworks researchers from the different disciplines need to be able to use each other's data, but in order to do so these data need to be in a standardized format accessible to others. XML technology is likely to play a major role in this.

The future use of information technology in the field of urban morphology will be threefold. First, the role of GIS will continue to grow. Existing techniques, especially of rectifying historical maps, will improve. Provided that maps are well annotated, comparative studies will become easier with the increased digitization of data. Secondly, there will be increased use of three-dimensional virtual townscapes: improved automated techniques will allow these models to be created faster. Combinations of GIS and three-dimensional townscape models are still rare but a growing interest can be seen in several disciplines. Thirdly, there will be greater standardization of data.

The Paper and Virtual Cities project provides a number of tools to help these developments in urban morphology. It does so by creating a meta-data format that can be used to describe the variety of the townscape and by providing researchers with a number of tools that can be used to annotate the townscape as a whole. The same meta-data format can be employed in analysis and the visualization of data in both two and three dimensions by the use of GIS and virtual reconstructions. Urban morphologists should think about the data structure necessary to store the different datasets and to create the necessary framework. The internet and web technology will help in facilitating the exchange of data in order to undertake more comparative studies.

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Fringe-belt theory and polarities-landmarks theory

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During the keynote address on fringe belts by M. P. Conzen (2008) at the ISUF conference in Artimino, I was suddenly struck by the great assonance that the fringe-belt theory developed by M. R. G. Conzen (1960) has with Muratorian polarities-landmarks theory (Muratori, 1959). The Conzenian and Muratorian schools have been interrogating each other for some time, and finding affinities (see, for example, Kropf, 2004; Marzot, 2005). But I had never noticed before that these two theories, both fundamental to the study of urban form, shared so many aspects as to be considered almost