

# Building on geometries of intelligibility: Planning the Leiden region as a layered movement fabric

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## Abstract

This paper discusses the application of space syntax within Dutch planning practice. It contributes to the knowledge of urban spatial structure and dynamics, by way of a study of the functional and movement logic of the urban fabric of the town of Leiden in the Netherlands. The study is done in the context of planning discussions about possible regional scale road and rail infrastructure connections through and in the immediate vicinity of the central fabric. In such discussions the role of the urban fabric itself in mobility patterns is often very unclear as is the role of the fabric as an intelligible walkable/cycleable environment. At the simplest level, elements of the fabric are taken as accessibility routes, connecting into the regional network or connecting parts of the fabric. But the possible secondary centrality and functional effects of changes are usually a matter of pure speculation. Space syntax ideas, coming out of previous research on Dutch cities, are used to unravel emergent natural movement networks (supergrid) in Leiden's fabric. At the same time, the local potentials for centrality inherent along these networks are mapped separately. The mappings of respectively networks and local potentials along that network are presented alongside each other in order to provide a framework for discussion in which the role of the fabric itself and the effects of possible changes is made clearer.

The research is focused initially on tracing the geometric correlates of the factor of scale synergy through the urban fabric for the situations in 1958 and 1998 - revealing what is proposed is an imperfect, not fully continuous, spatially defined supergrid. It is shown that this spatial supergrid is more coherent as a geometry in 1958 and that the types of intervention since then have tended to work against intelligibility within the fabric. This demonstration is used to begin the discussion, which is then directed towards creating new more intelligible structures within the central fabric of Leiden as a by-product of connections at the regional scale.

Current planning alternatives for the improvement of the regional scale mobility networks are tested in the axial map of the Leiden agglomeration in order to uncover the fabric effects of the alternatives. The results are interpreted in relation to the factors proposed above and the mappings of these factors. It is shown that the solution of a regional infrastructure problem can have consequences which go beyond the simple facilitation of accessibility. The fabric itself can react in complex ways to changes, causing unexpected problems - but also delivering unexpected opportunities for the reconfiguration of the pattern of functional centres within the fabric. Space

## Keywords

Intelligibility, urban fabric, regional mobility

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syntax techniques offer an instrument for bringing these complex effects within reach of planning thinking and discussion, and for generating alternatives which may not otherwise be given serious consideration.

### **1. Introduction**

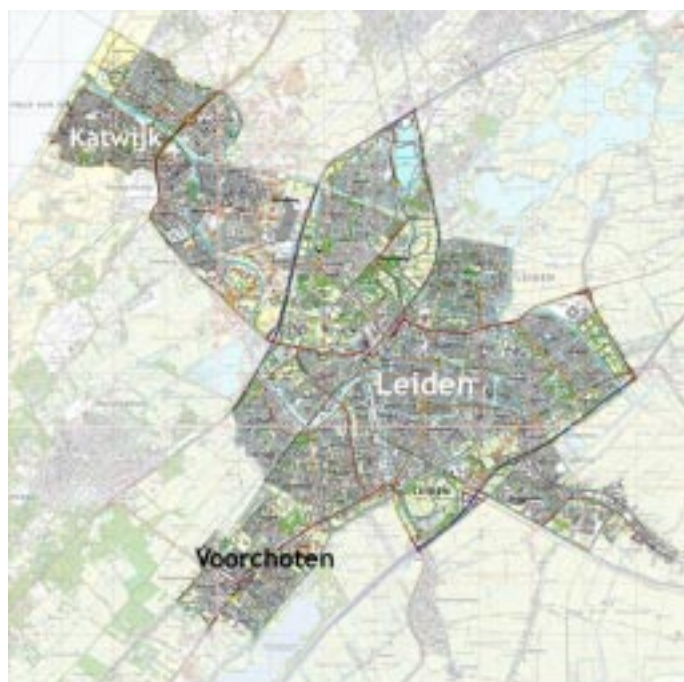
This paper concerns itself with the application of space syntax and ideas about spatial structure derived from space syntax within the planning system of the Netherlands.

The extraordinary relationship between the Dutch and their landscape has engendered a culture of planning quite unlike that anywhere else in the world. The effort put into winning land from the water, and the unequivocally made character of the environment means that the landscape is understood here as a much less neutral background to development activity. Land comes at a price and is made for a purpose and this purpose marks its space - striates it, if one wants to use Deleuze and Guattaris' term - from the beginning. The technocratic mindset of the Dutch environmental engineer will tend to see the landscape as organised by planning strictures and regulations before seeing it as an integral part of a more comprehensive social organisation. The landscape becomes a surface for the placement of functions, which are then connected one to the other by various connective means of transport infrastructure. Social and economic patterning are presumed in the first instance to follow unproblematically this logic of placement and access, though it is well understood that the consequences of planning decisions can be other than what is expected.

The planning idea of the Randstad is one which has since the middle of the last century played a huge role in co-ordinating and directing planning decisions in the context of the whole urban agglomeration of the western Netherlands. This urban agglomeration has developed from being, in the 17th, 18th and even the 19th centuries, a sprinkling of relatively autonomous social, political and economic urban units, to the much more interconnected, integrated entity it is today. The idea of the Randstad was a step in the process of understanding the urban agglomeration as a higher scale metropolitan unit in its own right, but the huge increase in personal and public mobility as well as in connectivity through communications technologies over the last few decades has provoked an even more radical rethinking of the urban landscape as a functional unity. While there is plenty of discussion - and much disagreement (see for example de Boer) - about the viability of such a metropolitan idea, there is a growing consensus within the spatial and economic planning professions at least, that the present situation of small individual cities and low urban densities of the western agglomeration seen as a whole, works against the positioning of the Netherlands within a global economy articulated through a network of global cities (as theorised by Sassen, 2001). A process of discussion within the planning profession

and in local and national politics has been set up in a way which aims at working towards the shifting of planning ideas and priorities, and the exploration of the idea of a strategic concentration of development activity in the region which already contains the major urban centres; towards the development of a metropolitan city - Delta Metropolis - in the urban agglomeration of the western Netherlands (see Frieling, 2003).

Rijnland is an urbanised region within the ambit of the Delta Metropolis that has recently been the subject of a debate on its future within the Delta Metropolis concept (Figure 1). Important issues within this debate were the position of Leiden with respect to the more densely urbanised regions of Amsterdam and Den Haag-Rotterdam to its north and south (especially with regard to transportation infrastructures) and the development potentials of locations throughout the region. Rijnland itself consists of the Leiden urban area and a number of smaller villages woven through areas of intensive farming and recreational landscape from Katwijk on the coast to Alphen aan de Rijn 20 km to the east. Since the Second World War the Netherlands has experienced a very rapid economic expansion, with short periods of recession between 1970 and 1990. Economic growth and a growing population have kept the country in a permanent state of reconstruction, which has changed the shape of Dutch cities significantly. The high demand for new residential areas and the car explosion, especially after 1960, defined a new phase in spatial planning in the Netherlands. Leiden is one of the Dutch cities that experienced fast growth during this period. At this moment, the Leiden agglomeration has reached the Northern Sea in the west and the Den Haag agglomeration in the South.



**Figure 1: Area of investigation**

Leiden itself, with a population of 115,000, is big enough to provide its inhabitants with a wide range of cultural and recreational options and exerts a powerful influence as a regional centre. As a planning problem its position between the urban regions to the north and to the south is crucial to understanding the logics of its functioning. However the discussion in this paper concerns functional patterns at a lower scale - that of the region itself - in relation to changes in the infrastructure working at the larger metropolitan scale.

## **2. Placing Space Syntax in Dutch planning practice**

The functional logics we are talking about here are assumed, within the planning culture, to consist in the relatively straightforward placement of social, cultural, commercial and recreational facilities, and their linking through networks of transportation infrastructure. The idea of social, cultural and economic dynamic forms themselves emerging out of the everyday use by mobile populations of the connective tissue is still difficult as a starting point, and the consequence is that there exists a knowledge and understanding gap, especially at the point where these emergent dynamics are at their most complex and influential - within the more traditional central urban fabric. Centres are conceptualised as more or less attractive (depending on population size usually) nodes in networks working at relatively large regional and metropolitan scales, and the internal workings of these centres tend to be collapsed as far as their conceptual understanding is concerned, to the point of the node. In larger centres, which may themselves comprise quite extensive surfaces, to greater or lesser degree polycentric in their functioning, this leads to an incomplete understanding of the dynamics and potentials of the centre itself. It is customarily assumed for example that the internal functional dynamics of the centre are determined by the attractive power of large programmatic units, or concentrations of programmatic units, within a functionally neutral central city fabric.

Space syntax has as its strength the uncovering of space-structural detail within a dense, fine-grained central urban fabric. Space syntax techniques and previous space syntax research can expose the logics of the fine-grained fabric as a field of movement and activity, making them discussible within the broader debate on the whole region. Within a region such as that of the Rijnland therefore, which has a substantial part of its surface composed of such a central urban fabric, the application of space syntax may expose this otherwise undifferentiated zone, potentially opening up a rather different set of possibilities for the future of the region.

## **3. Leiden and its fine-grained fabric**

This section presents an analysis of the geometric composition of the fine-grained spatial fabric (the urban surface consisting of the street grid) of Leiden.

It has already been proposed that the spatial-functional logic of the central urban fabric of Amsterdam, reveals itself as a grid pattern which splits into the two distinct networks of supergrid and local area (or neighbourhood) (Read, working paper, 2001, 2003). This logic is reflected in the intensity of activity in these respective networks, supergrid spaces carrying very significantly higher levels of activity than local grid spaces attached to them. The logic is however given not so much in this distinction with regard to intensity of use, but rather in the scales of movement for which they tend to be used. Local area grids are used as a local, or neighbourhood, scale movement network, while supergrid networks typically carry a complex of movement scales. They form on the one hand a coherent movement network at the larger scale of the central city, carrying the movements of people who are travelling at anything above the most local scales, while at the same time, due to the typically direct physical connection between local area networks and the supergrid network, they carry local scaled movement as well. In fact in most cases the function of supergrid spaces at the local scale goes beyond simply constituting a part of the local area movement network; supergrid spaces tend (in Amsterdam at least) to also form centres at the local scale - at the same time as they carry through movement. Supergrid spaces become therefore, at those points where they function simultaneously as local centres and city-scale network, those spaces where the neighbourhood and the city at a larger scale meet as far as the movements and lives of people are concerned.

Following on from this work on Dutch cities, an attempt is made to understand the way two different scales, the local and that just above, structure the urban fabric of Leiden. The study consist of 2 parts:

1. The development of the current urban spatial structure; it compares the spatial structure of Leiden in two different periods, the first one is 1998, which represents the present condition and the second one is 40 years earlier; 1958, the period before the car began to play a major role in urban planning.

2. The spatial impact of a regional scale infrastructural intervention, in different scenarios, in the urban fabric of Leiden.

### **3.1 The development and functioning of the Leiden urban fabric**

The hierarchy or functional layering built into the shape of the urban grid of Dutch cities involves firstly the city-scale movement network (the supergrid), a set of spaces in the grid which are suited by their geometry for carrying traffic over the medium and longer distance, and secondly the grid at the scale of neighbourhood. It has already been proposed that the interaction of the activities in these grids together is fundamental to the intelligibility of the fabrics of at least some cities (see Read; working paper, 2001, 2003 and Read & Budiarto, 2003)

### 3.1.1 The supergrid

An analysis of the fine-grained fabric of Leiden in these terms finds a significant fragmentation, both in the way the fabric has grown together out of a number of small villages, and in the more recently developed and consciously designed residential areas, where expansion of the city has taken place in relatively self-contained pockets, rather than around and attached to pre-existing movement routes. The geometric investigation using space syntax gives an insight into how the urban space of Leiden has changed in the last 40 years.

The supergrid is isolated with the help of the integration gradient map (Read, working paper) which picks out spaces with high integration values relative to other lines local to them. The raw integration gradient maps (Figures 2a and 2b) are used to trace continuous lines of high integration gradient (radius  $n$  and radius 3 both work as the basis) through the fabric (Figures 3a and 3b). In the 1958 maps (Figures 2a and 3a) relatively small patches of fabric generate a fragmented picture because the patches of fabric are disconnected from each other. It is probable that this fragmentation is not experienced as such however, but rather as a relative thickening of urban intensity as routes connecting villages pass through the centres of those villages. By 1998 (Figures 2b and 3b) the fabric makes up a much more continuous surface and fragmentation takes another form. Here lines of high integration gradient values tend less and less to form continuous routes in the newer, more consciously designed areas. The tracing procedure breaks down as gaps start to appear between lines of high integration gradient value.



**Figure 2a: The raw integration gradient map of Leiden 1958**



**Figure 2b: The raw integration gradient map of Leiden 1998**

This procedure is designed to find the geometric correlate in the actual space of the city, of space syntax scale synergy or intelligibility measures, but highlights also why it is so necessary to refer issues of intelligibility back to the physical space of the city rather than leaving it in the space of the global-local integration scattergram.

In principle scale synergy or intelligibility measures refer to collections of spaces which centre themselves (with a gradient of increasing integration measure from edge to centre) on strong integrators (usually supergrid spaces). But if supergrid spaces do not join up to form coherent continuities (movement networks) within the fabric it could be argued that the real intelligibility of the fabric is compromised.



**Figure 3a: The trace of integration gradient map of Leiden 1958**



**Figure 3b: The trace of integration gradient map of Leiden 1998**

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Even in 1998 the fabric does not form a completely continuous surface and road elements are constructed in order to complete the supergrid network at the scale of Leiden and its immediate surroundings. These completions of the supergrid (some of them historical routes between the original villages, some of them engineered in order to complete the city-scale movement network) are highlighted in Figure 4, which is a representation of the complete supergrid.



**Figure 4: The representation of complete supergrid network (white lines are the supergrid that emerges out of the fabric, the black lines are the engineered supergrid network)**

### 3.1.2 The grid at the scale of neighbourhood

Two axes are picked out in Figure 4; the Pieterkerkstraat-Doezastraat-Herenstraat-Vrijheidslaan-Vijfmeilaan-Trompweg axis, for simplicity the street and; the Lelylaan-Churchillaan axis, which will be the subject of one of the connection scenarios in section 3.2. A point-depth map of the street is shown in Figure 5, demonstrating the degree to which the axis is physically integrated with the surrounding fabric. Scattergrams of areas which centre on the street are shown in figs. 6a and 6b, and demonstrate the way the continuity of the fabric - its physical integration transverse to the axis - typically influence the scale synergy measure in the cases we have studied. The highly physically integrated fabric to the east has a high scale synergy measure while the fabric which is less physically integrated has a much lower scale synergy measure (correlation coefficient R in the global-local integration scattergrams). The difference in these measures is, again typically for the cases we have studied, reflected in a quite different functional character on the ground.

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Figure 5: A point depth-map of Pieterkerkstraat-Doezastraat-Herenstraat-Vrijheidslaan-Vijfmeilaan-Trompweg axis.

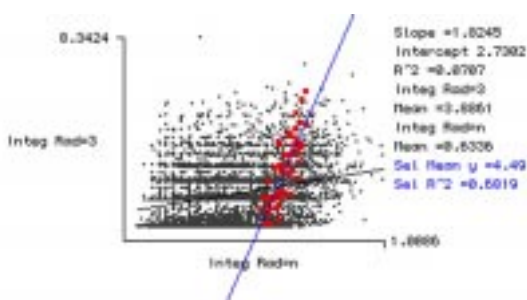


Figure 6a: The spaces of the neighborhood Pieterkerkstraat-Doezastraat, highlighted in red, in the scattergram of radius-3 integration against radius-n integration for Leiden as a whole.

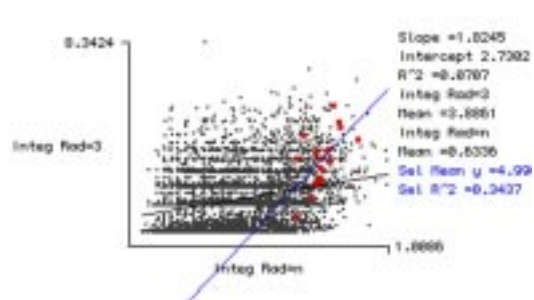


Figure 6b: The spaces of the neighborhood Vrijheidslaan-Vijfmeilaan-Trompweg, highlighted in red, in the scattergram of radius-3 integration against radius-n integration for Leiden as a whole.





Figure 7a: Image of the Doezastraat



Figure 7b: Image of the Vrijheidslaan

Figures 7a and 7b reflect the difference in this functional character, the part of the street which is more physically integrated and with a higher scale synergy measure reflects a functional and social integration with the neighbourhoods which about it, while the part with lower physical integration and a lower scale synergy measure reflects, with its shopping warehouses and institutional functions, a stronger connection with the city as a whole. One could say that where the physical integration of the axis with the fabric is lower, the social and functional character tends to orient itself towards the supergrid network - towards the scale of the city as a whole - while where the physical integration of the axis with the fabric is higher, the social and functional character tends to orient itself towards the local grid - towards the scale of the local neighbourhood.

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Figure 8: Area integration map (white circles indicate high concentration of area integration)

**Figure 9: The high area integration (white circles) coincide with supergrid spaces (black and white lines)**



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Area integration (a measure designed to highlight areas in the city with a high general level of radius-3 integration) was used to further reveal the local potentials of the fabric. In general one could say that local concentrations of high radius-3 integration (the redder or darker patches in the area integration map - Figure 8) reflect high integration and social interactivity between supergrid and area. Those areas of high area integration, where they coincide with a supergrid space (see Figure 9) will usually be those which exhibit, on the supergrid space at that point, a high level of street-edge activity and a vital 'high-street' character with shops and other facilities serving the local neighbourhood. This is always providing that the block sizes of the area in question are not so large that they inhibit comfortable pedestrian use.

### **3.2 The spatial impact of A11 intervention in the urban fabric of Leiden.**

In the last few years there has been an intensive planning discussion about possible road connections between highways A4 and A44 within the Leiden agglomeration (see PZH, 2002 for example). This discussion is motivated by the interest to establish the connection between the urban area in the west of A44 and the urban area in the east side of A4 and also an attempt to reduce the traffic congestion on the A4 (one of the most congested highway in the Netherlands, connecting Amsterdam and the Hague). Often the secondary consequences of such intervention on the urban fabric and their social and economic potentials at local, city and regional scales, are not well investigated. The space syntax investigation shows how the simple solution of the highway congestion problem can have a significant effect on the urban fabric of Leiden.

Three scenarios of intervention for the possible road infrastructure between the highway A4 and A44 have been made:

1. Highway A11 flyover (Figure 10)
2. Highway A11 with exit to Voorschoterweg (Figure 11)
3. Up-grading the Churchilliaan -Lelylaan (Figure 12)



Figure 10: Intervention 1 - Highway A11 flyover



Figure11: Intervention 2 - Highway A11 with exit to Voorschoterweg



Figure 12: Intervention 3 - Up-grading the Churchilliaan-Lelylaan

In the first scenario, highway A11 flyover, the new highway route connecting A4 and A44 is proposed. It is a flyover highway, meaning it will not have any exit to the urban fabric.

This type of intervention definitely will give a direct impact to the movement of the automobile in the regional levels, but its impact on the scales of the urban fabric are likely to be negligible. Since it does not have any off-ramp, which connects the urban fabric of Leiden with the highway infrastructure, the intervention doesn't change the integration values of the axial map of the city.

In the second intervention, the proposed highway A11 will have an exit to the Voorschoterweg. The Voorschoterweg is the main road between Leiden and Voorschoten, the old road connection between the two towns. There is a small increase in the integration value of the Voorschoterweg in the global integration map due to the intervention. The intervention does not influence the integration values in the local integration and area integration maps. The size of the axial map is clearly an issue here since the whole functional area at the regional level (which would include at least Amsterdam and Den Haag/Rotterdam) is not included, and the actual applicability of space syntax at this scale and with highway type networks has not been extensively tested.

It is also quite clear intuitively that in the first and second scenarios, the interventions will have consequences on the regional scale network and that the urban scale will be only marginally affected because of the lack of close connection between the two levels.

But in the third scenario, the proposed intervention does contact the city scale, with the new connection in the regional infrastructure being embedded in the urban fabric. The Churchillaan, in the southeast is stretched to join the highway A4, while the Lelylaan is stretched to the highway A44 to the north west. The intervention creates a direct connection along the Churchillaan-Lelylaan between the A4 and the A44 through the urban fabric.

The effect of the intervention is quite surprising. While the full effect of the connection between the two highways cannot be read due to the limited range of the axial map, it is clear that the ultimate effect in terms of movement will be much more complex than simply that of a regional scale link. The stretching of the Churchillaan-Lelylaan through the fabric increases significantly the local integration value of neighbourhoods alongside. This factor is reflected in the area integration map. This suggests an increase in the spatial potential for intensity of activity along the Churchillaan-Lelylaan at the same time as this axis is connected and accessible at city and regional scales. The Churchillaan-Lelylaan becomes a long highly integrated space, the longest street axis in the Leiden agglomeration, and potentially strong as a centre at a combination of all three scales.

Overlaying the supergrid and area integration maps highlights variations of spatial-economic potential along the Churchillaan-Lelylaan, pointing particularly to the area around the intersection with 'the street' as a point of high potential.

The combination of strong city-scale and local centrality potentials with high regional connectivity is one that offers an interesting challenge at the design level. This relatively simple and cheap intervention constructs an interface between three layers of high integration; those of the local scale of the neighbourhood area around the Churchillaan-Lelylaan, the middle (supergrid) scale of the city fabric, and the regional scale. The merging of these scales contributes to the potential of this space as a rather different type of functional centre. It draws the regional/metropolitan scale, by way of the highway network, directly into the functional field of the central fabric, offering the possibility of a hybrid centrality which combines aspects of centre and periphery through being simultaneously part of the two larger scaled networks, while being embedded in the local through the fine-grained grid. It creates opportunities for the reconfiguration of a pattern of functional centres within the fabric of Leiden and has implications for planning places of distinctiveness and particular functional specialisation within the centre seen as a whole. Problems of congestion and through-movement as opposed to to-movement are issues which would need to be addressed at the design level, as would the issue of appropriate character and programme given the highly particular set of conditions set up here.

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#### **4. Space Syntax and the planning discussion**

Space syntax techniques - more particularly the tracing of the supergrid by way of the integration gradient map, and the area integration map - highlight the variations in potentials for activity levels over the urban field, making the exact targeting of interventions less a matter of guess-work. Perhaps even more important, previous space syntax research suggests a mechanism for the interaction of the local and supergrid (middle) scales, which offers a way of thinking about the ways social and economic activity potentials are structured into the physical space by movement dynamics through the scaled networks of the city. This is knowledge which can guide decision-making at the planning discussion and design level.

A combination of space syntax representational techniques and theory derived from space syntax research opens up new levels of discussion in deliberations about complex urban regions, and can reveal potentials that may lie latent in a complex overlay of scaled networks and movement patterns. An over-simple model of the regional movement network connected to attractive place-nodes is replaced by a much more realistic model consisting of layers of differently scaled networks which produce emergent social and economic formations through their interaction, in the

surface of a complex urban fabric. The regional movement network is supplemented by two further network layers at the city (supergrid) and local scales, which serve to ground and structure spatial flows and processes, producing coherent social and economic patternings in the urban surface.

A planning practice which incorporates practical and robust procedures for dealing with networks layered by scale may go beyond the rather simple issues of accessibility and attraction to issues of the generation of social-spatial and economic-spatial forms in the city resulting from the interface between mobile populations at regional, city and local scales. The analysis of particular locations in these terms suggests not only ways of understanding the functional unevenness of the more traditional kinds of urban fabric - as well as ways of intervening in urban structures with which we are already familiar within the fabric of the central city - but also begins to suggest the principles by which new scales may be integrated with existing functional structures. It suggests also a different take on the problem of designing new centres - one which may recognise 'the local' as a condition rather than as a location and which may direct us to ways of making socially and economically dense and supportive environments. The exact elaboration of these principles into projects on the ground will be a task for invention and design but the theoretical model allows this design work to track potentially productive pathways.

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