A configurative approach to understand pedestrian-based and car-based shopping centres:
Configurative studies on Oslo and Eindhoven

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Akkelies Van Nes
Delft University of Technology, The Netherlands

Abstract
This paper discusses the spatial analyses of the effects of ring roads on sub-centres and city centres in Oslo and Eindhoven. The studies of Oslo and Eindhoven show some features of the type and configurable pattern of shopping areas. Successful pedestrian-based shopping areas tend to locate themselves in the locally most integrated areas. Smaller local pedestrian-based centres depend on a high degree of connectivity to the vicinity 2 steps away. Car-based shopping centres tend to be located along the globally most integrated roads. They are located closely to the junctions of these roads. In which way a sub-centre turns out to become pedestrian-based or car-based depends on its degree of connectivity and the dispersal of integration values.

Keywords
Car-based and pedestrian-based shopping centres, urban transformation, ring roads, configurable changes

akkievn@hotmail.com

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The subsequent studies of Oslo and Eindhoven are meant to answer the following questions: How do ring roads affect whole cities? How do outer ring roads influence local shopping centres in the suburbs? In what way does the degree of connectivity of ring roads affect their vicinity, and in what way do ring roads affect the dispersal of pedestrian or car-based shopping areas?

1. The optimal location of shops as regards configurable changes

This paper intends to explain how shops search for an optimal location in an urban grid. In order to understand or gain general knowledge about these location processes, one has to invest what happens when the configuration of an urban grid changes as an effect of larger road projects.

How it is possible to gain general knowledge about future behaviour of shops owners, when each of them has different reasons and intentions for their locations? If their reasons and intentions are unambiguous, then it must be possible to predict shop owners' actions when an optimal location is affected by configurable changes on a street grid. As regards economic activities in society, a marked rational behaviour is profit maximising. It is recognised to be an unambiguous intention decisive for a shop's location.

Two hypotheses had to be set up before approaching the configurative issue. On the one hand, in order to survive in a competitive market, shops will always search for an optimal location such that they can reach as many potential customers as possible. On the other hand, if the optimal location changes as an effect of configurable urban changes, one has to presume that shops will relocate themselves to a new optimal location.

So far, research on the configurative structure of an urban grid has come up with the following general statements on the relationship between the dispersal of shops and urban structure. As regards the theory of the natural movement economic process, shops tend to locate themselves along the most integrated streets (Hillier, Penn, Hanson, Grajewski and Xu 1993, p. 31 and 61). The degree of connectivity of an urban grid on a micro and meso scale seems to decide the dispersal of shops. A successful shopping area has a both global and local strategic position in a built environment (Hillier 1999, p.119). Not only the most integrated streets on a local and global scale decide where shops locate themselves, but also a shopping street's degree of connectivity with its immediate vicinity (van Nes 2002, p. 300). If these configurative conditions change, the location of the shopping area will change.

2. Two types of ring roads and two types of shopping areas

In order to illustrate the relationship between the location pattern of shops and the configurative structure of an urban grid, two case studies from my PhD thesis "Road Building and Urban Change" will be represented. In the main this thesis investigates how ring roads change the dispersal of shops and retail in Western European cities and towns. As it concludes, the ways a ring road affect the dispersal of shop and retail seems to be dependent on the type of ring road and on the way it is imposed on an urban grid.

There are two types of ring roads. One is the highway ring road and the other is the boulevard type of ring road. A highway ring road is designed mostly for car traffic. There is little or almost no space for pedestrian movement. The degree of connectivity to the grid on which it was imposed is low. In most cases a highway ring road is connected to the main routes of a city or town. They consist in curves and junctions for carrying car traffic of a certain kind of speed with the purpose for reaching different parts of a built environment effectively. A boulevard styled ring road has pavements and is mostly well connected to all streets of the grid it is imposed upon. Some of them have tree rows. Sometimes there are hybrids between these two types of ring roads. There exist boulevard ring roads with few, as well as highway ring roads with many connections to their vicinity. Seemingly, a precise distinction

between these two types is difficult to assess extrinsically. In terms of a configurative approach, the difference between a highway and boulevard ring road can be defined in terms of their degree of connectivity to the vicinity.

Moreover, there exist outer and inner ring roads. Inner ring roads encircle the central core of a built environment's main shopping area. Outer ring roads also encircle surrounded dwelling areas and industrial areas located around a built environment's central core. In what way these different types of ring roads affect the location of shops seems to depend on their degree of connectivity to their direct vicinity and on the ways they segregate the central core they encircle.

In a paper presented to the Third Space Syntax conference by the author, four UK towns with inner ring roads were discussed. Space syntax analyses were taken only from the central area (van Nes 2000). In all cases with highway ring roads, the location pattern of shops changed from a linear to a convex form. In one case the linear pattern of shops remained, because a part of the ring road was boulevard styled and directly connected to all streets in its vicinity.

Some discoveries were made by research on whole cities with several ring roads. Like the two types of ring roads, there exist two types of shopping areas. On the one hand there is the pedestrian-based shopping area, on the other hand the car-based one. The study of Oslo and Eindhoven shows that the car-based shopping centres locate themselves at the junctions of a highway ring road – provided the ring road implies high global integration values. The pedestrian-based shopping areas tend to be in streets with high local integration values and a high degree of connectivity with their immediate vicinity. Naturally, there is a distinction between city centres and sub-centres. However, whether they are pedestrian-based or car-based depends on a ring road's degree of connectivity with its vicinity and the degree of connectivity on the urban grid on which it is imposed.

3. The study of Oslo – the pedestrian and the car shopper

Until the 1930's Oslo had a small city centre located mostly inside its first ring road, officially called Ring road 2. Most of the expansion of the city occurred after the Second World War. The boulevard styled Ring road 2 was finished in the 1950's. The large highway styled outer Ring road 3 was finished in the beginning of the 1980's, whereas the inner Ring road 1 was finished in the beginning of the 1990's.

The boulevard styled Ring road 2 is well connected to its vicinity. It is located about 2 - 3 km outside the city centre. Ring road 3 illustrates the highway type of ring road with few direct connections to other streets in its vicinity. It is located 2 -

4 km further outside Ring road 2. However, there are separate pavements for pedestrians and bicycles located along this ring road. On several junctions between Ring road 3 and main routes leading towards the city centre, local shopping centres and larger car-based shopping centres established themselves during the last two decades.

Ring road 1 encircles the central core of Oslo. It is a hybrid between a boulevard and a highway ring road. At the east and the western parts of the city it is well connected to the streets in its vicinity. At the northern part it has a highway standard with few connections to main streets leading towards the city centre. The purpose of Ring road 1 is to relieve the city centre of through traffic and to disperse the flow of traffic into the city centreFigure 1 shows the global and local integration of Oslo in 1929. The most globally integrated streets are badly connected to the city centre and the local areas in its vicinity. As local integration shows, black axial lines highlight Oslo's 3 main shopping areas. The streets Bogstadveien in the west, Karl Johans gate in the centre and the streets Markveien and Th. Meyers gate in the east imply the highest local integration values. Figure 2 shows the dispersal of function in Oslo in 1929. The black pattern of shops is located along the most integrated lines from the local integration analysis in Figure 1.

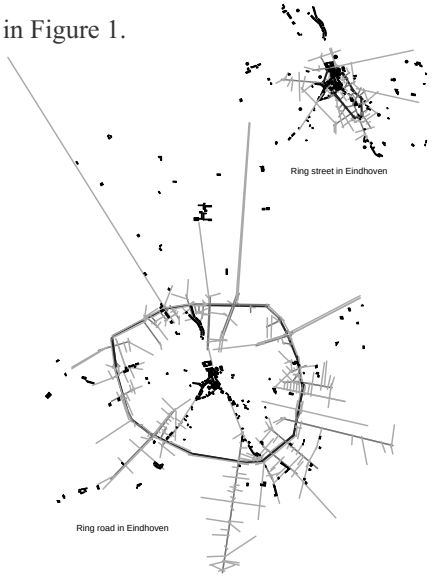

Figure 1: Global and local integration of Oslo 1929

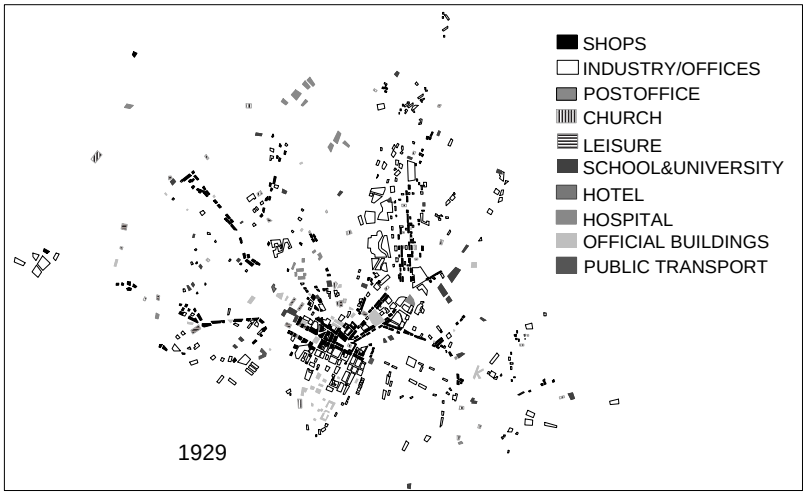

Figure 2: Dispersal of functions in Oslo 1929

Figure 3 shows the global integration of Oslo in 1999. All 3 ring roads are finished. Main routes from Ring road 3 towards the city centre and northern parts of Ring road 2 imply high global integration values. The city centre has become segregated compared with 1929.

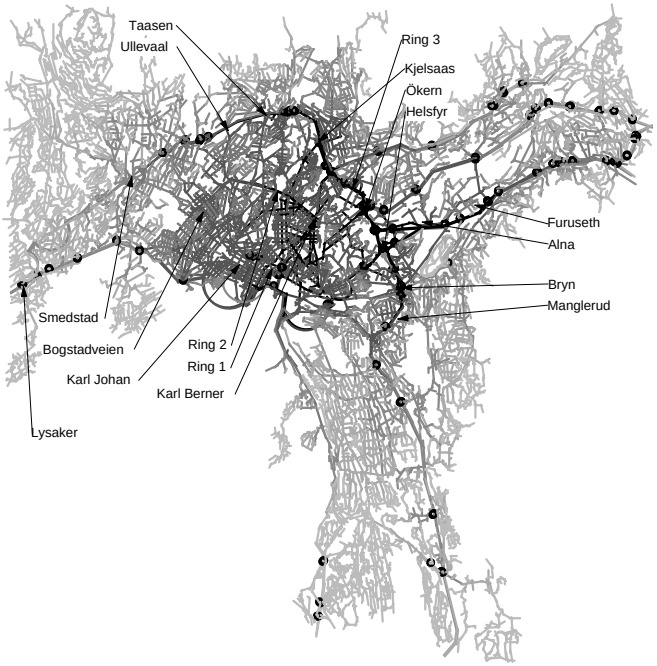

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Figure 3: Global integration of Oslo 1999

Figure 4: Local integration of Oslo 1999

Figure 4 shows the local integration and Figure 5 shows the dispersal of functions of Oslo in 1999. As regards the local integration and the dispersal of shops, the main shopping streets remained the same since 1929. Otherwise, the local integration is slightly reduced on the main street Karl Johans gate. Consequently,

the kinds of shops located in Karl Johans gate change from being expensive fashion shops to cheap chain stores. The eastern area got several new shops, cafés and restaurants during the last 3 years. The demolish-threat of the last 50 years in this area has disappeared. The streets with high local integration values are the most successful shopping streets in the eastern area. The shopping street Bogstadveien in the west has the highest local integration and level of vitality in 1929, 1954, 1984 as well in 1999. Compared with the eastern area, the shops located along Bogstadveien are more concentrated along this street. They shape a linear pattern. There are almost no shops in the side streets. In the eastern area the shops are more dispersed into the side streets. This is due to the fact that the western shopping area consists of one strong locally integrated axial line, while the eastern shopping area consists of 3 parallel strong locally integrated axial lines.

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As regards Figure 5 the dispersal of car-based shopping centres is located closely to Ring road 1 and 3. The black ovals indicate the location of the shopping centres. They are easily accessible for car traffic and offer sufficient parking possibilities. In general, the pattern of shops did not change substantially between 1929 and 1999. There is just one exception: large shopping centres established themselves at the junctions between the ring roads and streets leading towards the city centre. In the case of Oslo, the individual shops are located along the line with the highest local integration, while shopping centres are located along the lines with a high global integration where the street or roads are well connected with the city centre.

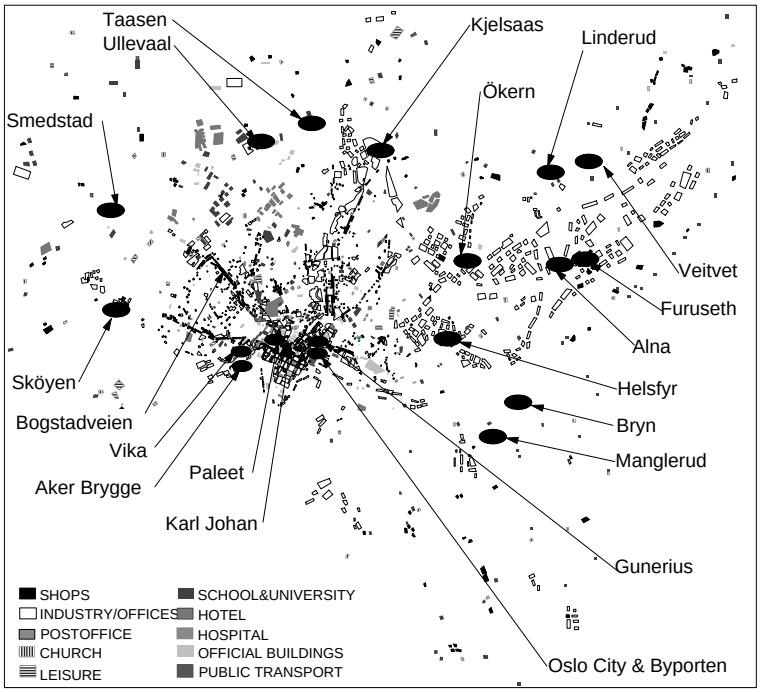

Figure 5: Dispersal of functions in Oslo 1999

As regards global and local integration, Ring road 1 has separated the town centre from the rest of the city, thereby the relevant streets have lost some of their vitality. The density of industrial activities increased in the area along the globally most integrated parts of Ring road 3. In general the dispersal of pedestrian-based shops in the main shopping streets of Oslo kept their linear structure since 1929.

A 2 steps analysis of the streets of car based shopping centres located along Ring road 1 and 3 seems unable to explain their location. An analysis of this kind hardly covers the local grid in their vicinity. Therefore, a 2 steps analysis of the three ring roads was carried out with the purpose of finding out why shopping centres locate themselves along or in the vicinity of some of the ring roads' junctions. The 2 steps analysis was intended to assess the correlation between axial configuration and the distribution of shops along the ring road. It was also meant to explain why shops establish themselves in particular parts of the ring road or avoid them. The analysis is supposed to show how well connected the ring road is to the city centre or its vicinity.

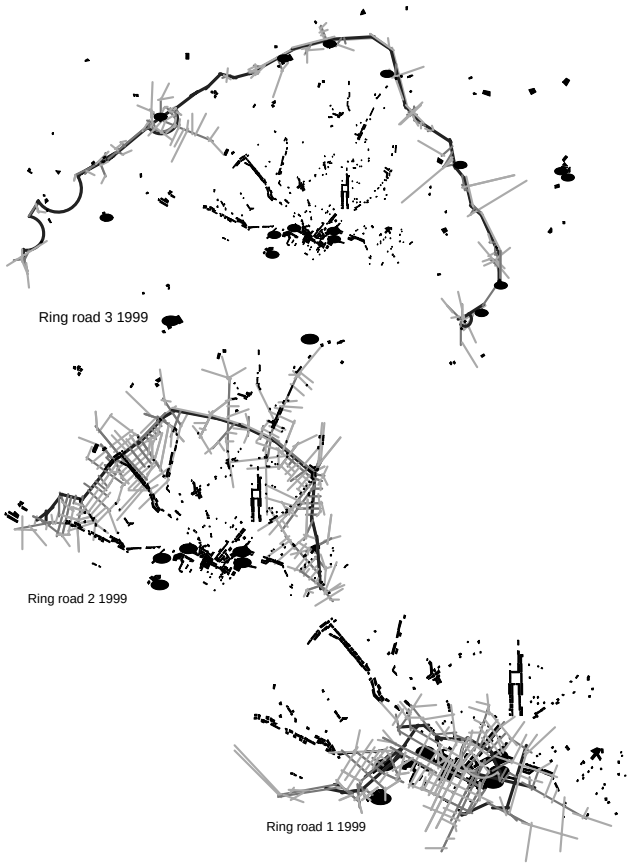

Figure 6: 2 steps analyses from ring road 1, 2 and 3 with shops

Figure 6 shows the extension from the 2 steps analysis from Ring road 1, 2 and 3 with shops in 1999. This analysis shows that Ring road 2 is well connected to its vicinity. The extension is largest at the local pedestrian-based shopping area at Carl Berners Plass at its north-eastern part and at Bogstadveien. The Ring road 2 has kept these old local centres alive, and even though increased it at Carl Berners Plass. These areas imply high global and local integration values, which contribute to these vital local sub centres and shopping areas.

Ring road 1 is well connected to the city centre, except from the area around the street Pilestredet. There is no direct connection between this part of the ring road and the city centre. This correlates well with the dispersal of shops, where all of them in Pilestredet have disappeared during the last 10 years.

Ring road 3 has few direct connections to its vicinity. In the vicinity of its junctions local car-based shopping centres are located. In general the 1999 analysis shows how badly Ring road 3 is connected to its vicinity on a local scale, but how well connected to the whole city on a global scale.

There has always been a pressure to establish car-based shopping centres located along Ring road 3. The industry is expanding in the areas located in the vicinity of Ring road 3. The dwelling areas in the suburbs located outside Ring road 3 have low global and local integration values. Due to the high integration of the ring road, it has become an attractive place for the establishment of shops and retail at all its junctions. More recently the municipality has decided to be less restrictive than in former times as regards the pressure from shop owners to expand and locate shopping centres along Ring road 3.

Obviously, the ring roads of Oslo have contributed to the segregation of the city's centre. However, it has not affected the local integration of main shopping streets in the city centre and the Bogstadveien and the eastern area.

Ring road 3 has moved the global integration values from the city centre towards its northern parts. However, due to its low connectivity to its vicinity, it did not become the main shopping area of Oslo. In general, the vicinity of the northern areas on Ring road 3 was subjected to large transformations during the last 15 years. It is slowly turning into Oslo's main industrial and retail area.

Ring road 1 contributed to the segregation of the centre of Oslo from the rest of the city even more in 1999 than in 1984. Especially the southern parts of Oslo's old centre were segregated. Several efforts were made in order to create some urban

life in these segregated areas. However, newer shopping centres tend to locate in streets close to the well-connected parts of Ring road 1. Examples are the shopping centres Gunerius, Oslo City, Aker Brygge, Vika, and Paleet. And these areas are located far from the southern parts of the old city centre. In terms of a configurative explanation there are too many steps between the ring road and this area. There are almost no shops and dwellings located there. Even though the density is high, the functions are mostly offices, retail, art galleries, main banks and official buildings.

One the relationship between the dispersal of shops and axial integration, the study of Oslo has shown that pedestrian-based individual shops locates themselves according to the axes with high local integration. The car-based shopping centres locate themselves according to the axes with high global integration. The car-based shopping centres for the suburbs have located themselves along the junctions of Ring road 3 and ring road 1. In many ways Ring road 3 has become the main shopping area of Oslo for those who travel by car. It can be concluded from the studies of Oslo's ring roads that highway ring roads spits up areas and affect the pattern of shops more than boulevard ring roads.

In the case of Oslo, car-based shopping centres established themselves at the junctions of outer ring roads – in areas where there were no sub centres before the ring road was built. Naturally, one wants to know what happens in the complementary case, i.e. when a ring road is imposed upon already existing sub centres. Eindhoven represents a case of this kind.

4. The study of Eindhoven – pedestrian-based sub centres

Until the 1930's Eindhoven had a small city centre with 5 surrounding suburbs, the former villages of Gestel, Strijp, Woensel, Tongelre and Stratum. The former villages had a small vital shopping area with a market. Like Oslo, most of the expansion of Eindhoven occurred after the Second World War. The outer ring road was completed in the beginning of the 1970's. It encircles the city centre and touches the old centres of 4 of the 5 surrounding old villages. Some parts of the ring road are boulevard styled. Other parts have a highway standard. It is located about 2 km outside the city centre. In general it is well connected to the main streets leading towards the city centre. An inner ring road encircles the city centre. It is more a street than a road and the concept "ring street" is hence used for this inner ring road. It is well connected to all the streets it is imposed upon. Some parts of it are filled old canals. Some of its parts were constructed in the 1970's. From 1934 to 1999 Eindhoven changed from a small self-grown town to a thoroughly planned large city.

Figure 7 describes the global axial integration of the grid of Eindhoven in 1934 and in 1999. For a close investigation of how the inner ring street of Eindhoven changed the city centre, the area inside the ring road was analysed separately; cf. the 1999 analysis in Figure 7.

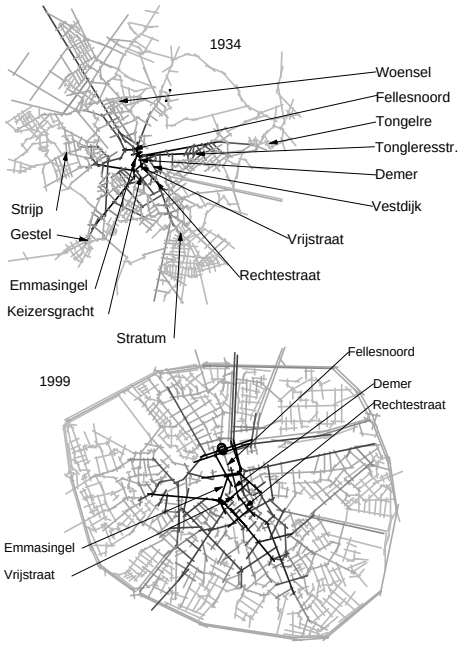

Figure 7: Global integration of Eindhoven 1934 and 1999

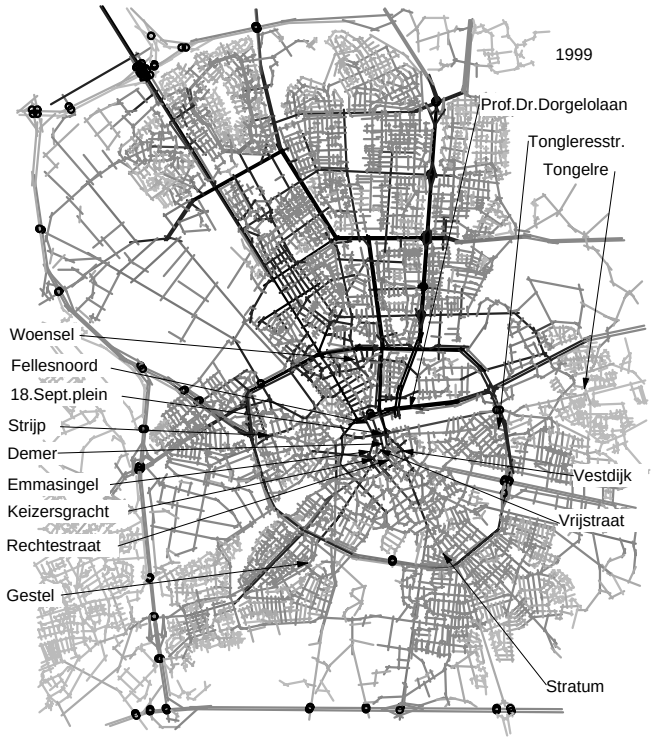

Figure 8: Global integration of whole Eindhoven 1999

In 1934 the highest integration is found in the main shopping streets. The principal shopping street Demer is located in the middle of Eindhoven. The dispersal of integration values shows a structure that looks like a deformed wheel where the dwelling areas represent segregated lines and the main streets leading into the city centre stand for integrated lines. Shops are located in the city centre, in the centres of the former five villages and along the main streets from the former villages into the city centre. There is a correlation between the highest global integration values and the dispersal of shops.

As regards the whole city, Figure 8, the highest integration values are on the main routes and the outer ring road in the global analysis of 1999. The figure shows the "super grid" structure of Eindhoven. Streets in the modern dwelling areas are segregated, while the net of main routes has high integration values. This is an effect of the large thoroughly planned areas of Eindhoven with their hierarchic road and street structure. In Christopher Alexander's terms, the city's street structure is ordered like a tree (Alexander 1966, p. 51).

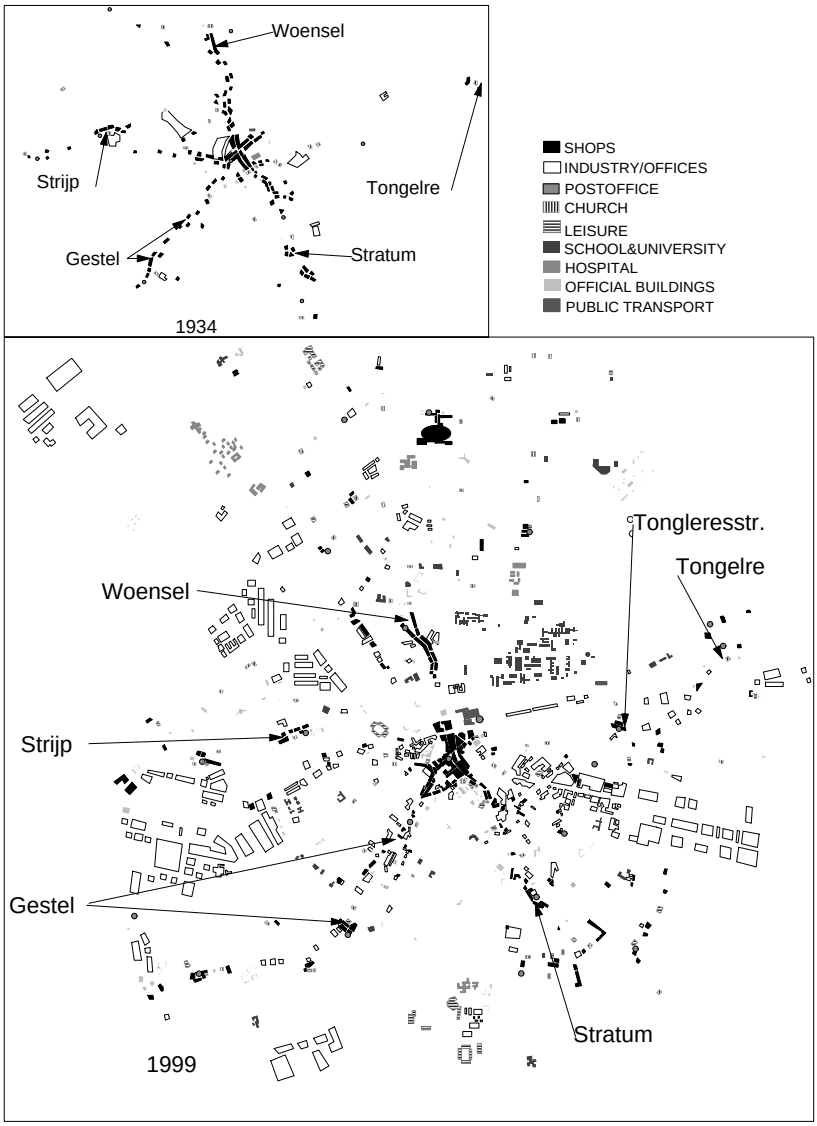

Figure 9: Dispersal of functions in Eindhoven 1934 and 1999

The ring road helped to globally segregate streets in the city centre. The northern parts show the highest integration values. This is due to the large expansion northwards at the end of the 1970's and the beginning of the 1980's in Woensele. Professor Dr. Dorgelolaan, one of the main roads leading into Eindhoven's centre, has the highest integration values. Its connectivity values are low. It ends in the central shopping area, and turns into a local main street.

Figure 9 shows the dispersal of functions in Eindhoven in 1934 and in 1999. In 1934 the location pattern of shops follows the main routes from the centre of the former villages into the city centre. In general the pattern of shops has a linear structure in 1934.

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As regards the dispersal of shops in the city centre, they are located on the same streets as in 1934, but their pattern is more convex. Shops are located in parallel and in side streets of the main shopping streets. This development could result from the pedestrianisation of the streets Demer and Rechterstraat and of the ring street. Large shopping centres located themselves in Demer and close to the railway station. In view of old photos from the 1930's, Demer kept its high vitality even though all its buildings changed.

Figure 10: 2 steps analyses from the ring road and ring street in Eindhoven

According to the axial analysis of 1999, the ring road and the hierarchic street organisation of Eindhoven's new areas help to drag the highest integration values towards the main roads. However, the local grid conditions in the city centre and the centre of the former villages are not affected at all. In this way most main shopping streets are not affected by the outer ring road and the inner ring street.

Figure 10 shows the extension of the 2 steps analysis from all parts of the outer ring road and inner ring street with the pattern of shops. This analysis shows how well connected the outer ring road is to all the former villages, except for Tonglere. Local shopping areas are located where the outer ring road is well connected to its vicinity. The inner ring street is well connected to the whole city centre. The shops are located along the metrically and topologically best located streets in the city centre. Therefore few shops are located along the ring road. The axes Demer and Rechterstraat are the most centrally located streets, and therefore their area was and is the central shopping area of Eindhoven.

A 2 steps analysis of Eindhoven's ring road and ring street shows that in general both rings are generally well connected to the city. The ring road is well connected to the main streets leading into the central core and the local shopping areas located along the ring road. The ring street and the ring road did not cut off any important shopping streets. Even though the inner ring street contributed to a slight decrease of the local and global integration values of the main shopping streets, it did not affect the pattern of shops.

Eindhoven's ring road affected the urban areas of the surrounding former villages as follows. Due to their direct connection to the ring road, the local shopping areas of Gestel, Strijp, Woensel and Stratum kept their position. The local shopping area of Tongelre moved inside the ring road. It is situated on the main route between Tongelre and the city centre, in close proximity to the ring road. The location of the new area is well connected to its neighbourhood, centrally located in its suburb, and directly connected to the ring road. Due to the low connectivity of the new dwelling areas, and on account of the fact that the ring road is badly connected to these areas, the live centres remained the same in 4 of the 5 former villages. Moreover, the ring road helped to increase the local integration values in 3 of them.

The new thoroughly planned dwelling areas have low connectivity and low global and local integration values. Moreover, their street grid has a "tree-structure" with dead end dwelling streets. Naturally, this contributes to the result that the old local, naturally grown live centres located along a well-connected ring road remains. One may conclude that neither the ring road nor the inner ring street affected the

existing shopping areas in the city of Eindhoven, except for the former village Tongelre. The ring road helped to move the local shopping area from Tonglere towards the ring road in Tongelresestraat.

Studying Eindhoven's ring roads show that boulevard ring roads or highway ring roads directly connected to main routes help to preserve or to increase the vitality of the local shopping areas on which they are imposed.

5. Conclusions – outer and inner ring roads, the pedestrian and the car shopper

In which way several ring roads affect the structure of pedestrian-based and car-based shopping centres in a city depends on several factors. Firstly, the degree of connectivity of these roads is influential. If the outer ring roads are well connected to the main routes leading into the city centre and out into the suburbs, local shopping centres tend to locate themselves closely to the junctions between the ring road and the main routes. It is a feature of modern, suburbian dwelling areas that they tend to have low connectivity, global and local integration values.

Ring roads located far outside the central core tend to play a central role for the location of local shopping centres. If the integration values are dragged towards the ring road and if the local grid conditions are dense at the junctions between the ring road and main streets leading towards the city centre, then these places become attractive for the location of shops. In the case of Oslo new ones established themselves in these areas, whereas in Eindhoven existing local shopping areas are kept alive because of the ring road and its direct connections to them. Otherwise outer ring roads tend to become a part of a city's super grid. This overall road net implies the highest global integration values, and therefore becomes attractive for the location of car-based retail and shopping centres.

The studies of Oslo and Eindhoven also show that an inner ring road well connected to the grid on which it was imposed does not affect the main central shopping streets. As regards configurational analyses, a well-connected inner ring road slightly drags the integration values from central shopping streets, though on a low scale. As long as after implementation of a well connected ring road the central shopping streets keep their central local position, this does not affect the pattern of shops.

The studies of Oslo and Eindhoven also show that car-based shopping centres and retail tend to locate themselves along streets or roads in accordance with the dispersal of global integration, while individual shops tend to locate themselves along streets in accordance with the dispersal of local integration.

Studies of Oslo show that Ring road 2 and Ring road 3 have little effect of the pattern of pedestrian-based shopping areas in the city centre. However, they have a strong effect on the global integration core of the city as a whole. Moreover, large global changes in the integration values of the street grid affect the location of car-based shopping centres in Oslo along Ring road 3. In spite of its high integration values, Ring road 3 has a low degree of connectivity to its vicinity. It is almost impossible to buy for example floor carpets, wood, larger tools, garden furniture, cars, etc. in the city centre today. Ring road 1 cuts off the local catchment area of some central shopping streets in the centre of Oslo and draws the integration values away from the city centre. Ring road 2 contributes to increase the vitality in the pedestrian-based shopping areas. This is due to its high degree of connectivity to the vicinity.

The ring road and ring street in Eindhoven affect the integration core of the whole city. However, due to their high degree of connectivity to existing local shopping areas, the pattern of pedestrian-based shopping areas remains the same – except for the former village Tonglere. This result is due to the way in which the ring road is directly connected to existing local shopping areas in the suburbs, and the way in which the ring street is well connected to all the streets in the city centre on which it is imposed.

Can changes in a street grid help to understand how shopping centres function? Thirty years ago most people experienced shopping as an activity necessary for the acquisition of food or clothing. In the main, housewives then did the shopping. More recently shopping changed in at least two respects: other social groups started to accept and to practise shopping as a regular activity. The range of objects equally changed. Shopping increasingly was meant to include the acquisition or at least inspection of goods that do not account for basic needs, but help to articulate and experience social or personal values. In this way shopping gradually changed into an activity similar to leisure activities.

The way we move through a built environment in order to shop can change too. Before, most people were shopping by foot. Now, most people use cars. As more women have entered the job market, indispensable shopping has to be done efficiently. All necessary items have to be gained in a short amount of time. Leisure shopping seems to be a social activity. It is not only the shopping as an activity in it self, but to see others and to be seen by others is equally important. Evening shopping, Saturdays and Sundays shopping are effects of these societal changes.

How does this affect the location pattern of shops? In order to understand the shop owners' location behaviour under these conditions, the studies of Oslo and Eindhoven allow one to propose the following general hypothesis: Shops locate themselves in the most integrated streets, either on a local or global scale. Pedestrian-based shopping areas seems to be located in streets with the highest local integration, while car-based shopping centres seems to be located along globally integrated roads. The first one depends on the high density of a street structure in an urban area, while the other one depends on the global connectivity of a city's supergrid. Thus, shops always search for the optimal location, independent on societal changes. And their optimal location heavily depends on a street grid's configuration.

Notes

[1] According to Hillier " 'Life centrality' means the element of centrality which is led by retail, markets, catering and entertainment, and other activities which benefit unusually from movement" (Hillier 1999, p.107). In this context the term "live centre" is used for describing local sub-centres containing shops and retail with purpose serving people living in the vicinity.

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