Leading the city

The redevelopment of Leiden Central station area based on the theory of the urbanism of networks.

Koenie Roorda- van Veen
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MSc thesis

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Figures and tables are by author unless stated otherwise.
Preface

As an inhabitant of a middle-sized city in the Randstad, I am interested in the historically grown cities in the western part of the Netherlands. The choice to go to Delft for studying was therefore easily made; it was either Delft or Leiden.

A second drive for this project is my interest for public transport. I grew up with travelling by public transport; as a student, but also before to visit family, at college and even primary school. Trains were, and still are, very interesting to me. What fascinates me are the new developments in networks of light rail and the High Speed Network with its new station development under the name ’New Key Projects’. Thus the RijnGouweLijn from Gouda to Leiden and the coast attracted me.

My interest for both historical Dutch cities and new transports lines led me to the book OverHolland5 (Engel, 2007) with an article called ”5x5: Projects for the Dutch city”. The book is a base for an experiment of research by design into the Dutch city. (Van Duin, 2008) Five historical Dutch cities are designed with the main station underground. A leading question was how to join the neighbourhoods of the city when the barrier of the train is taken out. I will not deal with the area as the experiment did –putting the stations underground– but with network thinking and the perspective of the user.

Koenie Roorda- van Veen
14th of April 2011
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PART I
INTRODUCTION AND THEORY
1. INTRODUCTION TO THE PROJECT

This booklet describes my graduation project of Urbanism on the faculty of Architecture at the TU Delft.

1.1. PLANNING AND DESIGN THROUGH SCALES

The graduation project comprises different scales, from the regional to building scale. These scales are interconnected and influence each other. I will explain this briefly with governmental policies. The National Government makes planning for the large scale of national, regional some of the issues in national policies come from an even larger scale level like the ecological main structure. Other elements are passed on to a lower governmental organ to be worked out. An example is the planning of new neighbourhoods where the provinces deal with maximum borders of villages and they form an opinion of where the build area reaches this border. The municipalities make new documents for the future strategies. The only document with legal status is a very precise document by the municipality. The map with the program of every square meter is called zoning plan (Dutch: Bestemmingsplan). This map does not state future developments but the current one. It focuses on the low scale of the neighbourhood and does not link to larger scales.

Network approach

In the graduation project the switching of scales is very important. As a spatial intervention has effect on the larger scales and a governmental discussion on the lowest of scales. By looking for networks the scale issue is easier to cope. The interaction between the scales is more obvious when looking at networks. There are different networks which work on different scales. And there are nodes in the network operation on a level, but there are also nodes which form the connection between different networks. The scale of networks and centres will be explained in the second chapter. Thinking in terms of nodes and networks is an important basic element in the graduation. By using it the problem of a disconnection in planning and design from national level to the building is minimized. How network theory is theorized and can be used is explained in chapter three.
1.2. STATION ENVIRONMENT LEIDEN CENTRAL

Planning and designing with networks, nodes and places can be seen best in the hub of a railway station. This graduation project consists of a redevelopment of the station area of Leiden Central. This station area is changing, both as a place in the city and as a node in the network.

STATION AREA REDEVELOPMENT IN PROGRESS

The station and the surrounding area in Leiden are under development for a long time. In 1995 the station itself was renewed (architect: Reijnders) and the station area became car-free due to a tunnel parallel to the railway tracks. New buildings, high rise towers, were realised and others are due to be build. The station area has been redesigned with a buffer system for the bus and a taxi platform. Also many new or renewed spaces for bicycle storage have been realised on both sided of the station. (Gemeente Leiden, 2010a)

The light rail, which is planned to be partly operative at the end of 2012, is not incorporated in these plans. Therefore the municipality gave the assignment to the firm Maxwan Architects & Urbanists to make an urban design for the area. The changes in the area and the new urban plan are discussed in the location analysis in the second part of this booklet.

METROPOLITAN NETWORKS

The public transport in the Netherlands is divided into different levels. These levels and the operating transport is further explained in the next chapter. In the network of public transport several changes are realized or planned. These changes are needed to cope with the growing use of the public transport in the (highly) urbanised areas. The changes in the public transport network lead to new and stronger connections for the station of Leiden Central.

The main station in Leiden has at the time been renewed. New tracks were needed to let the fast trains pass the stopping trains at full speed, to be able to densify the supply of trains on the railway network. With these new tracks more platforms were needed. Therefore there was another reason to renew the station.

A second change influencing the transport in the Netherlands is the wish for high speed train traffic to connect Amsterdam to the southern countries and Germany. With the High Speed Line South and East (HSL South and HSL East) this should be realised. To cope with this new form of transport and the increasing numbers of travellers due to the new development, several stations needed adaptation. The government started the program of the New Key Projects (Dutch: Nieuwe Sleutelprojecten, NSP). It consists of funding for six redesigned railway stations in the Netherlands. Leiden Central station is not one of these Key Projects. It is positioned between two high speed stops; those of Schiphol (Amsterdam) and Rotterdam. The connections to these stops give the city a good accessibility by rail and air for the surrounding countries.

The light rail is a third element in the strengthening of the public transport network. It is a project which is initiated in a policy plan already in 1996. The main reason for the plan is to cope with the slightly densification of the urban region. The housing stock is increasing year after year, thus the transport supply should grow as well. (RijnGouwelijn and Zuid-Holland, 2011) Light rail is an upcoming means of transport in the Netherlands. Many tram services have been stopped in the second half of the previous century. The number of buses and cars have had an enormous growth. Currently the more sustainable means of transport are growing in attention and use. Light rail is a form of transport between a stopping train, a tram and a fast bus (on its own lanes).

These developments in the station area and the supply of public transport are related to each other. This can be made explicit by thinking in networks. The theory of an urbanism of networks is therefore explained more in the following chapters as well as the research approach.
2. RANDSTAD HOLLAND, A METROPOLIS UNDER CONSTRUCTION

The station has been seen in the past as the place where the train stops. This changed into the description of the station being the place where travellers get in and out. The station, once outside the inner city, is nowadays inside the built area. The city is different. The orientation to the inner city has been replaced by a system of places and spots, inside a region. Due to the availability of fast transport and the densification of the network of public transport the distance is replaced by travel time. (Hermans and van der Spek, 2000, p.8)

2.1. THE METROPOLIS

The Randstad Holland, roughly visualized in figure 1.1, is becoming a metropolitan area (Rocco, 2008, p.177, Rooij, 2005a, p.4-5). The Dutch government sees and acknowledges this, and tries to enhance it with its policies. To be in a better competitive state in relation to other metropolitan areas measures are taken. One of the measures they take is that they try to 'enhance the attractiveness and spatial quality to be able to gain the interest of knowledge workers, trendsetters and decision makers for the cities of the Randstad Holland' (VROM, 2007, p.2). The main competitors in the metropolitan field are Greater London, Frankfurt and Paris, and some lesser are the Brussels area and the Rhine-Ruhr.

A metropolis can only function as one coherent area if the functions of the transport network are up and running. These networks cannot be completely car-based; Public transport (PT) by road, train, and even water networks is indispensable. By serving the city centres with high quality and high speed public transport the urban network can become an urban field (Rooij p.4-5). The enhancement of the infrastructure and the growth toward becoming a metropolis are transformations which go hand in hand.
2.2. SCALES OF NETWORKS

The urban field consists of many centres and networks, all on different levels. Good connectivity asks for centres on the different scales having networks serving them on those scales. The High-speed lines connect the various metropolitan areas on the international level. Of course, on these distances, and the level above (global), many people also travel by air; airports are the main hubs here.

Different scales, with centres and networks

Table 1.1 (page 6) shows the different scales with the public transport networks serving at these distances. The national distance (100-300 km) is served mostly by the intercity train. A new form of transport is offered nowadays with the Shuttle train which serves a small number of stations in the Netherlands and in Belgium. The metropolitan scale is served by the intercity trains as well, but also by stopping trains (sprinters) which in turn also operate on the regional scale. The absence of a dedicated operation service on this level illustrates the work which has to be done to fully operate as a coherent metropolis. Next to the heavy rail services there are also light rail vehicles on this network-level. They tend to be more hybrid in appearance, by operating on different levels. These non-traditional forms of transport make the urban field of Randstad Holland operate in a more dynamical way. This is relevant because by hybrid transport different spatial levels are served to create a flexible system.

High Speed Network and the New Key Projects

As said, the high speed network connects the Randstad Holland with metropolitan regions like Paris, London and Frankfurt. In order to speed up the metropolitanization of the Randstad Holland the Dutch government has subsidized a number of station reorganizations or redevelopments. These projects are called ‘New Key Projects’. As figure 1.2 shows, most of these stations are in the Randstad Holland area, served by either High Speed Train (HST) or the supplemental HST-shuttle. Effort is put not only in upgrading the stations, but also to lift the surroundings, by attracting important businesses, and even international company headquarters. The aim is to let the Dutch urban area become international competitive with other European urban areas. When combined with a high quality of public space, these two components of the redevelopments will ‘...strengthen the international position of competition of the Netherlands and support the development of urban networks’ (VROM, 2003, p.7).
<table>
<thead>
<tr>
<th>LEVELS</th>
<th>TRAVEL DISTANCE</th>
<th>CENTRES (example)</th>
<th>TRADITIONAL PT-NETWORKS</th>
<th>HYBRID PT-NETWORKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>international</td>
<td>300-1000 km</td>
<td>Amsterdam, Rotterdam</td>
<td>airlplane, hsl</td>
<td>Shuttle</td>
</tr>
<tr>
<td>national</td>
<td>100-300 km</td>
<td>Utrecht, The Hague</td>
<td>intercity</td>
<td>light rail</td>
</tr>
<tr>
<td>metropolis</td>
<td>30-100 km</td>
<td>Leiden, Gouda</td>
<td>intercity, sprinter</td>
<td>regioliner</td>
</tr>
<tr>
<td>regional</td>
<td>10-30 km</td>
<td>Delft, Haarlem</td>
<td>sprinter, interliner</td>
<td>regioliner</td>
</tr>
<tr>
<td>agglomeration</td>
<td>3-10 km</td>
<td>Noordwijk, Schiedam</td>
<td>metro, light rail</td>
<td>line-bus, tram</td>
</tr>
<tr>
<td>local</td>
<td>1-3 km</td>
<td>Alphen, Wassenaar, Lisse</td>
<td>line-bus, tram</td>
<td></td>
</tr>
<tr>
<td>district</td>
<td>300-1000 m</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>neighbourhood</td>
<td>100-300 m</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ensemble</td>
<td>30-100 m</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>building complex</td>
<td>10-30 m</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>building</td>
<td>&lt;10 m</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 2.1 Collective transport and spatial level (based on Vereniging Deltametropool; Klaasen, 2004)
OTHER TRENDS IN THE METROPOLITAN P.T. NETWORK

Next to the coming of the High Speed Line and the accompanying New Key Projects other transformations in the public transport are in progress. First, a massive densification of the operating services on the metropolitan and regional levels is underway since the nineties of the previous century. Although being already one of the most crowded train network systems in the world, this trend will strengthen the PT on these levels. The densification was started with the Rail 21 project. A project to double existing tracks form 1 to 2 tracks and from 2 to 4, to be able to let fast trains pass slow ones. A contemporary example of this densification in the Southern part of the Randstad Holland (Dutch: Zuidvleugel) is the project “Stedenbaan”. In this project, not only the running-table is augmented, but also the stations along the lines receive attention. At the existing stations, and the newly planned ones, the potential of the (sub)urban areas is examined, and where possible used. ‘The stopping trains can get the character of a metro like rail facility, which together with the RandstadRail and the planned RijnGouweLijn will form a new regional public transport system for the South Wing’ (Atelier Zuidvleugel, 2006, p.7). This project is incorporated in the plan “Deltanet”. Deltanet is a plan, which tries to make the difference between a primary and a secondary connection in the transport network. This network consists of passenger traffic of both railways and roads. (Frieling, 2004) Deltanet thus reorganizes the system of public traffic on rails. With new high speed lines connecting the largest cities in metropolitan areas, the intercity serves the large cities and light rail and heavy stopping trains serve the villages and small cities in between the intercity stops.

A second new development is the strengthening of the regional network system. More and more hybrid systems show up, transforming metro lines into light rail lines, while also ‘declining’ stopping train lines are revived as light rails. The RandstadRail is a good example of this hybrid development. This former stopping train from Rotterdam to The Hague has just reopened as a light rail line. It serves the regional level, although it starts off as a metro or tram, on the agglomerational level.
Figure 2.3 Leiden and the spatial levels (inter)regional, agglomeration, d = 100, 30, 10km
2.3. SCALES OF CENTRES

In the structure of the urban field the scale and the configuration of the area give a lot of information about the working of the smaller places as the cities and centres in the urbanised area.

METROPOLITAN CITY- REGIONAL CITY

An urban field like a metropolis can be built up with one or more economical centres. Most metropolitan areas are concentrically formed, with a core city and satellite neighbourhoods spread out in radials around the core city. Familiar examples are Greater London, Paris or Madrid. As the name suggests the metropolitan area is built around the central city. The historical centre and one or a few business districts are connected to satellite cities by regional trains or the more hybrid form of light rail. Green areas are often put up as buffer zones around the core city, as is the case with Metropolitan Green Belt, around London. (See figure 2.4)

Some metropolitan areas are the combination of two or multiple cities grown towards each other. This network-like configuration can be found at the cities of Liverpool and Manchester or Antwerp and Brussels. At the Rhine-Ruhr area and in the Deltametropolis collaboration of multiple cities can be found. The Deltametropolis is a cooperation of the four larges cities in the Netherlands. Figure 2.5 shows the example of the urban field of the Randstad Holland with more and less dense areas, while often a green buffer is put in between; i.e. The Green Hearth (Dutch: Groene Hart).

Surprisingly, these two general forms (concentric, network) can be found on lower scales as well. Within a concentric metropolis different network-like centres appear which again seem to be concentric in form when zoomed in even further. This principle is analogue to the famous schemes of Christaller, who studied the forming of centres and networks in Southern Germany in the 1930’s. (See also Guyt and Hulsbergen, 2002, p.268, Rocco, 2008, p.136)
Figure 2.6 Concentric build-up in the city of Leiden (Engel, 2007)
The centre of the regional urban area

The middle-sized cities are the main centres in the regional network (diameter 10-30 km). In the west of the Netherlands this can be seen at the agglomeration of Leiden (Leiden, Leiderdorp, Voorschoten, Valkenburg, Rijnsburg and Oegstgeest). It is the main urban area in between the South Wing (twin city Rotterdam- The Hague) and the North Wing (Haarlem – Amsterdam – Almere). (See figure 2.3)

With good accessibility from the surrounding urban area, the central stations of the cities become hubs for transferring between the different modalities. By connecting the station to other centres in the agglomeration, the station area is strengthened as a central space in the urban area.

Besides the main centre, often close to the main public transport hub, other centres rose in the urban field. Neighbourhoods and districts close to the highway suddenly discovered their potential, and large shopping centres, entertainment areas or business districts appeared. These centres are primarily car-oriented, although a lot of effort is being put in, to connect these centres with new public transport lines.

As goes, connected centres on a lower scale also profit from being in the vicinity of a big hub. Forming a hub has got an oscillating effect. It is the connector between shopping, recreational, leisure, educational and business centres. The hierarchy of transport lines should be consistent with the importance of the connected areas.

The local centre

At the level of the city itself one generally sees a concentric form. Due to geographical, economical or military circumstances this form used to be the most efficient. Nowadays this is changing, as is illustrated by modern experiments like Almere (the Netherlands).

Within this concentric form, at the local scale mostly there is the historically built city. In the city of Leiden this is clearly visible due to the canals (figure 2.6). As the railway track, with its station, was laid outside the historical city they can be found directly on a tangent of this concentric form. Ongoing expansion of neighbourhood after neighbourhood ‘locked’ these stations in, leaving an awkward situation. Schematically this can be visualized as a core within a concentric city, where the railway track forms a dividing line. (Figure 2.7) This can be seen as a problem (as is illustrated by the desperation to ‘put these stations underground’) or as an opportunity. The station area can, for instance, form the link between the high and the lower scale (by its networks) and between the older and the newer neighbourhoods (by its program and building form).

Figure 2.7 Scheme, station in the city (Van der Spek, 2009)
3. NETWORK THINKING

‘A lot of the concepts (nodes, fractals, organized complexity, pattern) may, as yet, be unknown to the urban designer. Getting to know them, however, is worth one’s while. One needs these concepts to build the scientific body of knowledge for urban design, which can be used over and over again by urban planners and designers all over the world.’ (Van Bilsen, 2005)

3.1. THEORETICAL FRAMEWORK

Thinking in networks is logical and makes sense according to Barabási (2002), especially in the contemporary world where travelling is not only physical but also wireless. ‘Today we increasingly recognize that nothing happens in isolation. Most events and phenomena are connected, caused by, and interacting with a huge number of other pieces of a complex universal puzzle. We have come to see that we live in a small world, where everything is linked to everything else. We are witnessing a revolution in the making as scientists from all different disciplines discover that complexity has a strict architecture. We have come to grasp the importance of networks.’ (Barabási, 2002, p.7) From Barabási we see that networks are logical elements in life. People are looking for concentrations of elements and the connecting elements (“links”).

**Table 3.1 Pattern-orientated transforms to process-orientated (Klaasen, 2004)**

<table>
<thead>
<tr>
<th>pattern-oriented design</th>
<th>versus</th>
<th>process-oriented design</th>
</tr>
</thead>
<tbody>
<tr>
<td>pattern</td>
<td></td>
<td>process</td>
</tr>
<tr>
<td>living, working etc. (residing)</td>
<td></td>
<td>travelling / transporting</td>
</tr>
<tr>
<td>places</td>
<td></td>
<td>routes</td>
</tr>
<tr>
<td>zones</td>
<td></td>
<td>networks</td>
</tr>
<tr>
<td>accessibility: distance</td>
<td></td>
<td>accessibility: journey time</td>
</tr>
<tr>
<td>distance between residential function - work function, residential function - amenity function etc.</td>
<td></td>
<td>temporospatial activity pattern</td>
</tr>
<tr>
<td>(pattern-based) blueprint planning</td>
<td>(functional-spatial)</td>
<td>structure planning</td>
</tr>
</tbody>
</table>

Approach of networks by Castells

Castells (1996) writes in his books “The informational city” and “The information age” about the rise of ‘new economies’ based on generating, processing and applying information. The production, consumption and circulation of this information are organized on a global scale. Businesses tend to get connected in international networks. Due to this change into a network society there will be a new logic Castells calls the “space of flows”. ‘As I understand it, “space of flows” means that the material arrangements allow for simultaneity of social practices without territorial contiguity’ (Castells, 1999, p.295, In: Peek, 2006, p.104) Next to the space of flows Castells also defines the “space of place”; it is a location where form, function and meaning are solemnly within the edges of the physical closeness. (Peek, 2006, p.105)

The network city is no longer fiction, nor a utopia. It is a reality.’ (Idem, p. 28) He thereby highlights the automobile and the electricity networks as a standard in life and urges towards a network oriented approach of urbanism in stead of zones and places. (Idem, p. 28-29) (See table 3.1)

Network City

The theory of the network city is based on network thinking. Drewe illustrates the trademark of network thinking with the scheme of Dupuy shown in figure 3.2. (Drewe, 2005, Dupuy, 1991) The scheme consists out of three levels. These are the hardware, software and brainware, consistent with the network of infrastructure, production and consumption and of urban households.

Dupuy uses this framework for the analyzing of urban networks. A network can be characterized by three criteria (Rooij, 2005b, Dupuy, 2000):

1) A topological criterion.
   The search for physical connection links between nodes. This involves discontinuity and heterogeneity.

2) A kinetic criterion.
   The speed of the connection qualifies the network. Thus rapid transfers and transits without losses of time or interruptions make the network apt in accommodating movement.

3) An adaptive criterion.
   The network can be adaptive in two ways. On the one hand it can be able to integrate new elements or systems in the network. On the other hand the proportions of use in the network can change to give a range of choices to its users.

Network city is ‘both a space of places and a space of flows’ (Rooij, 2005a, p.122). The physical places were these flows are visible are, for example, transport nodes like public transport stops, airports or a square. Rooij makes this clear with figure 3.1. The change in thinking succeeding this theory is the alteration from thinking in zones to thinking in points and connecting lines. This is also what Rooij states: ‘The traditional city is under pressure and ideas for sustainable spatial developments have to be distilled from network thinking instead of zonal thinking, from integral instead of sectoral design and planning approaches’ (Rooij, 2005a, p.218).
Bertolini and others also deal with network thinking; they have developed it in relation to mobility and infrastructure and thus station environments. As people move more nowadays and the distance is not as important as the time needed to travel the distance, the use of the transport network is more elaborate and needs to be efficient. Bertolini and Dijst state this in the following way: ‘The leading thought is that in an increasingly mobile urban society a crucial quality of locations is their physical accessibility, or the quality of their connections to transportation (and increasingly, telecommunications) networks at multiple spatial scales.’ (Bertolini and Dijst, 2003, pp.27-28)

In the book “Cities on Rails” Bertolini and Spit (1998) describe the railway station area as node in the network and place in the city by stating ‘seaports, railway stations and airports are (...) nodes in complementary transportation networks: the nodes are turning into multimodal interchanges of passengers and/ or goods flows.’ (1998, p.15) Next to the movements in a network the starting point and destinations are important. This is explained in the node and place model: ‘Basically, the unique challenge of the development of node-places is the need to deal, at the same time, with both transport and urban development issues’ (Idem, p.20). ‘Node’ and ‘place’ are defined in the following way: ‘A transportation ‘node’ means how many destinations, within which time and with which ease can be reached from an area.’ And ‘a “place” of activities means how many and how diverse are the activities that can be performed in an area’ (Bertolini, 1999, p.201). Bertolini states that for a good station environment node and place facilities should be in balance to the scale they serve. (Figure 3.3) ‘The emergence of ‘unbalanced’ nodes and places (...) can be seen as an essential factor in the development of the urban transport and land use system: without unbalanced situations, there will be no change at all’ (Bertolini, 2008, p. 39).

From network theory we learn how we can make complex interacting systems into stable systems. These ‘rules of composition’ mainly deal with the importance of the smaller scales and the coherence between spatial levels (built up from the smallest spatial level). (Rooij, 2005a, p.231)
3.2. GRADUATION OF NETWORK THINKING

The relation between city and railway is a special situation. Cavallo (2008) writes in his dissertation "Railways in the urban context": The understanding how railway and city interact with each other in a specific urban context means also becoming aware of the identity of the place through the analysis of transformation processes' (Cavallo, 2008, p.184).

This graduation project takes network thinking as an approach for coming to a solution for the problem of incoherency existing between different levels in planning and design. By using the approach the design location can be better understood in the dynamic processes it supports. The city is part of an urban field and also hosts several parts of the different scales. Klaasen (2004) calls this the scale paradox; a node can be split up in multiple little nodes which consist of different elements themselves. This is visualized in figure 3.4. The coherence between the elements is the connection and interaction between them.

NODES AND PLACES

When networks and nodes are distinguished, the area is seen top down, but in a bottom up perspective the area can be seen as a place in the city, build from multiple smaller interesting places itself. In this light Bertolini (Bertolini and Spit, 1998) has developed the node-place model, in which he states that a station can be seen as both a node in the network and a place in the city. As explained before balance between node and place elements is characteristic for a good working urban transport and land use system. This is comparable to what Peek states in his dissertation. He writes about the synergy between a place, node, network and location. ‘An equally balance between the four perspectives [connecting link, transfer machine, urban centre, meeting place] contributes to creating a coherence of node and place elements which can lead to an increase in value’ (Peek, 2006, p.146). He focusses more on the two notions of moving and staying, notions Dupuy also uses. (Dupuy, 2000)

In the layout of a city a node can thus be the city as a whole, but also the neighbourhood centres or a school. The connections between the activity centres are materialized in the transport over road or rail. Different means of transport or routes strengthen the connection. This can also be seen on the local scale or within a district. In the station area, for example, the user-flows between the different functions or transport stops form the network of brainware as described by Dupuy (1991).

Figure 3.4 Scale paradox (Jong&Rosemann, 2002, p.37 in Klaassen, 2004)
Network thinking in practice

The location of Leiden Central station can be analysed in the light of networks by searching these elements in the city. To grasp the theory and the location the analysis should not be focused solemnly on the scale of the city. As explained before the networks and centres exist on different scales and they work together. Some centres are operative on different scales and thus form the connection between two (or more) networks. On the other hand a network sticks to one scale. In this light the activity centres are more important than the networks connecting them. Dupuy makes a distinction between infrastructural networks, the supplying networks and the usages of households. The latter forms the base of urban planning. The city is planned in one way and thus the infrastructure has been realised, but the citizens use the paths in the most practical way, with the shortest or simplest routes. To understand the station area in the city the most used routes can be sought and documented. The same can be done with the infrastructure and the important area for inhabitants, visitors and working people.

According to Bertolini (2008) the value of node and place can be measured as an index. The values are composed from ‘different variables by means of multi-criteria analysis’ (Bertolini, 2008, p.40). He states that ‘the node-index is a measure of the accessibility of the station area. Intensity and diversity of transport supply are the key criteria here.’ (Idem) And ‘the place-index is a measure of the intensity and diversity of activities in the station area. The station area has been defined as the surface included within a ‘walkable radius’ of 700 metres from the main pedestrian entrance to the station.’ (Idem, p.41) Thus intensity and diversity form the pivot of the study.

The station area itself can be analysed and documented, but what is the relevance of the research when it cannot be compared to an ideal situation or otherwise a standard situation? Therefore the station environment has to be analysed to the node and place qualifications it possesses and lacks. The comparison is done with not only the element of node in a network or the place it is in the location; also other elements are important for the design. Amongst others these elements can be found in the notions “Connector” and “Meeting place”, as Peek calls them. The four perspectives Peek distinguishes are based on the matrix of node/place to network/location, they are visualized in figure 3.5. These approaches can be analysed with the values of transfer quality, centrality, intensity and environmental quality. They are related to the attributes of infrastructure, real estate,
transportation functions, real estate functions, activities of moving and staying. (See figure 3.6)

**Transit-oriented development**

Transit-oriented development (TOD) is a form of network-oriented development as the transport lines and its stations are part of a network. According to Cervero, a professor of city planning at the University of California, three dimensions need to be addressed to make a project of TOD work: density, design and diversity. (Tumlin and Millard-Ball, 2003) Newman (2009) is more elaborate in an article in the book "Transit Oriented Development; making it happen". He splits the development up in policy, planning and funding, referring to the actors: the municipality or regional government; the design agency; and the land owners. He states there are four strategic planning tools for a TOD-project. These are:

1) ‘A strategic policy framework that asserts where centres need to occur and at what kind of density and mix;
2) A strategic policy framework that links centres with a rapid transit base, almost invariably electric rail;
3) A statutory planning base that requires development to occur at the necessary density and design in each centre, preferably facilitated by a specialized development agency; and
4) A public-private funding mechanism that enables the transit and the TOD to be built or refurbished through a linkage between the transit and the centres it will service.’ (Newman, 2009, p13, 22)

In another article Curtis (2009) states other tools to define TOD in the regional plan. These are:

1) ‘Centres based on public transport accessibility;’
2) Density to provide certainty for infrastructure providers;
3) ‘Arterial roads to achieve TOD at centres rather than simply maintaining a car-based traffic function;’
4) Multi-sector and cross-agency collaboration; and an important element in the definition of TOD is to
5) ‘Provide for collaboration with the community.’ (Curtis, 2009, p.47)

**Conflicting actors**

The railway station development is a multi-actor project. In the Netherlands next to the property division of the Dutch Railways, the railway infrastructure owner, other stakeholders have a say in the process. The municipality, the regional government and the inhabitants have different demands for the
design. The traveller wishes a fast journey; the visitor cares less about time and looks for more comfort. The shop owner tries to profit from the flows of people passing by. (Kusumo, 2007) These contradicting visions can be directed by knowing and respecting each others wishes. 'Working with developers at an early stage of designing railway schemes ensures not only that property development is well integrated with stations, but also that there is a sharing of financial risk between the parties. Well-knitted development is to everybody's advantage – government, users, communities and investors.' (Edwards, 1997, p.15-16)

Middle-sized cities

In this graduation project the typical sub-HSL station of Leiden Central is treated. This node has much potential to become a larger centre than it is nowadays as it is the fifth station of the Netherlands measured in use. The plans of the municipality are strengthening the area already, but the expectancy is that they do not balance the area in the sense of node and place. In the light of the theory of network city, the inner city of Leiden can be a stronger centre in the polynodal, metropolitan area of Randstad Holland.

The city of Leiden is not the only city in the western part of the Netherlands (see figure 3.7) which can profit from the new developments of HSL, intercity transport and regional connections. Other middle-sized cities well connected to the large four cities of the country can also benefit. For example Haarlem has a new bus connection to the HSL-station of Schiphol. This is foreseen to become a rail connection in the future. Gouda is situated centrally between Rotterdam and Amsterdam; the connection to Rotterdam gives the city access to the cities of Belgium and Paris and London in an easy way. The regional RijnGouwe line gives strengthens the central function of the city. The city of Delft is connected to Rotterdam as well and has the same international connections. As is Dordrecht, this city has also to the south the city of Breda. Thus it will have an international shuttle connection in the vicinity. All these cities are currently redeveloping or have plans to redevelop the central station. But the cities do not use the potential to the fullest. By analysing node and place elements this can be made clear. One of the restricting elements in the redevelopments is the traditional character of the cities. They are historically grown cities and mostly have an inner city with much monuments and little space for redevelopment. As the officials are bounded by the history they tend to be cautious to look forward in a progressive way. Almere is an exception to the traditional middle-sized cities, as it is fully planned and built from the
second half of the previous century. Here developments at the station area give space to the pedestrian and the station area is in the centre; the main shopping area.

**Connecting networks**

In the designing of the urban project an important aspect are the scale jumps and the focus on the flows of the slow networks. The project is neither top down nor bottom up; it is based on different levels. It is a constant switching of scales, as an intervention has effect on the larger scales and a governmental discussion on the lowest of scales. These scales all have their own elements, but some work on multiple levels, as shown in table 2.1 for the transport networks. Figure 2.3 and 3.8 show these scales projected on Leiden and the design location in the city.

Next to the different scales in urbanism, you also deal with a time aspect in the designing and the context of the location in the region. Gall states this in a special way: 'If it weren’t for time, all would be architecture,' and 'As long as urban & regional designers continue to think in terms of urban forms, we will be stuck with making blueprints.' (Gall, 1996, p.28)

Thus the aim is to design the station area for the Dutch middle-sized city of Leiden with the input of the theory of ‘network city’. Petit (2006) explains the relation between theory and project best by stating that ‘taking advantage of the network theories and the principles of urban structure, city planning and city architecture can evolve and merge into a science of urban designed connective projects’ (Petit, 2006, p.65).

![Figure 3.8 Design area (d = 300m, 100m) 1:8.000](image-url)
4. RESEARCH APPROACH

The stations are different from the New Key Projects in level, but they need to change also to benefit from the changes - new and stronger connections - in the network (Cavallo, 2008, p.60).

4.1. PROBLEM STATEMENT; A MISSED OPPORTUNITY

In the Netherlands the ambition to turn the urban landscape in the western part of the country into a metropolitan area, is ongoing for several decades now. Starting with an economical approach with the name “Randstad”, it developed into the Deltametropolis and afterwards into the “Randstad Holland”. The government focuses on a strong international position of competition. The “Delta Metropolis Society” (Dutch: Vereniging Deltametropool) states that next to this approach the plans for the coming decades should also be directed at the social dimension. (Vereniging Deltametropool, 2008)

GOVERNMENTAL INTERVENTION

The government has plans for the country; projects are wished for, other development is obstructed. A lot of these decisions are made by the provinces themselves. The last decades the national government has made programs of subsidizing new neighbourhoods in the periphery of a city and station redevelopments in the network of the High Speed Train (HST). This development is wishful according to the ministries involved. The cities are made enthusiastic by granting subsidies for the investment costs. in almost all cases this funding is used to make a new station or to renew the current station (see figure 4.1). According to Cavallo (2008) Mr. Coenen, the former chief architect of the state, is of the opinion that cities need to be “drawn” so the conceptual level can change into projects as ‘a way of focussing on the process’ in the debate about the future developments of the Randstad (Cavallo, 2008, p.185).
NEGLECTED POTENTIAL

According to Bertolini (1996), the redevelopment of station areas needs to focus on the synergy of urban dynamics and transport infrastructure. Priemus (2008) gives a number of improvements for the synergy:

1) A comprehensive spatial policy. “Good horizontal coordination between property development and infrastructure networks at the regional level and good vertical coordination between local, regional and national/international spatial policy.” (Priemus, 2008, p.30)
2) Seamless connections between networks;
3) Develop or redevelop nodes in balance between functional and transport value;
4) There needs to be a good functional mix of railway station areas;
5) Accessibility by public transport in the form of light rail to integrate urban and regional PT. (Priemus, 2008)

The middle-sized cities near the high-speed train stations (a lot are historical grown cities, see figure 4.3) are neglected in the governmental development and are not subsidized to be transformed to the potential present. This potential even grows when other high quality transport is introduced, for example a fast bus service or tram. A new connection gives the city an opportunity to strengthen both the built environment and the user networks in the public space around the stops. Thus the station area has an opportunity to be redesigned into a balanced whole. The development needs to be directed with governmental intervention because the redevelopment is not a likely perspective for the future. (See figure 4.2)

The forming of an urban centre is of much importance for the whole city as Rooij also states: “With respect to the planning of urban and metropolitan infrastructures, (...) it can be hypothesized that the connection between the infrastructures on the other [one] hand (i.e. transport node) and the relation with the urban programme on the other (i.e. mobility environments) will become crucial for the functioning of the city of the future.” (Rooij, 2005a, p.113)
4.2. RELEVANCE OF THE STUDY

The public transport system is a network of stations and connections. With the ongoing globalization and innovation these interconnections, or 'mobility environments' as Bertolini and Dijst call them (2003), are tending to a sense of flows rather than a sense of places. The stations in the Netherlands are more functional organized than others in Western Europe; it is fully designed for 'traveller comfort and safety'. (Edwards, 1997)

THE REALISATION OF CHANGE

In the Dutch cities the station is situated generally besides the inner city. To go to the train a street was made. In the last decades the station has grown from a train station, a place near the city, into a place in the centre of the city. The city centre has limited possibilities to change; the street from the station towards the centre is an historical connection with monumental buildings and thus even less flexible. However, in the present situation the axis street (the "Stationstraat") is not really suitable for pleasant walking, but rather for running along. This is because of too much traffic and too narrow pavements.

The citizens of middle-sized cities are more conservative than the inhabitants of the four large cities in the Netherlands. This makes interventions difficult and a reorganisation very hard to realise as appeared in the discussion of the RijnGouweLijn (RGL).

RijnGouweLijn Discussion

Leiden has the issue of the light rail line. The municipality has been struggling how to place the line through the city for a long time now. Already in the 90s the line was foreseen as a light rail line. It took until the year 2001 to begin a test. The Leiden Municipality did not agree with the route of the track through the city. After a referendum in which the citizens said 'no' to the (layout of the) light rail, the track was changed and contracts were signed. Shortly after elections were held. The new governing parties in the Council did not want a light rail at all. Ultimately the Provincial Council of the province of South Holland had to make clear that things were already agreed on. The station area will have to be changed to incorporate the light rail stop. In municipal plans the stop is situated at the taxi-spot. Thus a new area for the taxies has to be sought for. (RijnGouweLijn and Zuid-Holland, 2011)
Network City at the TU Delft

From 1997 to 2003 a research program called ‘Network City’ was operative at the faculty of Architecture. With this program a part of the Urbanism staff has been involved. They researched and educated the theory in papers, dissertations and courses. Related to this research program a number of dissertations have been made (Calabrese, 2004, Cavallo, 2008, Kusumo, 2007, Nes, 2002, Peek, 2006, Petit, 2006, Rocco, 2008, Rooij, 2005a, Van der Spek, 2003, Trip, 2007). But also numerous articles and (articles combined in) books (Banister, 1995, Bertolini and Spit, 1998, Graham and Marvin, 2001, Salingaros, 2005) both from authors related to the TU Delft, University of Amsterdam, the University College London and University of Durham (UK). ‘The book, Shifting Sense in Spatial Planning (Hulsbergen et al., 2005), with contributions from many academics and experienced professionals, should be considered as a statement by the scientists of the Spatial Planning research group involved in the Network Cities Programme’ (Webredactie OTB, 2010).

Design and Research

Bertolini and others have picked up the theory of networks and nodes in the nineties and developed the idea further for transit oriented urban projects. As people move more nowadays and the distance is not as important as the time needed to travel the distance, the use of the transport network is more elaborate and needs to be efficient. The idea that cities have to be “drawn” to change their station area to a central place in the city is derived from reading the dissertation of Peek (2006), he states that ‘inner city station location are mainly seen as a booster of locale and regional economic development’ (Peek, 2006, p.33). The government finds the need for development as a centre around nodes of transport systems also essential (VROM, 2001, p. 181). Stimulated by these governmental policies the municipalities see their station location as a starting point for new development (Bertolini, 1996, Bertolini and Spit, 1998, p. 39)

Network thinking is more integrated in urban design than in architectural. The architecture of flows and activity places is in a developing status. With this graduation the feasibility of designing from the flow of the users is elaborated.
4.3. RESEARCH QUESTIONS AND METHODOLOGY

The main research question of this graduation is:

*What interventions are necessary in the redevelopment of Leiden Central station area to create a place in the city in balance with the node it is in the railway network?*

A first research in the network theory shows the importance of an intensity and diversity of functions for the urban area at the inner city station. This creates a place which invites the use of the public space and cultural facilities. (Peek, 2006, p. 117-122, Bertolini, 2008, p.40-41)

Next to these there are other elements in the network thinking which can be used in the redevelopment plans.

1. How can the redevelopment of Leiden Central station benefit from the theory of the network city?
   a. How can the “space of flows” be used in the urban design?
   b. How can the “space of places” be used in the urban design?

This question is answered by the design of the station environment. As input the theory of network city is explored through literature study and practical study. Helpful literature is the dissertations of the research program called 'Network City' of the chair of Urbanism (faculty of Architecture). And also the dissertations of Cavallo (2008), Peek (2006) and Trip (2007) are very interesting in this respect.

The designing is alternated with analyses and the theory, especially a practical case study is used to deal with the theory when designing.

The understanding of the node and place of the network city is the aim for a practical analysis on station areas. This study researches node and place elements in the station areas of similar or somewhat larger cities in the Netherlands and in other West-European countries as Leiden Central. The central stations of the following cities are examined: Leiden, Tilburg, Rotterdam, Arnhem, Karlsruhe, London south (Elephant and Castle) and Mechelen. To specify the opportunity for a redevelopment at Leiden Central the study compares the station environments in the node and place-elements.

2. What development potential has Leiden Central station in the coming decade?
   a. How and to what account have the spatial conditions of node-elements
been improved or are planned to be improved at Leiden Central station?
b. How and to what account can the spatial conditions of place-elements be improved at Leiden Central station?

To be able to conclude on the situation of Leiden the other cities are studied in their redevelopment plans. The case study is structured by the theory of Location synergy ( Peek, 2006) which is based on the network theory. This research is elaborating on the node and place-elements to define types of stations. By relating spatial conditions to the types a comparison is made between station environments.

Thirdly the understanding of the design location in its context is important to be able to make a plan fit for the city and region it is in and to be a lasting plan for the future. The use of the theory of networks in urbanism will structure the analysis and give insight in the networks in the city and at the station area.

3. What are the "space of places" and the "space of flows" of Leiden and its Central station area?

To answer the question the diagram of Network City by Dupuy (1991) as modified by Rocco (2008) is used. By mapping the location on different scales and with the input of network thinking this research is a base for the designing. The analysis gives extra attention to the municipal plans for the design area.
4.4. STRUCTURE OF THE BOOKLET

The following sections are Research and analysis, Concept and design and Evaluation.

The part of Research and analysis consists out of two main analyses; the location analysis and the case study research. The location is analysed in the form of five levels described by Dupuy (1991) and Rocco (2008) analysing the network and context. The case study follows the types described by Peek (2006) to come to small analyses at a station area. Seven station areas have been researched and documented.

The part of Design works out the designing process. It reviews the concept drawings derived from the recommendations of the analyses and theory readings. And it shows the final design in its composition, spatial organisation, the typology of the buildings and the public space.

The Evaluation part is discussing the feedback of the design to the case study research. It gives the conclusion to the main question and explains the difficulties and recommendations of the project.
PART II
RESEARCH & ANALYSIS

Introduction

This part of the booklet discusses the translation of the theory of network thinking into practical research in two chapters. One is location specific and the other is a comparative study into station areas.

In the location analysis the theory is applied to investigate the city of Leiden and the station area in it. By adding to the three levels of Dupuy (1991) the two levels of Rocco (2008) the city is analysed on all important aspects. The study leads to the understanding of the theory and of the ongoing working of the station area.

The case study analysis is using the theory to compare station areas on the aspects of node and place. This is elaborated with the theory of Location Synergy by Peek (2006) into four elements of study. These are the station area as a Transportation node, as a Connector of traffic, as a place in the city the Urban centre and as a Meeting place for people. The leading idea in the study is the transformation at Leiden Central station as an Urban Centre.
5. LOCATION ANALYSIS

Leiden, trots van Neerlands steden
Parel van het Hollands land

Stad van heden vol verleden
Stad van werk met hart en hand

Plaats van dromen en van daad
Waar ieder blijft en niemand gaat

Leiden, stad van denken en van doen
Stad van mijn hart door nu en toen

R. Heruer, 2000

5.1. THE SITUATION OF LEIDEN

Leiden is a historical city in between the Northern and Southern part of the Randstad Holland. The city is strongly connected to the cities Amsterdam, Utrecht and The Hague by rail and road. Because a large part of the town can be seen as inner city and as it is car unfriendly, there are many bicycles in the city. Another reason for the huge number of cyclists is the many students living in the city. Leiden is a university city. It hosts a university (UvL) in the discipline of the medical science and also a large university hospital (LUMC). With the related business and a college these relatively new buildings are grouped on the west side of the railway line. The east side is more historically grown. The station is situated on an old feeder road from the city centre. The building of Leiden’s main station is relatively new. The building, designed by Reijnders, was finished in 1996, and is the fifth station of the Netherlands with more than 60,000 users a day. (Gemeente Leiden, 2009, Gemeente Leiden afdeling BOA, 2010) This intensity of use is expected to grow with 150-175% in the coming ten years.
AN ANALYSIS

To be able to make a design fit for the location, the context is an important part of the research to make the design location specific. Consistent with the theory of network thinking the main question in this research is the following: What are the “space of places” and the “space of flows” of Leiden and its Central station area?

The analysis is structured by using the "Network City" model as made by Dupuy (1991, see figure 10). The starting point in the levels of Dupuy is the physical network. These networks are the structure of an area; they give the means to connect different points in the area. These points, or places of activity, are the locations where the production or consumption takes place. The top level of this model shows the use by people. By making and selling or buying the process of movement is set. People and goods use the network to go from one place to another.

To structure the analysis more a method of Rocco (2008) is used. The method is based on the three levels of Dupuy. Rocco elaborated the levels technical urban networks, production and consumption and Household networks with two more levels: Geography and Governance (Rocco, 2008). Figure 5.1 shows these levels, starting with Geography "The First Nature" and The Interface Governance

This model of Dupuy and Rocco, used for the analysis, consist of a rhythm in time. The layer of Geography is a layer with elements formed in the previous centuries. The Governance layer consists of decisions made in the last hundred years. The networks are formed in the last decades (although this depends much on the kind of network). Production and consumption areas are mostly formed in the last decades with the expansion of cities. The top layer, households, is a very changeable layer because the use of the network is dependent on the lower layers. When a new centre arises others get less attractive and the network of the individual household can change. This can also change by a difference in the physical network or due to another factor like the household composition.

Figure 5.1 Method of analysis, the levels of spatial analyses based on the Level of Network Operation (Dupuy, 1991) with two supplementary levels (Rocco, 2008, p.153)
New and historic buildings of the University of Leiden

Figure 5.2

Historical development of the city (Engel, 2007)

Figure 5.3
5.2. GEOGRAPHY

Leiden is a middle-sized city between the bigger cities The Hague and Amsterdam. The city has its origin on the west bank of the river Rhine at the junction into an Old and New Rhine. In time the open connection to the sea has been gone. The Rhine was a Roman border line. In the eleventh century there was a courtyard of counts, a fortified building and some agricultural housing. These grew into a village with a moat and extended to the other sides of the river. From the end of the 19th century the city expanded enormously in a concentric way as can be seen in the maps of the city of Leiden (figure 5.3). The city expanded toward the highways, and along the river towards the coast. Nowadays the city has more than 115,000 inhabitants. (Gemeente Leiden, 2009, p.21)

MORPHOLOGY OF THE STATION AREA

As the railway track, with its station (1842), was laid outside the historical city, the station can be found directly on the feeder road of the city centre. This road was used by diligence and stage coach in earlier years to go to the city of Haarlem. The station was strategically placed outside the city because this land belonged to the neighbouring municipality and the river Rhine prohibited a track closer to the city. From the end of the nineteenth century the city expanded. The agricultural land on the west side of the station was ignored at first. Nowadays this can still be found in the structure of the city, because of a spatial division between both sides of the railway line. On the city side, the side of the historical inner city, the city consists of small scale building blocks with an inner court. The university and the academic hospital on the other hand prefer large buildings in a pavilion style. At first these buildings were located at the Rapenburg, a canal street at the west side of the city (figure 5.2 under). When they wanted to expand the hospital and the university could not find enough space inside the city and moved outwards. The hospital first began building systematically at the sea side of the station. In the beginning of the 80s the hospital began building a new home. It was completed from 1984 to 1996, in that last year all the old buildings (except for one in the centre of the area) were torn down. The third station of Leiden Central, build in 1953 was placed directly on the regional road, giving the station road a new function for the city. The station became a badly conceivable area with increasing demand of traffic. The roads in the vicinity of the station became regional connections for the city roads. This all changed with the new developments in the nineties. When looking at the block sizes on the north-west side and the south-east side of the station a difference can be noticeable (see figure 5.4). The large programs of the hospital, the university and the companies it

*Figure 5.4 Scale of building blocks - inner city (r) versus Bio-science park (l)*
Figure 5.5 track and stations of the Rijn-Gouwe Line (www.rijngouwelijn.nl, 2010)
5.3. GOVERNANCE

The before mentioned High Speed Line is a mayor change for the public transport of the Netherlands and its surrounding countries. On the lower levels of the city and region this is not directly noticeable. Although the importance of high speed stations has increased, the middle sized cities do not directly benefit. The government has therefore more plans for strengthening the public transport. These are directed by regional and municipal authorities.

REGIONAL COOPERATION

Holland Rijnland is a regional cooperation of the villages in the Dunes and Bulbs area (Dutch: Duin- en Bollenstreek), the municipalities of Leiden, Katwijk and Alphen at the Rhine (Dutch: Alphen aan de Rijn) and the rural municipalities in between. Holland Rijnland is a voluntarily cooperation, but it is not without liability. It consists of fifteen municipalities in the heart of the Randstad; in between the northern and southern wing of the Randstad Holland. These municipalities operate from a common strategic vision on the development of the region, shown in figure 5.6. The areas have a strong relation to the city of Leiden for transport, shopping and spatial planning. The aim of the cooperation is to enhance the quality of living, working and recreating of inhabitants, companies and organisations. Therefore the core issues to deal with are living, working, nature and landscape, traffic and transport, society and welfare.

PROVINCIAL PLANS

The lightrail connection between Gouda, Leiden and the coast, to the villages of Katwijk and Noordwijk, is called the RijnGouweLijn (RGL). (Figure 5.5) This is a distance of 43 kilometres. The lightrail line is supposed to be the downgrading of the current stopping train connection between Gouda and Leiden. The line between Leiden and Utrecht can become stronger when it has its own tracks. The connection is debated a lot in the city of Leiden. The municipality was split up and a referendum was held to convince the opposing parties of the municipality. In the referendum two-third of the citizens said ‘no’ to the plans. The municipality wanted to continue, so they decided on a new track. Currently elections have been held, the lightrail was a political point of choice. The citizens of Leiden gave their vote to a party against the lightrail. The Leiden Municipal Council newly formed after the elections stated that they would no longer participate in plans having the lightrail go through the city of Leiden. The province does not accept this statement, and will hold the municipality to their agreement.

Figure 5.6 Main goals of the cooperation Holland Rijnland (www.hollandrijnland.net, 2009)
Station area in transition

The station area is seen as an area with a radius of about 700 meter. The station area consists of a strong diversity between the city side and the sea side (LUMC side). It is under construction since the early nineties. The station was rebuilt in 1996 to enlarge the capacity on the line The Hague - Schiphol. The design by the Dutch Railway architect Reijnders is part of the urban plan for the station area. Figure 5.9 shows all redevelopments completed or in progress.

With funding of the government the regional road in front of the station was lowered in a tunnel. The bus station was transformed into a buffer model (see figure 5.8) and the taxi stop combined with bicycle storage was made on top of the tunnel (architect: Cepezed). To be able to make the city side less dominated by bus traffic and to give better reach to the hospital, a bus tunnel was built under the railway tracks. Between the new tunnel and the station entrance a bicycle shed was renovated and a small catering building is realised. There is always a shortage of bicycle sheds in the station environment; the newest shed has been built under the sea side station square.
**HIGH RISE IN THE STATION AREA**

The Leiden Municipality has the ambition to build higher. There has already been development of high rise, for example the Social Insurance Bank (SVB) (architect: Groosman Partners BV) on the city side of the station (see figure 5.7). Other high rise in the station area is realized on the sea side of the tracks. The high rise consists of apartments; the lower part gives space to offices, a restaurant, the province of South-Holland, a bank and shops. The buildings in the station street (Dutch: Stationsstraat), consist mostly of housing, small public offices and hospitality business. Except for a new high rise next to the taxi platform and at the corner Station Square / Station Street, this part of the station area is kept as it is. (Municipality of Leiden, 2010)

On the Schipholweg, which is the road in the tunnel and to the north of the station area, a large office building is realised. The municipality foresaw many businesses to be housed there, but it is hired to a large insurance company instead. Other plans in the area are a super-cinema and discotheque and a third hotel, but these are postponed for the moment.

The ‘sea side’ of the station area was cleared from unused buildings. The ‘Poortgebouw’ [gate building] was rehabilitated with space for examinations, conferences and offices. The next phase of the transformation will show the sea side being transformed. This side is dominated by pedestrians crossing the area. In the zoning plan there can be found additional services for the hospital, student housing and catering industries. To the other side of the Poortgebouw housing is planned. Next to the railway tracks a large complex is being built. It accommodates to the Regional Education Centre (ROC) (Architect: Meyer and Van Schooten), a hotel, offices, shops, hospitality business and a conference centre (see figure 5.10).

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**Figure 5.9** Plans of the municipality, 1:5.000

**Figure 5.10** ROC Leiden Central, Meyer en Van Schooten (www.vernieuwendeleninleiden.nl)
Unclear is still how the RijnGouweLijn will change the projects in the station area. In early documents of the municipality it will run along the front side of the station (city side). The municipality has given the office Maxwan Architects+Urbanists the assignment to make a new vision and urban plan for the station area. (See figure 5.11 and 5.12) In this vision the stop for the light rail is proposed at the sea side. (Wilms Floet, 2007) The urbanist (and architect) involved is Dijkstra, he made a visionary plan with small building blocks of high rise. The building blocks on the city side of the station area are designed with a base of mostly three storeys and a tower at the centre of the block.

It is likely the element of the situation of the track for the light rail line to be adopted in the ultimate plan of the municipality because the stop at the front, on the (site of the) taxi stop, is difficult in feasibility. (Koster, 2010)

“Dijkstra investigated before he started with the design process, the essence and the atmosphere of the centre of Leiden. In our historic inner city we have many small and high streets and smaller building blocks than at the station. This scale he intents to apply in the surroundings of the station square. So seen from the street he copies the view from the street of the inner city with a maximum of four stories. In the middle of the proposed building blocks, he makes the square metres by going higher in steps. With the new street pattern of low-high buildings he makes a visual attractive connection between the inner city and the high rise of the station area. In stead of the massive concrete blocks currently framing the station area, he places lower buildings in the streets and alleys giving space for shops, living quarters and companies.” (Van Hoek, 2010, translated by author)
5.4. TECHNICAL NETWORKS

A network is a system of nodes and interconnecting lines. On these connections flows can run between the nodes. ‘Spatial networks are networks in which the links between nodes are constrained by the location of the nodes in space’ (Rocco, 2008, pp.143,145). Networks can operate on different levels, for instance the highway network runs on a higher scale than a neighbourhood access road or a regional road between districts. The same is true for public transport (PT). As table 2.1 (page 6) shows PT also has different operating systems for the scales. But there are hybrid forms making the city more dynamic and addressing the difference of users. The technical urban networks can be made perceptible by visualising the infrastructure routes in maps as is done in figure 5.13 for Leiden.

PUBLIC TRANSPORT NETWORK

The public transport of Leiden is built up with a planned new light rail and local and regional bus lines. As stated in the previous section the light rail will go from the station, to Noordwijk, Katwijk and Alphen. The bus lines reach almost all towns and cities in the region. The interliner busses follow the regional roads and even highways. The local bus lines form the connection between the station, the inner city and the neighbourhoods in the agglomeration. (Figure 5.14) When the light rail is realized a number of bus lines will not be necessary anymore, because they have the same routing at the inner city.

CAR NETWORK

The car-oriented elements in the city of Leiden are the two highways which run on the east and west side of the city. Regional roads connect them to the districts in the agglomeration. The network, as seen by the municipality, consists of three circles around the inner city and a number of lines from the inner city outwards in a radial form. A direct connection between the two highways is foreseen for the near future by a new road to the south of Leiden.

The station area of Leiden Central is lacking local streets. From the dissertation of Kusumo (2007) it can be stated that the building blocks at the city side are not consistent with the scale of the inner city. The connectivity in the area does not reach the insides of the building blocks. The regional network alone is ‘not enough to generate a vibrant urban place full of different kinds of commercial activity.’ (Kusumo, 2007, p. 9) The solution to a lively urban space at the station area lies in the connectivity for the slow networks of cyclist and pedestrians. This can be realized by small block sizes.

Figure 5.13 Leiden in the networks of public transport infrastructure
**BICYCLE NETWORK**

The main bicycle network is very spread out in the city. Mostly the regional roads are part of this network as well as the inner city ring road and the paths along the river Rhine. Some neighbourhoods have special bicycle paths in the urban tissue. Leiden Municipality gives much attention to the bicycle network by stating that intersections of the main car network and the main bicycle network are indirect junctions due to a difference in height. At the station area the bicycle routes are fluent; bicycles can use all existing roads to reach the sheds. (See figure 5.15)
Figure 5.16 Economical centres in the city of Leiden, 1:30,000
5.5. PRODUCTION AND CONSUMPTION

The network level of production and consumption is related to the centres in the city. This network can be seen in a city as connection between business, industrial and distribution areas, but also consumer shops have a spot in the network. On the scale of the Randstad Holland the network is noticeable as connections between (inter)national hot-spots. These centres (on different levels) are called activity places as they attract activity of businesses or consumers.

Activity places in the region

Leiden is one of the centres of scientific knowledge and new technologies in the Randstad Holland. The university is active on an international level. It investigates in interdisciplinary research and cooperation with organizations, government or offices. The University of Leiden was the first university in the Netherlands (1575). It has, in combination with the academic hospital, a specialism in bio-medical education. The historical centre has a regional attraction. Its shops and cultural facilities and of course the catering industry are together a well used place to go for recreation or work.

Activity places in the city

Leiden has a historical centre; The “Haarlemmerstraat”, parallel to the Old Rhine (Dutch: Oude Rijn) is the main shopping area. The shopping street is one kilometre long. It is a touristic and regional attraction. The Breestraat is another important street in the inner city. It runs parallel to the New Rhine (Dutch: Nieuwe Rijn). This street hosts a lot of the public services for the city, such as the municipal office, theatres, music program, stores and restaurants. Other nodes in the city are the neighbourhood shopping centres and recreational facilities, as can be seen in figure 5.16. Elements like parks or public squares can also be seen as nodes in the city, as well as schools with additional functions or a cluster of (specialized) companies. These places in the city all have their own reach of influence. A larger and divers city centre has a wider reach than a neighbourhood centre.

Activity places in the station area

The station area is currently not a diverse activity place; the main activities are transfers between modalities. It thus attracts a lot of people who are travelling. The workforce in the area is numerous due to the LUMC in the vicinity of the station. The consumption in the area is moderate. The station itself has some small shops for foods and drinks. Directly on the station squares on both sides the catering industry is limited. Two supermarkets have their stores in the ground floors of the adjacent buildings. Most of the public program is situated in the street towards the inner city as visualized in figure 5.17. Other activities like the elementary school or the supermarkets do not add to the neighbourhood due to the route of supply. The program inside the large building blocks does not have a relation to the station and the Stationsstraat.

The station area lacks program in the scale of the city as can be found in the Breestraat. The addition of program active in the evening hours as restaurants, bars and music facilities are scarcely present in the vicinity of the station.

Figure 5.17 Distribution of retail activities of Leiden Central station
Figure 5.18  Space syntax, three changes of direction from the station passage
5.6. HOUSEHOLDS

The top layer, households, is a special layer in the sequence. It is a very changeable layer because the use of the network is dependent on the lower layers. When a new centre arises others get less attractive and the network of the individual household can shift. Therefore it is not easy to show household networks. They are not hardware (infrastructure) or software (centres) but brainware. It is strengthened by giving a choice to the user.

THREE STEP ANALYSIS

The brainware network consists of the routes the inhabitants and visitors of a place take to get from their point of departure to their destination. Space syntax has ways to show the working of the infrastructure of an area in a three steps analysis. This analysis is done by starting from a point or street and drawing the direct and straight lines from it. This is the first step. The second is a turn in direction or a curve in the road. This way also a third step can be found. The whole of lines shows the connectivity of the starting point or line in the urban tissue. In figure 5.18 this has been done for the station passage of Leiden central. The hand made version of this analysis shows the connectivity best, because the degree of bending in a street can be seen as a straight line. Or the other way around; a crossing breaks the line into segments. The regional routes in a city can be visualised by showing the public transport lines with their stops and reach.

THE USE OF THE STATION AREA

The main station of Leiden is well connected to the city. This explains the catering industry in the axis street (figure 5.19). The shopping street in the northern part of the inner city is connected to the station in less than three steps. The regional roads are connected as well. The sea side of the station area is poorly connected, there are only few roads present and the axis of the station passage ends at the square, thus the second step does not lead the user far from the station.

At the city side the analysis shows the bad connectivity of the station area on this side. The large building blocks with parking inside cannot be reached well from the station, thus the relation between the areas and the station is weak. This is most evident at het western building block with parking for the bank at the Stationsstraat and an elementary school. The activities have no relation to the transferring at the station and in the Stationsstraat.

Figure 5.19 Current station area in activities
5.7. CONCLUSIONS

The location analysis gives much information about the working of the station area, its position in the city; opposed to the city centre and the transport connections it has attracted. (Figure 5.20)

**Base levels**

The geographical analysis gives the historical position of Leiden’s main station in the city. It is located on a historical feeder road and has therefore a strong connection in the regional road network. The station has been build outside the historical city. Because the large institutes as the hospital and university grew too much to stay in the city centre, the new locations were assigned at the other side of the railway tracks, thus creating a neighbourhood of related industries.

The municipality has the wish to change the area into a stronger build area. The sea side of the station area has been cleared from unused buildings of the adjacent hospital and is planned to be built again. At the city side a lot of projects are planned as well. Some have been realised, others are taking some more time. In the mean time there has been made a new urban plan for the area with much high rise and smaller building blocks. The light rail line planned in through the city is unclear at the station are; will it run over the old long moats in the inner city or the rather small “Breestraat”? And second, will it pass the station at the city side or at the sea side?

The neighbourhoods of the historical city and the Bio-Science Park form the most important areas of the agglomeration. The connection to the station in between these areas is very important, as it feeds the areas by public transport. The light rail can play an important role in the connection between station and university and station and inner city by putting the stops at the right places to generate activities and use of the light rail.

**Main levels**

The public network in the city has a large node at the station. The bus, future light rail and train all serve the main station of the city. The car-based transport is not the main priority in the dense area of the city. The station attracted the regional road connections very strongly. The direct connection between the two became problematic when the focus was laid on the slow transport; the road “disappeared” into a tunnel. The bicycles have a less clear network in the area. There are many cycle paths giving short cuts and much choice in the directions. The use of the area by pedestrians is based on three routes: 1) The route from the station passage to the shopping streets in the inner city; 2) The route from the station to the hospital and
3) the route from the station to college and university, crossing the grass diagonally.
The networks show the paths between the activity centres. The analysis shows centres on the neighbourhoods and on city scale. In the station area itself smaller concentrations of activities can be noticed. The station itself is a large transfer machine with also some shops. You can see most activities in the main street between the station and the inner city. The use of the physical networks is visualized by using the connectivity of the station in the city. It shows a good connection of the station to the inner city. In contrast to the sea side of the station, this is just poorly connected. The building blocks close to the railway tracks are rather solid blocks, without connections through. From the dissertation of Kusumo (2007) it can be stated that the building blocks at the city side are not consistent with the scale of the inner city.

**Flows and places**
The station environment is not only influenced by the public transport, infrastructure and the areas of production and consumption. It is also influenced by the historical geography and governmental interfering. The space of place at the station environment of Leiden Central is determined by the "Stationsstraat" and the station passage. Their commercial activities give the area liveliness and safety for its users by the active climate the whole day long. The activities are declining in intensity when nearing the station; this effect needs to be addressed.

The space of flows is visualized by the patterns of the users in the area. The use of the area by commuters, visitors and inhabitants is the grade for the area as a whole. If a public space is not interesting to be or not a safe place to be, people will stay away or find alternative routes, especially in the evening hours. For example in the station area, the inner areas of the building blocks are avoided.

**Elements for designing**
The analysis has the aim to understand the processes of the station area in the agglomeration of Leiden. A few things are important to keep in mind and to enhance or strengthen when redesigning the area.

The city has three areas functioning on a large scale these are the historical inner city, the Bio-Science Park and the main station area. The main pedestrian routes addressing the station are to the hospital, the university or college and to the shopping streets of the inner city. The newly planned lightrail will have its route through all three areas in the city. A second element is the public activities. The station area has not much program for activities not related to travelling. The station itself has some small shops and many places to buy food and drinks, but outside the station there are functional areas for the bus, taxi and bicycle. Restaurants can only be found in the Stationsstraat and one at the square on the Seaside of the station. The hospital LUMC has therefore a large restaurant facility. The station area needs program to ensure the liveliness in the area, during the day as well as in the evening hours. The city is planning for a new music facility for the youth of the city, as it can no longer stay in the Breestraat. This can be a chance for the area. The municipality has also plans for a new cinema and a hotel in the station area. These facilities, together with restaurants and cafés will add to the station area in attractiveness and liveliness and thus in a more secure area to go to.

The third aspect to look at in the redevelopment has also to do with the attractiveness and liveliness of the station area. Research at the TU Delft (Kusumo, 2007) shows the importance of the size of the building blocks for the liveliness of the area. The block size of the historical city, with its many small plots, proved to give an opportunity for restaurants and stores. In the station area this is also visible in the Stationsstraat. The combination of people passing by and the historical plots gives restaurants and other public services a feasible accommodation. This principle can be used in the wish to add public services and create a lively public space. The last element to use in designing is the routing of people in public and private means of transport. The Stationsstraat is a crowded place to be.

The street is used by pedestrians, cyclists, busses and access traffic. The profile of the street is to narrow to combine all the traffic in a safe way. Especially the combination of bicycles and busses is a dangerous one, as is the frequently stopping of access traffic on the bicycle path. The station area is pre-eminently a place for the public and slow traffic. Thus cars can be of secondary importance and parking on the street should be limited to visitors. At the other side of the station the current situation foresees in a limitation for the traffic by car. Here the bus tunnel under the railway tracks is equipped with a camera to fine car drivers using that road. Also the roads to reach the buildings are limited to access traffic by a barrier. These limitations are harsh methods in a public space of the station area.

Thus special attention needs to go to the routing of slow, public and private traffic. As well as to the islands formed by the routing and to the functions wished in the station area.
Legend

High Speed Line:
- 300 - 350 km/uur
- 200 - 250 km/uur
- < 200 km/uur

Metropolitan areas and the high speed train network in North-Western Europe

Figure 6.1 Metropolitan areas and the high speed train network in North-Western Europe
6. CASE STUDY RESEARCH

‘In order to provide real examples, against which the theoretical ideas (…) may be measured, four railway station areas are selected for case study.’ (Kusumo, 2007, p. 51)

6.1. NODE AND PLACE THEORY

The reference to Bertolini led the graduation project to the result of the testing of the node-place model on stations in Amsterdam and Utrecht as done by master students (Zweedijk and Serlie, 1998). It also led to dissertation of the TU Delft, especially those of Peek (Peek, 2006, Peek and Louw, 2008) and Trip (Trip, 2007) about the redevelopment of railway station locations. The usage of this knowledge gave the project a direction in the form of case study. For this the tool by Peek to make station redevelopment better organized had to be transformed into a model suitable for analysis. The research is used as a tool to understand the station area better in the light of the theory. The aim is to state recommendations for the design by searching the aspects to balance the node and place-elements.

CASES AND CRITERIA

The cases analysed are all unique station areas, although there are similar criteria to the chosen cases. By looking at inner city railway stations with a diverse offer of public transport in the railway network the focus is not only on the balance between the types of node and place, but also more specific elements come into scope. These multimodal hubs have a range in the daily uses from one third to more than twice as much amount of users compared to the case Leiden Central. In transport connections they are similar in the regional layout; as they are the centre of a larger urban area. Both high speed train stations and regional centres in the vicinity (within 15 minutes) of high speed train stations are analysed. The station areas are preferred to be renewed in the last decade, as to get contemporary conclusions and to make good comparisons to the first case.

Apart from Leiden Central there are three station environments selected in The Netherlands: Rotterdam Central, Arnhem Central and Tilburg. In the neighbouring countries Karlsruhe Hbf (G), Mechelen station (B) and London’s Elephant & Castle (GB) are researched. (See figure 6.1 for the geographical location)
6.2. TYPES OF LOCATION SYNERGY

For the case study the node and place are broken down into four types analogue to Peek (2006). These are defined as Transportation node, Connector, Urban Centre and Meeting place (idem) and are visualized in figure 6.2.

**Ideal types**

All types have a different approach to a station environment. The approach of the inner city station area as a Transportation node is mostly in use by transport planners. It is a supply oriented approach of the influence of a station in the network of public transport or car-oriented transport. The aim in the approach of the Transportation node is to optimise the efficiency and effectiveness of the network by spreading its use over the day. The area of influence can be determined by looking at the distance reached in a certain amount of time or the position in the road network. ‘In this perspective the station’s area of influence is spatially defined by its accessibility. For every transportation network the distance or number of stops in reach of a particular station within a certain period of time can be determined.’ (Peek and Louw, 2008, p.129)

The station area itself is also an important aspect of the working of the transport networks as it is the connection between them. At the station travellers can transfer, for example from train to bus or from bicycle to train. The layout of the station is therefore an important factor in the efficiency of the transfers. A transfer-route is a connection in space, distance and time between two means of transport. These are characterized by physical and social aspects. Next to the spatial layout also the modes can be made more efficient by fine tuning the important lines of the different transports. Although effort has been done to make a station work more efficient the transfer is still experienced as a large delay in the trip. (Van der Spek, 2003, p.4)

The efficient station can be seen as a connector, ‘connecting the different means of transport (transfer), different destinations (connectivity) and the local urban tissue (reach). With the term “connector” the focus is on the transferring’ (idem, p.vii).

An urban centre, as a station area can be, can be determined in the degree of density. A centre can be (inter)national, regional or just a centre for the city itself. Frieling (2003) stated in a lecture in the series of sLIM, a sustainable high rise organisation (www.slim.nu), that the scale the nodes operate on change according to the amount of living and working people...
per hectare. A station area is a place that can be a vivid centre in the city. This can be seen in the amount of commerce like hotels, cafés, restaurants, supermarkets, hairdressers, sports facilities and other services. In the direct vicinity of the station (reach of 500 metre) offices can be the main function next to the services; in a larger reach of the station also housing has to be present for the station area to be an important centre. Frieling (2003) stated in the previously mentioned lecture, that in the typology for urban nodes the ratio between the three, offices, housing and commerce, can change from a business centre to a services centre or a urban centre on different scales (see figure 6.3).

The approach of Meeting place deals with urban experiences and human encounters. For the surroundings of the railway station to be a part of the mental map of citizens the area must be an agreeable place to go to and use. The station hall, passage to the platforms and the public area near the station must be safe, comfortable and, to a degree, enjoyable, to be an environment in which interaction between people is encouraged.

**Balance**

Peek defines these focuses and types and relates them to each other, but in consistency with the theory of Bertolini he states that the types, and thus the stakeholders, are ideal when in balance.

“All ideal types together form the overall spectrum of possible synergies. A balance of all four ideal types helps create coherency between the elements of the node and of the place.” (Peek, 2006, p.390)
Figure 6.4  Outcome of node and place elements in a station area
6.3. RESEARCH QUESTIONS

In order to state a question that links the theory of node and place to design proposals the cases handled need not to be inconsistent to the principles in the theory. Thus the study of the cases must confirm the theory of Bertolini about the balance between node and place elements. When this is the case, the case of Leiden Central can be enhanced in a new design by knowing the answers to the following questions:

What development potential has Leiden Central station in the coming decade?

a. How and to what account have the spatial conditions of node-elements been improved or are planned to be improved at Leiden Central station?

b. How and to what account can the spatial conditions of place-elements be improved at Leiden Central station?

The main questions lead to a need for clear definitions and to an analysis of spatial conditions of the node and place-elements:

1. How can the spatial conditions of node-elements be defined and analysed?
2. How can the spatial conditions of place-elements be defined and analysed?
3. What spatial conditions can be improved to enlarge the place-value in a station environment?
4. How do the four types of the model by Peek relate to each other?

To understand a station area in the spatial conditions of node and place-elements the diverse cases are analysed and documented. These case-analyses can be summarized in a spiral diagram in which the four types are represented by a figure (figure 6.4). By comparing the data and the relation between them, a proposition can be given to the enhancement of the place-value of Leiden Central station in the coming decade.
6.4. SPATIAL CONDITIONS

The station environment can be seen in the focuses of node - place and network - location. These give approaches and elements of synergy and antagonism. In this study the types of the model by Peek (2006) are used to analyse different station environments. The approaches Transportation node, Connector, Urban centre and Meeting place are represented by spatial conditions derived from literature models. These are visualised as much as possible in maps and drawings in addition to tables with figures.

THE NODE ELEMENTS

The primary focus of the node consists of two elements; the Connector and the Transportation node. These are analysed in the study with help of academic literature. The first element is a comparison on the position in the network. The thesis of Van Bakel (2001) in commission of “Vereniging Deltametropool” and the study of Stedenbaan (Zuidvleugelbureau, 2003, Programmabureau Stedenbaan, 2009, 2010, Atelier Zuidvleugel, 2006) are both dealing with the node in the network, they made a study by giving an amount of points to the services present. These documents do not specify the local elements in the station area. Therefore the dissertation of Van der Spek (2003) is used to calculate the value of the connector. All these methods of calculation are, if possible and feasible, enhanced with the comments of Peek in his dissertation and article (Peek, 2006, 2008).

VALUE OF THE TRANSPORTATION NODE

The position of a station in the transport network is determined by the accessibility in an amount of time over rail and road. It is very time consuming to gather information about the number of services. Also this information is not applicable to the future situation. Therefore the analysis focuses on the directions you are able to travel from the station per type of service and the number of exits from national roads in the range of a station.

The research is focussing on the presence of modalities and at the accessibility per modality in a number of directions. The area of influence is set to 30 minutes for main transport and 15 minutes for urban transport like light rail, metro and tram. This is defined by the chain of transport, where the total acceptable trip takes 45 minutes. This is broken up in thirty minutes main transport and fifteen minutes pre and past transport. The smallest stations are not included.

By road the radius is set to three kilometres, equal to the research done by Van Bakel (2001) (see figure 6.5). The through roads with lower speeds...
are in the calculation when they are no further than one kilometre from the station. The information is obtained by accessing maps and timetables of the rail transport providers and scale maps of the inner cities. The amount of stations, exit roads and directions per modality have been credited similar to the values of Stedenbaan (Atelier Zuidvleugel, 2006) and Van Bakel (2001). For example a station that can be reached with intercity or fast train services within half an hour gets a credit of 10 points added to the value of the station with intercity supply itself (100 points) and the directions travel is possible with these trains (directions times 20 points). Calculating all modalities within reach by rail and road an average value of the cases analysed is 769 points.

Value of the Connector

According to Van der Spek (2003) a connector can be analysed with different instruments. These are described in his dissertation:
- Value of the Connector;
- Transfer profile;
- Three dimensional analysis of the composition;
- Logistical analysis of the transport and pedestrian flows;
- Programmatic analysis of the surroundings;
- Analysis of the position.

In this case study elements of these instruments are used. Especially the value of the connector is calculated (see figure 6.6). This can be done by multiplying the distance of transfers with the use of these transfers per day. The product is divided by the total amount of transfers to compare the weighted amount of transfer distance. To make this figure more realistic in the spatial layout of the station both the distance and the use can have stress factors. These are respectively the addition of the length of stairs or escalators present in the path and the presence of a gate in the form of a (small) entrance or a corridor which gives a large flow of pedestrians a delay in the transfer.

The average value of the connector in the cases analysed is 117 metres. To be able to compare this figure better the credits have been divided by the calculated transfer possibilities to get the average transfer path length per station. The average of these last figures is calculated as 6.54 points.

Visually the station area, as expected to be in 2020, is explained in organisation and public and private transfer logistics. These maps show how the connector functions.
The place elements

The position of the node shows the surroundings of the node; dense and metropolitan or a large spread of nodes. The same can be done for the urban surroundings. By statistically determining the amount of building program, the diversity and density; and with it the position in the urban setting, can be determined. In the study of Stedenbaan, (Zuidvleugelbureau, 2003, Programma bureau Stedenbaan, 2009, 2010, Atelier Zuidvleugel, 2006) commissioned by the province of South Holland, density is measured with in a Floor-space index. The statistical data used is obtained from the national Central Office for the Statistical data (CBS) and the municipalities themselves.

Intensity and diversity of the urban centre

For the measuring of densities the program ‘Spacemate’ by Permeta is used. With Spacemate space can be described in both quantitative and qualitative terms. Density can be describes as building program in relation to the total area. Spacemate elaborates this info with ‘footprint’, which can be described as the built ground floors. Next to a Floor Space Index (FSI) also a Ground Space Index (GSI), an Open Space Ratio (OSR) and amount of Layers (L) can be calculated with the data of building program, total area and footprint. The Dutch cases analysed give average figures of 0.69 (FSI), 0.27 (GSI), 1.15 (OSR) and 2.56 (L).

The outcomes per case can be visualized in a graphic (figure 6.7). Thus a better comparison between neighbourhoods can be made. The FSI is the most important of these figures and is visualized per neighbourhood in a scheme.

The reach of the station in urban setting is set to 1200 metres in correlation to the research done by the Zuidvleugelbureau, (2003). To the current figures, calculated with information by CBS, the new plans for buildings are added to make a comparison of the redeveloped areas. The new plans are derived form documents of the evaluation of the Key Projects by the ministry of Housing, Spatial Planning and the Environment (Van der Wouden et al., 2009). The reach of 1200 metres is transformed into an erratic boundary corresponding to municipal neighbourhood borders. (Figure 6.8) To be able to compare the figures in square metres the amount of inhabitants and working people have been searched, these are transformed by a number of square metres per working person. This is calculated by a statistical study done in the city of Leiden. The figures are divided into working area, living area and space for commercial activities. The Dutch cases analysed
give and average division of 25% working area, 58% housing and 17% commerce. These are ideally structured in a good function mix, but in reality the commercial activities and working area are realised closer to the station than the housing.

**Value of the Meeting place**

For the surroundings of the railway station to be a part of the mental map of citizens, the area must be an agreeable place. The station and its public area must be safe, comfortable and, to a degree, enjoyed. Gehl (2006) has made these fundamentals explicit in a study for a good public square (figure 6.9). He gives twelve themes in which a public space can be examined. By giving no, half or full credits for a theme he judges the public space in Copenhagen.

In this case study these themes are interpreted into testable elements. The themes are equally credited. With twelve main criteria the analysis of the station environment can have a maximum value of 24. In this analysis the location is reduced to the station hall, station passage, front station square second station square, if present, and waiting space for Light rail, tram and bus. When there is much difference between two areas near the station, the station hall and the main square have the upper hand in crediting. The maximum credits of 24 can almost never be reached. In the cases analysed the average of 12.11 credits is given.

**The cases explained**

The cases are analysed on the four elements, the whole analysis can be found in the appendix as also the system of crediting, calculations and scores. The following paragraphs are a summarized reading of the analysis. The subsections and graphics are similar for all seven cases, thus the comparison is most simple. The outcomes of the calculations are visualized in a spiral diagram. The diagram has a horizontal axis of the network related types and on the vertical axis the location related types. The values correspond to the outcomes of the cases with the lowest scores at the centre and the highest scores at the ends. The value of the connector is reversed because the length of the paths should be as short as possible for a good transfer quality.

**Figure 6.9** A key word list for Urban Quality (Gehl, 2010, p. 8)
6.5. LEIDEN CENTRAL

The central station in the city of Leiden has a station area under construction. The municipality has initiated the change with a car-tunnel under the station area and a new station in the nineties. There are several emptied areas in the vicinity of the station, some are temporarily reorganised to bicycle storage. Leiden is a city with many students and therefore more than 30 percent of the travellers come by bike. The shortage of bicycle storage is visible in parking of the bikes on the large open squares near the station hall. Currently the firm Maxwan architects and urbanists has made and an urban plan for the area with a large expansion of the building program and a redevelopment of the public space. This plan also foresees in a light rail stop at the seaside of the station. The city is positioned in a strong network by road and rail. The train is the most important public transport in the city. The main station however does not provide a good access for car-based traffic.

Transport Node

The municipality is planning a new tram line. This line serves the offices and industry in the Bio-Science Park, the station, the inner city and the highway exits to the east and west of the city. Outside the city the line acts as a regional train connection. This hybrid form of transport is called light rail. Rail connections are strong; the station of Leiden is in three directions directly connected to the four large cities in the Randstad Holland. The high speed stations of Schiphol, Amsterdam South and Rotterdam are reachable within an hour. The city is in-between two highways. The local accessibility is served with bus lines; the agglomeration is connected to the main station of Leiden by regional and local busses. Because the station is not a high speed train stop, the value of the node stays under the average 769 points. The credits given are mostly due to the railway station and the adding of a light rail line.
The station area is not operating in a very smooth way. The relatively new bus stop with a buffer system and a waiting space is not safe for the pedestrians as the path of travellers and busses cross each other when boarding and alighting the bus. The light rail stop is, both in the masterplan by Maxwan and in the original plan of the municipality, more than 100 metres away from the railway passage. The stop could be positioned closer by placing the light rail line underneath the railway tracks at the railway station. Also the functioning of the railway station itself can be improved. The users of the train and walking to the destination are forced to go through the station passage, because the only stairs and escalators are situated there. By making new exits at the already present tunnels the long platforms can be more useful. Due to the long distances between the light rail stop and the train and bus, the station as a connector, calculated as 124, is graded higher than the average of 112. This means the paths are longer for transferring. Per transfer the length of a path is 8.30 metres while the average is 6.33 metres.
The influence of the central station at the surroundings becomes visible in the densities around the station. The station area is stated to be very dense with a Floor Space Index (FSI) of more than 1.50. The inner city is the densest district of the city with an FSI of 1.24.

Compared to the average of the case study the case of Leiden Central is not the densest. With a FSI of 0.57 the area stays behind to the average 0.73. This can also be noticed in the Ground Space Index and the Open Space Ratio which are respectively 0.25 and 1.30 to averages of 0.28 and 2.13. The Layers of building mass is also less than the average (2.35 to 2.58). This means that there is less building program than at the average of all cases. Thus less pressure of the buildings is put to the open space.

The diversity of the area is disappointing. Though the calculation shows much working space in the area of influence, this building mass is grouped in one neighbourhood, together with colleges and the university. At the station area (radius 300m) the amount of diversity is very poor. This can be seen in the amount of commercial space in the area. Places to buy food and drinks, to have dinner or to shop are limited in the area, although the main shopping streets are also within the calculated area. Large businesses like the academic hospital enlarge the fragment of working space even more. Due to the new developments the national government aims for (Van der Wouden et al., 2009) the diversity will enhance. The station area should become more an urban centre operating on a national scale as it is documented by Frielings (2003). But this is not the case with these plans. The percentage for commerce rises from 8 to 9 despite of the housing.
MEETING PLACE

The almost 40,000 square metres of public services that is planned in the area can be dealt with in different ways. One possibility is to build a cinema, or to make a shopping centre. Other plans are to create space for the youth in the form of an evening program for music. The liveliness of the area can be enlarged by spreading the program over the day. This will also have influence on the safety in the area.

The public space in the area is pedestrian oriented. Nevertheless the different modalities do stem each other. Here the precise layout of the space is determining the safety of crossing. The constant sun in the area is not a negative element of the place, but no protection against wind and rain are. The wind is the most negative as the empty spaces of the station area are in the south-west to north-east direction, which is the most frequent strong wind in the Netherlands.

The main square at the city side is at the time very empty despite of the presence of trees and designed lightning. In the masterplan a large work of art is added to give the square a new meaning. With the element the square becomes an area to go to, to sit and to look around. The station itself has been improved recently with two paths along the little shops (used as walking on the right hand side), in the middle of the passage benches have been placed with tables to sit and wait or to work on a laptop. Also the square on the side of the hospital has been altered when making a bicycle storage under the square. The square has two routes from the entrance of the station to the Park and Ride and to the hospital/university. These routes differ from the square with two steps height difference and a balustrade.

The buildings at the station area go up to four storeys. The new buildings are high rise. Therefore the masterplan incorporates a typology in the high rise buildings. The buildings consist of three parts; a base of maximum four storeys; a set back tower; and a unique topping.
6.6. TILBURG

Tilburg is one of the first stations where the principle of “all-under-one-roof” has been realised. The architect Van der Gaast designed in 1965 a shell roof for the trains and the bus station. This gives the station a lively, frisky and light appearance.

The architectural firm Cepezed has made a design as a result of a contest for the station and the station area on the side of the city centre. The bus square and taxi platform are redesigned, as is the station hall and a second entrance from the north side of the railway tracks.

The masterplan does not show new plans for the north side, which the municipality does foresee. The emplacement of the National Railways is to be redeveloped into housing and office space. The urban office BDP. Khandekar has made a vision for the north side of the station and is making an urban masterplan for the 16 hectare large area.

TRANSPORT NODE

In the network of road and rail the city of Tilburg is not very good connected. Over road the city can be reached from the east and the west; north and south is only accessible over small regional roads. The accessibility over rail is also focussed on the east-west direction. To the north Utrecht can be reached via ‘s Hertogenbosch. To the south the national border prohibits rail lines from being planned.

The main station of Tilburg is not a high speed train stop. The station is only served by train and busses. Therefore the value of the node stays much under the average 769 points, with only 335 points gathered by the connections of the intercity trains.

The province of North Brabant and the national government invest in bus transport by making fast lanes. Also new developments in the busses themselves are being done. For the inner city of Tilburg it would be a large improvement to let small, electrical busses make a tour through the centre of the city.
**Connector**

The station area is currently very small. The railway lines are paralleled by a large road. All modalities are clustered on the centre side to the east the bus station and to the west the taxi and bicycle shed. This makes quick transfers possible.

The station as a connector is therefore graded lower than the average of 112. This means the paths are shorter for transferring than the average of all cases. This grade is very low, but it is not completely valid. The station of Tilburg has short paths, but also very few paths are calculated as there is no tram or metro at this station. If the value would be divided by the amount of transfer possibilities the value comes near the average value. This average, length of a path per transfer, is 6.52 metres while the planned situation gives 6.33 metres.
The centre of Tilburg is rather dense with housing; most working areas are located on the industrial sites to the ring road or the canal around the city.

The zone to the north of the railway track is to be redeveloped in the coming years as is done at the neighbouring city of 's Hertogenbosch. The area will be filled with green, walking areas, semi-public inner courts and large buildings. These buildings mostly will be offices and housing, at the public areas, like the northern station square, commercial activities will be given space.

The case of Tilburg is very near the average of the Dutch cases. The FSI of 0.70 is marginal lower than the average of the study of 0.73. This can also be noticed in the Ground Space Index and the Open Space Ratio which are respectively 0.36 and 0.90 to averages of 0.28 and 2.13. The Layers of building mass is less than the average (1.97 to 2.58). This means that there is just as much building program, but the open space is less; the buildings are fewer storeys high. Thus the pressure of the buildings to the open space is higher.

The diversity of the area is crooked. The area consists for 66% of housing, 16% of offices and 17% of commerce in the current situation. The development will change these figures into 65% housing, 18% offices and almost 18% commerce. The lack of working space is due to the ring of industry around the inner city at a distance from the station area. Here the city has the space for large businesses located at the highway for good accessibility by car or on the canal for the more heavy industry. The public transport at the main station of Tilburg is mostly directed at inhabitants of the area of influence and travellers of the surrounding villages.
MEETING PLACE

The public space at the station area consists of a small square at the centre side, the station hall and passage and a planned square at the renewed north side. The current area is rather empty, except for all the bicycles. The north square is a large area with large buildings to the east. These buildings are at such a distance that the scale of the open space meets the height of the buildings. The green layout is pleasant and gives space for walking and for resting. The new program of commercial activities gives the space movement during the day.

The large road in front of the station square at the centre side makes the area unsafe for pedestrians. Despite this unsafe character, the street gives a good view to the historical buildings in front of the station.

The large roof above the station and station square is a positive point to the public space. As in The Netherlands rain falls quite often, the roof protects the pedestrian from most of the rain and gives shelter for bright sunny days. Another effect of the large roof is the boundaries it gives for the station area.

Figure 6.22 Drawing of station facade by Cepezed

Figure 6.23 Impression of northern station square by BDP.Kandekar
6.7. ROTTERDAM CENTRAL

Rotterdam is one of the largest cities in the Netherlands. To the south of the city’s centre there is a large harbour, one of the largest in the world. The station area of Rotterdam Central is currently under construction. A team of specialists gathered under the name Team CS have made plans for the stations main square, the adjacent streets and the station itself. The station is a large complex which will be made visible in the grand overall span resting on large Y-formed columns.

Transport Node

In the network of road and rail the city of Rotterdam is very good connected. Over road the city can be reached from all sides. The accessibility over rail is similar. The accessibility of the city is rather good due to the High Speed connection. The station is served by train, metro, tram and busses. Therefore the value of the node is one of the highest with more than thousand points (the average is 769 points).

With the introduction of the high speed trains several stations were given the status of New Key Projects. The national government invested in the redevelopment of the station. When finished, the station will be able to cope with approximately 325,000 travellers a day.
The station area of Rotterdam Central is almost completely positioned to the city side of the railway tracks. The railway lines are paralleled by roads on both sides. All modalities are clustered on the centre side to the west the bus station and to the east the taxi and tram stop. The underground bicycle shed can be accessed via the main square. The extensive amount of tracks makes the transfers between modalities in Rotterdam very long. The station as a connector is therefore graded higher than the average of 112, with 175 metres. This means the paths are longer for transferring than the average of all cases. This grade is very high, but it is also very logical. The station of Rotterdam has long paths, but also very much paths, and the width of the train tracks, adds heavily to the weighted average. If the value would be divided by the amount of transfer possibilities the value is still higher than the average value. As the length of a path per transfer is 8.35 metres while the average is 6.33 metres.
The centre of Rotterdam is rather dense with housing; most working areas are located on the industrial sites near the harbour. The zone to the south of the railway track is to be redeveloped in the coming years with high densities. These buildings are mostly offices. The case of Rotterdam is rather dense compared to the other cases. The FSI of 1.09 is one of the highest values for the station environments in the study. The buildings are mostly designed as high rise parallel to the railway tracks. This can also be noticed in the Ground Space Index, which is 0.34. The Open Space Ratio is 0.61; almost half of the average of 2.13. The Layers of building mass is more than the average (3.24 to 2.56), as the high densities are not placed as footprints on the ground but in the form of multiple stories in the new buildings. Thus the pressure of the buildings to the open space is higher.

The diversity of the area is good. The area consists for 61% of housing, 28% of offices and 11% of commerce with the new plans as foreseen by the Bureau Stedelijke Planning (Van der Wouden et al., 2009). Rotterdam has multiple stations, of which the station of Blaak is on the edge of the area of influence. Some people can choose whether to go to the main station by tram or metro above ground or by train via Blaak. This makes that some of the calculated housing and offices should not have been calculated in for this case.
The public space at the city centre side of the station area consists of a large square, the station hall and the passage to the platforms. The impressions of the station area give a rather empty view of the square and the hall. Under the square a metro stop has been renovated to give access to both a regional line to the southern part of Rotterdam, towards Spijkenisse, and in northern direction, towards The Hague. The station square will partly be covered with an iconic roof.

The northern square, at the Proveniers side, is a small area with many bicycle storages. The compactness of the area with little space for traffic gives the area the character of a functional place. It is not a pleasant area to wait. Nevertheless it is a safe place to walk over due to the double use of the ground in parking and subway connections.

The large road in front of the station square at the centre makes the area unsafe to use. The plan foresees in a short tunnel for the regional traffic. This gives the pedestrians a safer crossing towards the centre of the city.

The large roof of the station as a prolongation of the station hall is a positive point. It gives shade at summer days, it gives protection from rain and it has good detailing.
6.8. ARNHEM CENTRAL

The main station in Arnhem is placed to the east of the inner city. It is close to the waterfront of the river Rhine and the green space of Sonsbeek. The tracks at the station are recently renewed with extra tracks and a fly-over to enlarge the capacity of traffic by road. Also the station is under construction. The architectural office UN Studio has made the new design. It is an extraordinary building with no straight parts in it. The station will become a hub of bus, trolleybus, car, bicycle, pedestrians, trains and high speed trains. The station area is densified with two large towers in the same architectural style. The difficulty of such a transfer machine is that all elements melt together in one phase of building. Thus the building of the station got a large delay when, after building the office towers, the station itself had not found a contractor to build.

TRANSPORT NODE

In the network of road and rail the city of Arnhem has good connections. Over road the city can be reached from all directions. The accessibility over rail is focussed on the east-west direction in the city, but on both sides the railway lines split up to main and regional connections. To the west Utrecht can be reached via Ede. To the south the twin city is situated. Arnhem and Nijmegen form an urban region. The cooperation has led them to a unified vision of the future in transport and development of space for offices. The station of Arnhem is a high speed train stop, but the train does not yet go really the high speed it was intended to. The station is also served by other trains and regional and local (trolley-) busses. The value of the node is higher than the case of Leiden, due to the high speed stop. But is does not exceed the average of 769 points.
Connector

The station area is a sloped space with a recently finished parking garage under the bus station (to be). The trolleybuses are stopping inside the adjacent building, connected to the main hall. Most of the modalities are clustered on the centre side of the station area. This makes the rather transfers short. The railway lines are paralleled by roads. The road on the city side has been altered in the design with a tunnel for the regional traffic and a bus lane for more safety at the station area. The station as a connector is therefore graded lower than the average of 112. This means the paths are shorter for transferring than the average of all cases. This is a positive conclusion to the design as it is supposed to work as a connector.
The centre of Arnhem is near the station area. It consists of many shops, small restaurants and bars. To the north of the station a small living neighbourhood is situated. Within reach is also the natural area of Sonsbeek with the Sonsbeek pavilion. Together with the river Rhine and the polders to the south the density of the case Arnhem Central is low. It is calculated as a FSI of 0.53. This is less than calculated for Leiden Central. The city of Arnhem near the station lacks the presence of office space.

The Ground Space Index and the Open Space Ratio are directly related to the large open spaces in the area of influence. The first is very low, 0.18 and the second high 1.53 (averages are 0.27 and 1.15). The Layers of building mass is more than the average (2.98 to 2.56). This shows that in the urbanized areas the density can be quite high, but the open space is flattening-out the nuances.

As mentioned the diversity of the area is not balanced between office space and housing. The area consists for 57% of housing, 14% of offices and 29% of commerce. The lack of working space is due to the positioning of the industry in the inner city. The industrial areas are close to the highways around the city. Or it can be positioned at the riverside.
MEETING PLACE

The public space at the station area consists of a covered station hall with the passage under the railway tracks. The area currently is rather messy, because of the building site and the temporary buildings. The long walking distances from the edge near the inner city to the station passage is not going to disappear; the plan foresees in a long sloping entrance to the station hall, thus using the slope of the area. This gives a possibility to connection between station hall and passage. The public space outside the station on the city side is occupied by the bus station. In the many renderings the atmosphere of the space cannot be determined. The first impression is to see the square functional and empty. The focus in the visualisation has been put to the form of the station itself, not so much on the public space. The design of the station itself is giving the user a nice view, when built correctly.

The northern side of the station is to be renewed with a small entrance to the passage. Here the (lack of) height differences can be used to make a smooth transfer between bike and train. The public space at this side of the station is limited as the regional road is bordering the space.
6.9. KARLSRUHE HBF (D)

The city of Karlsruhe is interesting because of the large network of light rail, a combination of regional and city trams. The station is rather far from the city centre and thus the city invested in good public transport between the Bahnhof and the city centre. The city is surrounded by satellite villages, depending on the large city for work and leisure. The buildings near the station are scarce. To the south of the station there is a regional road with an exit to the station and the city. To the north of the station area the city’s zoo and a large park have been situated. The high speed train from the Ruhr area to Switzerland has a stop at Karlsruhe Hbf, as well as the ICE to Paris.

Transport node

The transport network at Karlsruhe is strongly present both in the city and at the station area. The light rail network starts as a tram in the city and is elongated towards several nearby villages and even far away villages. The rail connections are mostly also present in road connections, because the typography of the region is irregular. The network value of the station of Karlsruhe is the strongest in the case study, as it incorporates all modalities in the study. The value is calculated as 1285 points.
**Connector**

From the case of Karlsruhe can be learned that when supplying the connection between station and inner city in a dense way the walking and cycling to and from the station is less than expected at such a large station. The station itself has a number of restaurants and shops for food and drinks. But at the station area the main attention is drawn by the tram, light rail and bus stops. There are several hotels in the historical buildings nearby the station, but for the inhabitant of the city the station area is not a place to be.

The connections between train, light rail, tram, bus and car are very good as the station passage is leading the traveller directly to all the means of traffic. One exception to this is the bicycle storage, as this is situated to the side of the station façade. The station as a connector is therefore calculated as 77 metres. This means the paths are the shortest for transferring than all other cases. Especially when you compare to the amount of transfers possible, this is a good score. The main reason for this is the many transfers between tram, bus and light rail. The train has just as many alighting and boarding people as in the case of Leiden.

![Diagram of Karlsruhe station](image)
The centre of Karlsruhe is positioned at a distance of the station. At the south side of the station are several small villages, connected to the inner city of Karlsruhe by light rail. The area around the station has therefore a lower density. Between the station and the centre the city’s main park and the zoo are situated. This brings the density of the station area even more down.

The case of Karlsruhe has the lowest density of all cases. The FSI of 0.44 is in sharp contrast to the good transport network and internal connection of the station. The diversity of the area is dominated by housing. The area consists of 70% housing, 19% offices and 11% commerce. The lack of working space is due to the clustering of industrial areas at the harbour to the west of the city and the inner city that is out of range. Thus the station area has much public functions in the station itself; in the station hall and some in the passage.
MEETING PLACE

The public space at the station area consists of a large square at the centre side. The area is edged by the station façade, the entrance of the zoo and the building blocks to both sides. The restaurants at the station square and also in the station hall are well used in sunny days. The square is rather large, compared to the Dutch cases. But this might be an incomparable element as the whole city is build up with more open spaces in between. The road at the edge of the station square does not hinder the travellers much, only the visitors of the zoo cross the street. The direction of the stops for light rail and tram give the area a division into places to wait and places to walk on.
6.10. LONDON ELEPHANT & CASTLE (GB)

The southern part of London, to the south of the river Thames, is organised by large roads and roundabouts. One of the central areas of Southwark is the traffic node of Elephant and Castle. At this area in London the train has a stop, as well as two subways. A large shopping mall gives the neighbourhoods a centre at the railway station. The area will be transformed with funding of the Climate Positive Development Program, one of sixteen projects in the Clinton Climate Initiative programme. The redevelopment planning was started more than a decade ago and is now ready to be built. The new plans consist of the integration of the north-south tram, more safety for the pedestrians and densification in the form of high rise. The new buildings will give space to education facilities, a shopping street and additional functions.

Transport node

The transport network in London is highly based on road traffic (especially the red double-deck busses) and underground. The train, as a regional connector, is an alien in the neighbourhoods as it is lifted on bows of brick. The bus network is therefore a strong and dense network throughout the city.

The railway station of Elephant and Castle is not a high speed train stop. The station is only served by train, on street level by trams and busses and by metro. These modalities are all strongly present with stops and runs in multiple directions. These give the value of the transport node 908 points.

Figure 6.45 London’s station Elephant&Castle situated in the regional transport network
As a connector of modalities the station is less successful. The railway station has a rather long walking distance to the tram and undergrounds. The busses have several stops, depending on where their route passes the area. The average of 112 metres is thus not even near the distance for the station of Elephant and Castle; it is calculated as 152 metres. The long walking paths are mostly due to the distance of the train, but also the park and ride, under the park at the centre of the housing block, and the underground walking paths to the stops of the metro are adding to this number. Important to keep in mind is that stairs, escalators, elevators or small doors have a negative effect on the paths.
This centre of Southern London is rather dense with housing. But there is also a large working force in the area. Near the shopping area are educational buildings for the college of communication and the London South Bank University.

The case of Elephant and Castle has the highest density of all cases. The FSI of 1.18 is an estimation as the exact figures were not accessible as they are in The Netherlands. The diversity of the area is dominated by housing. The area consists of 70% housing, 19% offices and 11% commerce. The diversity is based on an estimation as to the amount of current work force in the area. The lack of working space is due to the dense character of the site where there is no space for industrial areas. Public functions are only present along the Walworth Road and at the centres of the individual neighbourhoods.
MEETING PLACE

The public space at the area consists of a number of squares and parks. These are:
- The Civic Square on the former roundabout
- New Market Square
- New Walworth Square
- New Town Park, and
- St. Mary’s Churchyard

(Gehl Architects, 2003)

These public spaces are linked together and all have their own character and design ideas. Thus the façade at one square is fully directed to the public function it hosts, while the other has a split level to accommodate parking. The squares have few area to wait or sit, but overall the station area (defined as the New Market Square) is proposed to be a rather busy public space.

Figure 6.50 Impression of the square Elephant&Castle in London (E&C Development team)

Figure 6.51 Impression view towards the railway station (E&C Development team)
6.11. **MECHELEN (B)**

The station of Mechelen will be renewed to cope with the expansion for high speed train. The train has no stop in the city but will run along the current railway tracks, thus new bridges will be made for the new tracks. The city tries to benefit from this development by solving the traffic problem in the city. The through roads in the city are overcrowded by regional traffic. By putting this in a tunnel under the high speed tracks the cars do not pass the inner city, but use the by-pass.

The station is situated on an axis road to the south of the inner city. The station is next to a large industrial site of the national railways. These large sheds are incorporated in the redevelopment plan by Salvatore Bono. In Belgium the railway and bus company “De Lijn” has the wish to downgrade multiple railways to light rail systems. Also new tracks are in development. The city of Mechelen has plans to replace the busses through the inner city by a tram to the North West of the city.

**Transport node**

In the network of road and rail the city of Mechelen is very good connected to Antwerp and Brussels. By rail the city can also be reached from the east and the west; the accessibility over rail is focussed on the east-west direction. These are supplied by light rail or L-line vehicles (stopping trains).

The station of Mechelen has to expand because of the high speed line, but the trains will not stop at the station at all. The new development does foresee in a connection to the Brussels airport. This gives the station a value of 655 points for the transport node.
The station as a connector gives expression to the goal of the design. The main route between station and centre are congested in the current situation. Therefore the flows of people that do not go to the city itself should not have to drive through it. The solution was found in a tunnel for regional traffic and thus creating a separation between local and regional traffic. Space has been given to the slow traffic of pedestrian and bicycle. The station as a connector is therefore graded lower than the average of 112. This means the paths are shorter between modalities and it functions more together.
Urban centre

The centre of Mechelen is rather dense with housing and public functions; most working areas are located on the industrial sited to the ring road or the canal around the city. To the south of the station such a development has been taking place. The "Arsenaalside", as it is called is a large working environment for all sorts of producers.

The zone to the north of the railway track is to be redeveloped in the coming years as is done at the neighbouring city of ‘s Hertogenbosch. The area will be filled with green, walking areas, semi-public inner courts and large buildings. These building are mostly offices and housing, at the public areas, like the northern station square, commercial activities will be given space.

The densities in the case of Mechelen are very near those of the Dutch case of Leiden. The FSI has been set to 0.60. Because the footprint of the area could not be determined correctly the GSI, OSR and layers will not be discussed. They are base on an assumed footprint.

Figure 6.55 The density variables of Mechelen station in a graph

Area: 5000000 m²
Footprint: 1500000 m²
Total floor space: 3021135 m²

FSI: 0.60
GSI: 0.30
OSR: 1.16
L: 2.01

Area: Footprint: Total floor space: 5000000 m² m² m² 1500000 3021135
MEETING PLACE

The public space at the station area of Mechelen is rather large to the functions it host. The restaurants on the city side give the station area a lively character, also in the evenings. The new designed Arsenaal side of the station is not threaded in the same way. Here the scarce functions are not linked to the whole square, but only the nearest areas.

The design does not add much program, it does help organizing the area and bringing together the ‘front’ and ‘back’ side.
6.12. CONCLUSIONS ON THE ANALYSIS

The case study shows the use of networks in urbanism in a way of criteria to analyse and compare different station areas. The goal is to give directions for the redevelopment of Leiden Central station.

Node-elements in a station environment

The theory of Bertolini (Bertolini and Spit, 1998) with his model of node and place (figure 6.58) is the starting point for the study. The node as a point in a network of public transport and in the situation of routes in a city and the connections by highway or regional roads gives the station a position in the network. Ideally the amount of traffic movements from and to the station would be compared. This is not realistic for a case study because it cannot be accessed for the development in the coming decade. Therefore Bertolini and the students he tutored (Bertolini, 1996, Zweedijk and Serlie, 1998) used other means of comparison. For example the possible directions you are able to travel from the station. This gives insight in the strength as a transfer station. The case study does not only look at the presence of network elements at the station itself, but also at the connections of nearby nodes. In the category of the trains there is also looked at the number of stations that can be reached within a certain amount of time (15 or 30 minutes). For the exits of the larger roads they add to the station if they are within a certain amount of distance (1 or 3 kilometres). Thus for example a dense network of tram can add to the station a lot more than a regional tram connection with limited stops.

Another element for comparing the node can be the amount of use of the modalities. Bertolini focuses hereby on trains. But research at the TU Delft shows better means of looking at the strength of a station in number of travellers. This research looks at the station as a connector (Van der Spek, 2003). In this research the station is analysed in its composition of modalities. The walking distances are multiplied with the amount of use of the transfers per day. By dividing the product with the total amount of transfers at the station a weighed walking distance is obtained (Van der Spek, 2003). According to the research of Peek (Peek, 2006) this can be enhanced by looking spatially at the paths of transfer. If there are height distances to be crossed or there is a narrowing of the path the transferring people need to weight at each other in crowded times of the day. This is expressed in the calculation of a stress factor. The case of Arnhem Central is typically a transfer machine, as it places as much modalities as possible directly connected to the main hall. The analysis focusses thus in the node-elements on the larger scale of the

Figure 6.58 The node-place model (based on Bertolini, 1999)
position in the network as on the scale of the station as a public transfer-machine (Dutch: OVerstapmachine).

**Place-elements in a Station Environment**

As the station also takes its position in or near an urban area, the area of influence of the station is of importance for the station environment. The “Vereniging Deltametropool” did some research at the position of stations in the Randstad Holland in the urban field and the potential of development of the node in 2010. Therefore they researched (in collaboration with the TU Delft) the densities around the stations and looked at the development potential and the actors in the process of redevelopment. (Vereniging Deltametropool and CPS TUDelft, 2010) In this research the reach of 1200 metres was also used to measure the position in the urban field, the same as the reach used in the study of Stedenbaan (Atelier Zuidvleugel, 2006).

The analysis of place-elements is divided into an analysis on the larger scale of the city and its neighbourhoods as well as on the scale of the station itself.

Within the area of influence, which incorporates the neighbourhoods in the vicinity of the station, the amount of houses and working people were calculated with data of the Statistics Netherlands (dutch: Centraal Bureau voor de Statistiek, CBS). These figures are translated into square metres of housing, office space and commercial space. Thus also the diversity in the area could be measured.

At the station area itself the analysis looked at the public space near the station. Not only the density and diversity in the vicinity of the station is important for the station as a place to be, but also the public space itself must be attractive. The urban quality is measured with the criteria as used by Gehl (Gehl et al., 2006) in the city of Copenhagen. The criteria are based on safety, comfort and enjoyment at the square. The criteria of enjoyment is thought to be of less importance for a square at the station area as it is mostly a place to change from modality to modality. The safety and comfort is nevertheless very important as it gives the area its character of agreeable place to be. At the station areas in the case study some criteria are always present, as the Dutch national rail company (NS) have always tried to make their stations safe and comfortable for the users. Other stations mostly lack, for example opportunities to stand or stay as edge effect or places to sit, other than the benches at the platforms, by placing a line of benches or a border to sit on.

**The relation between the four types**

To balance the node, the place-elements can be strengthened, or another possibility is to weaken the node elements. The types of *Transportation node* (node in the network) and *Urban centre* (place in the network) are the most important in this respect. (See figure 6.67) These elements will trigger a redevelopment or expansion of the transfer possibilities when they are not balanced. The types of *Connector* (node at the location) and *Meeting place* (place at the location) add to the strength of the design, but do not form the base of the opportunity in a redevelopment. Nevertheless the station as a *Connector* and the *Meeting place* of the station environment give the station its quality in the use as a transfer machine and a strong place to go to in the city.
Looking at the station environments of other cities is inspiring for the space at the station in Leiden. But also the methods addressing the used literature are leading the design in a direction.

**Leiden: improvement of node-elements**

The station as a node in the network is strengthened by a new high speed connection, the densified schedule of intercity trains and a regional light rail route. These developments give the station a stronger position in the network. This can also be seen in the growing number of travellers at the station. The introduction of the light rail will add to the amount of users even more. Thus it creates a base for the development of the *Transport node*.

The placing of the light rail stop at the station is crucial for the good working of the station as a multimodal node. The large bus station and many bicycle storages make the station a moderate connector. Placing the light rail stop at a distance from the bus and train stops can have negative effect on the use of the new transport line, especially in the starting period of the exploitation. A recommendation for redevelopment is to put the light rail stop in between the path from platform to bus, for example by placing it in the station hall or passage. This will better the weighed average path length for the station as a *Connector*.

**Leiden: improvement of place-elements**

The station as a place in the city has also been strengthened already; a new station has been realized in the end of the previous century, there have been built a number of high rise buildings with offices, and the bus stop and taxi platform have been renewed with better designs. To strengthen the place of the station further it has to be made a place of destination in stead of transition. The combination of housing and offices is important to realize to create a lively environment every time of the day. Also the realisation of new program such as housing and public services adds to the diversity and liveliness in the station area.

From the comparison of the case study the conclusion can be drawn that there is room and need for more density and diversity at the station area of Leiden. Currently this density is 0.55 Floor Space Index (FSI), while the average of all cases is 0.61 FSI. The diversity of housing, office space and public services is calculated as respectively 42%, 50% and 8% of a total of...
almost 3 km² of building area. The remark must be made that these figures are calculated with the data of the whole area of influence (with a range of 1200 metres) and that the average is very much dependent on the cases chosen. The cases are similar or more urban station areas as Leiden. When the calculated areas are limited to the station area itself the values become denser and somewhat more diverse. The FSI of the station area is calculated as 1.26 (city side: 0.93; sea side: 1.76) were the whole historical city is comparable (FSI= 1.27). The diversity in the station area is not good; the building space is mostly offices (81%) and some housing (15%). The public services is very little present (4%). When looking at these figures for the city side and sea side the similar ratios can be found.

In the case study the analysis of the public space is done by looking at the squares at the station and the public areas inside the station. The focus is on the comfort of the area for people to walk, sit and look around. Also criteria like the scale of the square and adjacent buildings and the safety with traffic or public safety is credited. The station area of Leiden is found to be bad in the sense that it is an empty square on the city side with no guidance for pedestrian flows. The station itself has been improved recently with two paths along the little shops (used as walking on the right hand side), in the middle of the passage benches have been placed with tables to sit and wait or to work on a laptop. Also the square on the side of the hospital has been altered when making a bicycle storage under the square. The square has two routes from the entrance of the station to the Park and Ride and to the hospital/university. These routes differ from the square with two steps height difference and a balustrade.

The development potential at Leiden Central station

The potential for development is seen as the new program needed to balance the Urban centre to the Transportation node. In the case study the attempt was made to calculate this with the regression line based on all cases. With the data available the station area of Leiden would have a potential to densify with a part of the total densification of the area of influence. The numbers stated in this view are unrealistic due to the fact that it does not take into account the current economical situation and the location specific restrictions. Also the figure found is not realistic to the development potential stated in literature about the office market situation in Leiden. The plan should be more realistic to the market situation and will thus not balance the station area fully. The focus for the plan must be on the liveability of the public realm; this can be reached by adding mostly
housing en public services, but also small companies or the combination of working and living can add to the use of the station area. Nevertheless the station area is an excellent place to build the main office for a regional company.

To conclude the design for Leiden Central should bring the city a new Urban centre, with many activities and a strong supporting area of inhabitants.

OTHER ELEMENTS FOR DESIGNING IN STATION AREAS

The cases all have their own specialties and can be hard to compare due to factors that have not got attention in this case study. Nevertheless some elements are very interesting to notice in the analysed station areas. These can be categorized into routing and public space.

The routing at the station area is a crowded situation to let all traffic pass in a safe and conveniently arranged way a separation can be made between pedestrian areas, parking and roads for cars and those for public transport. In Karlsruhe (D) the station is organized in a front and a back side, where the front is the city side with its light rails, trams and busses. The back side is more regional oriented with a large car parking and a regional road. The station area of Mechelen also has to cope with a regional road. Here the road is planned to be put underground completely, while the high speed tracks are but above ground at the same place. The connection between car and station will be realized by parking garage. The same counts for Rotterdam Central station. Here the through road is put in a dock with access to the parking area. The station area of Leiden has already undergone this transformation of putting the road under the public space and thus ending the crossing of pedestrians to the city centre and the regional traffic.

Another element of struggle at multiple station areas is the position of a light rail. At stations with both a tram system and a light rail supply the tram runs on street level and the light rail either on street level or on the level of the trains (at all cases the trains are on a elevated level). Karlsruhe Hbf has light rail lines both on street level to the inner city as on train level to villages in the region. At Leiden central the route is not clear yet. Two highly possible routes foresee the lines as a tram through the city, one other possible routes is the current route of the trains. The last option is not wishful for the line, because it would break the connection at the station with a transfer from train level to street level and vice versa.

The bus lines are relevant for the safety of the slow traffic. The design must be directed at a clear view for the bus driver as well as for the travellers. In Tilburg the streets became too narrow to let all the traffic pass in two
directions. The city decided to make the ring route around the city centre to be in one direction. The station is an important stop in this route. The consequence of this change is that part of the centre is not well reachable by bus any more. In Leiden this one way traffic could work to make the bus traffic in the station area better predictable for the slow traffic. The route around the entire centre is not wishful and realistic at the city of Leiden.

The public space at the station area is mainly focussed on a square where the bus and, if present, tram have their stops. The square brings a clear view of the main route of pedestrians. The public space should be designed focussing on the slow traffic as is done in the plans for Mechelen. The triangle shows pedestrians on the bottom, than cyclists, public transport and at the top the car. Thus the car gets the least attention. Sometimes the public space is roofed as in the concept of “all-under-one-roof” as has been realized at Tilburg station. In the redevelopment plan of London’s station Elephant & Castle there is not a clear square, due to the densities in the capital. The tram stop is at a roundabout and the train station nearby in an elevated form. The route in between the two is planned to be roofed as a shopping street. Another possibility for the station square is partly as a station hall and partly as an open square. This is the case at most station area. For example the station area of Rotterdam central is designed to be inside a large hall with access to the metro underground and to the passage under the tracks. Outside the square is situated with the tram stop on the east, an access to underground bicycle storage at the south and the bus stop on the west. As at Rotterdam the space at the main station is scarce; thus the use of ground double is, despite of the higher costs, very feasible to create an agreeable public space. The same can be said for using the space under the railway tracks. A nice example is the station of Elephant & Castle in London. The train tracks are placed on bows of brick. The space under the bows is used for shops, bicycle storage, public space and the entrance to the platforms.

The basic element of network and location is worked out into density and diversity. But the elements of spatial organisation and public transport should not be forgotten. (Twynstra Gudde, 2008)
PART III
DESIGN

Introduction

In the third part of the booklet the theory and analyses are used in designing.

The first chapter is focusing on the conclusions of the research and addressing concept aspects. The location analysis led to the aspects of the position of the station area in the city, the size of the building blocks, the routing of public transport, car and slow traffic and the connectivity in the area. From the case study the design has four recommendations. These are a good transfer quality by short distances between modalities; a high density area by high rise; a large diversity by adding public services in the ground floor spaces; and by making in the design a safe and lively central meeting place.

These aspects are used in the designing. The design is explained as a system of networks and building blocks with a spatial and functional organisation. The open space is designed as well as some argumentation for the building blocks.
7. FROM RESEARCH TO DESIGN

‘A concept does not have to be decisive about the form of the definitive design. It expresses in first instance the overall idea, the character and direction in which the solution is to be found.’ (Leupen, 2002, p. 109)

The concept is made by studying the results of the case study and the location analysis. The concept, or more the strategy for the area, consists of two main elements:

1) The station area as an urban place,
2) With a lively public space.

These elements can be found at multiple ingredients in the plan and are strongly connected to each other.

These main elements are based on five ingredients:

1) The position of the station area in the city;
2) The direction and size of the building blocks;
3) A higher density (mainly) at the city side of the station;
4) A larger diversity and thus more public program;
5) A public space fit for the business at the station; and

These ingredients are found in the research of the location and the cases. Some can be found back directly, others are the conclusion of linking elements together. The conclusions of the research themselves give more insight in the findings.

7.1. THE STATION AREA IN THE CITY

The station area is to become a central area in the city, in the mental map of the citizens that is. The station is the gate to the city, so the relation between station and the main destinations must be strong.

HISTORICAL CITY AND BIO-SCIENCE PARK

The position of the station area is in between the historical city and the Bio-Science Park as visualized in figure 7.1. The inner city consists of blocks of buildings with small plots, often with a court in the centre of the block. The Bio-Science Park (BSP) is a neighbourhood almost without houses. The academic hospital (LUMC) moved from the inner city to this side of the railway tracks and has been elaborated with many individual buildings. Also the University of Leiden has its faculties in the area. The large companies in the city of Leiden attracted many companies in the same sector to the neighbourhood. The BSP consists of about 60 companies in the sector of...
life sciences. These companies have about half of the number of employees as the hospital and three fourth of those of the university. The “Hogeschool Leiden” has an establishment in between the hospital and the university.

**City side and sea side**

Spatially the station area can be divided into the city and sea side. The city side is strongly connected to the inner city with the axis of the “Stationstraat”. The sea side is more connected to the Bio-Science Park; it contains larger buildings and has green open spaces. The buildings are stand alone elements in the neighbourhood as in the pavilion style of the former buildings of the hospital. The part of the BSP directly connected to the station is cleared from unused buildings owned by the LUMC. The land currently is empty. In the plan this valuable land is to be rebuilt again. The historical building with a gate, the “Poortgebouw”, remains. It is used by congress facilities and functions as a public building for education and meetings of the LUMC.

The city side of the station area is an in-between environment. The area is not part of the inner city, nor is it part of the Bio Science Park. This because of the specific borders of the historical city canal and the railway tracks (see figure 7.2). In the design the area has a new direction of streets and building blocks. The station area on this side consists of two large building blocks. The buildings are of different construction times. The buildings on the “Stationstraat”, the street between station and city canal, are historical houses on small plots. Many of these have a monumental status. The other parts are all different styles from the twentieth century. Some are in good state other are neglected or have much vacancy. The inside of the building blocks is dedicated to the car. The large parking makes the supermarkets functioning well. The other building block has, next to private parking, an elementary school inside. This school was one of the first buildings at the “Schuttersveld”. This terrain was kept empty for practice by the military. At the railway side of the eastern building block the buildings are vacant or torn down. Here new development has had many delays. Recently the municipality bought the ground and made it into a temporary bicycle storage.

**Rijn-Gouwe line**

A regional light rail line is planned to connect the station of Leiden to the coastal villages and the towns along the Gouwe. In the city of Leiden it is foreseen to be a tram like service. There it will have stops at the inner city, the station areas of Leiden Central and Lammenschans and the Bio-Science Park. Thus it connects the most important parts of the city by rail.
Figure 7.2 Composition derived from train tracks and historical lines (1:6,000)

Figure 7.3 Buildings composition based on grid (1:6,000)
To realise a better connectivity in the area and to give space to public program, the sizes of the building blocks should be kept small. In the current situation the building blocks are large at the city side of the station area compared to those of the historical city (see figure 7.4). Kusumo (2007) argues that a good connectivity is a base for a lively neighbourhood. As mentioned before she stated that the railway network and the urban place should enhance each others attractive powers to create a ‘vibrant urban place full of different kinds of commercial activities’ (Kusumo, 2007, p. 9). The solution to a lively urban space at the station area lies in the connectivity for the slow networks of cyclist and pedestrians.

As the city side of the station area is considered not a part of the inner city, but a place on its own, it has its own spatial configuration. This configuration is based on the direction of the railway tracks and the tunnel under the station area. The program on top of the car tunnel is related to the transfer function of the area. The buildings at this landing field, as an employee of the municipality of Leiden (Koster, 2010) called it, are directed at the railway tracks. This line of buildings can be doubled and cut through by the road system. In order to let new and smaller building blocks in the plan, attention should be given to the size of the parcel in relation to the height of the buildings and the width of the streets. Also attention needs to be given to the bringing together of old and new buildings as not the whole area will be torn down. (See figure 7.3)

The station area at the sea side is part of the BSP and is strongly related to the “Poortgebouw”. This building is elongated almost perpendicular to the railway tracks. The buildings at this side are angled in relation to the railway tracks. This angle is derived from the morphological situation of the ditches and first roads. The monumental Poortgebouw has a passage for slow traffic at the central part of the building. This passage is an element in a strong bicycle route through the city. These directions of building and bicycle path are taken as a base for new development. The area can be seen as four part of building sites. From west to east these are the LUMC and the parking for the hospital; the triangular site and opposite triangular site with a large building site to the north; the Poortgebouw with a gate for slow traffic; and small scale housing blocks of family houses.
The potential of the place can be realized by densifying the area with a variety of building programs. That is the main conclusion of the case study. To create a good human scale the building blocks can gradually heighten, as is done in the plan of Maxwan architects and urbanists. The diversity can be reached by designing hybrid buildings with a public program at ground level and parking under ground or at the insides of the larger blocks.

In literature (Gemeente Leiden, 2010b, Stec Groep B.V., 2010) the need for 3600 houses and 65,000 m² office spaces is stated for the coming decade. The addition in the station area is aimed at 100,000 to 200,000 square metres. This is in line with the vision of the Office of Urban Planning (dutch: Bureau Stedelijke Planning) (Van der Wouden et al., 2009) for the development potential. This addition will bring the Floor Space Index (FSI) for the station area from 1.26 up to a value between 1.49 and 1.73. Figure 7.5 visualizes the figures in the current situation for the BSP, the inner city and both the sides of the station area. This will not balance the station area in the city completely because some factors are constraining the building program. First the market situation restrains the inhabitants and the offices from moving, and investors are postponing the decision to buy and sell real estate. The literature found relates to this by lowering the need for houses in the province of South-Holland with three fourth of the amount (difference between vision on housing of 2010 and 2011). Second the station area can not be built at all spots because there is a tunnel under the station area. And the new developments need to be done in small building footprints to create the connectivity needed.

From the literature of Bertolini (Bertolini and Spit, 1998) and the dissertations mentioned in this booklet the connections of the main station of Leiden in the network of public transport is giving an opportunity to densify the station environment to make the area an urban centre. This centre is, next to the inner city, a centre on the scale of the agglomeration. This it can be regarded as the centre of the region from the North Sea coast to Alphen at the Rhine and from Sassenheim to Voorschoten.
7.4. DIVERSITY - MORE PUBLIC FUNCTIONS

The place elements consist not only of a dense area, but also the diversity of functions is important to make it a lively place in the city, according to Bertolini (1999). ‘A “place” of activities means how many and how diverse (...) the activities that can be performed in an area’ are (Bertolini, 1999, p.201). Although the design needs high densities, the focus for a lively neighbourhood lies on the ground floor functions. These functions need to contribute to the public space and attract visitors. As figure 7.6 shows, almost all public functions are located in the city centre and at the Stationsstraat. This makes the connection between station and shopping streets a pleasant one. In the design there should be a good division between working spaces, houses and public services. This is currently a false position. The diversity is calculated as 15% housing, 81% offices and 4% public services. The aim for the station area is to realize 10% of public services, as at the inner city the percentage is 11.

One of the new functions in the area can be the attraction of a pop centre to the station area. This cultural program attracts the youth living in the region and, even more important, it attracts them in the evening hours. Thus the area is, in combination with cafés and restaurants, attractive both during daytime and in the evening. This new function is very suitable in the area because of the characteristic of the railway environment and the accompanying noise and crowdedness. The public functions can be concentrated best at the street from the inner city to the station and at both station squares. As is also the case in the current situation (see figure 7.6).

By making the station environment both dense and diverse it will become a place to be, a destination.
Minder hinder, een project van cruciaal belang

De werken in de stationsomgeving zullen naar schatting 10 jaar duren en onvermijdelijk hinder met zich mee brengen. Verkeersstromen worden anders georganiseerd, openbare vervoerhaltes veranderen van plaats, omwonenden worden geconfronteerd met werfverkeer. Het is daarom van bijzonder groot belang om de hinder die zal optreden in al zijn aspecten te beheersen en te minimaliseren. En tegelijk snelle en efficiënte informatie te geven over die wijzigingen.

Gelukkig hanteren de projectleiders een uitgebalanceerde fase-ring, zodat niet elk werk hinder met zich mee brengt en niet elk deelproject 10 jaar zal duren. Om die informatie te verstrekken, maken we gebruik van een uitgebreid gamma aan middelen en kanalen. Vergeet daarbij vooral onze website niet. Daarop zullen we heel duidelijk aangeven wat er allemaal gebeurt. En dat niet alleen in tekstvorm, want we willen zoveel mogelijk met kaarten en andere visuele middelen werken. Specifieke info over Minder Hinder zal je binnenkort op de projectwebsite www.mecheleninbeweging.be kunnen terugvinden.

Stop-principes toepassen waar mogelijk

De bereikbaarheid van het station en de ontwikkelingen rondom moeten aangepast worden aan de noden van de verschillende weggebruikers. Hierbij wordt vooral gekeken naar de noden van de zachte weggebruikers (voetgangers en fietsers). In de tweede plaats houdt men rekening met het openbaar vervoer. En in laatste instantie kijkt men naar het privévervoer.

The station area as a meeting place (NS Poort)

De station area can be a nice place to go to by adding services for shopping or working in the vicinity of the station. This creates a presence of people during the day and thus a stronger social control. By providing housing spaces the area is livelier at non-working hours. The amount of commercial facilities should be enlarged in the area.

The theory of Gehl (Gehl et al., 2006) used in the case study showed the importance of designing the public space. At station areas the main goal is to ensure a quick and smooth transfer between modalities. Thus there needs to be a division between the walking area, waiting area and shopping area. This effects pedestrians, but cyclists are also of importance in a city as Leiden. Leiden is a university city with many students, the transport to and from the station is almost half the time by bike.

To create an agreeable public space at the station it is important to limit traffic conflicts. This is addressed in the research by Van der Spek (2003). The conflict between two modes of transfer, for example when crossing a street, leads to a more unsafe public space. Therefore these conflict points need to be minimized. The conflict between bus and bike can be dealt with by making separate paths for the bicycles. Also the bus routing can be made more predictable and less dense by making the access streets oneway traffic. The traffic by car needs to be limited to the most. (Figure 7.8) This can be done by having two Kiss and Rides; one on both sides of the station. The Park and Ride facilities can be in the form of a parking garage; also one on both sides of the railway tracks. The conflict between cyclists and pedestrians is one that needs attention at the squares. The station square at the sea side had bicycle storage underground. The entrances are placed in the direction where most cyclists come from.

The conflict between light rail and slow traffic is more difficult. It depends on the routing of the light rail. (See for the two routes in the station area the green lines in figure 7.9.) The route on the city side crosses the station square and thus the main flow of people between station and city.
centre. This is a situation that is not adding to the station environment in a positive way. Better is the route along the sea side of the station where the crossings with slow traffic are minimized.

In the case study the transferring between modalities is one of the criteria for analysing the station area. In the station area of Leiden central the routing of the coming Rijn-Gouwe line is not yet clear. The line is the catalyst for the station area to develop. The transfer possibilities are enlarged with the coming of a light rail connection to the east and west. By realizing a smaller average transfer distance, the station will function better as a connector. This can be done by bringing the stops of train, bus and light rail closer to each other. The stop of the light rail should thus be in the station itself. This would not hinder the main public flows on both sides of the station. The transfer flows to and from the train, light rail, bus, taxi and the many bicycle storages are joined together in the mobility square in front of the station. This public space needs special attention to let it function smoothly and pleasant.

By aiming at short and safe transfers between the modalities and by designing no conflict points between flows of different modalities, the transfers will be of a better quality.
Figure 8.1 Redevelopment plan at Leiden Central station (1:5,000)
8. DESIGN

'The eventual design is always an interpretation of the concept. Another designer would probably have made something else, as everyone has their own individual world of associations to throw at it.' (Hertzberger, 2002, p. 406)

‘Vervoersknooppunten vormen de marktpleinen van de 21e eeuw en de schakelpunten in de dagelijks[e] activiteitenpatronen van mensen.’ (Govers, 2011)

As the Dutch sentence above tells, the transfer nodes form the market squares of the 21th century. Here is the place where people pass by to and from work, school or other daily activities. When passing by the station area, the route is often expanded with additional activities like shopping or meeting others. The potential of the area is for a long time neglected in the Netherlands. Recently the Netherlands has been connected to the network of high speed trains. This development brought acceleration in the development of station areas. Nowadays even historical grown cities are looking at the potential of the station areas of their city. Without governmental intervention the potential of the station areas in these cities would not have been picked up by developers. If they would have been redeveloped, there was a tendency to compete with similar node environments. (Van der Wouden et al., 2009) The historical character of the cities only adds to the reluctant attitude of municipalities.

The main reason for redesigning the station area at Leiden Central is the coming of the RijnGouwe Line. This light rail line runs through the inner city of Leiden and also goes through the station area and the Bio-Science Park. In the station area there is an uncertainty of the precise position of the tracks and the stop(s). The discussion in the council led to a referendum for the inhabitants of Leiden and to a fierce battle at the time of the municipal elections. The elections resulted in cancelation of the project. Due to interference of the province the light rail line is again in the phase of routing alternatives. In this graduation project the route at the former canals is chosen (the green route in figure 7.9). This is the route chosen by the municipality after the referendum was held.
Three step analysis from the station current situation (1:10,000)

Figure 8.2

Three step analysis from the station planned situation (1:10,000)

Figure 8.3

Space for roads and space for building blocks (1:6,000)

Figure 8.4
8.1. PHYSICAL NETWORKS

The design consists of networks in the public space and building blocks to provide for housing, office space and public services. The following networks will be discussed:
- Slow networks of pedestrian flows and cyclists
- Public transport networks
- Private transport networks

The connectivity in the design location is strengthened by adding paths through the building blocks and by making it easier to pass through the area at multiple ways. (Figures 8.2 and 8.3). This is analogue to the literature by Kusumo (2007). She stated that ‘it can be concluded that in designing an urban area around the railway station, the regional network only is not enough to generate a vibrant urban place full of different kinds of commercial activities. Its attracting power is too limited and creates only one type of activity, the one that is oriented to regional scale only.’ (Kusumo, 2007, p. 9) The solution to a lively urban space at the station area lies in the connectivity for the slow networks of cyclist and pedestrians. This can be realized by small block sizes. Kusumo’s study ‘highlights the importance of integrating a railway station into different layers of movement (at least into the city- and the local scale networks) with small block sizes for a retail clustering effect, especially for urban-oriented stations’ (Idem).

In the composition of the urban design the block sizes are based on the measurement of the planning area and the positioning of connections under the railway line. Thus the station area can be divided into three parts, where the station passage is situated asymmetrically (figure 8.4). In the station area a number of buildings will be torn down to be able to make an integral plan for the area. Several buildings have already been torn down from the eighties on at the sea side. At the city side there are also several open spaces close to the railway tracks and on top of the underground tunnel. The historical buildings in the Stationsstraat and the Poortgebouw have been remained; neglected housing and office buildings are torn down.
Main network of pedestrian traffic in the station area (1:10,000)

Figure 8.6

Main network of bicycle traffic in the station area (1:10,000)

Figure 8.7

Network of bus and light rail traffic in the station area (1:10,000)

Figure 8.8

Network of car traffic in the station area (1:10,000)

Figure 8.9
**Slow traffic networks**

The flows of people can be reduced to three main directions. (See figure 8.6) The Stationsstraat is used by inhabitants and visitors to go from the station to the inner city and vice versa. At the sea side the route to the entrance of the LUMC is well used and mostly students and the route along the bicycle path at the "Hippocratespad" (in between the hospital and the parking garage).

The bicycle routes to and from the storage points to the neighbourhoods and to the BSP do not have a concrete path at the station area as there are many storage points. (See figure 8.7) The route along the Hippocratespad and the Stationsstraat are two well used paths. In the station area there are also bicycle paths that are used by cyclist not going to the station. For example the bus tunnel close to the hospital is used well for cyclist going to the inner city, as this route has less traffic lights. At the sea side an important bicycle path goes through the Poortgebouw. The regional roads in Leiden are usually also well used by cyclists and are part of the cities main bicycle network.

**Public transport networks**

The network of local bus service and regional busses is a dense network. All busses serving the city of Leiden have a stop at the central station. In the Breestraat in the inner city 700 busses pass per day; at the station area this number is exceeded. The bus station has been altered into a buffer system so fewer platforms were needed. The design foresees a renewed bus station where the bus picks up the travellers in stead of the other way around. This way the bus square is used as a roundabout. Bus drivers that are too early or have break time scheduled can use the redesigned buffer. (See figure 8.8)

The light rail in the station area is designed to pass through the station to make the transfer between train, bus and light rail the shortest possible. At the city side the route of the light rail is as follows: In the inner city the tracks are at the centre of the "Langegracht"; at the "Lammerenmarkt" it has a stop at the crossing of the river Mare. The light rail goes towards the station area via the mill "De Valk" and the accompanying bridge. The bridge needs to be renewed to be fit for the light rail tracks. The pop centre leads the light rail to the station square from which the tracks go inside the station to the north-east of the station passage. It runs over the station square, on top of the new bicycle storage; along the bicycle path towards the Hippocratespad and the college and university buildings.

**Private transport networks**

The car is a guest in the station area. The road network is not continuous to prevent traffic without a destination in the station area. A number of buildings have a parking garage underground which can be reached from the street by ramp. (See figure 8.9) At the sea side the car is even more unwished in the area. The neighbourhood can only be driven through in southern direction. The current situation of a fenced off area is hereby undone.

These networks are the base for the organisation of the public space in the station area. The different routings allowed in the plan give the streets a high diversity. This is an important element in the plan as the physical networks is one of the networks formulated by Dupuy (1991). The other levels are the level of consumption and distribution and the level of use. The first can be found by looking at the public services and working areas.
Main network of slow traffic with public functions (1:5,000)

Figure 8.10

Functions on ground level (1:10,000)

Figure 8.11

Functions on elevated levels (1:10,000)

Figure 8.12
8.2. FUNCTIONAL ORGANISATION

The station area in its functions shows the importance of a busy street for public program. But of course the different modalities have their own space in the plan too. This is made visible in the station as a connector.

PUBLIC FUNCTIONS NEAR FLOWS OF SLOW TRAFFIC

As already mentioned the pedestrian flows are the reason for shops and small businesses to settle in a street. People walking by give the shops their consumers, as travellers always have the tendency to consume. With the development of the new station in the station passage some small shops were added. These are mostly food and drinks shops. At the sea side the public services are less present than at the city side. (See figures 8.11 and 8.12) The main flow of pedestrians is going to the LUMC. Because this is close by the station, these travellers will be more reluctant to buy goods. In the design there are public functions at the route to the LUMC. These functions specify on the focus group of the visitors of the hospital and people with an appointment in the hospital. The ground floor of the building is dedicated to medical shops, such as a rollator shop, a pharmacy or a baby shop.

The route from the station to the BSP is not covered with public functions. Although this route is well used, mostly by students, the largest group of people goes by bike. People on a bike usually do not stop at a shop when they are not specifically in need of something.

THE STATION AS A CONNECTOR

The public space of the station area is divided into parts. One part is an empty path. This gives space to the travellers walking. The path takes up most of the station hall, passage and the squares as it must have enough width to not constraining the flows of pedestrians. At the square on the city side there are, next to the main path, two parts of waiting area. These areas are of a different height to the main path, as the path is lowered thirty centimetres gradually. To the south-west, along the street, there is an active waiting area for travellers by bus. The other side is edging the main path in a green waiting area. Here the light rail passes the square in the grass. The square turns out at the bicycle storage and taxi platform and the new building with small businesses at ground floor.

The square at the sea side does not have these three parts. Because the main path is split up into several paths the green element is not present. The waiting area is accentuated by a raise of the square gradually into two steps. Figure 8.13 shows these squares at the station with the functions related to travelling.
8.3. SPATIAL ORGANISATION

The station area is a place in the city where there is much movement in the public space. The non-build area is therefore all public space. The spatial layout of the plan does provide semi-public areas; although these are not on ground level. An exception to this is the square for the elementary school and two housing elements at the seaside. The design has a clear division between public and private domain.

Typology of building blocks

In the current situation the south-western building block at the city side of the station area only has mass at the edges. The building next to the bus station is a longitudinal formed student housing. This building makes the bus station and adjacent public spaces be more of a landing field than a station area. To break this wall of buildings parallel to the railway tracks, a sequence of high rise buildings is proposed at the city side of the plan. The blocks are composed of four high rise elements and lower elements on the sides. The higher elements can be topped of with a small element of two storeys high. Cantilevering high rise is supported with an arcade. The columns can be in the line of trees along the street.

At the sea side other types of buildings are needed. To adapt to the pavilion typology started by the hospital, large composed buildings are situated as free-standing structures in the area. Here the densities are made by high rise on top of a base of more public functions. The high rise is rectangular and positioned on the edge of the building block. Cantilevered elements should be executed without columns, to keep the open structure of the public realm.

Figure 8.14 Good public space provides for a meeting place (Gehl et al., 2006)
Meeting each other is no longer an automatic part of daily life, due to the individualized society. Especially at the station area the squares can be very functional. One of the factors for a pleasant public space is the human scale in the area. People do not like to be standing at the centre of an empty square or other sort of open space. The station squares at Leiden Central are very open, as the viewing distances are long. Means to solve this can be placing trees and furniture in groups on the edges of the square, for example by a terrace for a restaurant. Another element is to create bordering buildings to shorten the view into the distance or to place higher buildings that draw attention. Human scale is also one of the criteria used by Gehl (Gehl et al., 2006) to qualify the public area.

Other criteria for a good public square described by Gehl are: Safety for traffic; safety in the evening hours; comfort against wind and rain; possibility to enjoy good weather; Gehl makes a clear division in the public realm between space for standing and space for walking. And the activities for enjoyment in the area are important for people to meet. These have been used in the designing of the public space at the station area.
8.4. DENSIFYING BY THE RULES

The high rise in the design consists of clusters of high rise at the city side and ensembles of building elements at the side of the hospital.

City side

The sequence of buildings is grouped by the physical networks into clusters of similar higher en lower buildings. Both are situated on a base of two storeys hosting public services. (See figure 8.17) The higher element is four or more storeys higher than the lower element and is called a tower. The towers are built up with a base of two storeys (each four metres); the main tower of two, four, six, eight, ten or twelve storeys (height 3.20 metres); it is topped with two extra storeys. The base and the top have smaller floor area than the main tower, thus there is a projecting part where an arcade is designed. The underground parking garage gives an outline of 2.5 metres by 16 metres.

Each ensemble consists of housing and office spaces in the main volumes, as well as public services on ground level. Some buildings have no definition as to the function; they are designed flexible to be used as an office or housing or a combination of these. These are comparable to “Solids”. Solids are projects where there is no strict function assigned; they are multifunctional buildings with a free layout and no interior finishing.

The façades of the buildings are adding to the flexibility of the program. The ground floor has an open character to host public functions. The upper floors are showing the outline of the building in the window rhythm. (See figure 8.18) The surfaces are realized in a plain way. This is seen as a façade with few irregularities. The windows have a reveal of maximum 200 millimetres to the in- or outside, in one fourth of the windows present. The other windows have a reveal of maximum 100 millimetres. The basis material for the façades is brown or grey bricks. These can be combined into a nuanced or mottled whole.

In the façades no balconies are hanging to the outside; when present these are inside the volume. Also larger holes in the flat façades are possible, but to a limit of one-fourth of the surface. The towers are accessible from an inner circulation area; thus no galleries are visible at the city side. The entrances are as much as possible in well viewed public domain.
Sea side

The ensemble of buildings at the sea side has different guidelines for the architecture. Here the expression of the façades is stronger and the shape of the elements of the ensemble is more dramatically. The design foresees in triangular shaped building locations. Together with the set back of the ground floor this gives a good opportunity for special solutions in the design of façades. For example the smaller surfaces of the higher elements can be in another material than the standard bricks. (See figure 8.20) The expression can also be realized in prefabricated brick tablets with a special pattern.

The height of the buildings is varying on the position and the relation to the street. They vary in height between four and twelve storeys. The building elements are positioned on the edge of the base and can be cantilevering. (See figure 8.19) At the main street "Bargelaan, parallel to the train track, the buildings have a public ground floor. The area is divided into four parts from south-east to north-west. These are: the LUMC and parking garage; new development of mainly office space cut through by the light rail tracks and bicycle route; the historical Poortgebouw; and family housing with new developments of low rise housing. These four parts are all cut through by a bicycle route parallel to the railway tracks.

In the second part of the station area on the sea side, between the hospital and the Poortgebouw, three building blocks have been planned. These are all build up with a base of one to three storeys and a higher element on top of it. The ration between lower base and higher elements is half to quarter of the height. Thus a two storey base can have higher elements of four to eight stories. The total stories at such an ensemble is set to ten stories.

Figure 8.19 Example of build up of ensemble of buildings

Figure 8.20 References of facade 2e Katendrechtse Haven, Rotterdam (DKV architecten)
Impression of station squares (city side above; sea side under)
8.5. DESIGNING THE PUBLIC SPACE

The use of the public space can be seen in the functional context and atmospherically.

SPACE OF FLOWS AND SPACE OF PLACES

The public space of the station squares is determined by the main flows to from the city to the city centre, the hospital and the Bio-Science Park. The squares lead to pedestrians in these directions with a broad path. Next to the main flows there are the paths between the station passage and the bus stops on both sides of the station. These paths are less used than the routes for walking, as the inner city is such a short distance to walk. Few people will wait for a bus to go to the shopping streets. Parallel to the railway tracks are roads for busses and bicycles. These roads lead to the main bus stop and the bicycle storages. The roads cross the main pedestrian paths, especially at the sea side. Here the plan foresees a large zebra crossing to make it safer. At the city side the square is crossed by the bicycles coming from or going to a bicycle shed. The crossing is made in such a way the bicycles have no special path to go over. The square foresees in places to cross by paving a part of the grass and by a small slope of the edge of the pedestrian path. The cyclist is hereby the guest on the square.

The plan is organizing the routes of the pedestrian, the cyclist, the busses and the car. The slow traffic is hereby the most important (see also figure 7.8). This kind of traffic is also the least bounded to a specific path. The routing of the bus, tram and car on the other hand is, making it clearer for the slow traffic, and thus creating a safer environment.

THE STATION ENVIRONMENT

The station squares are designed with a functional starting point, but are also looked at in atmospherical sense. The squares therefore give space to walking and to waiting people. The waiting can either be covered or on a fender. This ridge can also be enjoyed by children to walk over. The good detailing of adjacent buildings and the material of the pavement give the areas a rich appearance. Added to this rich exterior are the designed light structures and the shelter for the bus on the city side.

The station area is by its character rather stony and lacks green spaces. Often at station areas in the case study a large park is adjacent to the neighbourhood. In the case of Leiden Central this is not the case. The north-eastern part of the city has more open space, but not clustered into a city park. The canals of the inner city do have the character of parks, but
Figure 8.23 Impression of parks (at city canal, city side above; at Poortgebouw, sea side under)
The networks in the plan are at most places giving space to bicycles and pedestrians along the roads. At the sea side these spaces are wider than at the city side of the station area. These roads are accompanied with lanes of trees varying in height and wideness. At the open spaces the trees can be larger than in between street and building. The current stony station area is hereby transformed in a lively public space.

these are very elongated elements. Therefore a green element is added to the station squares in the form of grass or large flower-stands.

In the station area currently there are some green spaces, for instance the above mentioned canals or near the Poortgebouw. These do not have much quality due to their size (elongated along the canals) or the dominance of the car (Poortgebouw). In the plan these green spaces are redesigned to give quality to the environment. The little park at the canals is enlarged. This could be done by breaking up the road along the canals to structure the routing of car and bus in the area. The cyclist using the road currently are redirected through the station area; through the bus tunnel to the north. The quality and the usefulness of the place are hereby enriched. At the sea side the monumental building the Poortgebouw (Building with a gate) is assisted by trees clustered at several sides of the building. The bicycle route through the gate is given space and is connected to the route from station to BSP. The group of trees between the gate and hospital is structured by adding several more trees and placing them next to the bicycle path. The group of trees is transformed into a park again by removing the parking for cars and the dominance of the roads and giving space to pleasant walking and sitting in the area.
PART IV
EVALUATION

Introduction

The evaluation consists of a reflection on the design and on the whole graduation, as well as conclusions and recommendations.

First the design is treated as a case in the case study. The new situation is compared to the current situation and the planning for the future. The four elements in the study show the possibilities for the station area.

The conclusions give the answers to the questions in the previous chapters of this booklet and especially the main question is treated. There will be a focus on the general aspects of station redevelopment and in cities comparable to Leiden.

The reflection will review the process of graduation as experienced by the author. This is followed by the recommendations where several under exposed elements will be discussed.
Figure 9.1 Primary and secondary focuses defining different approaches to railway stations (based on Peek and Louw, 2008, p127)
9. TESTING THE DESIGN

'The success of a station area depends on multiple factors. Four of these are: the position in the network, the complex of the station, the environment of the station and process and realisation of the plan.' (Van der Bijl and Hendriks, 2010, translated by author)

9.1. CURRENT SITUATION

Transport node

Without the new developments of international high speed rail and regional light rail, the value of the transport node is calculated as 330 points. These credits are mostly gathered by the intercity connections in four directions (The Hague, Haarlem, Amsterdam and Utrecht). Also the nearby exits of the highway A44 is contributing to the credits for the station.

Connector

The value of the connector is calculated as 116 metres. This is the weighed average walking distance between the different modalities of transport in the station area. The modalities adding most to this figure are the train and the bus. The transfer between them is rather long because travellers need to cross the square and walk through the station hall and passage to the platforms, on the platform they need to walk large distances sometimes because the trains stop on the a or b part of the platform.

Urban centre

The density in the area is calculated as Floor Space Index. This is the amount of square metres to the area it is built on. The FSI is calculated as 0.55 in the current situation with a range of 1200 metres from the station. Around half of the high dense inner city is part of the area of influence. But also the low dense Bio-Science Park is partly within this area. The diversity in the area is calculated as mostly housing and working area (respectively 50% and 42%) and only 9% of commercial activities. The commercial activities focus on at the inner city and the most used streets by slow traffic.

The station hall, station passage and the two squares on both sides of the station are looked at for the urban quality. For this analysis attention was put to three main criteria:
- Protection;
- Comfort;
- Enjoyment.

Sub elements of these criteria were graded with good/ present, neutral/scarcely or bad/none. The maximum score with 12 elements is thus 24. Leiden score badly at the meeting place quality in the station vicinity; it has only 8.5 points.

Figure 9.2 Leiden Central current situation
9.2. “LEADING THE CITY” SITUATION

TRANSPORT NODE

The nearby high speed station of Schiphol gives the station of Leiden a connection to the high speed train network (as well as the international network by plane). This gives the station a stronger position in the urban field in relation to station in similar cities without a connection to the high speed train network. Also the planned light rail connection to the coastal villages of Katwijk and Noordwijk and towards Alphen at the Rhine and Gouda gives the travellers at the station another network of public transport to use. These developments give the station almost the double amount of credits; from 330 to 580 points.

CONNECTOR

The value of the connector is calculated as 109 metres. This is a good enhancement for the station. The transferring between train and tram can be very smooth. The transfer between station and bus is also better because the crossing of the street is no longer necessary; as the bus will pick up its travellers.

URBAN CENTRE

Not all densification will occur in the station area; also in the Bio-Science Park densification is in progress. The design consists of part of the program necessary to balance the node elements at the location of the railway station. The other program can be build in better economical times and spread around in the area of influence. The new development in the design adds more building program as the plans of Stedenbaan (2009/2010) foresee. The plan is not densifying the area as much, as it is not possible in these economical times to build twice the existing program. This gives diversity in the area of 9% commerce, 41% offices and companies and 50% housing. These figures are comparable to the study of Stedenbaan (Atelier Zuidvleugel, 2006).

MEETING PLACE

The design makes a clear distinction between space for walking and space for standing. There are places to sit when it rains and when the sun is shining. The light rail is integrated into the public area and can be crossed very good and safe. The focus has been put to a clear view of driver, cyclist and pedestrian when passing the squares. The surrounding buildings and the pavement of large stones give the visitors of the area a nice view.
9.3. A MORE BALANCED STATION AREA

An important conclusion to be drawn is that the facts and figures of the study are difficult to compare purely on the calculations. Thus the interventions in the design to balance the station area of Leiden Central are also directed at the elements of the Connector and Meeting place.

The station as an Urban centre with its density and diversity gives a positive development to the area. Not because it will boom the area in building program. But the area needs to be enhanced on the quality of the meeting place and the urban neighbourhood. The station area is undergoing redevelopment constantly and the empty spots have never been gone since the hospital moved into the large complex it is in. The main conclusion that has to be drawn is that the station area needs a coherent vision and a plan that is consistent and can adapt to the future developments in public traffic.

The density realized with the plan is an FSI of 1.65 for the station area (city side and sea side, with the railway tracks not excluded). The current FSI is 1.26. In economical better times the sea side of the station area can be densified more, but this is not a wished development in order to let the area be a pleasant place to be.

For the diversity in the station area the effort was on realizing more public services. This proved to be very difficult to add at the sea side. The diversity in the design is calculated as 23% housing, 70% office space and 7% public services. The public services at the city side are expanded enormously, but the sea side is only 1% more (from 2 to 3%), this can be related to the large hospital at the sea side.

As stated in the previous section the value of the Connector is enhanced to the current situation with 7 metres. The addition of a modality can thus also lead to a better connection between them seen in weighted averages. The distance of the light rail stop to the platforms and the bus stop can thus either lengthen or shorten the weighted average path. This can be done by placing the new stop at a distance of the station hall or by making it as close by as possible.

The meeting function of the public space at the station area is enhanced by making the division between walking space and standing/ looking/ sitting. The public realm in the station area is dependent on the functioning of the main squares and other qualities like the little parks or sheltered paths for pedestrians along the buildings.

Figure 9.3 Leiden Central new situation
**10. CONCLUSIONS**

Space at the node (SprintCity)

The expectation is the Floor Space Index (FSI) and the use of the public transport (PT) will rise. And the involved real estate projects will make profit, despite of the complexity of the location. ‘From this perspective there are large possibilities for urbanisation and optimization of PT-mobility at the stations in the Randstad.’ (De Tekenkamer, 2010, translated by author)

### Design and research

The design and the research have a strong relation. The design uses the ingredients found in the case study and location analysis. These ingredients lead the design in the direction of networks and building blocks. The networks, visualized as the physical infrastructure, lead the design and the user of the station area to its destination.

The density and diversity in a station area can be seen in relation to the strength of the station in the network of public transport. This leads to the seen opportunity. Next to these quantities the station area is also a place in the city and has a station with different modalities functionally organized. Thus for an urban planner the first is important, but for an urban designer the last two are more important. This graduation tried to tackle all three visions on the station area; Urban centre, Connector and Meeting place.

When using the theory of network city in designing, main focus lies on the networks and no longer on the building blocks. The design becomes more functional than spatially elaborated. Focussing on networks leads to the connected places and thus to the public realm.

The enlarging of the scope due to the forming of a metropolis in the western part of The Netherlands thus relates strongly to the infrastructure and other networks in the urban field. In the book “Het ontwerp van de stadsplattegrond” (“The design of the urban plan”) Heeling, Meyer and Westrik state it in the following manner:

“Urbanism the task has been to redesign the delta metropolis. The urban plan needs to map the important elements of the public domain on this level. The analysis and proposals of Tummers, for instance, where she uses a new set of drawings on the metropolitan system, put the accent no longer on the clusters of highly urbanized areas, but on the connection of large open spaces, whether or not combined with infrastructure. Until not so long ago people were fixated on the dimension of urban areas. Important were
the urban areas, not the left-over open spaces used as a buffer. Nowadays the structuring and designing of the open areas themselves, in cohesion with the infrastructure of roads, railways and water are the central design exercise that in its turn limits the urbanisation in diverse areas.” (Heeling et al., 2002, p. 164, translated by author)

**Economical restrictions**

After all the study made by the Atelier Zuidvleugel, Stedenbaan, now a part of the Deltanet proved to be quite accurate in a realistic potential for the station area. The economical restrictions and location restrictions made the potential of the area a lot less than can be expected of the fifth station of The Netherlands. Therefore the station of Leiden will always be a strong node in the network. The place values can not be balanced fully in the current circumstances of no or little economical growth. A lot of offices are left vacant and many building projects have been stopped or cancelled. House owners are reluctant to move to a new house and building cooperatives are selling there properties to be profitable. Nevertheless the need to cooperate between cities and city neighbourhoods still exists. Thus the light rail can add to the developments in Leiden that the Bio-Science Park is strengthened, this brings new employees to the city and most positively also more students travelling from station to school. Thus an investment of the government brings up the spiral in a positive way, and creates spin-off for a variety of urban cases.

**Middle-sized cities in the Randstad Holland**

This graduation project is done in the city of Leiden, but also other middle-sized cities can be redesigned in the light of the theory. For instance the cities of Haarlem, Gouda, Delft and Dordrecht all have ideas about the redevelopment of the station area, but they lack the insight into the need to make the station area strongly connected to the city centre. Not only by realizing a shopping street at the station area, but by interconnecting the neighbourhoods on multiple ways. The connection needs to be search not only in the physical infrastructures, but also in the network of distribution and consuming and the household level. Thus the shopping street is a good first step, but it must be kept in mind that the station area is more than a station and some shops. Currently the municipalities are too careful to change the entire set-up. They are dealing with issues as double use of the grounds and the intensification of the ‘back-side’ of the station, but these are too much splintered actions. This results in a constant building site where one building at a time is handled. The station area becomes a mishmash of buildings and transport flows.

To summarize: The light rail line is leading the city of Leiden into a redevelopment of the station environment as an urban centre.
11. REFLECTION

‘The essential characteristic of design as a discipline is its ability to conceive unity in a set of mutually contrary requirements. Design integrates opposite requirements and transforms them in a unified whole. This makes design the essential discipline of all technical sciences.’ (Architectonische Interventie, 1998, In: Van der Spek, 2003, p. 19)

During the process of graduation I learned a lot, about searching literature, the theory itself, the making of a research question and writing an abstract, a paper and how to bring all this together in a thesis (plan).

Starting this project as a double graduation track, I gradually realized that this took simply too much time to realize it as planned. Though I am not the person to stop something I started and had made progress in, I kept trying until I was forced to quit the double track. From that point on the Architecture was put on hold and the Urbanism continued. I got fascinated by the writings on the theory of node and place and started my own research. I was constantly switching between reading and researching, until time ran out and decisions had to be made. These were the most difficult elements of the process. Why should I do this and not the other, while the other can be working fine as well? The choice should be a well considered one, but it is the most effective when I was told to make a choice or when I realized I had to go on into a new aspect. Thus the intended research by design was not followed as planned. In the beginning of the graduation I looked carefully at using the literature in the plan, but the research took over and the design came to a halt. When I realized I had left it to be for a while I tried to finish the research to be able to use it. That was not very easy as the research had the tendency to go into the direction of urban planning. I liked to do the research, even more than the designing, because it gave me clear result. I could see where it is based on and how it can be used.

Looking back on the process of graduation I could have done several things better or earlier. First the design has, for a long time been stuck in a plan, a horizontal projection. I have the tendency to wait with drawing 3D until all elements are fixed, and will not change. When I finally set up a good 3D model simple solutions were possible that I would not have seen from a 2D view. Especially the ground level experiencing could be enhanced.

To conclude I am more a researcher than designer; I need the grounds to design from own research or literature. And I like to fine-tune and get lost in details that are not noticeable or relevant, but very interesting. I Need to take a distance more and earlier in the process to go back to the main line.
12. RECOMMENDATIONS

ANALYTICAL ANALYSIS AS URBAN PLANNING

The case study is very interesting, but not usable as Bertolini used his model as there are only 7 cases. In the master theses by his students there were more than 20 cases examined. The case study on four elements could be elaborated with more cases of cities near high speed stop and with a central station in an urban field. Also for the case study there needs to be looked more into differences of abroad situations of station areas. Governmental intervention or legal restrictions can make a large difference for the comparison of cases in different countries.

DESIGNING FROM THE INHABITANT

The design does not look at what kind of people want to live in station environments. For example, the car is a guest in the neighbourhood, so people cannot rely on their car in front of the house. Also there is limited housing on ground level, so the target groups are double incomes, students and people of 60+. Making a study of the building block in depth would definitely strengthen the design.
13. REFERENCES


KOSTER, N. to VAN VEEN, A. G., 22-09-2010, Telephone interview, Leiden/ Gouda.


ROOIJ, R. M. (2005a) The Mobile City. The planning and design of the Network City from a mobility point of view, Delft: TRAIL.


