TRANSIT ORIENTED REGENERATION

Stedenbaan station areas as drivers of urban regeneration in the South Wing of the Randstad

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10.1.1 Public transport network analysis
10.1.1.1 Problems with modal split
10.1.2 Public transport network design
10.1.2.1 Design alternatives
10.1.2.2 Multimodal transfer node
10.1.2.3 Station design
10.2 Street network
10.2.1 Street network analysis
10.2.1.1 Isolated networks and street patterns
10.2.1.2 Street hierarchy and street types
10.2.1.3 Physical barriers and spatial integration
10.2.1.4 Centralities
10.2.2 Street network design
10.2.2.1 Design alternatives
10.2.2.2 Scope of the intervention
10.2.2.3 Street types
10.2.2.4 Scope of the intervention
10.2.2.5 Extensions
10.3 Public space
10.3.1 Public space analysis
10.3.1.1 Green network at city scale
10.3.1.2 Existing public spaces in the area
10.3.2 Public space design
10.3.2.1 Integration to green network and bikepath network
10.3.2.2 Public space structure of the project
10.3.2.3 Main public spaces: Spangen station square
10.3.2.4 Main public spaces: Spaansebocht Park
10.3.2.5 Main public spaces: Marconiplein
10.4 Program
10.4.1 Program analysis
10.4.1.1 Existing uses
10.4.1.2 Density
10.4.2 Program design
10.4.2.1 New program definition
10.4.2.2 Program distribution
10.4.2.3 Housing typologies
10.5 Morphology
10.5.1 Morphology analysis
10.5.1.1 Existing block types in the area
10.5.1.2 Plot sizes and building types
10.5.2 Morphology design
10.5.2.1 Block typologies
10.5.2.2 Plot sizes
10.5.2.3 Building typologies
10.6 Spatial strategies summary and project overview
11 Practical line / phase 3: strategy and key projects
11.1 Reduced impact of the infrastructure (prepare)
11.2 Enhancement of existing assets (prepare)
11.3 New high quality transport nodes (position)
11.4 New high quality streets (consolidate)
11.5 Completion
12 Practical line, phase 4: scenarios evaluation
13 Theoretical line / phase 3: conclusions
14 Theoretical line / phase 4: recommendations
15 Sources of information

New office building in Blaak station area, Rotterdam
INTRODUCTION
Abstract

This thesis explores the links between the concepts of Transit Oriented Development and urban regeneration, studying the design variables for the creation of high quality urban environments in station areas and the spin off effects of station area developments on the existing urban context.

Two lines of works are defined in this research, a theoretical line and a practical line. The theoretical line builds a framework of design variables of station areas, which is tested in the design case of the practical line. The design case is a station area in the context of the Stedenbaan project in the South Wing of the Randstad: the new station of Spangen in Rotterdam.

Conclusions and recommendations are extracted from the design case, as a set of key spatial strategies to design successful station areas.

Keywords: compact city; network city; Transit Oriented Development; public transport; land use; Stedenbaan; spatial integration, density, diversity, design, place quality, multimodality
1 Introduction

1.1 Aim of the thesis

The aim of this thesis is to explore the links between the concepts of Transit Oriented Development and urban regeneration as complementary strategies to achieve sustainable urban development. Specifically, the research focuses on the design variables for the creation of high quality urban environments in the Stedenbaan station areas, and the key elements that can improve the social and economic conditions of their surrounding areas.

1.2 Description of the context

1.2.1 Urban decline and urban renaissance

European cities at the beginning of the XXI century are being affected by two strong trends of transformation: (1) change in their economic base from manufacture to service and consumption and (2) de-concentration of activities caused by the moving of functions from the inner city areas towards the periphery (Couch et al, 2003). These trends create risks of abandonment and degradation of large parts of the cities as well as uncontained sprawl, in this way affecting the environmental and social sustainability of urban areas.

Different strategies are being used to counteract the effect of these trends in cities. In England the answer to this threat was set out by Richard Rogers in the first Urban Task Force for England in 1999 as urban renaissance: ‘...a vision of well designed, compact and connected cities supporting a diverse range of uses - where people live, work and enjoy leisure time at close quarters - in a sustainable urban environment well integrated with public transport and adaptable to change’ (Urban Task Force, 2005). Behind the urban renaissance concept lies the idea of attractiveness. This strategy aims to make urban environments more appealing to people for living and working, in this way bringing life back to the cities.

In the Netherlands, the policy document ‘Nota Ruimte’ recognizes the importance of concentration of urbanisation and economic activities. It calls for clustering as a way to support the role of cities as economic and cultural engines and as a way to make better use of the infrastructure (VROM, 2006). In this way, the policy encourages compaction through revitalization, restructuring and transformation of existing urban areas.

Two other emerging trends in Europe in the last decades that are being reflected by policies are: urban
networks and urban cities competition.

### 1.2.2 Urban networks

One of the characteristics of urban networks is polycentrism (Hall, 2010). Polycentrism has been transformed from a purely descriptive model into a policy instrument, a condition to which national policies in Europe should aim. Urban networks have been included as a concept in Dutch spatial planning policy since the Fifth Report of Physical Planning of 2001, and are defined as: ‘...highly urbanized zones that take form of a network of larger and smaller compact cities, each with its own character and profile within that network...’ (Vijfde Nota Ruimte, quoted in Burg & Dieleman, 2004, p. 113). But its roots can be found in the concept of “concerted deconcentration” proposed in the Second Report of Physical Planning of 1966. This concept consisted in concentrating urbanisation in or around major cities, and offering opportunities for expansion in new satellite towns around them. (Burg & Dieleman, 2004).

### 1.2.3 Cities competition

Following the emergence of urban regions another phenomenon that arouse in the last decades is that of cities competition. In Europe, several cases of urban regions can be identified, among the most important are: South East England, Paris Region, Central Belgium, Randstad, RhineRuhr, Rhine-Main, Northern Switzerland and Greater Dublin (Hall, 2010, p.31).

The Randstad Holland is the only Dutch example of an urban region at the European scale. It is the largest and economically most important urban region in the Netherlands, consisting of a roughly concentric pattern of urban centres that includes the four biggest cities of the Netherlands: Amsterdam, Utrech, Rotterdam and Den Haag. In administrative terms it consists of four provinces: Noord-Holland, Zuid-Holland, Utrecht and Flevoland (www.regio-randstad.nl).

According to the OECD (2007) the competitiveness of the region is under pressure, a trend that can be read from a decline in levels of productivity. Special recommendations for the region include aspects like cooperation between cities and economic specialization, strengthening of the city region, solving mismatch in housing market, preserving character of the Green Heart, solving congestion, improving public transport, among others (OECD, 2007). Several programs have been launched by the central government to give new impulse of the development of the region: Randstad 2040, Randstad Urgent, Key projects, Area Development. At the same time the sub-regions that compose the Randstad, (North Wing and South Wing) have their own approaches to tackle the main obstacles of their development.
1.3 Description of the problem

1.3.1 Mobility in the South Wing region

The South Wing of the Randstad falls into the limits of the province of South-Holland. It is formed mainly by the city regions of Haaglanden and Rotterdam. It has 3.5 million inhabitants, being one of the most densely populated regions of the Netherlands. In 2000 the province created an executive platform called ‘Bestuurtijk Platform Zuidvleugel’ to strengthen the international competitiveness of the region. The platform coordinates initiatives in four main aspects: economic vitality, nature and water, accessibility and housing.

Regarding accessibility, a challenge arises from the increment of regional travels. It is projected that a predominant amount of trips in the region will take place within a radius of between 10 and 40 km. (Balz & Schrijnen in Curtis et al, 2009). This high level of mobility is causing severe problems of congestion. Large investments in infrastructure are being executed in order to minimize the negative effects of this trend.

The improvement of the regional train service is the most important initiative from the point of view of public transportation. For this ambition a number of previous steps were taken in order to specialize the train networks into three main categories: the Betuweroute was completed in 2007 for freight transport between the port of Rotterdam and Germany; the high speed train line was completed in 2008 from Amsterdam to Belgium. These works left extra capacity for improving intercity services, but another category of services is expected to have much more impact on the demand for traveling in the regional scale. This is the sprint service, a regional metro system with high frequencies (up to 6 trains per hour) that is going to run using the extended capacity of the line connecting Leiden to Dordrecht and Gouda. The last works necessary to increase the capacity of the lines and to allow the sprinter service to run with high frequency are currently being executed in Delft, where the tracks will be doubled from two to four tracks by 2016 (www.spoorzonedelft.nl).

The public and private parties involved in this project are aware of the potential of this new service to attract more passengers, and developed a strategy to increase the density of functions around the stations. In this way even more people will feel attracted to use the train and therefore the improved service will increase its financial viability.
1.3.2 Stedenbaan

This synergic project of transport and urban development has been pointed as a flagship program by the Zuid-Holland region. It consists of 35 stations (32 existing and 3 new) identified as potential locations of new development in a radius of roughly 1200 metres around them. Concrete ambitions have been attached to the development of these station areas including them with a role in the growth of the region. The South Wing Executive Platform has set a target for the next ten years consisting in building between 25.000 and 40.000 new dwellings (about one third of the housing need of the region) and between 700.000 and 1.200.000 sqm of office space (about two thirds of expected office development) in the Stedenbaan station areas (www.stedenbaan.nl).

Stedenbaan plus is the latest stage of development of the Stedenbaan project. The NS Sprinter (in the future with 6 trains per hour) is still the backbone of this program, but the new approach recognizes the importance of multimodal integration involving all means of public transport. Research in order to find the potentials of each station was carried out on early stages. Examples of this are: ‘Ruimte en Lijn’ (Atelier Zuidvleugel, 2006), ‘Almanak Stedenbaan’ and ‘Environmental Differentiation’ (Urban Unlimited, 2005) and ‘Steenbaan Monitor’ (Zuidvleugel Stedenbaan, 2008-2010).

‘Ruimte en Lijn’ analyzes existing four characteristics of station areas: density, mix intensity, position in the public transport network and position in the road network. From these indicators, it groups the stations into 9 typologies according to their development potential. Finally it elaborates 3 scenarios of development: compact scenario, network city scenario and sustainable scenario. ‘Almanak Stedenbaan’ analyzes population and social indicators of the stations, in order to elaborate a profile of them, and in some cases proposing ideas for development. ‘Environmental Differentiation’ analyzes the stations in terms of supply and demand (supply of functions and demand of mobility styles). It groups the stations into 7 profiles according to function and 4 profiles according to users. It also proposes some ideas for development of specific stations. ‘Stedenbaan Monitor’ focuses in the fulfillment of the compromises made by the regions and municipalities in terms of densification and infrastructure construction (P+R and bicycle parking), and by the railway company in terms of train product.

The available research on the Stedenbaan is strategic. Some exceptions are the Urban Unlimited proposals at ‘block level’ found in the ‘Almanak Stedenbaan’ and ‘Environmental Differentiation’ reports. But even these examples are mostly focused on functions and lack of a spatial analysis at the local scale.
The spatial integration of the station area with the surroundings presents an opportunity of new research on the Stedenbaan project, as it is developed in this paper. The integration of the infrastructural elements of Stedenbaan with the street network is a big challenge to address in this direction.

### 1.3.3 Social segregation

The Zuid-Holland region faces challenges as well in the social aspect. In a national context in which the four major cities (Amsterdam, Rotterdam, The Hague and Utrecht) show higher levels of unemployment than the rest of the country, Rotterdam stands first (Stouten, 2010). In this metropolitan area, unemployment is associated with a high number of ethnic minorities and an increasing exclusion from the formal labour market.

Burgers and Musterd (2002) explain the difference between the levels of unemployment of Amsterdam and Rotterdam referring to the theories of social polarization (Sassen, 1991) and mismatch (Wilson, 1987). Both theories explain social inequality as a consequence of the process of economic globalisation. For Sassen, specialised services and corporate headquarters located in cities are also an important source of low-wage jobs. This would explain the growth of inequality in the service economy. For Wilson the ‘truly disadvantaged’ living in cities are victims of a double mismatch: they don’t qualify for employment in the post-industrial economy, and they live far from the places where still some remnants of the industrial era could provide jobs for them (Burgers and Musterd, 2002).

For long time Amsterdam has gained a strong position in international trade and finance and developed a varied economic structure. This has helped it to adapt itself more quickly than Rotterdam to the new service economy. Rotterdam is mostly focused on its port and is getting behind in terms of growth of the service industries (Burgers and Musterd, 2002). According to Burgers and Musterd, the polarization theory helps to explain inequality in Amsterdam, while the mismatch theory does the same for the Rotterdam region. They state that: ‘where Rotterdam fits the mismatch theory because of a lagging growth in the number of post-industrial jobs, Amsterdam fits Sassen’s theory because of a rapidly expanding post-industrial economy.’ (Burgers and Musterd, 2002, p.411) The mismatch theory provides a good insight of the problems that the South Wing is facing, and it can be used as a starting point when it comes to define a strategy to intervene in this context.

### 1.3.4 New urban renewal

As a result of increasing inequality in the income structure and spatial concentration of immigrants, a growing trend towards spatial segregation is affecting Dutch cities. Several programs have faced the...
Transit Oriented Regeneration

challenge of spatial segregation, and this policy gains even more importance given the recent developments in the economic and social structure in the Netherlands, especially in the South Wing.

Interventions in urban areas have occurred in the Netherlands, as in other European countries since the 19th century. Concern about living conditions at the turns of the 20th century led to the Housing Act in 1901, and around 1930, the term redevelopment was used to refer to slum clearance. These operations were executed exclusively on the physical structure and were hoped to have social impact (Stouten, 2010). After 1945, the national policy aimed primarily to tackle the post-war housing shortage through demolition and new construction.

This process was more intense between 1968 and 1972 (Priemus, 2004). In the 1970’s the old urban renewal policy was reformulated shifting the focus from demolition to renovation, with attention also to the process of social development. In this period, the ‘building for the neighbourhood’ policy included more participation of the population and avoided forced displacements. In the 1970’s and 1980’s urban renewal was still concentrated in pre-war districts. Since the 1990’s attention shifted to post-war districts.

The term urban regeneration is used for the first time in the Fourth Report on Spatial Planning (VROM, 1988), referred to the stimulation of economic activity and the quality of public space (Stouten, 2010). In 1994 the Major Cities Policy was launched as an integrative agenda and in 1997 a new Urban Renewal Memorandum was published by VROM. With this new policy scenario, urban intervention was structured upon 3 pillars: social, economic and physical. The physical pillar consists of the new urban renewal program. The consolidation of subsidies in a major fund for urban renewal was accompanied by a decision-making process based more on the local scale.

In physical terms, the new urban renewal aims to differentiate the housing stock and increase the number of owner-occupied dwellings, while pushing up the price and quality of part of the housing stock by means of enlargement. Also it deals with the quality of the urban structure, public space and facilities for parking (Priemus, 2004). It has a strong focus on housing and living environment quality and diversity of income groups in the neighbourhood.

The evolution of the policy led to a more area based approach, identifying the origin of problems in neighbourhoods in a concentration of low-income groups, high residential mobility rates, high crime rates and sense of insecurity. The stock of social rented housing is seen as excessive and to be the cause of the migration of higher income groups out of the city looking for better quality housing. Initially a

New housing projects in Bijlmermeer and Poptahof. Source: www.kei-centrum.nl

Location prize areas 2010. Source: http://kenniscentrawijken.vrom.nl/
redistribution of income groups was used as a strategy, but since 2000 a return to neighbourhood based approach was made. New urban renewal now is targeted mainly at the residents of problem areas providing them a variety of housing alternatives (Priemus, 2004).

The new urban renewal policy of 2000 addresses the urgency for reshaping inner cities, brown fields (former industrial sites/harbours) as well as post-war neighbourhoods. In 2002 the Ministry of Housing started an action program in order to accelerate and stimulate new urban renewal. 56 priority neighbourhoods were selected in the 4 largest cities and 26 medium-sized cities. In 2007 40 districts (‘prize areas’) in 18 cities were selected to receive extra investments in view of their social, physical and economic problems. The ambition is to transform these areas into attractive neighbourhoods that provide opportunities for people in about 8 to 10 years (www.kei-centrum.nl).

2 Motivation

2.1 Sustainable development

The general motivation of this research is to explore the concept of sustainable development and its relation with urban form. Sustainable development concerns much more than the protection of the environment. It also includes social and economic aspects (Stouten, 2010).

The first signs of concern on the international arena about sustainability issues emerged in the 1972 UN Conference on the Human Environment. Later, in 1987 the UN World Commission on Environment and Development published ‘Our Common Future’, known as the Brundtland Report. In this report, sustainable development is defined as: ‘...the development that meets the needs of the present without compromising the ability of future generation to meet their own needs’ (UN, 1987). Two key concepts are included in this definition: the concept of ‘needs’ and the idea of limitations.

Before this report it was hard to conceive that environmental concerns were compatible with social and economic needs. The document merged all these three aspects as part of one same goal. This holistic approach has helped planners to give coherence to policies that tackle different issues under the same conceptual umbrella, but sometimes it creates ambiguity in the declaration of ambitions and lack of clarity in the definition of goals. The challenge is to be precise in the use of the sub-concepts of environmental, social and economic sustainability and to create clear connections between these concepts.

The role of cities in the road towards sustainable development has been recognised since the early...
1990’s at international level. It is since then that the UN started running the Sustainable Cities program (www.un-habitat.org).

2.2 Environmental (urban) sustainability

The idea of sustainable urban development appears as the ‘new big idea’ of urban planning, a way in which planning can recover its role in society (Breheni, 1996).

The strongest concept that supports theories of urban sustainability is the vision of the city as an ecosystem and its derivative concept of urban metabolism (Newman & Kenworthy, 1999; Priemus, 1999; Girardet, 2009). In this view, the city is a system that processes materials and energy in order to maintain life. It was conceptualized by van Leeuwen and van Wirdum as the Eco Device model, which describes cities and buildings as a box, which receives “into” (feed) and produces “out of” (disposal) (Priemus, 1999). In order to keep the equilibrium of cities and the environment, the “into” and “out of” functions need to be regulated to a minimum. For this purpose, the model adds 2 new functions, in terms of resistances: “not into” in order to reduce the flow of resources into the city, and “not out of”, in order to reduce the flow of waste and pollutants to the environment. Regarding regulation of flows, the first and most important measure is to reduce inputs of resources in order to reduce the amount of flows within the system and consequently the amount of waste that leaves it (Newman & Kenworthy, 1999).

The transportation sector is responsible for high share of total global energy consumption, growing from 23.1% in 1973 to 27.3% in 2008 (www.iea.org). 70% of this usage is caused by road transport (passenger cars and trucks) and 66% is used for passenger transport (Girardet & Mendoca, 2009).

In terms of urban transport, the effort should focus in two main directions. Firstly it should focus in reducing the need for travel. In this sense, there is a considerable research effort to find the relation of environmental sustainability and spatial configuration of urban environments from the transport planning field (Ewing & Cervero, 2009) based in the relation of design variables and travel choice. Secondly, the effort should focus in making use of the most efficient modes of traveling. Research has shown that the most energy-efficient urban transport mode is by far the rail mode (Girardet & Mendoca, 2009).

2.3 Social (urban) sustainability

The definition of development is by essence of social nature: ‘The satisfaction of human needs and aspirations is the major objective of development’ (UN, 1987). But not only this, it also means equity of access to the meeting of essential needs. In terms of urban sustainability, an important observation to
the ecological view of the city is to consider what is being maintained by the metabolic process of urban environments, and this is: cities as creators of human opportunity (Newman & Kenworthy, 1999).

Social sustainability is strongly related with the built environment in cities, and can be interpreted as the extent to which the built environment continuously satisfies the needs of its residents through their lives and allow them so improve their social condition: ‘that quality of a residential situation or dwelling which makes it suitable for continued use by its residents and permits improvement in their physical, social and economic condition’ (Stouten, 2010). Sustainability of a residential situation is influenced by adaptability, viability and quality of the built environment. These factors influence the appreciation of their living environment by the users.

3 Field of research

Within the framework of sustainable development, this research focuses on the issues environmental sustainability and social sustainability and their application in urban theories and models. In this sense, it focuses on two theories that emerged in the last three decades under the umbrella of sustainable development: Transit Oriented Development (TOD) and urban regeneration.

3.1 Transit oriented development

The relation of transport and land use has been present in the emergence of urban forms since the origins of cities. The development of transport technologies and the possibility of traveling incrementally longer distances and with more freedom is the main reason of urban expansion (Newmann, 1996). Since the 1960's transport and land use are subject to numerous studies in transport planning in order to find the right links between their relation and travel behaviour. (Giuliano, 1988) In urbanism this link is a used as a basis for planning theories since the early 1990’s (Calthorpe, Newman). The most relevant theory that has arisen from this relation is Transit Oriented Development (TOD).
Transit Oriented Regeneration

TOD has been conceptualized to highlight its benefits in the creation of compact urban environments. Cervero & Kockelman (1997) coined the 3 main variables that characterize good examples of development around stations in terms of three D’s. Density, diversity and design have influence in travel behaviour that can be proved statistically (Ewing & Cervero, 2009). A literature review upon the context of TOD is conducted in the first phase of this thesis project in order to draw conclusions in terms of design aspects of a station area (see methodology). The conclusions then are tested in a case study during the development of the project.

3.2 Urban regeneration

Urban regeneration can be defined as a ‘comprehensive and integrated vision and action which leads to the resolution of urban problems and which seeks to bring about a lasting improvement in the economic, physical and environmental condition of an area that has been subject to change’ (Roberts, 2000, p.17). It is an aspect of the management and planning of existing urban areas rather than the planning and development of new urbanization (Couch et al, 2003), and is characterized by a ‘greater emphasis on rehabilitation and improvement rather than demolition of the existing housing stock’ (Stouten, 2010, p.13).

Urban regeneration distinguishes itself from previous forms of intervention by its integral approach. It emerged in the 1970s as a result of growing dissatisfaction with slum clearance operations typical of urban renewal of the previous decades. It has a strategic character, in this way it is better described as a process not as a final product (Stouten, 2010).

Given that TOD and urban regeneration are framed by the concept of sustainable development, it is no surprising that both strategies share common visions such as the concepts of: compact development and mixed functions as ways of creating attractive urban environments and providing conditions for social interaction and sense of community. It is also important that TOD and urban regeneration can act coordinately in order to overcome social segregation. In this aspect, emphasis must be given also to accessibility to facilities like public services and commercial activities, as well as to employment opportunities. Two possible strategies that can help to integrate both policies in an urban design project are program definition and spatial accessibility.
4 Problem statement

- Lack of spatial dimension at the local scale

Stedenbaan focus on land use variables (density and diversity) of Transit Oriented Development (see theory review). It doesn’t give too much attention to the third variable of TOD (design) which relates directly with spatial configuration.

Stedenbaan is a strategy focused on regional scale objectives. The Stedenbaan requires a complementary vision on the lower scale in order to identify its conflicts and test its real possibilities of materialization as well as to envision its actual spatial effects. In this sense, the focus is put on the coordination of regional and local ambitions.

- Unexplored potential of Stedenbaan for urban regeneration

As it is stated above, Transit Oriented Development and urban regeneration can be seen as two sides of the same coin: sustainable development. While this relation works well at the conceptual level, it needs to be reinforced in the practical field. Policies and programs that point to the same goals need to be coordinated in order to maximize potential synergies. In this sense, there is a need to study the Stedenbaan project in relation to its potential as a driver of urban regeneration. A special look should be given to the ways to create spin-off effects in the socially deprived zones related with the station areas, with regard to the kind of development that could bring more benefits.

Research claim: It is necessary to complement the regional character of Stedenbaan with a vision at the local scale. This vision must include the spatial dimension, and must focus in finding the key elements that contribute to the improvement of the social and economic condition of the surrounding areas.

5 Research questions

Main research question:

Which spatial strategies can be used to turn the Stedenbaan station areas into economically dynamic and well integrated sub centres that can improve the social and economic conditions of their surrounding areas?

In order to answer the main research question, the first sub question is formulated as the research question of the literature review, intended to draw conclusion for the design phase of the project:

Which elements of Transit Oriented Development theory and design variables are relevant to define a station area as a high quality urban environment?

The second sub question focuses on the design aspects that can help to build the connection between TOD and urban regeneration:

Which variables of a station area development can affect the dynamic of existing neighbourhoods and improve their social and economic conditions?
6 Methodology

The research and design process is structured in two main lines of work: a 'practical' line and a 'theoretical' line. The practical line includes all the area-based analysis, strategy formulation and design interventions of the project. The theoretical line aims to connect the applied work of the practical line with theories and trends that can be observed outside of the project area. The general phasing is based on the 'planning cycle' (Rooij, 2005).

6.1 Theoretical line

A. Literature review

This part of the research builds a conceptual framework of the concept of Transit Oriented Development at different scales: from the scale of the city and urban planning to a local scale of the station area and urban design. The outcome of this research is used for the local analysis and design.
B. Reference study

A comparative case study tests the application of design variables in two station areas. In this study, the main conclusions of the literature review are used. The outcome of the case study is a set of conclusions on the success (or failure) of the design measures in creating high a quality urban environment.

C. Conclusions

This phase builds answers to the research questions, analyzing the effectiveness of the design measures used in the design phase and making inferences about the spin off effects that the project could create in the surrounding areas.

D. Recommendations

A second set of conclusions is built in the form of recommendations for the development of similar cases of new stations in the context of the Stedenbaan project. These recommendations focus in design aspects with emphasis in the street network integration and public space quality.

6.2 Practical line

A. General analysis & site selection - analysis

For the selection of the design location of the local phase, socio-economic and livability data are combined with a spatial analysis using space syntax in order to orientate the project towards the most deprived and less spatially integrated neighbourhoods around the Stedenbaan stations.

B. Local analysis and design operations - design

In these phase the design variables of station areas defined in the literature review are translated into a tool to analyze the chosen location and propose design interventions.

C. Key projects - strategy

After the local analysis and design interventions definition, a local strategy for the station area is defined focusing in the project components that add more value to the surrounding area.

D. Scenarios evaluation - evaluation

The evaluation phase compares the existing situation with the scenario with project, highlighting the spin off effects that the intervention could generate for the area and for the city.
7 Theoretical line / phase 1: theory review

Starting from the need to specify spatial aspects for station areas, the aim of this review is to build a conceptual framework for the understanding of the concept of TOD at different scales: from the scale of the city and urban planning to a local scale of the station area and urban design. In this way, the research question is formulated as follows: which elements of Transit Oriented Development theory and design variables are relevant to define a station area as a high quality urban environment?

For this purpose, the review is structured in three parts, each approaching from a different perspective. The first part consists of a review of the planning theories that provide support to the idea of development around transit. The main two theories that are reviewed are: the compact city and the network city, with their application in the Netherlands. The second part reviews the concept of TOD in light of the land use-transportation link and focuses on two approaches that predominate in the discussion: a normative approach and a descriptive approach. The third part tries to build a framework for a third approach to TOD that can be called the ‘operative approach’. It includes a review of analytic tools, design principles and design variables for high quality urban environments in station areas.

The outcome of this part of the research is a conceptual framework for the analysis of a station area in the Stedenbaan project and a set of design variables that can be translated into a tool to design a station area.

7.1 Transit Oriented Development and planning concepts

7.1.1 Compact City

The compact city can be described as having two main dimensions: a physical and a social one. The physical dimension is based on the two fundamental characteristics of contention and concentration, as ways of reducing travel distances and protecting the open landscape from urban sprawl. The social dimension is characterized by a varied pattern of urban functions and population that leads to a more integrated society and a better quality of living (Jenks et al, 1996).

Breheny (1996) identifies 2 traditions in planning: the centrist and the decentrist tradition. Both groups started from the interpretation of the work of Ebenezer Howard, but with opposite views about the way in which cities should grow. The compact city movement is one of the last expressions of the centrist view and is much in debt with the work of Jacobs. In 1961, Jacobs championed the ideas of con-
centrization and diversity based on the qualities she observed in big cities and inner city areas, starting the wave of revalorization of the city we are living at present time.

In 1990, under the light of environmental concern, the idea of concentration entered into the political agenda with the appearance of the ‘Green paper on the built environment’ of the European Commission. In order to find an answer to the problems of degradation and pollution being faced by European cities, the paper proposes to conceive ‘the city as a project’ that recovers the assets of historic cities. ‘This new concept takes as its model the old traditional life of the European city, stressing density, multiple use, social and cultural diversity.’ (European Commission, 1990, p.29)

In the academic field, the concept of compact city became by that time one of the most debated issues relating urban form and sustainability, being promoted and questioned as a solution for about 2 decades up to this date. It was assumed that cities play a role in sustainable development, and the exact form of this connection became the focus of research of many scholars. The works of Newman & Kenworthy (1989) and Breheny (1995) are important pieces of this discussion.

Comparing cities in the US and the world, Newman and Kenworthy (1989) find a clear negative relationship between urban densities and gasoline consumption. They conclude that re-urbanisation is the next phase in urban development, which consists of ‘redevelop, restore, reuse and more intensely develop urban land’ (Newman & Kenworthy, 1989, p.33). This should be accompanied by a reorientation of transport priorities to transit systems and pedestrianisation and bicyclisation.

Breheny (1997) has a skeptical view of the compact city. He summarized the critics in three aspects: veracity, feasibility and acceptability. The veracity aspect concerns the reliability of the empirical evidence on energy consumption. The feasibility aspect contrasts the implementation of the model with the strong trends of market-driven decentralization that are shaping cities. The acceptability doubts are based on housing preferences and satisfaction levels associated with density. Dempsey and Jenks (2010) added a question about the applicability of the model in different contexts: ‘The context within which the compact city is examined is critical to one’s understanding of it. While there may be compact city features which can be applied to any developed, developing, rapidly growing, medium-sized, large or mega-city, it is an over-simplification to suggest that the resulting urban form would be the same for each...’ (Dempsey and Jenks, 2010, p.116)

Against the extreme positions of the centrists and de-centrists that he describes as ideological, Breheny (1996) proposes a realistic middle ground that he calls the ‘compromise’ view. This position mixed

Growing car dependency in the Netherlands

the merits of each extreme in the form of contained decentralization.

### 7.1.2 Network city

The process of urbanisation outside of the city limits began at the turn of the 20th century, mainly because of the availability of new modes of transport. ‘The city dispersed and decentralized. New homes and industries were built in the suburban periphery. The new technologies of transport –the electric tram, suburban train, subway, bus- allowed this dispersion process.’ (Hall, 1988, p.58) Even more drastic changes came with the rise of the automobile as the dominant mode of transport.

Increased mobility has allowed the creation of a society in which physical boundaries and distance no longer constrain the social and economic structures. Far more important are ‘...the connections that an individual actor (person, company, institution) has with places, persons, or activities elsewhere.’ (Rooij, 2005, p.3) In social and economic terms, relations become far more complex as the number of possible connections increases.

The network city can be described in physical terms as a ‘spatial constellation’ of multiple centers structured around transport and communication networks that overcome physical and administrative borders. In this sense it can be related with the ‘compromise’ view of Breheni, as it is a form of contained decentralization.

Dupuy (2008) identifies three levels of network operators organizing urban space. The first level is constituted by transport and communication networks, involving the construction and operation of infrastructure of roads, public transport, telephone, etc. The second level is formed by production and consumption relationships, namely the distribution of goods and flow of information necessary for economic activity. The third network level can be described as the ‘end user territory’ of each person or household, who makes connections between the other network levels in order to create its ‘own city’.

This distinction of levels of operation is relevant for urban planning, as we can identify better where it is possible to intervene and which are the probable consequence of this action. Dupuy calls for a much more decided involvement of urban planning in the configuration of the networks. This intervention must take place at level one through the planning of the infrastructure networks, and at level two through the development and coordination of the key nodes of the networks where the different operators interact but are unable to handle on their own. ‘These tend to be interface, intercommunication and interconnection points -such as seaports or airport nodes, multimodal stations/platforms or teleports.’ (Chaline cited by Dupuy, 2008, p.53)
7.1.3 Compact city and network city in the Netherlands

Dutch planning practice has a long tradition of policies aimed at controlling urban expansion. From the 1920's there was a concern about this matter but it was in the 1960’s that suburbanization became a serious threat and policy actions were taken (Dieleman et al, 1999).

The compact city concept took the form of polynucleated urban regions. Firstly, new towns were planned outside the existing cities (Second Report of Spatial Planning, 1966) and later, greenfield expansion was located close to urban areas (Fourth Report on Physical Planning Extra, 1991). Dieleman et al (1999) stress that the implementation of compact urban growth in the Netherlands was possible due to very specific circumstances: the strategic planning tradition, the centralized municipal finance system, the mass production of social housing and land policies that include subsidies and strong regulation. The result was successful in terms of housing provision but not so much in terms of reducing the trend of urban deconcentration and car dependency (Dieleman et al, 1999).

More recently, the policy switched from the compact city concept to the urban networks concept included in the Fifth Memorandum on Spatial Planning (2001). Dieleman & Burg (2004) mention as the reasons for this shift the expansion of daily urban systems across the borders of metropolitan regions, the insufficiency of public transport as an organizing principle, the development of a network-based society and global competition: ‘Urban networks are highly urbanized zones that take on the form of a network of larger and smaller compact cities, each with its own character and profile within that network.’ (Fifth Memorandum on Spatial Planning 2001, quoted by Dieleman & Burg, 2004, pp.114)

In the Fifth Memorandum (2001), the network concept was also incorporated as part of the ‘layer approach’, the conceptual framework of the document. This approach states that the territory can be analysed in three layers: the substratum, the networks and the occupational pattern. Each level is subject to change but at a different rate depending on its characteristics, being the substratum the most stable and the occupational pattern the most flexible one. In this way, the approach creates a hierarchical relationship between the layers.

Priemus (2007) proposes an amendment to the ‘layers approach’ to what he calls the ‘network approach’. He starts from a more detailed inspection of the layers, finding that each layer is also formed by networks. The substratum is formed by the green and blue networks, and the occupational pattern is formed by the urban networks. The relationships between the layers are not always hierarchical in the way suggested by the ‘layers approach’. Sometimes it can be the opposite, so changes at the upper
Transit Oriented Regeneration

layers (more dynamic) can influence changes at the lower layers (more static). From these observations, the ‘network approach’ connects the different spatial scales in order to find opportunities for spatial planning.

In the same line of Dupuy, Priemus highlights the nodes as links between the infrastructure networks and the occupational patterns: ‘Node forming leads to reciprocal reinforcement of networks. In other words, networks work in particular because of the nodes formed with other networks.’ (Priemus, 2007, p.682)

7.2 Urban form and transportation

The relation of transportation and land use has been present in the emergence of urban forms since the origins of cities. The walking city and the transit city are mentioned by Newman & Kenworthy (1999) as two models in history in which transportation and land use were closely connected.

Cervero (1998) describes the urban form-transport link as a two-way relationship. In principle, transport modes and services shape land use patterns and urban form based on location theory, explaining the observations of Newman & Kenworthy about the walking city and the transit city. At the same time, land use patterns would have an impact on travel behaviour, being density the most decisive factor in travel demand and modal choice.

A large amount of empirical studies have explored this two-way relationship (Giuliano, 1988; Cervero, 2009) trying to prove or to find adjustments to theory. The results not always fulfill the expectations mainly because reality is far more complex than the theoretical models. Despite this difficulty, general statements are still valid and can be further elaborated.

Cervero (1998) put the label ‘transit metropolises’ to those cities which have developed a strong relationship of ‘hand in glove’ fit between their transit services and settlement patterns. ‘...these places are highly adaptive. Either their cityscapes are physically and functionally oriented to transit or transit is well tailored to serving their cityscapes.’ (Cervero, 1998, p.xi)

But this fit is hardly achievable if planning policies of transport and urban development are not coordinated. Priemus (2007) observed that in the Netherlands there has been a separation between town and country planning on the one hand and infrastructure planning and water management on the other hand. Fortunately this is changing and spatial planning is moving towards more integration, as it has been proved by the rapid acceptance of the layers approach in the planning circles.

Transit and urban form relationships in adaptive cities. Source: Cervero, 1998

Land uses and densities along trinary roads in Curitiba, Brasil. Source: Cervero, 1998
Priemus (2008) enumerates four policy tools that can help to improve the relationship between urban dynamics and transport infrastructure, strengthening the development of network cities. These are: (a) coordination between property development and infrastructure networks, (b) special attention paid to the interconnection between the networks -the nodes-, (c) enhancement of the function mix of railway station areas, and (d) improvement of public transport in the urban region. All these policies should ‘...preserve the increased value (value capturing) of nodes due to greater accessibility in order to improve the quality of the urban space and/or co-fund infrastructure links between the nodes.’ (Priemus in Bruisma et al, 2008, p.30)

7.2.1 Transit Oriented Development

Different terms have been applied to the concept of development around transit, but the most popular is ‘Transit Oriented Development’ (TOD), coined by Peter Calthorpe in the early 1990’s. The concept of developing around transit responds to the need of restore the link between land use and transportation -specifically public transport- and it can be said to be the most concrete expression of the network city concept in current spatial planning practice. The basic concept of TOD can be described as: ‘...concentrating urban development around stations in order to support transit use, and developing transit systems to connect existing and planned concentrations of development.’ (Curtis et al, 2009, p.3)

Transit involves public transport modes that vary in capacity and flexibility. These modes can be classified in three categories: bus and coach; tram; and metro and train. In general they provide greater capacity and less flexibility compared to the private car. For this reason, they are often combined and structured around the mode with the higher capacity and speed: metro and train. Metro and train stations need to be integrated with non-motorized modes like bicycles and walking.

In order to improve transit as a competitive alternative to the car (i.e. both fast and flexible transport) the strengths of transit and slow modes need to be combined. This is a central idea of TOD. However, this transport combination can only be successful in presence of: ‘...short distance and/or high density spatial patterns.’ (Bertolini et al, 2009, p.4)

A basic condition for development around transit is to facilitate the pedestrian connections between modes of transport and between these and the buildings around them. Transit-related development typically includes: ‘...a variety of services within walking distance of the transit station; good pedestrian connections to transit and between buildings; and buildings that are outwardly oriented toward the street rather than inwardly oriented toward parking.’ (Dunphy et al, 2004, p.5)
The historic precedent of TOD in the western world is the suburban expansion of the industrial age triggered by the railway, especially in the cities of New York, Chicago, London and Birmingham. From the 1850’s in the United States and the 1870’s in the UK, promoted by local authorities and private developers, new neighbourhoods were built around railway stations, and new tram lines were connected with the stations (Hall, 1988). In Tokyo suburban rail construction began in 1915, encouraged by government policies and boosted by private entrepreneurs who combined railway and real estate development. The reason for this development was purely financial: ‘Placing shopping malls, apartments and entertainment complexes near stations generated traffic; in turn, railways brought customers to these establishments’. (Cervero, 1998, p.189)

7.2.2 Approaches to TOD: normative and descriptive

Two main approaches of TOD can be identified in philosophical terms. The most widespread is a normative approach represented by the work of Calthorpe and the new urbanists. As urban designer, Calthorpe delivers a precise blueprint of how transit villages should be. The other approach is less rigid and more based on evidence. The descriptive approach, represented by Cervero tries to draw conclusions from observation on the failure and success of transit villages and metropolises.

7.2.2.1 Normative approach

Calthorpe puts emphasis on a sociological view of the city and the power of design to define its characteristics. For Calthorpe, a neighbourhood means a community of place: ‘...they are complex, human scale places that combine many of the elements of living: public, private, work and home. They mix different kinds of people and activities in close proximity and provide places for them to interact.’ (Calthorpe, 2001, p.31)

His inspiration comes from traditional towns in the United States. As an alternative to sprawl he proposes what he calls ‘pedestrian pockets’ or ‘Transit Oriented Developments’: ‘The alternative to sprawl is simple and timely: neighbourhoods of housing, parks and schools placed within walking distance of shops, civic services, jobs and transit - a modern version of the traditional town.’ (Calthorpe, 1993, p.16) His diagram for a transit village is well known, and its main elements can be recognized in many of Calthorpe’s projects, leaving little space for the recognition of the emerging characteristics of the place where they are located. In addition it remains in the master plan sphere, leaving little room for more varied models of intervention.

New urbanism is perhaps the most determinist approach to TOD. Its principles are in line with those
Theory review

of Calthorpe, and are summarized in the ‘Charter of the New Urbanism’. This document recognizes the
neighbourhood, the district and the corridor as the essential elements of development in the metropolis.
‘Neighborhoods should be compact, pedestrian-friendly, and mixed-use. Districts generally emphasize a
special single use, and should follow the principles of neighborhood design when possible. Corridors are
regional connectors of neighborhoods and districts; they range from boulevards and rail lines to rivers
and parkways’. (CNU, 2001, p.2)

Duany proposes a methodology of planning based on an analytical view of the territory: the ‘transect’. A
rural to urban transect is divided into six zones to apply on zoning maps. From here he developed a
universal code for planning, that he called the ‘Smart Code’: ‘The Smart Code is a tool that guides the
form of the built environment in order to create and protect development patterns that are compact,
walkable, and mixed use’. (Duany, 2008, p.v) This tool is design-oriented and highly detailed, being the
ultimate expression of the normativism of new urbanism.

7.2.2.2 Descriptive approach

On the other hand, the descriptive approach to TOD is characterized by drawing conclusions from em-
pirical evidence in order to deliver strategies linking transit and land use. The main contributors to this
trend are Newman and Cervero.

In 1989, Newman and Kenworthy concluded from an international comparison of cities that density
plays a major role in travel behaviour. Although their findings were discussed by Breheny and others, the
general idea remains valid up to now. In 2009, Newman holds up his observation based on comparative
surveys, taking a step further: ‘The curve [of transport energy use vs. activity intensity] is found to be
universal and suggests a critical density at which car use increases dramatically.’ (Newman in Bertolini
et al, 2009, p.14)

Cervero & Kockelman (1997) tested the propositions of Transit Oriented Development using statistical
methods to measure the influence of the built environment in travel demand. They found that density,
land use diversity and pedestrian oriented designs generally reduce trip rates and encourage non-auto
travel in statistically significant ways…” (Cervero & Kockelman, 1997, p.199) In this way, the examined
urban form patterns proved to be relevant enough to be named as the ‘D’ variables as measures of the
built environment: density, diversity and design.

In 2001, Ewing & Cervero added two more ‘D’ variables: ‘destination accessibility’ and ‘distance to
transit’. In 2010 Ewing & Cervero made a statistical analysis of the existing literature relating quantita-

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Impact of built environment variables over walking and transit use.
Source: Ewig & Cervero, 2010
tively characteristics of the built environment to measures of travel like: vehicle miles traveled (VMT), walking and transit use. Their findings confirm the general conclusions from earlier studies, observing that the impact of each measure taken separately is relatively low, but that the combined effect of several built environment variables on travel could be quite large.

From the original 3 Ds, ‘design’ showed a significant association with VMT and mode choice, especially the sub aspect of ‘intersection density’. ‘Interestingly, intersection density is a more significant variable than street connectivity. Intuitively this seems right, as walkability may be limited even if connectivity is excellent when blocks are long’. (Ewing & Cervero, 2010, p.275)

7.3 Towards an operative approach to TOD

From the review of the normative and descriptive approaches to TOD, it can be summarized that the normative approach offers a blueprint of urban design, with little possibility of adaptation to different circumstances, while the descriptive approach provides much more insight of the causal relations that lead to the emergence of urban patterns. Causal relations -not to be confused with physical determinism- are of high importance if we want to define urban design measures that can lead to the development of a desired effect without prescribing a static form.

Conclusions from the descriptive approach form the knowledge base for the development of an operative approach. In this way, the operative approach is an extension of the descriptive approach with more emphasis on the definition of design workings that will produce the desired effect, in this case the emergence of urban quality. We need to define this concept before going to the description of design measures.

In order to define urban quality we can refer to the definition of ‘urbanity’ given by Montgomery (1998). ‘Good cities tend to be a balance of reasonably ordered and legible city form, and places of many and varied comings and goings, meetings and transactions.’ (Montgomery, 1998, p.93) Implicit in this definition are the concepts of form, image and activity. These concepts form what he calls ‘planning principles’ of urbanity.

7.3.1 Planning principles to create urbanity

Following Jacobs (1961), Montgomery observed that activity both produces and mirrors quality in the built environment, and that what supports activity is what he calls the ‘city transaction base’. This transaction base involves primarily economic transaction but not all transactions take a monetary form. The
more complex is the exchange base, the livelier and more interesting will be the urban area.

After observing the visible qualities of good urban places, he pointed towards the understanding of the underlying structure and dynamic of activity. Building upon the work of Canter (1977) and Punter (1991) he concluded that ‘successful urban spaces must combine quality in three essential elements: physical space, the sensory experience and activity.’ (Montgomery, 1998, p.96) These three elements work together to create a sense of place.

While Canter and Punter show in their diagrams these three components as equally distributed around a central core where the ‘sense of place’ is located, Montgomery concludes that form, activity and image must be considered ‘in tandem and progressively.’ (Montgomery, 1998, p.113)

When revealing the underlying structures of urban form, he found causal relations between these three elements. The understanding of the seminal role of urban form gives the designer the chance to elaborate a plan of action in order to achieve urbanity and sense of place, in other words to go beyond the normative statements towards an operative approach. With great confidence, he says that ‘it is perfectly possible to plan for and design the active city.’ (Montgomery, 1998, p. 93)

This doesn’t mean that there is a blueprint for urban quality. A good ‘fit’ for creating a sense of place: ‘cannot be too precise, for it must allow flexibility for the city to grow organically. If a city does not grow organically it is merely a planned as opposed to a living thing.’ (Montgomery, 1998, p. 103). The conditions to allow this organic growth are summarised in 12 physical conditions for making a city:

- Development intensity
- Mixed use
- Fine grain
- Adaptability
- Human scale
- City blocks and permeability
- Streets, contact, visibility and horizontal grain
- Public realm
- Movement
- Green space and water space
- Landmarks, visual stimulation and attention to detail
- Architectural style as image
The planning principles of Montgomery provide a framework of goals and methods. After contrasting them with the notion of compact city, network city and TOD, it is possible to synthesize five design variables for station areas. The first three variables elaborate on the original set of D variables of Cervero (1996): density, diversity and design, but in a different order: design, density and diversity. The reason for this shift that the design variable concerns primarily spatial configuration and as we have seen, space has a seminal role in the movement and location of activities. In this way it creates conditions for the emergence of diversity and density.

Two more variables are added to the original three: place quality and multimodality. These two are actually different aspects of the ‘design’ variable, but it was considered necessary to treat them separately in order to be more precise.

7.3.2 Design variables of station areas

7.3.2.1 Design

A. Spatial configuration and spatial integration

Hillier (1984, 1996) developed a configurational theory of space called Space Syntax, which starts from an understanding of the built environment as the relation between spaces (configuration) more than the size and shape of the spaces themselves. The relevance of the configuration of space relies in its direct relationship with social relationships. In other words, spatial configuration mirrors and shapes social encounters.

When related to urban scale, space syntax represents urban space a network of spaces that can be analysed in mathematical terms in order to understand its connectivity and its influence on people’s circulation. This analysis is based upon a set of theories about how movement in a network is shaped by cognitive decisions.

In practical terms, Space Syntax analyses the spatial configuration of street network and its relation to movement starting from a basic element that is the street segment between intersections. In order to analyse the spatial configuration of a street network, Space Syntax makes use of mathematical concepts, which are built into algorithms in the Depthmap software.

The first concept is the definition of distance. Depthmap uses three definitions of distance between a segment and its neighbours: metric, topological and geometric. Metric is the distance between the center of a segment and the center of a neighbouring segment; topological assigns a value of 1 if there

Relation of spatial integration with urban movement
Source: www.spacesyntax.com

Relation of spatial integration with land uses
Source: www.spacesyntax.com
is a change in direction between a segment and a neighbouring segment, and 0 if not; and geometric measures the degree of angular change between a segment and a neighbour, so straight connected are 0-valued.

The second concept used is the type of measure. Depthmap measures syntactic integration or mathematical closeness as the distance of each segment to all others and syntactical choice or mathematical betweenness as the number of distance-minimising paths between every pair of segments. (Hillier, 2009)

The integration analysis reveals the to-movement potential of a segment as a destination, since the describes its accessibility or how easy it is to get from all other segments. The choice value shows the through-movement potential of a segment since the measure describes how likely you are to pass through a given segment on trips, so its potential as a route from all segments to all segments.

‘Since the selection of a destination and the selection of a route are the two prime components of any trip, we have then a well grounded set of techniques for identifying movement related structural patterns in cities, and looking for functional correlates’. (Hillier, 2009, p.4)

By this techniques, Space Syntax shows how spaces are connected together to form patterns at different scales, bringing to light structures underlying the complexity of cities, suggesting that: ‘...cities have universal, as well as culturally determined spatial features, which play a role in both embodying and reproducing the underlying social and economic patterns in cities...’ (Hillier, 2009, p.2)

A number of studies have found correlation between spatial integration measures and human activities. The more integrated a particular section of a network, the more appropriate for certain kinds of movement it will be, and therefore, the more attractive for the location of certain kind of activities.

Nes (2009) observed the levels of spatial integration of pre-war districts and post-war districts in the Randstad. Analyzing local integration of the region as well as global integration she found that historic centers are the more locally integrated areas whereas highways are the more globally integrated. Local integration helps to explain the vitality of historic centers in cities vs. the planned areas, given that local integration is more appropriate for pedestrian movement. We can infer that when it comes to urban quality, spatial integration is a strong starting point to analyse the potential of a place as a successful urban area.

Analyzing the configurational properties of urban space, and their influence on movement and urban

![Connection of main routes with local streets in historical centers and post-war areas.](Source: Nes, 2009)
development, Hillier has observed that cities in general take a generic dual form, composed of a foreground network of linked centres at all scales with high movement and activity potential, set into a background of mainly residential space with lower movement and activity potential.

Hillier (2009) elaborates a concept from his findings that he calls ‘pervasive centrality’ to describe the way in which centers fit into the natural pattern of movement at different scales. For Hillier, emergent multi-scale centrality arises through a: ‘well-defined process of self organization, based on the relationship between the grid structure and movement at all scales.’ (Hillier, 2009, p.6)

Successful Transit Oriented Developments can become centres in the urban grid, but for this to happen their position must be supported by the spatial configuration of the street network around them. In order to understand how centrality emerges is important to go to the notion of pervasive centrality elaborated by Hillier. Every centre has a spatial seed, usually an intersection, but it can be a segment. The spatial value of the seed of the centre establishes a fading distance, which defines the distance of the seed to which the shops will be viable. ‘A centre becomes larger to the degree that it is reinforced by what are, in effect, new seeds created by the grid which allow the shopping to be continuous’. (Hillier, 2009, p.6)

B. Station accessibility

The methodology of space syntax has been used to analyse the accessibility of railway stations by Kusumo (2007) and Nes & Stolk (2008). Starting from the premise that spatial configuration is seldom taken into account, Nes & Stolk analysed the integration of stations at the regional scale as well as their local integration at neighbourhood level, concluding that a station needs to be integrated at both levels in order to be well functioning.

Peponis et al (2009) examined the impact of street connectivity on transit patronage. They found that the influence of street connectivity depends on the distance to the station, being more influential at an 800 metres radius than at 400 metres or 1600 metres. The explanation to this is that at lower distances people are inclined to use transit irrespective of the street connectivity, while at higher distances the extra effort to walk overpowers the influence of connectivity.

They also found that the shortest route is more influential than direction changes when reaching the station. Unlike movement in other urban environments, walking to the station is directed, not explorative (with the exception of tourists), and less cognitive decisions are needed because the route is well known (Peponis et al, 2009).
7.3.2.2 Density

Human concentration, sometimes considered too high, sometimes too low has put density at the core of the discussion between the ‘decentrists’ and the ‘centrists’. The former position represented by Unwin prescribed maximum values of density in the first half of the 20th century, while the latter position represented by Jacobs prescribed minimum values in the second half of the 20th century. As we are now living a predominance of the centrist view, it is more common to speak of minimum thresholds of density values for achieving urbanity. In this line, Newman suggests that: ‘...a minimum of 35 people and jobs/ha is required to reduce the need for driving; and... if established within the limits of a 1 km radius, a local center can be created for about 10,000 people and jobs.’ (Newman in Bertolini et al, 2009, p.15)

Density and urban form indicators: intensity, compactness and network density

Berghauser Pont & Haupt (2008), observed the shortcomings of the most common measures of density used in urban planning, both as descriptors and prescriptors of urban form. The major concerns with the existing measurements are their ambiguity and lack of spatial correlation, specifically relation with building type. Besides that, it is also criticized that the results of such measurements depend too much on the definition of the plan boundaries and the scale of measurement. Most common measures of density are: population and dwelling density, land use intensity, coverage, building height and spaciousness.

Berghauser Pont & Haupt (2008) observed that population and dwelling density have the disadvantage of not including the floating population represented by workers and visitors. Even if jobs are considered, the size of the units is their only link to urban form and this is highly variable. Land use intensity (FSI or FAR) is more effective but it doesn’t differentiate between spatial layouts. An alternative approach is to use more variables to describe an urban area.

They propose that: ‘...density should be treated as a multivariable phenomenon, consisting of the three fundamental indicators intensity (FSI), compactness (GSI) and network density (N).’ (Berghauser Pont & Haupt, 2008, p.210). This method allows them to the definition of urban fabric types, even leading to the evaluation of performance of urban form in terms of parking, daylight access and urbanity under different density conditions (Berghauser Pont & Haupt, 2008).

7.3.2.3 Diversity

In order to generate diversity of people is essential to provide diversity of land uses. Montgomery stressed the relevance of diversity to generate vitality: ‘...the most lively and interesting urban areas

3 areas with 75 dwellings per hectare.
tend to be places of complex variety, with a large representation of small-scale business activity which trades not only with customers but with other businesses.' (Montgomery, 1998, p.99)

Following Jacobs (1961), Montgomery identify several conditions for diversity from which I selected some because of their potential for causal relations and applicability in an operative approach to design:

- Variety in primary land uses: those which attract people, such as offices, residences, shops, places of education, recreation and entertainment. In response to primary uses a secondary kind of enterprises and services grow serving the people which the primary uses attract.

- Mixed land ownership: Allowing self improvement and small scale investment, as well as allowing enterprises with different management models.

- Differing unit sizes of property: at varying degrees of cost, so that small business can get a foothold and get around unexpected financial difficulties.

- Mixed use building types, in order to allow horizontal as well as vertical diversity.

- In-built adaptability: Allowing different activities to take place during the building’s lifetime.

### 7.3.2.4 Place quality

Gehl (1971) explored the relationship of public space and social life. Following the tradition started with Jacobs (1961), he developed a vision of urban design based on the human dimension and the sensorial experience of space, making a plea to re-focus city planning on the small scale, where the ‘battle for quality’ takes place.

#### A. Scale

Montgomery defines scale as: ‘...a combination of the ratio of the building height to street width, relative distance, permeability [of the street network] and the sense of grandeur or intimacy of space’. (Montgomery, 1998, p.106) Scale can be defined horizontally through the grain of the street network and vertically through the relation of street width to building heights.

A way to measure scale on the horizontal dimension is through the number of intersections. Referring to Jacobs (1994), Montgomery observes that successful urban districts covering an area of one square mile tend to have over 250 intersections, sometimes more (Amsterdam has nearly 600, Toulouse has...
Tri-dimensional scale is of outmost importance for Gehl (2010). For him it is in direct relation with the dimensions of the human body and the direct experience through the senses. He observed that in narrow streets and small spaces: ‘...we can see buildings details and the people around us at close range. There is much to assimilate, buildings and activities abound and we experience them with great intensity. We perceive the scene as warm, personal and welcoming’. (Gehl, 2010, p.53) In this sense, planning must start from the ground floor. Here the role of sightlines is relevant for providing feelings of safety, orientation and diversity.

B. Ground floor design

Gehl (2010) stresses the importance of the ground floor of buildings to influence life in city space. What he calls soft edges, define public space and are the exchange point with the private space. Rhythm, narrow units and openness and presence of activities are aspects that must guide the design of the ground floor façades.

C. Public space design

Gehl (2010) summarizes the quality requirements of public space in 3 main guidelines: protection, good comfort, and delight. We can extract from Gehl’s guidelines the following design aspects:

Protection
- Eyes on the street
- Overlapping functions day and night

Comfort
- Unhindered sightlines
- Street furniture that provides talkscapes
- Locate sitting utilising advantages: view, sun, people

Delight
- Good design and detailing
- Good materials
- Trees, plats, water

7.3.2.5 Multimodality

Rietveld & Givoni (2007) researched the components of the trip chain when the train is the main mode
of travel. Based on data obtained from the Dutch Railways customer satisfaction survey (2005), they analyzed the profile of the access and egress modes to and from railway stations, finding important differences between these two. ‘In general, passengers will accept longer journey time and distance for the access journey than for the egress journey’. (Rietveld & Givoni, 2007, p.358) This can be explained by the asymmetry in the availability of private modes (car and bicycle) at both ends of the trip.

They found that most public transport users (69%) live within 3 km of the station, and that bicycle has the largest share of access trips (46%) within this range, while bus/tram/metro has the largest share (50%) over the 3 km radius. At the activity end, walking is the dominant egress mode with 47.2% of trips. Car has a low share in both access and egress journey (13.8% and 5.5% respectively).

This data casts important information for the planning of car and bicycle parking and public transport connections in relation with the land use characteristics of stations. For example, parking facilities (P+R, bicycle guarding) are more needed in stations with predominance of residential land use in a 3 km radius. On the other side, when planning destination land uses such as schools, health or employment centers, distance to the station should be in a walkable range.

A. Access infrastructure

Rietveld et al (2009) focused on station accessibility relating it with two aspects: (1) the passengers overall satisfaction with the rail journey and (2) their propensity to use rail due to station accessibility. Four aspects of accessibility were included in the survey: connection with other public transport modes, car park capacity, guarded and unguarded bicycle parking facilities.

They found that the current level of satisfaction with access infrastructure has a negative impact on the overall satisfaction with the service, so it is a dimension where improvement is most needed. For infrequent travelers, accessibility was more important than for frequent travelers suggesting that there is room for increasing transit patronage by improving accessibility to the stations. Also they found that accessibility improvement would be more cost-effective in increasing the overall satisfaction level than improving the rail service.

Martens (2007) studied the effectiveness of bike & ride policies in the Netherlands. The latest development in this policy (‘Space for the Bicycle’) included guidelines developed in conjunction with the Dutch Cyclist Association regarding: the number of parking places, mix of guarded and unguarded parking facilities, maximum walking distance between facilities and station entrance (200 m) and visibility of facilities from busy areas to increase safety.
B. Transfer quality

Spek (2003) defines the main function of multimodal transfer points as the connection function. He stated that it is possible to measure the quality of the connector mainly in terms of the time spent in doing the transfer. For this purpose, he developed a methodology to evaluate the performance of the connector based on logistic analysis and quantitative data.

His method consisted in measuring the transfer distance of all the possible connections in a multimodal node, allowing him to calculate an average value for the connector. The method has a first stage of visual analysis and a second stage of quantitative analysis of pedestrian routing. In his case study, he detected the significance of barriers in the quality of the transfer. Removing barriers for pedestrian proved to be the main strategy to improve the performance of the connectors.

7.4 Conclusions from the theory review

A. Planning concepts

From the planning theories explored at the beginning of this review, it can be said that Transit Oriented Development can be related more directly with the network city. In fact it can be seen as an embodiment of this sometimes elusive concept. In this sense, the recent shift in planning strategy taken in the Netherlands from the compact city to the network city could be illustrated as follows: ‘Compact city policy: build in or next to the existing city. Transit Oriented Development: build within walking/cycling distance to station.’ (Curtis et al, 2009, p.7)

Transit Oriented Development has sufficient potential to be boosted in planning practice but it must overcome the normative doctrines and continue expanding its knowledge base of observable causal relations. Special emphasis must be put on the D variable of design, as it has proved to have a higher impact of travel behaviour than it was thought before (Ewing and Cervero, 2010). Spatial configuration theory (Hillier) provides a strong methodological basis to build such knowledge of the design aspect.

B. Design variables

The design variables of station areas included in this review are design strategies rather than blueprints. In order to contribute to the construction of an operative approach to TOD, the design variables can be translated into a methodological framework that would guide the design of a station area. This translation accepts adjustments in order to be usable as a tool.
In this way, the project variables are translated as: public transport network, street network, public space, program and morphology. Each aspect is leaded towards a goal. The goals are formulated following Montgomery’s definition of ‘conditions for urbanity’. The sub aspects included in the analysis and the design operations are enumerated in the table below.

<table>
<thead>
<tr>
<th>PROJECT VARIABLES</th>
<th>ANALYSIS</th>
<th>DESIGN</th>
<th>GOALS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transport network</td>
<td>P.T. networks, Station building</td>
<td>Network extension, Modes integration</td>
<td>Accessibility, Seamless transfer</td>
</tr>
<tr>
<td>Street network</td>
<td>Spatial barriers, Street patterns, Street types</td>
<td>Spatial connections, Street densification, Street hierarchisation</td>
<td>Spatial integration, Street density, Street hierarchy</td>
</tr>
<tr>
<td>Public space</td>
<td>Routes, Main spaces, Edges</td>
<td>Space sequencing, Space scaling, Edge definition</td>
<td>Public space system, Human scale, Edge permeability</td>
</tr>
<tr>
<td>Program</td>
<td>Primary uses, Secondary uses</td>
<td>Use concentration, Use association</td>
<td>Program intensity, Program mixture</td>
</tr>
<tr>
<td>Morphology</td>
<td>Block types, Plot sizes, Building types</td>
<td>Block subdivision, Plot differentiation, Typologies diversification</td>
<td>Fine grain, Plot variety, Built-in adaptability</td>
</tr>
</tbody>
</table>

New unguarded parking facilities, Groningen
Source: www.kcap.nl
REFERENCES STUDY
8 Theoretical line, phase 2: References study

The reference study focuses on the aspect of place quality. Two station squares cases are chosen as examples of successful places: Hackescher Markt in Berlin and Gare de Strasbourg, in Strasbourg. The following is a brief overview of these cases regarding the design aspects that were defined in the theory review.

8.1 Hackescher Markt

This square, laid out in 1750 as a market square received the S-Bahn station in 1882. Nowadays, it is a point of reference in Berlin for its ambience and vitality, in part because of its proximity with the Hackesche Höfe courtyard ensemble.

<table>
<thead>
<tr>
<th>Public transport</th>
</tr>
</thead>
<tbody>
<tr>
<td>The square itself serves as interface between the S-Bahn and the tram and bus networks. No formal special connections are made to facilitate transfers between modes, but the distance between the stops is relatively low, and the route is easily legible and without barriers, so transfer quality can be presumed to be reasonably high.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Street network</th>
</tr>
</thead>
<tbody>
<tr>
<td>The station is well integrated to the street network. There are several crossings under the S-Bahn flyover and several bridges crossing the Spree to the south, so the barrier effect of these elements on the street network is low. The station is located next to a crossing point of 3 main streets. The area up north of the station has a dense network with irregular patterns.</td>
</tr>
</tbody>
</table>
Public space

There is a sequence of public spaces in the area including squares and courtyards.

The space of the square is very narrow and human scaled.

Its length is 80 meters and its width varies between 20 and 50 meters. The average height of the buildings is 20 meters.

The edges are permeable, fine grained and active.

Program

The station has an active façade with many shops and restaurants looking towards the square.

On the other side of this space and the area beyond, there are mixed use buildings with housing and offices on the upper floors and shops and businesses on the ground floor.

Morphology

The predominant block type is the closed block with courtyard, sometimes interconnected.

The plots are fine grained.

The predominant building type is the multistory building from 4 to 8 floors, with commercial activities on the ground floor.
### 8.2 Gare de Strasbourg

Gare Centrale is the main train station in Strasbourg, France. The 1883 station building was renovated in 2007 with the arrival of the TGV to the city. The most visible modification to the station is the addition of a new glazed gallery in front of the existing building that allows the connection with the underground tram line. The square in front of the station and the diagonal streets that reach it create a strong spatial ensemble that accentuates the building. This square was also renovated in 2007 into a green area.

#### Public transport

Different modes of transport converge to the station: train, tram and bus. The station allows seamless transfers between these modes. Train and tram are connected through the new extension, with the tram going underground. Buses stop on the street in front of the station.

There is also a P+R facility under the square.

#### Street network

The railway tracks are a huge barrier to the west, so the integration of the station with the street network is one-sided.

The street network itself is arranged with the station square as the focal point of the main streets in the area.

The street pattern is regular with narrow blocks.
Public space

The square is the endpoint of many routes from the city.

It is shaped as a semi-circle with 150 meters of length and 80 meters of width.

It is a big open space predominantly covered with grass. Despite the lack of elements to scale down the space, people use the lawn to stay and meet.

Program

The program in the area is intense and varied, including housing, offices, financial services, hotels, restaurants and shops.

A big SNCF office building is located right next to the station, but not on the main routes from the city center, so it doesn’t interfere with the emergence of small businesses and shops.

Morphology

The predominant block type is the closed elongated block.

The plots are very fine grained.

The predominant building type is multistory building from 4 to 8 floors, with commercial activities on the ground floor.
8.3 Conclusions from the reference study

A. Public transport network

The goal is to allow seamless transfer with the less infrastructural elements and use of space. It is possible to integrate different modes of transport in the station itself or using public space as an interface. For example, when the number of bus and trams allow it, the connection with these modes can be made with a simple stop in front or next to the station.

B. Street network

A direct connection of the station with main streets is crucial for its integration with the street network. A dense pattern of streets also helps to create more integration. Main routes can be arranged in a radial order to accentuate the accessibility of the station.

C. Public space

In principle, narrow spaces, and more human scaled are more attractive for people and allow more optional activities (in Gehl’s terms). But more openness can also be attractive if it is combined with well designed features like green areas.

D. Program

Mixed use buildings help to add density and diversity to the station area. Also, the station building can contain special activities like leisure and horeca. Bigger programmatic elements can be located next to the station, but without interfering with the potential shopping routes.

E. Morphology

Closed blocks with small plots and multistory buildings create the conditions for the emergence of dense and diverse program. Small blocks in the immediate vicinity of the station create different spatial conditions for the location of shops and different routes to the station.
9 Practical line / phase 1: analysis and site selection

9.1 Comparative analysis of stations

The general analysis serves as a framework for understanding the social and urban problematic of the Stedenbaan station areas, in order to build a strategy for the intervention. It measures quantitatively different aspects of the station areas, focusing in the social aspect as well as the level or urban development. The basic unit of analysis is defined as an area of 1 km radius around each station.

The aim of this analysis is to compare the state of the different locations. For this reason, the outcome has the form of a ranking. The social variables were used to arrange the stations starting from the lowest values. The measurements in this case were the average income (data: CBS) and the life quality index (data: Leefbarometer). Both aspects seemed to be strongly related according to the figures.

All the stations in red belong to Rotterdam. When comparing the social values, this city-region immediately highlights as an area with social problems. This is confirmed by the life quality index which shows graphically the spatial quality of urban areas. The station area with the lowest income in Rotterdam is the new station of Spangen.

No direct relationship was found between the social values and the measurements of urban develop-

### Table: Stedenbaan stations analysis

<table>
<thead>
<tr>
<th>Station name</th>
<th>Average income</th>
<th>Livability</th>
<th>Density Inhab*work</th>
<th>Inflow passengers 2008</th>
<th>Jobs / housing balance</th>
<th>Space value</th>
<th>station type</th>
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<tbody>
<tr>
<td>DK Dam Haag Maaswijk</td>
<td>15.281</td>
<td>3.60</td>
<td>169</td>
<td>1.466</td>
<td>4.480</td>
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<td>3.40</td>
<td>161</td>
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<td>0.40</td>
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<td>125</td>
<td>4.500</td>
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<td>RF Rotterdam Stationpark</td>
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<td>CS Capelle Schollevaar</td>
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<td>GO Guinea</td>
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<td>NI Rijswijk</td>
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<td>ZO Zoetermeer</td>
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<td>ZS Zoetermeer Oost</td>
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<td>LG Leiden Centraal</td>
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<td>DM Dam Haag Centraal</td>
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<tr>
<td>GU Gouweoorp</td>
<td>20.100</td>
<td>5.00</td>
<td>31</td>
<td>-</td>
<td>1.86</td>
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<td>DM Dam Haag Marinasleep</td>
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<td>BS Stasiehaven</td>
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<td>3.22</td>
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<td>SK Schiedam Kethel</td>
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<td>DY Dam Haag Ypender</td>
<td>20.810</td>
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<td>HI Nieuwegein met Kassel</td>
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<td>0.43</td>
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</tr>
</tbody>
</table>

Stedenbaan stations analysis. Own elaboration New stations are written with italics.
Although it was not possible to extract conclusions from these measurements, the figures in the aspects of density, diversity and design provide a good characterization of the stations on these different aspects.

The density aspect is measured in terms of inhabitants+jobs per hectare (data: Atelier Zuidvleugel) and in terms of in/out passengers per day (data: Stedenbaan Monitor). From these figures a hierarchy of the busiest nodes can be observed, with Rotterdam Centraal and Den Haag Centraal as the densest areas.

The diversity aspect was measured in terms of the balance of inhabitants and workers (data: Atelier Zuidvleugel). The numbers are all positive because the dominant value was always divided by the lowest value. Higher values reveal monofunctional areas like Den Haag Bleizo or Leiden de Vink which are...
predominantly residential areas. The closer to 1 is the value, the more balanced in terms of activities is the station area.

Finally, the design aspect is a numeric value extracted from the local integration analysis made with the Space Syntax software Depthmap. Here the higher values reveal more integrated areas in terms of street network in the 1 km radius. Leiden Centraal, Dordrecht and Delft have the highest scores due to the influence of the high local integration values of their historic centers.
9.2 Site selection

From the comparative analysis of the Stedenbaan stations, it is concluded that Rotterdam is the area where an intervention is more needed in order to improve its social conditions. Among the existing and proposed station in this city-region, Spangen has the highest priority for the development of the project, because it has the lowest social indicators.

9.2.1 Study area and project area

The study area has a radius of approximately 2 km. around the project area. It includes part of the municipalities of Rotterdam and Schiedam. The project area is a polygon around the railway line, between Schiedam CS and Rotterdam CS. It falls right into the ring road of Rotterdam, on the south side of the A20.
The project area will be called Spangen area to distinguish it from the existing neighbourhood of Spangen, which will be called Spangen neighbourhood.

The project area has 63 hectares. It is bordered by the A20 on the north, the Schie canal and the Spangen neighbourhood on the East, Marconiplein on the South, Oud Mathenesse and Schieveste on the west.

The chosen area lies on both sides of the railway tracks, containing a mix of built-up and un-built areas. Most of the built-up areas are business areas of the Spaanse Polder, on the north side of the railway. These buildings are mostly garages and warehouses that can be replaced in the project. Some exceptions are office buildings and towers that can be preserved.

There are few important buildings in the area: the Van Nellefabriek and the Europoint Towers, which will be preserved. There is also a strip of schools and sport facilities that should be relocated in the project. Finally, there are green functions, like allotments, sport fields and educational gardens that should find their place in the periphery of the city.
9.2.2 Reason for the site selection

From the last reports of Stedenbaan (Stedenbaan Monitor, 2010), it was observed that this new station was not anymore the list of Stedenbaan stations. This was confirmed in an interview with the professionals in charge of the project.

Despite this fact, it was decided to go on with this station in the context of an academic research. This choice was based on the great potential that this location has for new development, expressed in the following aspects:

- Potential for urban regeneration and social improvement.
- Potential for new station
- Potential for new centrality in the inner city of Rotterdam

9.2.2.1 Potential for urban regeneration

A. Rotterdam city-region

Rotterdam is the second largest city in the Netherlands. It has approximately 610,000 inhabitants (www.cos.rotterdam.nl), with 48% of immigrant population. The city region of Rotterdam has approximately 1,200,000 inhabitants, which makes the area one of the most densely populated regions in the country. Its economy is largely based on the port which is one of the main gateways of goods in Europe.

This economic base of the city has a reflection of the high number of jobs for unskilled workers. A mix of this fact plus the high number of immigrants with low education puts Rotterdam as one of the cities with the highest rates of households with low income (54% of households) at national level (www.cos.rotterdam.nl).
B. Spangen

Spangen is located in the district of Delfshaven. This area is characterized by its relatively young population, its multicultural background and low levels of social index variables, such as education and Dutch language fluency (Deelgemeente Delfshaven, 2010). It is one of the top priority areas for social intervention in Rotterdam, along with Charlois and Feyenoord.

At city level, Delfshaven is in the group of districts with the lowest average income and higher proportion of low income households.

Several efforts to improve the conditions of this area have been carried out in the last decade and continue until now. Spangen and Bospolder/Tussendijken were included in the program of new urban renewal program of Rotterdam in 2005. New housing projects and educational facilities have been incorporated in the area since then.

Although there has been an improvement in the perception of life quality in the area, the image is still not optimal for Spangen and Delfshaven. There are still challenges related with education, housing stock and job opportunities (Deelgemeente Delfshaven, 2010).
9.2.2.2 Potential for new station

Oud West is the collective name for 7 neighbourhoods in the districts of Rotterdam Centum and Delfshaven. The area has over 26,000 homes and over 69,000 inhabitants (www.kei-centum.nl). The Spaanse Polder (8) is a business area of approximately 190 hectares, where about 900 companies are located. It is the workplace of 10,000 workers especially in industries of trade, repair, car dealing, construction, transport and business services (www.rotterdam.nl).
9.2.2.3 Potential for new centrality

A. Historic development

Much of the present day situation of the Spangen area is a result of the historic development of Delfshaven. It started at the end of the 14th century with the digging of a canal between the Overschie and the Maas River. The harbor of Delfshaven was located between the Schiedam and Rotterdam harbors. It developed as the ‘harbour of Delft’ until it declared itself an independent municipality in 1795. In 1886 it was annexed by Rotterdam.

Despite its administrative entailment with Rotterdam, Delfshaven remained as an in-between zone outside of urban development. It was at the beginning of the 20th century when the area was developed to cope with the housing shortage of Rotterdam.

The location of urban functions reflects this condition of no man’s land. The area situated between the infrastructure lines is highly isolated and has received functions commonly found in the periphery like sports fields and allotments.

B. Future Transformations around Spangen

The study area is surrounded by some of the major urban transformation areas in the Rotterdam city-region. The most relevant transformation that will characterise urban development in the next 30 years
Analysis and site selection

1886 (anexation of Delfshaven by Rotterdam)

1905 (after rail detour)

1st half of 20th century (before the ring)

End of 20th century (after the ring)

Urban growth of Schiedam and Rotterdam. Maps: TU Delft

Timeline of urban transformations in Rotterdam.
Transit Oriented Regeneration

-called Stadshavens- is the redevelopment of the vacant areas of the port activities that are moving to the Maasvlakte (west of Rotterdam, at the mouth of the Maas River on the North Sea). One of the Stadshavens areas is located right south to the project area. It is composed by the Meerwehaven and the Vierhaven.

Other significant redevelopments in the surroundings are the Dakpark (Rotterdam municipality) along the Vierhavensstraat, at the south of the project area and Schieveste (Schiedam municipality) at the west. The first consists of a park over a strip of big stores keeping the shape of the former dike. The second consists of a strip of mixed functions developments between the railway and the A15. Another development is the Spaansepolder, which is basically the upgrading of the existing business activities up north of the project area. This is a private development and it doesn’t involve a major urban transformation.

From the review of historic and future development in the vicinity of the project area, it can be said that there is great potential for a new centrality in the area. A new Stedenbaan station could become the anchor of this centrality and a hierarchical point to organize the growth and transformation trends that are taking place in the surrounding areas.

![Development strategy of Merwe-Vierhavens 2025 and 2015 priorities. Source: www.stadshavensrotterdam.nl](image1)

![New housing, office and mixed use developments in Rotterdam. New Bijlmer Arena station, Amsterdam. Source: www.nieuwekaart.nl, 2011.](image2)
DESIGN
10 Practical line / phase 2: local analysis and design

The methodological framework defined in the theory review will be used to guide the local analysis and design phase. The first project variable to be put into practice is public transport.

10.1 Public transport network

<table>
<thead>
<tr>
<th>PROJECT VARIABLES</th>
<th>ANALYSIS</th>
<th>DESIGN</th>
<th>GOALS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Spatial elements</td>
<td>Operations</td>
<td>Conditions for urbanity</td>
</tr>
<tr>
<td>Public transport network</td>
<td>-P.T. networks</td>
<td>-Network extension</td>
<td>-Accessibility</td>
</tr>
<tr>
<td></td>
<td>-Station building</td>
<td>-Modes Integration</td>
<td>-Seamless transfer</td>
</tr>
</tbody>
</table>

10.1.1 Public transport network analysis

10.1.1.1 Problems with modal split

In the context of the four major cities of the Netherlands, Rotterdam has severe mobility problems related with its modal split. It is the most car dependant city and it has the lowest share of bike travels. One of the reasons is the structure of the transport networks. Rotterdam Vooruit (2009) identifies 3 main issues, 2 related with the road structure and 1 related with the public transport network.

Modal split, external and internal trips per municipality.

Mobility problems in Rotterdam region.
10.1.1.2 Mobility strategy

In order to improve the efficiency of the mobility networks, Rotterdam Vooruit proposes to link the roan and OV network with multimodal transfer points, and to integrate the different modes of public transport in a single network (Zuidvleugelnet). The municipality of Rotterdam identifies 5 possible locations for P+R transfer points. One of these is located in the vicinity of the study area, somewhere between Schiedam and Spangen. It has the advantage of quick communication between the A13, A20 and the rail network.

10.1.2 Public transport network design

The mobility strategy of the Rotterdam city-region is taken as the starting point of the design proposal. In order to fit with this strategy, the first design decision is the location of the station. It must coordinate 2 aspects: potential integration of public transport modes and potential of integration with the street network.

10.1.2.1 Design alternatives

The strategy looks into the potential future integration of the Stadshavens and the Nordas projects by a new tram line which passes across the study area and reaches the new Stedenbaan station. This hypothetical line is shown in the diagrams.

The diagrams show the 2 alternatives studied. Despite the fact that alternative A is more equidistant with Schiedam CS and Rotterdam CS, it is too far from the metro lines (present and future) and has very low potential for local integration with the street network. For this reason, the alternative B is chosen as the project location.
10.1.2.2 Multimodal transfer node

In order to integrate the new train station with the metro network, a reroute of the metro must be made taking advantage of the construction of the new metro line from the south, that is coming underground. In this way, another aspect can be improved that is to replace the flyover with an underground metro. In addition, the tram lines in the area can be extended to the north, making the new station a multimodal hub. This would also integrate the Spaanse polder with the public transport network, adding more coverage area for the new Stedenbaan station.
10.1.2.3 Station design

The station combines the following modes of transport: train, metro, tram, bus, bike, car and walking.

Two concepts guide the design of the station: tangential approach and stratification. Tangential approach is used at ground level to organize the different modes that use this level minimizing interference:

- Tram and bus share a dedicated lane that crosses perpendicular under the railway.
- A parking building for bikes is located on the east side of the station. A bike path crosses under the railway and has direct access to the parking building. The bike path runs parallel to the green network which also crosses under the railway tracks.
Transit Oriented Regeneration

- A P+R building is placed in a similar way on the west side of the station. This is first point of contact of the station with the route coming from the A20. Both parking buildings -bike and car - have 2 levels. A K+R zone is placed also on this side of the station.

- A central pedestrian passage crosses under the railway right in the middle of the station giving access to all the platforms.

Stratification is used to create a compact station, with 3 main levels:

- Underground level for metro.
- Ground level for tram, bus, bike, car and walking.
- Upper level for train platform

Station design. Own elaboration.
10.2 Street network

10.2.1 Street network analysis

10.2.1.1 Isolated networks and street patterns

The street network of Rotterdam is very fragmented by infrastructural lines. Spangen neighbourhood is one the most iconic ‘islands’. Block composition in the area reflects this fragmentation, to the extent that the network of each island is autonomous and preserves the original structure of dikes and canals. There isn’t a unifying pattern of blocks.

10.2.1.2 Street hierarchy and street types

Street hierarchy in Rotterdam expresses a clear separation of functions, following the modernist distinction of roads for traffic and roads for access to buildings. (Marshall, 2005) Most of the streets with higher hierarchy are arterial roads that cross between neighbourhoods. Collector roads connect these arterial roads with the local streets. There are few examples of traditional streets that combine traffic and access within the urban fabric: only the Mathenesserweg and Schiedamseweg (highlighted in red) that connect Marconiplein with Rotterdam centrum.
10.2.1.3 Physical barriers and spatial integration

Spatial integration in the area is conditioned by the presence of physical barriers. In order to overcome isolation it is necessary to remove (some of) these barriers, as we will see in the evaluation of street network design alternatives.

10.2.1.4 Centralities

As we saw in the theory review, spatial integration is a condition for pedestrian movement and human activity. The location of shops is a reflection of these two aspects. With the local integration analysis we can extract conclusions of the more ‘central’ locations in the area, following Hillier’s concept of emergent centrality.

From this analysis we can see the potential for connecting different ‘central’ locations, like Franselaan and Mathenesseweg (in the picture).
10.2.2 Street network design

The main goal is to integrate the station area with the street network. Also is important to connect the Oud Mathenesse and Spangen area in west-east direction and Spaanse polder with Marconiplein in the north-south direction. Two alternatives were tested with Space Syntax to evaluate these aspects.
10.2.2.1 Design alternatives with space syntax

Alternative B was chosen and then improved to build an optimised scenario for the design.
10.2.2.2 Spatial structure of the project

The structure of the project is built around a T shaped array of high streets that connect the north-south and east-west directions. The north-south axis crosses the railway right next to the station, and then connects with the east-west axis that joins Oud Mathenesse with the Spangen neighbourhood. These high streets combine traffic and access to property in the traditional way. Secondary streets increase the number of crossings through the spatial barriers of the area: the railway dike, the Spaansebocht dike and the Tjalklaan.

The street network creates zones of regularity along the main lines of the project: the central central high streets, the Tjalklaan and the A20. The average block size is approximately 70 by 90 meters in order to achieve spatial integration. Street connectivity and street types are organised to create zones of high intensity for multiple uses and quieter zones for residential areas.

Spatial structure of the project.
Own elaboration
10.2.2.3 Street types

Modification to arterial roads.
Own elaboration

Street types of the project.
Own elaboration

Tjaiklaan / existing

Tjaiklaan / proposal

Marconistraat / existing

Marconistraat / proposal

Modification to arterial roads.
Own elaboration
Local analysis and design

Street type A design.
Own elaboration

Street type B to E.
Own elaboration
10.2.2.4 Scope of the intervention

In order to gain a position in the metropolitan context, the Spangen area needs a quantum leap in its connectivity and spatial integration. The project proposes a massive intervention in the street network to achieve this. Most of the existing streets, especially those on the south side of the railway should be redesigned, and a number of new streets should be opened.

The main infrastructural works are: new metro and tram line, new dike with crossing in the station area, new Horvathweg flyover, new Marconiplein junction and new bridges. The demolitions reach an amount of 160,000 m² of mostly business buildings.
10.2.2.5 Extensions

The project considers the future development of Spaanse polder and Stadshavens to the north and south of the area. As a suggestion, three strategic interventions are proposed to integrate them into the urban structure. These consist of parallel streets that create narrow strips of urban blocks along the main roads: Industrieweg, Schiedamseweg and Vierhavensstraat.

10.3 Public space

<table>
<thead>
<tr>
<th>PROJECT VARIABLES</th>
<th>ANALYSIS</th>
<th>DESIGN</th>
<th>GOALS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spatial elements</td>
<td></td>
<td>Operations</td>
<td>Conditions for urbanity</td>
</tr>
<tr>
<td>Public space</td>
<td>-Routes</td>
<td>-Space sequencing, -Space scaling, -Edge definition</td>
<td>-Public space system, -Human scale, -Edge permeability</td>
</tr>
<tr>
<td></td>
<td>-Main spaces</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>-Edges</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

10.3.1 Public space analysis

10.3.1.1 Green network at city scale

Much of Rotterdam’s potential of attraction for new inhabitants and urban development lies on its relation with water and nature. The relatively short distance between the Maas and Midden Delfland (about 5 km) creates conditions for bike routes that combine leisure with commuting. One of these routes runs along the Schie and through Delfshaven, on the east of the project area.
It is possible to bring this route into the project area associated with the metropolitan green network.

10.3.1.2 Existing public spaces in the area

There are few relevant public spaces in the area, only the Spaansebocht Park, the open space around the Sparta Stadium and Marconiplein. The quality of these spaces is low, especially the Sparta area and Marconiplein. The Spaansebocht park is hidden by the old railway dike which creates a feeling of insecurity (see barriers analysis).
10.3.2 Public space design

10.3.2.1 Integration to green network and bikepath network

The project proposes a connection of the recently developed Roel Langerakpark on the east bank of the Schie with the future Dakpark along the Vierhavensstraat. For this purpose, it widens the green strip along the Spaansebocht, removing the dike and creating a spine for the new green structure of the area. This is reinforced with the connection of the bikepath network through a new slow traffic bridge over the Schie.
10.3.2.2 Public space structure of the project

The main public space structure is formed by the green network which extends through all parts of the project area. These parks are narrow (about 30 meters) and are combined with the network of canals.

The project creates sequences of public spaces of urban character in addition to the green network. These sequences start from the 2 main stations in the project: Spangen (A) and Marconiplein (B).

One route goes in the north-south direction through a series of courts, connecting the station with the waterfront square (1) to the north.
10.3.2.3 Main public spaces: Spangen station square

At the local scale, the most important public space of the project is a double square on the two sides of the new station. The south square is designed with an asymmetric shape, opening to the high street. The station façade reinforces this gesture.
The size of these squares is small in order to achieve human scale, but they are connected with a series of passages and courts through the bounding urban blocks in the north-south direction, creating a small scale public space system.
A special route to the east connects the south square with the new theater and the Sparta Stadium. This route is designed so the public of massive events don’t interfere with the normal circulation of people.
10.3.2.4 Main public spaces: Spaansebocht Park

The Spaansebocht park is the spine of the new public space system of the project area. The proposal doubles its width from 30 to 60 meters, and reinforces the central promenade with new rest areas and...
playgrounds. The crossing point of this park with the Sparta park receives the influence of the cultural and sport facilities in the area.
10.3.2.5 Main public spaces: Marconiplein

At the moment, the size of this space is enormous: about 6 hectares of roads and empty space. The traffic solution creates a strange junction that consumes too much space and the bus stops are oversized. The result is the worst possible environment for pedestrians. The goal of the design is to create a more human scaled public space and to make better use of the space adding more functions.
For this motive, the design intervenes the traffic solution with a simpler a more regular alignment of streets. Two urban blocks are added in front and next to the Europoint Towers, and the tram-bus stops solution next to the metro station is simplified. The design allows the continuity of the Dakpark and the Spaansebocht Park with a green square next to the metro station.
10.4 Program

10.4.1 Program analysis

10.4.1.1 Existing uses

The current situation in the vicinity of Spangen area is of strict differentiation of uses. Residential areas and industrial areas are the rule. The exception can be said to be the high streets of Mathenesseweg and Schiedamseweg with high presence of shops in mixed use buildings.

Special functions are the Van Nellefabriek and Sparta Stadium. These buildings are also heritage buildings with great value. Educational and sport facilities in the project area are going to be relocated with the project.

Urban functions in Spangen.
Own elaboration. Data: DANS, 2011
10.4.1.2 Density

Existing density have an average gross density of 62 inh/ha (not considering parks). The FSI has a value of 1 (same area consideration).

<table>
<thead>
<tr>
<th>Borough</th>
<th>Density (inhab/ha)</th>
<th>Density (FSI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spangen</td>
<td>172</td>
<td>1,10</td>
</tr>
<tr>
<td>Oud Mathenesse</td>
<td>153</td>
<td>0,86</td>
</tr>
<tr>
<td>Average</td>
<td>162</td>
<td>0,98</td>
</tr>
</tbody>
</table>

10.4.2 Program design

10.4.2.1 New program definition

The new program in the project considers 65% of housing floor area, with 2820 units and a gross density of 136 inh/ha (not considering parks). The proposed FSI is 1,18 using this same area consideration.

These high densities are reached with a big amount of public space though. For this purpose the net FSI reaches almost a value of 2,8. It means building heights between 3 and 8 floors. Education is highly important as well, reaching 11% of overall program.

<table>
<thead>
<tr>
<th>Function</th>
<th>demolition (sqm.)</th>
<th>sqm. new program (sqm.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Housing*</td>
<td>-</td>
<td>417.650</td>
</tr>
<tr>
<td>Business</td>
<td>134.137</td>
<td>28.914</td>
</tr>
<tr>
<td>offices</td>
<td>16.738</td>
<td>25.702</td>
</tr>
<tr>
<td>Services</td>
<td>357</td>
<td>22.489</td>
</tr>
<tr>
<td>Education prim-sec</td>
<td>6.114</td>
<td>44.978</td>
</tr>
<tr>
<td>Education higher</td>
<td>-</td>
<td>22.489</td>
</tr>
<tr>
<td>Social</td>
<td>694</td>
<td>3.213</td>
</tr>
<tr>
<td>Culture</td>
<td>-</td>
<td>16.063</td>
</tr>
<tr>
<td>Leisure</td>
<td>-</td>
<td>16.063</td>
</tr>
<tr>
<td>Shopping</td>
<td>-</td>
<td>17.670</td>
</tr>
<tr>
<td>Horeca</td>
<td>381</td>
<td>9.638</td>
</tr>
<tr>
<td>Sports</td>
<td>4.181</td>
<td>4.819</td>
</tr>
<tr>
<td>Parking</td>
<td>-</td>
<td>12.851</td>
</tr>
<tr>
<td>Total</td>
<td>162.602</td>
<td>642.538</td>
</tr>
</tbody>
</table>

10.4.2.2 Program distribution

The highest program intensity is reached in the vicinity of the station area in a radius of 300 meters. A strip of high density is also located along the central high street that reaches the station and on the Tjalklaan on the west border of the project.

Higher education and public offices are located right next to the station, in the same proportion of private offices, retail and housing. In this way, it is aimed that the station area remains lively throughout different times of the day and becomes an attractive place. More quiet areas for a diversity of housing typologies (including single family houses) are located in other zones of the project.

Special functions are located in relation with the green network, in the vicinity of the Sparta stadium adding attractions to the green network. They are also well connected to the station area through a special promenade.
Transit Oriented Regeneration

Urban functions structure of the project
Own elaboration.

General zoning of the project
Own elaboration.
10.4.2.3 Housing typologies

The predominant housing typology is collective housing, from 4 to 8 floors. Single family units are located in the quiet zones of the project.

New dwelling units

<table>
<thead>
<tr>
<th>Dwelling types</th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single family</td>
<td>296</td>
<td>10%</td>
</tr>
<tr>
<td>Multi-family</td>
<td>2,663</td>
<td>90%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>2,958</td>
<td>100%</td>
</tr>
</tbody>
</table>

Housing types in the project
Own elaboration.
10.5 Morphology

10.5.1 Morphology analysis

10.5.1.1 Existing block types in the area

The predominant block typology in Spangen is the elongated closed block of 4 storeys. In Oud Methanasse, there is a majority of open bar blocks with 4 storeys. The industrial areas show scattered big buildings with no clear definition of public space and block interior.

Existing block types in the area.
Source: Bing maps
10.5.1.2 Plot sizes and building types

The situation changes from one side of the railtacks to the other. In the Spaanse Polder, the average plot size is 1.000 sqm. While in the Spangen neighbourhood and Oud Mathenesse, the plots are much smaller.

The predominant building type is the multifamily housing building without lift. Some buildings have collective courts in their interior, while other have private gardens. Others have school facilities in the private court. An exception to this norm is Witte Dorp which is composed by single family houses. New housing projects combine single and multifamily housing.

10.5.2 Morphology design

The Proposal consists mostly of closed blocks with heights from 3 to 8 floors forming block clusters. Higher buildings are located as urban facades along the main streets and enclosing quiet zones with lower building heights.
10.5.2.1 Block typologies

Five block typologies are used in the project:

Continuous perimeter, filled interior. Narrow blocks, located near stations. Appropriate for housing or offices with big shops on ground floor.

Semi continuous perimeter, public interior. Small blocks, next to stations. Appropriate for housing or offices with small shops on ground floor.

Continuous perimeter, private court. Medium sized blocks, on different locations. Appropriate for housing or higher education complexes.

Continuous bar, public exterior. Narrow blocks, located in the waterfront. Appropriate for housing or offices with small shops on ground floor.

Island, public exterior. Big blocks, located in park. Appropriate for special program, like concert hall or sport facilities.
10.5.2.2 Plot sizes

Different plot sizes are used in order to fit with different kinds of developers. Some blocks can have a single developer, like in the case of housing complexes or higher education buildings. But the majority of blocks will have a mix of plot sizes for different developer sizes.

Taking a typical block configuration, there will be big plots for higher buildings on the main street side of the block. Medium size plots will be on the side streets and small plots for single family houses will be on the backside of the block.

10.5.2.3 Building typologies

The predominant building type is the perimeter building, which can be used to configure 4 of the 5 block typologies mentioned above. Variations in this type will be on the number of floors, use of the ground floor and circulations (vertical and horizontal).
10.6 Spatial strategies summary and project overview

Public transport spatial strategy

Street network spatial strategy

Public space spatial strategy

Program spatial strategy

Morphology spatial strategy

Combined spatial strategy
Local analysis and design

General plan indicating sections
Own elaboration
General sections. Own elaboration
Local analysis and design

Waterfront square from the north. Own elaboration

Main street from the south. Own elaboration

Station from the west. Own elaboration
Spangen station square from the west. Own elaboration

Spangen station square from the north. Own elaboration

Spangen station square from the east. Own elaboration
Local analysis and design

Station building from the south. Own elaboration

Public court from the north. Own elaboration

Tram/bus stop from the west. Own elaboration
Transit Oriented Regeneration
11 Practical line / phase 3: strategy and key projects

In order to integrate the new area of Spangen to the city and to trigger a regeneration process beyond the project area, the strategic plan must position Spangen in the collective mind as a new and vital part of the city. In order to do this, the strategy is guided by 2 concepts: quality and opportunity. In other words, the project must show its best attributes from the beginning.

The construction of urban quality must start from the spatial aspect at street level. In order to add spatial quality to Spangen, we must avoid spatial nuisances and enhance spatial assets. 3 main tasks are defined to implement this strategy, in the following order: to prepare the area for change, to position it in the metropolitan context and to consolidate the change. In practical terms, this means: to reduce the impact of the infrastructure and enhance the existing assets (prepare); to connect the area to the transport network (position) and to add new assets (consolidate). The following are the translation of these steps into key projects.

11.1 Reduced impact of the infrastructure (prepare)

Because of its original development as a sort of no-man’s land between the cities of Rotterdam and Schiedam, Spangen received heavy infrastructure lines, first the cargo rail tracks over a dike that gave shape to the Spangen quarter and later the metro flyover that runs parallel to Tjalklaan. Road design also benefited from the weak position of this area in the metropolitan context. The Horvathweg and the Tjalklaan layout create too much lost space in and around them.

The new position of Spangen in the city region of Rotterdam requires strong intervention in order to avoid the nuisance of the infrastructure. The metro line needs to be put underground, the rail tracks that are no longer in use need to be removed so the dike can be leveled down, and the cross sections of Horvathweg and Tjalklaan need to be redesigned in the new context to favor the pedestrian. The whole area must evolve from big empty space available for infrastructure to a compact urban area.
11.2 Enhancement of existing assets (prepare)

The generation of quality must build upon the existing spatial elements that contribute to an attractive urban environment and to the identity of the place. These elements are natural: green network and blue network and cultural: heritage buildings. These assets must be related in a way so that the punctual heritage buildings are connected by the green and blue networks.

A. Green network.

The strategy connects the local parks with the green network at city scale. The Spaansebocht park is connected with the recently developed Dakpark to the South and with the Roel Langerakpark to the east, on the other side of the Schie. The cross section of the Spaansebocht park is improved with the removal of the railway dike. The usable space is doubled and the central promenade is reinforced. This park is the spine of the new green network that is distributed through all the project area as a system of narrow parks. This configuration seek to maximize the benefit of the green area on the built environment.

B. Water

Water is a big attractor for new housing and other activities. It is present in many regeneration initiatives in the city of Rotterdam, mainly in the Stadshavens projects. The waterfront of the Schie can be rediscovered in the Spaanse Polder at short distance of the new station, adding quality and variety to the north-south spatial sequence of the project. Water is also present combined with the green network adding more natural features and life to these spaces.

C. Heritage

The main heritage buildings in the area are: the Van Nellefabriek, the Sparta Stadium and the Justus van Effencomplex.

The Van Nellefabriek occupies a large plot with big open spaces around the buildings. Some of these spaces don’t have a good image especially at the back side of the plot. The waterfront is occupied by part of the building ensemble, without a route that takes advantage of the image of the Schie. The strategy improves the spatial conditions of the borders of the plot. The backside is strenghtened as a green area and is partially contained by new buildings, leaving a connection with the project’s green network, a new sightline to appreciate the building complex from the public space. A pedestrian and a bike route is traced on the waterfront in front of the building, connecting it to re bike path network of the project.
The front side of the Sparta Stadium is cramped by the Horvathweg and the old rail tracks. Its lateral squares are isolated not very well designed. The strategy turns the open space around the building into a hierarchical component of the park system, creates a special pedestrian route from the station and adds cultural and sport facilities to reinforce the character of this part of the project.

The Justus van Effencomplex now is hidden behind the railway dike and the emerging structure of the metro flyover. The strategy removes these 2 barriers, redesigns the existing green area in front of the building and adds new urban blocks in an armonic relationship with the complex.

11.3 New high quality transport nodes (position)

Some parts of the project will be the most representative of the new urban quality in Spangen. These elements are basically of 2 kinds: transport nodes and streets. The nodes are the entry point to the project area and therefore must be treated with special care.

Two nodes will add quality to the project: the new Spangen station and the new Marconiplein. The transport nodes will be designed at human scale, with spatial attributes and amenities for the pedestrian like well designed surfaces, plantation and street furniture. The station buildings also will contribute to the new image with a design that will privilege sunlight and transparency.

The Spangen station squares on both sides of the railway will be compact and interconnected with a series of courtyards in the first rows of blocks like open shopping centers. A network a pedestrian routes will re-create the feeling of an historical center, fine grained and dense. Parking facilities for bikes and cars will be hidden by frontage buildings. The space under the elevated railtrack structures will have smooth surfaces and natural light.

The Marconiplein junction will be restructured to diminish the space used by traffic lanes. For this goal, the alignment of Tjalklaan and Schiedamseweg will be corrected. New blocks with mixed use will scale down the vast open space and add variety of functions in the area. The space used for bus and tram stops also will keep the continuity between the Spansebocht Park and the Dakpark.

11.4 New high quality streets (consolidate)

In the streets category, the Tjalklaan will be transformed from an arterial road to a urban street. For this goal, the cross section of the street will allow access to property as well as through traffic, and the space dedicated to each transport mode will be balanced to improve the conditions for pedestrians and slow traffic. The new design will save space for a future tram line that will connect the Spangen stations with the Standshavens. All these measures are aimed to attract intense and diverse activities along this street which will the one of faces of the project area to the city.

The new Spaanseweg will be the main street of the project. It will cross the project from the north, connect the new station and split in 2 branches that connect the Oud Mathenesse with the Spangen quarters. The cross section of this street will give priority to public transport bike and walking over car traffic. The detailed design of the public space will be of high standard with plantation and good materials. The ground floor of the buildings will have space for shops of different sizes and tenure modes to allow local businesses to flourish.

11.5 Completion

After the consolidation of the new image of Spangen, the project should continue developing mostly with it own energy and less external help. The generation of quality continues through this phase. The next areas to be developed are a mixed use areas structured by a dense street network. This phase will create a variety of spatial conditions for different housing typologies, from very active to quieter zones.
Step 1: reduce impact (prepare)

Step 2: enhance existing assets (prepare)

Step 3: new high quality transport nodes (position)

Step 4: new high quality streets (consolidate)
12 Practical line, phase 4: scenarios evaluation

The evaluation phase aims to test if the plan is worthy of consideration as a Stedenbaan project, and if it creates benefits for the Spangen area and the city-region of Rotterdam. Two scenarios of development are analysed, with the distinction of including or not a Stedenbaan station. The criteria for the evaluation is adapted from the design variables and the strategic plan.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Scenario 1 (without station)</th>
<th>Scenario 2 (with station)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public transport coverage</td>
<td>- The area would still depend on Schiedam CS for regional travel and on Marconiplein for metropolitan travel. - Car traffic would dominate over slow modes.</td>
<td>- The area would have metropolitan and regional coverage. - Slow modes would have priority over car traffic.</td>
</tr>
<tr>
<td>Infrastructure</td>
<td>- The metro flyover and the winding route of the Horvathweg would have no reason to be modified. - Maybe the dike of the old rail tracks could be removed.</td>
<td>- Obstrusive infrastructural elements would be modified.</td>
</tr>
<tr>
<td>Public space</td>
<td>- The Horvathweg would interrupt the continuity of the metropolitan park system. - There wouldn’t be new public spaces. - Maybe Marconiplein could be redesigned.</td>
<td>- There would be continuity in the metropolitan park system. - New public spaces of high quality would be opened.</td>
</tr>
<tr>
<td>Street network</td>
<td>- The area would still be fragmented: Oud Mathenesse and Spangen would still be disconnected; as well as the north and south sides of the rail tracks. - Road design solutions would still be the image of the area.</td>
<td>- New connections would integrate the area in east-west as well as north-south direction. - Arterial roads would be transformed into urban high streets.</td>
</tr>
<tr>
<td>Program</td>
<td>- There wouldn’t be any new housing attracted to the area, because of the isolation and nuisance caused by the infrastructure. - The exception would be some car dependant big box that could be placed next to the existing arterial roads.</td>
<td>- New housing and non residential activities would be attracted to the area. - Existing housing would become more attractive.</td>
</tr>
</tbody>
</table>

Without the station most of the plan couldn’t be realised, with the exception of the Spaansebocht Park and Marconiplein which are more independent components of the project. But still, these would remain as isolated projects with no coherence, and they wouldn’t make a difference for the position of the area in the metropolitan area.

Although the station is not the first element to be realised during the execution of the plan, it gives reason to the whole scheme, from the preparation to the consolidation phase.

- **Benefits of the plan**

It can be concluded that the station is indispensable for the transformation of the Spangen area into a high quality area with a role in the metropolitan context.

Moreover, with the station the plan is beneficial for the surrounding areas by creating a new centrality and connecting the area with the metropolitan system. It also is good for the city-region of Rotterdam because it adds new quality and a new focus for growth in the inner city.
CONCLUSIONS
13 Theoretical line / phase 3: conclusions

The conclusions consist in an answer to the research questions 1 and 3. Question 2 was answered in the theory review chapter.

Research question 1:

Which spatial strategies can be used to turn the Stedenbaan station areas into economically dynamic and well integrated sub centres that can improve the social and economic conditions of their surrounding areas?

In order to answer the research question, the research put 5 theoretical design variables into practice through a design task. From the result of the design phase, it can be concluded that these design variables are useful to guide the design work, and that each variable unfolds into 2 main spatial strategies.

The following is a synthesis of the key spatial strategies to create centrality around Stedenbaan stations. It can be seen as a refined version of the methodological framework:

<table>
<thead>
<tr>
<th>Variable</th>
<th>Spatial strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public transport</td>
<td>Integrate modes</td>
</tr>
<tr>
<td></td>
<td>Facilitate transfer</td>
</tr>
<tr>
<td>Street network</td>
<td>Dense network</td>
</tr>
<tr>
<td></td>
<td>Spatial integration</td>
</tr>
<tr>
<td>Public space</td>
<td>Human scale</td>
</tr>
<tr>
<td></td>
<td>Active ground floors</td>
</tr>
<tr>
<td>Program</td>
<td>Concentration around station</td>
</tr>
<tr>
<td></td>
<td>Mixed use buildings</td>
</tr>
<tr>
<td>Morphology</td>
<td>Closed blocks</td>
</tr>
<tr>
<td></td>
<td>Small plots</td>
</tr>
</tbody>
</table>

Research question 2:

Which variables of a station area development can affect the dynamic of existing neighbourhoods and improve their social and economic conditions?

From the strategic plan we can conclude that a prerequisite to generate spin off effects on the local context of the plan is the generation of spatial quality. This general strategy is built upon 2 spatial aspects: elimination of nuisances and enhancement of assets.

From the spatial strategies synthesized above, we can underline two aspects with more potential of creating spin off effect on the surrounding areas: accessibility and program.

In terms of accessibility, an intervention should include a boost in the connectivity of a place in terms of street network as well as public transport systems in order to maximise the closeness of job opportunities outside of the area.

In terms of program, an intervention should help the creation of jobs that fit the education level of unemployed people. This means attracting new businesses and offering space for local business. Training is also important. Educational institutions can be a key element to improve the opportunities of the younger population.
Conclusions and recommendations

14 Theoretical line / phase 4: recommendations for the development of station areas

A. Focus on spatial quality

The spatial aspect is vital to create successful sub centers. It is not only increasing density around stations what matters. The quality of the space in and around this density is equally important.

B. Reinforce centrality

The design of the network can improve the connectivity of the station and reinforce its centrality.

C. Create street life

‘A multitude of valuable social and recreational opportunities naturally emerge when you reinforce life on foot’. (Gehl, 2010, p.19)

D. Design for humans

‘Man is small, and therefore, small is beautiful’. (Shumacher, 1973)
Transit Oriented Regeneration
SOURCES OF INFORMATION
15 Sources of information

15.1 Bibliography


Dunphy, R., Cervero, R., Dock, F., McAvey, M., Porter, D., Swenson, C. (2004). Developing around Tran-
Sources of information


Nes, A. van, Stolk, E. (2009). Degree of Sustainable Location of Railway Stations. Delft


15.2 Reports


Sources of information


Urban Unlimited (2005b). Environmental Differentiation along the Stedenbaan.


15.3 General information

http://www.atelierzuidvleugel.nl
http://www.bereikbaarheidskaart.nl/
http://www.cos.rotterdam.nl/
http://www.deltametropool.nl
http://www.iea.org
http://www.kei-centrum.nl
http://kenniscentrarrowiijken.vrom.nl
http://notaruimteonline.vrom.nl
http://www.rotterdam.nl
http://www.rotterdamvooruit.nl
http://www.rr2020.nl
http://www.ruimtextmilieu.nl
http://www.stadshavensrotterdam.nl
http://www.stedenbaan.nl
http://www.stedenbaanplus.nl
http://www.spoorzonedeflt.nl
http://www.top010.nl
http://www.un-habitat.org
http://www.urbanunlimited.nl
http://www.urbantaskforce.org
http://www.vierhavenstrip.nl/
15.4 Geographic information
http://www.ahn.nl
http://www.bereikbaarheidskaart.nl
http://www.gis.rotterdam.nl/
http://www.cbsinuwbuurt.nl
http://www.leefbaarometer.nl/
http://www.niewekaart.nl.nl
http://www.ruimtelijkeplannen.nl

DANS Data Archiving and Networked Services (2011). Kadaster - Top10NL bestand