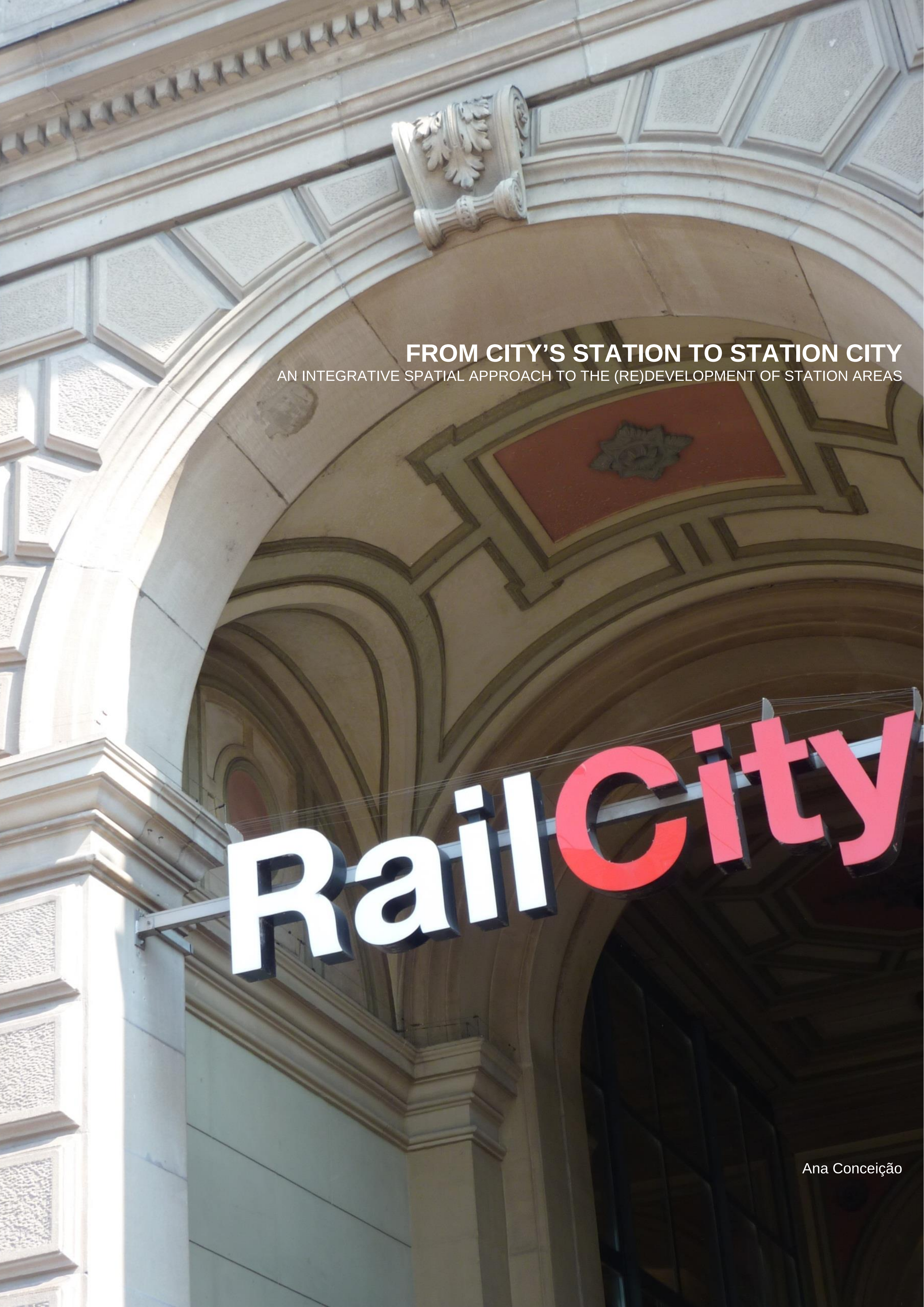

FROM CITY’S STATION TO STATION CITY

AN INTEGRATIVE SPATIAL APPROACH TO THE (RE)DEVELOPMENT OF STATION AREAS

Ana Conceição

From city's station to station city

an integrative spatial approach to the (re)development of station areas

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an integrative spatial approach to the (re)development of station areas

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Ana Luísa MARTINS DA CONCEIÇÃO
Licenciado em Arquitectura pela Universidade Técnica de Lisboa e
Mestre (MSc.) em Urbanística e Gestão do Território pelo Instituto Superior Técnico (Portugal)

geboren te Alhos Vedros (Portugal)

Dit proefschrift is goedgekeurd door de promotoren:
Prof. ir. L. van Duin
Prof. dr. ir. L. Bertolini

Copromotor: Dr. ir. R. Cavallo

Samenstelling promotiecommissie:
Rector Magnificus, voorzitter
Prof. ir. L. van Duin, Technische Universiteit Delft, promotor
Prof. dr. ir. L. Bertolini, Universiteit van Amsterdam, promotor
Dr. ir. R. Cavallo, Technische Universiteit Delft, copromotor
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Prof. ir. D. van Gameren, Technische Universiteit Delft
Prof. ir. A. Reijndorp, Universiteit van Amsterdam
Dr. ir. drs. Th. S. de Wilde, NS Stations
Prof. dr. ir. T. Avermaete, Technische Universiteit Delft, reservelid

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For my children

who (un)balanced my *journey*

PREFACE

From early on, I have been acquainted with the challenges and opportunities that rise from the mix of urban fabric and railway infrastructure. I grew up in Pinhal Novo, a village in Portugal near Lisbon that originates from the implementation of a bifurcation of railway lines. It became a major railway junction and a growing dormitory town, with the *right side* and the *other side of the railway tracks*, until today. I myself became a commuter when studying Architecture in Lisbon.

During my post graduate studies in Urbanism, the introduction of the High Speed Train in Portugal was a heated debate. Further, the redevelopments this transport mode triggered all around Europe had been bringing the station areas back in the spotlight. I took the opportunity to study these spaces from a planning perspective. This work, which broadened my previous architectural knowledge to the wider field of the spatial planning discipline, also brought my focus back to the scale of the interrelation between the building and its immediate urban surroundings. The underexplored reciprocal influences of the building and its immediate urban surroundings, and the evolution of their spatial (morphological and functional) relationship, caught my interest.

Determined to explore this theme, I contacted Prof. ir. Leen van Duin and Dr. ir. Roberto Cavallo, who received me as guest PhD researcher at the Building Typology Chair - Department of Architecture of Delft University of Technology. They became, respectively, my main supervisor and my co-supervisor. Prof. Dr. ir. Luca Bertolini of the Faculty of Social and Behavioural Sciences of the University of Amsterdam, who supervised my Master thesis, also became my supervisor in this new *journey*, which started in 2008 with the award of a grant by the Portuguese Foundation for Science and Technology – FCT.

As with many doctoral researches, mine was also a *journey* with pauses at *stations* and *crossings*, resulting in several adjustments to the initial *route*. Those moments were caused by the developments in the research field and personal events, which contributed to the considerable time span of this research and thus to adaptations. Overcoming these moments wasn't effortless, but they certainly became significant learning experiences. All in all, the PhD research period was a rich one, which wouldn't be possible without the precious help of others.

My first words of acknowledgement go to my supervisors and co-supervisor, for all their support, critics and input. I want to thank Leen for his sharp and timely interventions, which provided crucial energy to persist with this work on several occasions; Luca for his scientific integrity and constructive comments, which so many times shed light on the path to follow; and Roberto for always encouraging me to find ways to improve the work further, as well as for his precious operational support.

I am in debt with all the people who granted me some of their time and knowledge either by interviews, books, drawings, maps, etc., pushing this research in a good direction. I am also grateful to FCT, whose sponsorship made this research possible. Special thanks go to Magda Rocha, Ana Pereira Roders, Carla Vieira and Emilie Yane Lopes, who helped me, in different ways, in improving the content of this thesis.

Last, but not least, I must thank my children (who hopped on the *train* in 2010 and 2011), my husband, my parents and family, Mimi (our priceless devoted *guardian angel*), Margareth, and many other friends, for all the energy, love, care and attention, which helped me to persist to the end of this important phase of my academic and personal life.

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1. INTRODUCTION

The need to improve the spatial performance of contemporary European railway station areas and to understand how architecture can contribute to this goal, are the underlying motives of this research. The spaces of station areas do not fully achieve the liveability[1] level sought out by recent redevelopment projects. Additionally, the role that architecture plays in their spatial definition seems to be constrained, likely because of the projects' highly complex interdisciplinary planning processes.

With the aim of contributing to revert this scenario, this thesis proposes a set of 'design recommendations', which are grounded in a series of (comparative graphical) analyses on the factors that influence the spatial transformations of case studies, at several scales and historic moments. A structural change to the design task of station areas emerged as being crucial in order to integrate the public spaces of the building and of its urban surroundings, mitigating (spatial) discontinuities between them. By focusing design efforts on this intermediate scale, the city's station can become a 'station city', which enhances the city's liveability, instead of draining it out.

1.1. Research background

Societies and cultures transform as social, economic and environmental paradigms change and technologies[2] evolve or emerge. Cities' spaces (its buildings, squares, streets, etc.), as physical support for urban life, (should) reshape accordingly. As such transformations affect the use of these spaces by people (and the use of resources), and thus also societal, economic and environmental performances, they should preferably be done in a sustainable way. **Station areas**, i.e. the ensemble of the railway station buildings, transport infrastructure and their immediate urban surroundings, are paradigmatic examples of such spaces.

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[1] In this research, the term liveability, connotes the suitability for human life of an urban area. It encompasses a wide variety of characteristics that influence people to live in, or use, an urban location, such as: its economic strength; adequate provision of social and physical infrastructure; public participation; social inclusion; environmental preservation practices; etc.. Locations that embody these characteristics provide conditions to sustain lively communities.
Because liveability can be a very wide concept, in this research, it is bounded to the notions of *"public domain"* and *"cultural exchange",* as defined by Hajer & Reijndorp (2001). For these authors *"public domain"* encompasses public and private spaces, which *"are positively valued as places of shared experience by people from different backgrounds or with dissimilar interests"* (Hajer & Reijndorp, 2001, 11). Thus, in this research it is not enough that an area is crowded with people or commercial facilities to say it has liveability, as groups of people can be (un)explicitly excluded from using it. A liveable area is one that is accessible and attractive to different groups of people, and where they can interact with each other, even if not directly.
In this research, such areas are named public spaces. The term public space is used here referring to areas that gather characteristics to be considered *"public domain"*. Thus, the term refers to areas that are able to fully achieve liveability, independently of being formally publicly or privately owned.

[2] The evolution and emergence of technologies of building, transport, telecommunications, etc., introduce changes to peoples' lives. One example is the introduction of the train, which has shortened distances in an unprecedented manner and has opened way for a different use of the land.

Since the railway, with its infrastructure, viaducts and buildings, appeared in the city in the nineteenth century, it has been influencing the spatial development of its surroundings (Cavallo, 2008). The spaces of city and railway changed along their evolution, and so did the relationships created between them. The station building itself, usually placed at the boundaries of the city in the early days, emerged then as a new building typology (Meeks, 1975). It has been progressively creating relationships with the (inner) city urban fabric, becoming more complex - multimodal and multifunctional - by the addition of new modes of transport and other non-transport related functionalities.

From early on, the relationship between railway and city has been characterized by physical, functional and social conflicts (Conticelli & Tondelli, 2011), resulting from the lack of integration between transport and urban policies. Stations and their surrounding areas have known days of glory but also decay (Richards & MacKenzie, 1988), as society, economy, politics, culture and technology progressed and generated different needs, imposing changes onto their spaces. In order to accommodate the changing technological and societal paradigms, a redefinition and reshaping of the space of the building and of its surroundings, as well as their mutual relationships and relative positions, is necessary from time to time.
Nevertheless, despite the evolutions of station areas' spaces through time, physical and functional discontinuities are a reality of station areas spaces that has remained from the initial arrival of the railway to the city.

Indeed, the speed of change in station areas doesn't always match that of society and technology[3], as their physical nature, and economic and political interests imply a slower pace. Several dynamics can reinforce the gap of adequacy between the physical space of the station area and the contemporary demands upon it. As different spatial, temporal, and virtual dimensions intersect in the spaces of station areas, factors like a growing mobility, internet[4], actors' diverging interests, real-estate speculation, and institutional bureaucracy, among others, can intensify spatial discontinuities and increase pressures upon territorial balances.
Consequently, many station areas have become degraded[5], and some stations even became inadequate for mobility, marginal to urban fabric, and unattractive for its users, (in)directly representing social, economic and environmental burdens at several scales (Conceição, 2007). In fact, such problems can be felt at building, urban area, city, and even at region levels (including non-urban areas).
Thus, many of the existing station areas do not respond efficiently to emerging needs. Instead, many are still little more than just infrastructural 'nodes' with added functions, neglecting their potential as 'places' and the advantages of a balance between these two dimensions (Bertolini, 1999; Peek, Bertolini & de Jonge, 2006).

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[3] The difficulties of implementing or modifying transport infrastructure, and especially the railway lines in inner city environments, to respond to the changing traveling needs, is one example that illustrates the abovementioned mismatch very well. The time span for the introduction of such changes can be quite considerable as there are many constraints to overcome. The necessary efforts to integrate new features, imposed for instance by innovative technologies, can ultimately impose the construction of completely new outside cities. Such solution provides spaces equivalent to those of airports, which are (most of the time) not part of an existing urban scenario.

[4] Internet supports alternatives to some of the physical spatial functions of the city, as well as to some of the travel needs, absorbing them into a virtual dimension.

[5] One cause of this decay is the deactivation of railway facilities, due to the evolution of technology and consequent of the preference of users for the car over the train.

The concept of stations as transport 'nodes' and 'places' in the city (Bertolini 1996, Bertolini & Spit 1998) and the (suggested) balance between these two features (Bertolini 1999), are further detailed and discussed in the following chapter, defining their applicability in this thesis. Nevertheless, at this point, it is important to briefly introduce these notions to clarify their connotations in this research. Station (areas) are mostly regarded as 'nodes' in the transport network(s), as points where transport functions come together (facilitating mobility). But they can also be 'places', locations where people can (also) access non-transport functions. To integrate 'node' and 'place' dimensions of station areas, or in other words make them compatible, can be difficult, but can deliver benefits to both. This compatibility will be referred to in this research as 'node and place balance[6]'.

This balance is desirable and likely attainable. However, to provide cities with privileged 'places' for social and economic interaction at the location of transportation 'nodes', while also providing ecological benefits, is proving to be a very complex endeavour. These intentions continue to be predominantly bounded to the (abstract) planological[7] level, and not finding appropriate translation at the (concrete) physical level.
Stations areas (especially those) located in the inner city can indeed offer obvious advantages for mobility, real-estate development, urban cohesion, social vitality, and environmental gains. However, these advantages are often not optimized in the spaces of station areas. In fact, there are lots of opportunities, as well as many challenges for the (re)definition of such balance (Bertolini, 1998) in station areas, including the spatial ones.

Many of the city regeneration processes redefining urban environments occurring all over Europe, are projects related with the redevelopment of railway station areas. These operations, which often integrate transport and land use redevelopment at inner city locations, are frequently closely related to the implementation of the High Speed Train[8] (HST) Network. The latter is seen as an opportunity to strengthen local economies; for urban and social restructuring; for the improvement of the image of the inner-city and the urban region; and for the proclaimed environmental benefits (Pol, 2002). These projects are fuelled by the necessity of addressing the following matters: the problems raised by sprawl and car-dependent urbanization patterns; the freed space in inner city locations by railway or industrial facilities that became obsolete or relocated outside cities; the market oriented view of transport related companies[9]; and the

[6] In this research, balance refers not to a state of static equilibrium, but rather to a dynamic search for equilibrium. The constant changing features of 'node' and 'place' dimensions of station areas require their constant adjustment, at each moment. A parallel can be made with Communicating Vessels, in which the liquid inside them settles to the same level, regardless of (changes to) their shape and volume.

[7] Planology is the science of town and country planning and it *"[...] has to perform for society [...], to organize the spatial structure in such a manner that the social life can manifest itself under favourable spatial conditions."* (Casseres, 1937, p.103). To achieve this, the planlogical task must be based on *"fullest possible knowledge of the territory for which the plan is to serve"* (Casseres, 1937, p.103), for which geographical research is crucial. Nevertheless, the spatial planning guidelines provided by a plan might not have an evident translation in space.

[8] The *"Union Internationale des Chemins de Fer (UIC) defines high speed rail (HSR) as a railway system with operational speeds reaching or exceeding 200 km/h. Compared with other transportation options an HSR system has the following advantages [...]: less demand for land acquisition (about 20% of the equivalent highway needs), lower energy consumption (about 20% of that of the automobile), less impact on the environment (about 0.625% of automobile CO/CO2 emissions), and higher energy efficiency (energy requirements are about 20% of that of an automobile per seat/ km)"* (Chou & Kim, 2009).

[9] Many European transport related companies were privatized and divided into several companies managing the different branches of activity, namely the transport services, the transport infrastructure, and real-estate.

quest of cities for a competitive position as places to live, work and consume (Berg & Pol, 1998; Bertolini & Spit 1998; Peek et al., 2006; Pol, 2002).

Contemporary HST station area redevelopments in European cities seem to present themselves as an opportunity to rethink station buildings and their surroundings. These projects are proposing the addition of new functions and alternative ways to (re)conceptualize stations and their surrounding areas. Some of them embrace larger areas than the station building itself. They become urban redevelopments, anchored on the potentials of their coincidence with mobility infrastructure. These approaches seem to be redefining what used to be just a station in the city (Terrin, Marie, & Leheis, 2011), giving way to the design of new types of space.
These projects state the ambition to achieve better performances of the spaces at social, economic and environmental levels (see for instance: Lourenço, 2004; VROM, 2004). Actually, the way these HST station redevelopment projects are presented publically is illustrative of some of their ambitions and potentialities. As an example, some of the highlights of the brochure *"New Key Projects: the station as a gateway to the city"* [10] (VROM, 2004) follow:

> *"The HSL station areas must become:*
> - *Attractive [...] highly desirable places, with a balanced mix of dwellings, businesses, and urban facilities.*
> - *Transport hubs and 'passengers' palaces' [...] optimum accessibility, connections, and transfer capacity. [...]*
> - *Urban meeting places [...] the overall atmosphere must be one of a safe, lively public space.*
>   *In line with its overall policies on planning and the environment, the government wants the six New Key Projects to help improve the quality of life in their cities and encourage large businesses to move there."*

The stakeholders realised that boosting the liveability of station areas can increase their yields, and the intentions expressed in the excerpt above echo that. Thus, even if not always explicitly, balancing 'node' and 'place' dimensions became an important feature of station area's redevelopment projects. However, and as pointed out before, achieving these goals can be a mammoth task. This is due to several circumstances: the dimension of the projects; their time spans; the legal borders they can face; the technical challenges to overcome; the physical limitations of the built environment; the amount of actors, issues, disciplines and interests involved; available resources; limits of action of actors and disciplines; etc. Consequently, despite the investments of these interventions to overcome the problems of blighted station areas, the created spaces do not seem to achieve the desired integration between 'node' and 'place' dimensions.

[10] This brochure, issued by the former Dutch Ministry of Housing, Spatial Planning and the Environment (VROM), presents the six *"Key Projects"* of station area redevelopment endorsed by The Netherlands: Amsterdam Zuidas, Rotterdam Centraal, Breda Centraal, Arnhem Centraal, Den Haag Centraal, and Utrecht Centraal.

For transport and property developments to maximize the achievement of their ambitions at station areas simultaneously, they must find a difficult spatial synthesis in a limited amount of space (Bertolini, 1998). This can become a spatial dispute that increases the physical and functional barriers at station areas instead of dismantling them, which in turn jeopardizes the multimodal and multifunctional dimensions of these locations. The barriers at station areas can be further intensified by their redevelopment projects' complexity. The latter demands the division of the planning task into parts. Often, such divisions lead to the overlooking of spatial connections, introducing a gap in the design of the intermediate scale between the station building and its direct surroundings, and resulting in fractures in the relationships of these spaces.

The potential of balancing 'node' and 'place' dimensions of station areas is thus difficult to fully reach. This is especially the case with the spatial design[11] of stations, which doesn't seem to have changed with the demands placed upon it (Spek, 2003). Architecture, seen here as the art and science of designing buildings and their surroundings[12], is not always able to provide answers to these issues within its own domain.

1.2. Motivation

As outlined above, there are spatial dilemmas at the station area and, *"in order to realize synergies and manage conflicts, very creative planning, architectural and engineering solutions are required, [...]"* (Bertolini, 1998). Further, as Cavallo (2008) notes, the relationship between railway and cities spatial development is an architectural theme that should be treated as such. The spatial definition of the station building and its immediate surroundings should be approached the same way as well.

The interdisciplinary processes of station area redevelopment projects could contribute to the improvement of their spaces. However, they seem instead to be relegating architecture to a marginal role (Duin, 2008; Moreira & Guimarães, 2013) in the field of spatial design, in which it should be one of the main actors and knowledge providers. In fact, projects' stakeholders, largely concerned with economic benefits, and partially with social and environmental benefits, do not seem to be fully aware of how (the design of) the space of station areas can contribute to solving their problems. Architecture is often seen only from an (reductive) aesthetic perspective, overlooking its structuring skills at spatial and functional levels. In those domains, architecture can provide new directions to the definition of station areas spaces, which can mitigate their problems. It is therefore, relevant to demonstrate how can architecture do this.

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[11] Spatial design is regarded in this thesis as the common object of several disciplines, ranging from planology to interior design, and including urban design and architecture. All these disciplines define the physical conformation and functional structure of spaces. However, each discipline approaches spatial definition (traditionally) at a different scale, and with a different detail degree. The definition of station area's spaces involves several scales. Therefore, this thesis adopted the term spatial design to refer to the spatial definition of station areas, regardless of limitations bounded with specific scales or disciplines.

[12] Architecture is traditionally regarded as the art and science of designing buildings. However, a city, like a building can be considered as a piece of architecture (Lynch, 1960; Rossi, 1982). In this thesis, the term architecture has this wider connotation. Architecture is considered as a discipline concerned with spatial design, which is not bounded with the conventional limitation to the building scale. It incorporates the spatial definition at other scales, namely that of urban design, or even higher level planning scales. Here, it is thus envisaged as a comprehensive discipline, encompassing the project of the building as well as of its surroundings.

This research was thus motivated by the desire to contribute for a design driven solution for station areas' spatial dilemmas; a solution within the domain of architecture, which takes advantage of the interdisciplinary framework of station area redevelopment projects by learning from and working with it. By building (spatial) knowledge based on a wide variety of sources, but mostly based on the use of the instruments and methods proper of architecture, this research aims to develop architectural tools to design better performing spaces at station areas. Such knowledge can clarify and enhance the role of this discipline in the field of station area redevelopment. Further, it can benefit all the actors of these complex interdisciplinary projects, architects or not. It can ground a common path to the improvement of the (planning of) European station area's spaces and consequently, and most importantly, its users.

1.3. Existing fields of research

In the last few years, much attention has been devoted to station areas, prompted by the so-called *"second railway age"* (Hall & Banister, 1993) brought about by the HST. A wide spectrum of themes was explored, ranging from economics to social and environmental issues, reflecting the importance of the redevelopment of station areas connected with the HST to many realms of society. However, concerns and studies of actors and authors on station areas focused mainly on other knowledge areas than architecture. This leaves room for architectural research in the field, which can and should benefit from the knowledge developed so far. Interrelating this existing knowledge with spatial knowledge, allows the incorporation of social, economic and environmental dimensions in an 'integrative spatial approach' to the current problems of stations and its urban surroundings. In fact, a holistic approach is desirable (Bertolini & Spit, 1998; Peek, 2006), in which the spatial dimension, integrating social, economic and environmental dimensions (Conceição, 2007, 2009; Kennedy, Miller, Shalaby, MacLean, & Coleman, 2005), is explored.

Most of the existing studies focus on specific issues, despite the recognition of the importance of coordinating the aims and actions on the redevelopment projects of station areas (Peek, 2006; Pol, 2002). The complexity of station areas redevelopments is indeed considerable. Given the dimension of the problems involved, an integral multidisciplinary approach is very difficult. Nevertheless, the interdisciplinary character of these processes is unavoidable and should be taken into account in partial studies. The present research, which deals with the spatial dimension of station areas, is also a partial study. Yet, the research is aware of the need for an interdisciplinary discussion on the reconceptualization of station areas. The results provided by the architectural perspective of this research are an input to enhance this debate.

Below an overview of the existing research on station areas is provided. A division into two groups was made in order to distinguish their different levels of importance for this spatial research. A first group notes studies that contextualize the spatial approach of this investigation, but are not directly addressing station area spatial design issues. A second group offers an overview on studies that are concerned with the spatial design of station areas. The second group is depicted in greater detail as it is more relevant to this research.

1.3.1. Contextualizing studies

Stations and their surrounding areas have been studied from many perspectives throughout time. Works dealing with their historical development present us overviews on the changes they underwent, ranging from their social framework, significance and implications, to their architectural features (Ferrarini, 2005; Gerkan, Bund Deutscher Architekten, Deutcsche Bahn, & Förderverein Deutsches Architekturzentrum, 1996; Parissien, 1997; Richards & MacKenzie, 1988; Roth & Polino, 2003). How station areas evolved as 'nodes' and 'places', and especially in spatial terms, was however not explicitly addressed.

With the contemporary renewed interest in station areas, boosted by the introduction of the HST, their 'node' and 'place' features became explicitly noted and discussed (Bertolini, 1996), even though still not in spatial terms. The renaissance[13] of railway stations and their cities, often put forward (Gerkan et al., 1996; Hall & Banister, 1993; Parissien, 1997; Peters & Novy, 2012a; Pol, 2002; Terrin et al., 2011), generated studies debating related issues like: economy (Pol, 2002); management and real estate developments (Gospodini, 2005; Peek & Hagen, 2002; Wilde, 2006); territorial and transport management, policy and effects at several scales (Bertolini & Spit, 1998; Cervero, 2001; Peters & Novy, 2012a; Priemus, 2006; Trip, 2007; UIC & BB&J Consult, 2010); users' behaviour (Ritsema van Eck, Burghouwt, & Dijst, 2005); or environment (Kennedy et al. 2005).
These studies offered contributions, within their fields, to the definition of a renewed role of the station and its surrounding area. In general, the undertakings made to improve station areas' performances are noted. The efforts to reorganize transports' networks, the real-estate developments of the surroundings, and the exponential growth of retail inside the station building, echo the great expectations of project stakeholders on the potential revenues (for the station's operators, the city's image, economy, functionality, spatial quality, environment, etc.). These investments give expression to the increasing importance of the 'place' dimension of stations, taking advantage of its 'node' dimension and vice-versa.

These current approaches to 'node' and 'place' (functional) mix and synergy brings the discussion on the (re)definition of the station area to a new level, towards the 'station city' (Bourdin, 2011; Conceição, 2011). Is this new space a *"hyperpole"*, an *"urban connector"* or an *"extended hub"*[14] as categorized by Tiry (2008)? What is or should it be, especially in spatial terms is not yet depicted. In fact, the spatial implications of station area redevelopment projects weren't deeply explored so far.

1.3.2. Architecture and urban studies

The attention devoted to the station area redevelopments within the architecture and urban studies fields has explored diverse design issues, mostly focusing deeper into the station building's features (Binney, 1995; Edwards, 1997; Griffin, 2004; Ross, 2000; Spek, 2003). Even though recent publications on stations'

[13] The railway renaissance, or the *"second railway age"* (Hall & Banister, 1993), refers to the (re)development momentum at station areas, boosted by the HST advent. Within it, several characteristics related with the (re)development of station areas have been characterized. Pol (2002) distinguishes the cities (re)developing their station areas into two types: *"the international service city"* and the *"city in transition"* corresponding with different development strategies, respectively focused on the 'place' and on the 'node'. Peters & Novy, (2012c, p.12) identify four different types of station area (re)development, the *"strategic integrated"*, *"station renaissance"*, *"urban development"* and *"transport development"*.

[14] These concepts are detailed in the third chapter of this thesis.

spaces are more inclusive (Edwards, 2011; Leemans & Ivokovic, 2011; NetworkRail, 2011), discussing also their surroundings, they still mainly focus on the station building as a transport interchange (centre) and the needs of its users, namely the passengers. The interests and (spatial) needs of other users of the station area, namely those of non-passengers, are less taken into account.

The offered perspective tends to be the one of the station operator, as most of these documents are issued by (railway) transport (infrastructure) related institutions, project developers, and design firms[15]. They present their reflections on the reconceptualization of stations, and foremost showcase their own work and approaches to design (see for example: Bajard, Betoux, & Lamarre, 2007; Ferrarini, 2009; Gerkan et al., 1996; Paultre, 1998; Pickering, 2010; Networkrail, 2011; Niedenthal, 2008).

So far, the metamorphosis of stations seems to be centred on combining the transport services with retail. All over the world, main stations are becoming shopping centres (Terrin, 2011) promoted under the umbrella of the 'node' and 'place' notion.

> *"Shopping at the railway station? Yes, of course! [...] Long opening hours, presence at most central locations and an attractive variety of services, shops, amenities and gastronomic outlets – all in a safe and clean environment: this is what makes a visit to RailCity such a special experience".*[16] (SBB/CFF/FFS, n.d.a).

> *"Japan's Platform-Side Shopping Malls: Making Japanese Stations More Than Just A Place to Catch a Train".*[17]

However, the concept of 'place' at a transportation 'node' does not have to be restricted to a shopping facility to attract more passengers to public transport, or for passengers to squeeze some shopping into waiting times during their daily commute. A 'place' can also be a space to stay, a *"public living room"* (Gehl, 2001, p.43) where people can meet and perform a wider range of *"optional"* and *"social"* activities[18]. In fact, the public space of a station (area) can become actual *"public domain"* (Hajer & Reijndorp, 2001); embodying an increasingly rare opportunity in the contemporary city, which tends to be more and more

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[15] Design firms such as AREP in France or EUROSTATION in Belgium, often subsidiaries of privatized former public railway companies, are involved in several redevelopment projects in their countries, as well as abroad. In fact, one of their business targets is to sell their expert services (www.arep.fr; www.eurostation.be). It is also noticeable that several architects have been involved in many station (area) projects (see note 48). Further, projects are marketed by cities and transport companies. There are also conferences on the subject, like the *"Next Station"*, organized by UIC, or the *"Railway Terminal World"*. These conferences are very much connected with the railway industry and are thus not directly concerned with the spatial features of station areas in the architectural perspective.

[16] This excerpt refers to the *"RailCity"* project of the Swiss Federal Railways (SBB), announced in 2003. This project aimed to transform Switzerland's seven biggest railway stations into *" 'RailCities' - ultra-modern shopping and service hubs"* (Swissinfo, 2003).

[17] Title of an article about the growth of commercial facilities inside Japanese stations, published on a website dedicated to trends and lifestyle in Japan (Japan Echo Inc, 2011).

[18] Referring to activities performed on outdoors public spaces, Gehl (2001) distinguishes *"necessary", "optional"* and *"social"* activities. The first ones are those that people must do independently of nearly any condition, such as going to work or school, or wait for a bus. The second type of activities are those that require the wish, the time and place opportunity to do them. Taking a walk for a breath of fresh air fits in this category. The third type of activities is dependent on the presence of other people. It ranges from simply seeing and hearing others to actually engaging in interactions. For the last two categories, the spatial conditions are relevant.

socially compartmented. A station (area) can be a space truly accessible to people of all social provenances, instead of proclaimed as such but actually being formatted for a specific target group.

To reconceptualize stations in such way, it seems to be important to rethink their spaces to support (physically and functionally) the needs of different groups of users. In this, relating the spaces of the building with those of its urban surroundings is likely to play an important role. For example, highlighting and developing particular features[19] of (privileged) locations of (inner-city) station areas, might increase the significance, usefulness and attraction of these places for a wider variety of users (other than passengers), thus enhancing their liveliness.

Conversely, matters of architectural style and image, or most implications of specific technical requirements do not seem to introduce significant changes to contemporary stations' spaces. Still, much attention has been devoted to the daring architectural features of HST stations' projects (see for example: Pieters, 2004; Kleinman, 2008; Thorne & Art Institute of Chicago, 2001; Tilman, 2004). Authors suggest, however, that the introduction of HST, even if not demanding substantial spatial changes[20], does have implications on the way the station and its surroundings are envisioned, leading the way for their spatial transformation (Leboeuf, 2011; Leemans & Ivokovic, 2011, p.9).

In fact, it is necessary to go beyond the building's boundaries to grasp their (possibilities for) spatial transformation. Not only the station is part of an urban area, but also many projects involve the restructure of large urban areas around the building. However, the spatial relations between rail and the city are seldom approached (see: Edwards, 2011; Duin, 2008; Leemans & Ivokovic, 2011; Tiry, 2008). Systematic analyses are to be found in Paksukcharern (2003), Kusumo (2007), Cavallo (2008) and Brouwer (2010).

The researches of Paksukcharern (2003) and Kusumo (2007) explored these spatial relationships focusing on the urban scale and the 'place' characteristics of the station area. Both authors highlight the importance of physically integrate the spaces of the station with those of its surroundings to enhance their liveability, and address their blight. They assume that the configuration of the spaces influences pedestrian flows, and consequently uses, in the station area. However, also where specific uses are located can influence pedestrian flows.

The conclusions of Cavallo (2008) widen the scope of the integration of the railway infrastructure to the scale of the city. This author proposes that all the railway infrastructure elements, and thus not only those of the station area, should be subject to an architectural approach. On the other hand, Brouwer (2010) focused on *"fixing the link"* between the station and the city centre of several Dutch cities, addressing their connection axis. Considering the difficulties to realize interdisciplinary projects, the approach of Brouwer (2010) is an understandable and very valuable one, but perhaps not enough to heal the spatial discontinuities of station areas. As Cavallo (2008) suggests, a more comprehensive spatial approach is in demand. This is necessary to act on the causes and not only on the symptoms of the problem.

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[19] Features such as historic urban centres, singular buildings, rivers, or even empty space transformable into other amenities.

[20] The length of the HST trains, 385 m (D'Ascia, 2010), is perhaps the most noteworthy characteristic with implications in the station space, as it requires longer platforms. The appearance of HST lounges in the station buildings can be seen as a resurrection of the waiting rooms. In some cases a check-in procedure is necessary, introducing specific spaces for this use.

An understanding on the transformation adequacy of station areas spaces, at the scale of the relation between the building and its immediate urban surroundings, is thus still missing. It is necessary to explore in detail the spatial problems of station areas at this scale, within an inter-scalar approach, which should consider both the physical and functional 'place' and 'node' features. To do so, an overview on the evolution of the spaces of station areas, is required. This overview must have a spatial perspective, and provide insights on the likely futures of spatial development of station areas, supported (but not limited) by a wider framework of other sciences.

Such insight on new spatial directions for the (physical and functional) layout of station areas, within the optimization of the balance between 'node' and 'place' can also address an open question left by the latest developments in the research field. This question underlines the importance of finding out how the space of a new station typology should be materialized (Bijl, 2010; Edwards, 2011; Terrin, et al., 2011). If it is accepted that such a new typology is emerging, how to design it is still an open question.

The main focus of such study should thus be the public spaces of station areas, looked at from the perspective of users (passengers or not). It should search for how these spaces can be designed so that they support the activities (ranging from "necessary" to "optional" and "social" activities, and thus not being limited to those activities that deliver direct profit to station operators) the users may wish to perform, truly enhancing their liveability.

1.4. Problem statement

As stated above, railway stations in cities undergo updates periodically. So far, the operated changes were not able to overcome the physical and functional discontinuities of the spaces of station areas. Recent redevelopment projects of European station areas, and mainly those connected with HST, bring about (once again) their spatial restructure. They propose the redefinition and reshaping of the space of the station building and of its surroundings, as well as their mutual relationships, towards a 'station city'[21]. Is this finally the answer to the spatial problems of station areas?

These projects aim at improving economic, social and environmental performances of station areas. In this quest to boost liveability, project's stakeholders placed great expectations on the benefits of balancing station areas as (mobility infrastructure) 'nodes' and 'places' (in the city) (Lourenço, 2004; VROM, 2004), pointed out by researchers (Bertolini, 1996, Bertolini & Spit, 1998). Spatially, this requires the physical integration of the station in the city (Paksukcharern, 2003; Kusumo, 2007), as well as their functional integration. The layout and relationships of their spaces must be such, that the activities (transport related

[21] Explicitly or inexplicitly, a 'station city', as a space that balances station area's 'node' and 'place' features, is proposed by recent HST (re)development projects. Projects' banners like the Austrian *"BahnhofCity"* (see note 68) or the Swiss *"Rail city"* (SBB/CFF/FFS, n.d.a, n.d.b, n.d.c), illustrate this.

The integration of station areas' spaces is claimed necessary and attempted by these projects. However, the full potential of such concept is not spatially achieved (as many spatial problems still subsist at station areas), neither is architecture giving directions to accomplish it. Thus, in order to support the desired improvement of social economic and environmental performances, the spatial performances of the designed spaces must also improve.

Nevertheless, as Bourdin (2011) notes, the station, which is increasingly adding non-transport related functions into its premises, is indeed changing. It has the potential to become what this author calls an *"urban hub"*, a space capable of integrating 'node' and 'place' features of both the station and its surroundings.

or not) they support do not hinder, but mutually benefit from, each other. In short, it is necessary to improve the spatial performance[22] of station areas, and thus solve the discontinuities of their spaces.

However, despite the investments of the redevelopment interventions to overcome the problems of blighted station areas, the spaces they create do not seem to achieve the desirable integration. For example, the *front and back side syndrome*[23] of station areas subsists. Exemplary is also that the 'station city' is often more connoted with the concept of an 'airport city'. Railway operators hope to replicate the successes of the airport model at station areas. Despite announcing balanced and sustainable urban developments, their stations often result in enclosed and self-contained spaces with weak relations to its surroundings, as is the case with airport buildings. One cause for this alienation seems to be the use of standard formulas of functions and physical conformations incorporated in the space of the station. The same shops, the same facilities, the same spatial structures, which should not be applied everywhere. The singular characteristics of a specific station area location are made somehow irrelevant in the definition of its public space. But such space, located in the inner city, can destroy the city instead of bringing it back to life as desired by stakeholders, and foremost by users.

As a 'node' in the transport network, a station area space must be instead a recognizable 'place', and not just another uncharacteristic location, equal to all the others in the network. As a 'place' in the city, it can be more than just the location where one has access to the transport network. The station area redevelopment is an opportunity to disclose such a new type of space, which brings benefits to the city, the transport networks' stakeholders and users. This is a task for which architecture is likely best suited, although it hasn't been completely successful so far.

1.4.1. Research questions

Considering the exposed problematic, this research aims to explore the (re)conceptualization of station area spaces, through the use of graphical instruments[24] in the analysis, integrating historical understanding of the spatial evolution of these spaces. By doing so, the research intends to contribute to the clarification and enhancement of the role of architecture in the improvement of the spatial performance of station areas, and support the design of their spaces within this framework. The research targets at defining a clear set of knowledge based 'design recommendations' for the design of spaces which support 'node and place balance' at station areas. Thus, the research aims to provide architectural tools to improve their (spatial) performance.

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[22] In general, performance can be defined as *"[…] the manner in which or the efficiency with which something reacts or fulfils its intended purpose"* (Stein, 1983, p. 1070). For the purposes of this research, spatial performance designates the manner in which spaces of station areas facilitate the balance between their 'node' and 'place' dimensions. This concept will be further elaborated in the following chapter.

[23] The *front and back side syndrome* refers to the everlasting problem of integration between the railway infrastructure and the urban spaces. The barrier introduced by the railway tracks into the urban space often generated a *good* and a *bad* side of the city. This was emphasized by the station building itself, which would have its main (exuberant) entrance related with the noblest part of the city, and eventually a modest entrance on the other side of the railway tracks, related with less noble parts of the city such as industrial workers neighbourhoods.

[24] Drawings and maps, Architecture's own tools, are the main forms of analysis in this thesis. They are built upon the gathered data, mainly from graphical origin (maps, drawings, schemes) complemented with other sorts of sources such as written ones.

Pursuing the research aims, within the current (re)conceptualization of station areas towards balanced 'nodes' and 'places', the following research question (RQ) was formulated:

How can architecture contribute to the improvement of the spatial performance of European HST station areas?

Thus, the main concerns of this research were to understand how HST 'station areas' can improve their spatial performance, within the European context, and what is the role of architecture in such spatial transformation.

To address this, four sub questions (RsQ) were deduced. They are intended to, firstly, provide an understanding on what (and how it) facilitates the spatial performance of station areas; and secondly, to reflect on which tools architecture can offer to improve it.

RsQ1 - **What types of factors can influence the spatial performance of station areas?**
RsQ2 - **How did the spatial performance of station areas evolve?**
RsQ3 - **How are European HST station areas performing spatially?**
RsQ4 - **How can the spatial performance of HST station areas be improved by architecture?**

In order to ascertain how spatial performance of station areas can be improved, it is fundamental to identify the factors that can affect it. Therefore, the first sub question was set. Then, it is necessary to understand how these factors have changed, and are changing, the spaces of station areas and consequently their performance. It is particularly important to gain knowledge on the factors over which architecture can have control, i.e. the spatial characteristics of station areas. To do so, the origin, development and current situation of station area's spaces must be explored. The second and third sub questions were set with that purpose.

The second sub question tries to determine how the spatial performance of station areas developed through time. In other words, it is set to find which spatial characteristics of station areas, at which moments, were influential to their current performance. The third sub question looks into how the spatial characteristics of European HST station areas are influencing their current performance. This is relevant to determine what is necessary to change in order to improve the spatial performances of these station areas.

Gaining knowledge on how the factors that influence the spatial performance of HST station areas can be controlled and improved by architecture is the final necessary step to respond to the main research question. Therefore, the fourth sub question was set to reflect on this. The outcome of this reflection, sustained by the knowledge developed by the answers to the former sub questions, creates the basis for the definition of a set of 'design recommendations' for the improvement of the spatial performance of station areas.

By answering these questions, the research expects to identify how the spaces of station areas (have been and) are developing and how are they likely to develop spatially in the future. With this understanding, stations can then be positively integrated with the urban fabric around them, improving the development of both the (transport) 'node' and the (urban) 'place'. The 'design recommendations', delivered in this PhD research, intend to support the spatial design of station areas within this framework.

1.4.2. Position

The thesis sustains that the space of station areas in Europe is transforming from an isolated building (usually at the city's boundaries as a gate) towards a space progressively absorbed by the city. This spatial integration (claimed necessary) between the transport 'node' and the 'place' to be, is embodied by a close relationship between public space of the building and that of its urban surrounding area. To a certain extent, it can be regarded as a *fusion*.

As in every experimental stage of a new concept, so far the spaces produced to materialize it are not yet optimized. Their spatial performance needs to be improved. The thesis assumes that, if the transport and non-transport related spaces of the station and its surroundings are physically and functionally well integrated, dismantling barriers, their spatial performance improves and the new concept of station area is materialized.

The new station area concept, here named the 'station city', corresponds to an area in the city working symbiotically with a station, thus not circumscribed inside the latter. The station (complex) should not be a self-enclosed and standardized entity like an 'airport city' or a shopping centre, with no connection to the urban fabric. It shouldn't work as an island concentrating 'node' and 'place' functions inside it, and consequently draining the city from them and thus from its life.
Instead, it should respond to the identity of the city where it is located in. Thus, 'station cities' should necessarily assume different materializations according to the specific characteristics of the (physical and societal) contexts of their locations. On the other hand, there are common needs that these projects respond to, independently of context, which introduce common features to this (spatial) reconceptualization. The integration of the public spaces of the station building with that of its urban surroundings was expected to be the recognizable common feature among cases.

To operate such change and contribute towards the improvement of station areas' spatial performance, architectural interventions must likely go beyond their traditional scope regarding scale and methodology. The scale between that of the abstract urban plan and that of the detailed individual building has to be explored. By focusing on the spatial connection between the station and its surroundings, architecture is likely to attain solutions which quell station areas' spatial dilemmas. To do this, the traditional boundaries of architecture and other disciplines involved in the redevelopment projects of station areas have to be reconsidered.
Indeed, the interdisciplinary character of the design of these complex spaces can't be overlooked. Architecture has to take advantage of the benefits[25] that such processes can offer to the spatial definition of station areas. With such benefits in mind, architecture can define what contribution it can give to the spatial design of the public space of station areas, within its own field and with its own means, and freed from the constrains of the interdisciplinary framework. In possession of that knowledge, architecture, thus enabled to fight against the constraints and work with the facilitators of this interdisciplinarity, will have

[25] The contributions of each discipline can be enhanced by the contributions of the remainder ones, helping to breach gaps among them, and mobilize resources more efficiently. New perspectives and knowledge can emerge and mistakes are more likely to be detected within a collaborative process.

tools to improve its contribution to the design better performing spaces at station areas. Consequently, it will be necessary to restructure the design task of redevelopment projects of station areas.

1.5. Towards answers

This section presents the methodology adopted to explore the research's problematic, explained above, and how the manuscript is structured to expose the research's outcome. Closing this section, Figure 1.1 shows the relation between the research question, sub questions and methodology, with the thesis structure.

1.5.1. Research methodology

To answer the research questions and meet its purpose, this research focussed on the (physical and functional) spatial transformations of public space of stations and their urban surroundings. It explored their history and present situation, as a basis of possible futures.

In order to do this, the research used *"design research"* and *"research by design"* (Jong & Voordt, 2002). These expressions were adopted in this thesis to make a distinction between two approaches to the research of spatial design related issues. The first refers to the inquiry on design issues using conventional research methods, comprising namely of literature reviews, observation, interviews, etc.. The second refers to the use of design itself as a research method. Their combined use is bounded with the interest of the research of using architecture own tools, i.e. drawings for analysis and design, to look for answers to the problem[26].

Firstly, in the attempt to define concepts and gain a deeper understanding on the problematic, the research relied on the review of existing knowledge and analysis cases studies, utilizing *"research design"*. The first, second and third sub questions were addressed in this way.

Secondly, to give shape to the 'design recommendations', the research built on the learning done through the review and analysis mentioned above, as well as on that done from the use of design, utilizing *"research by design".* The fourth sub question was addressed in this way.

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[26] Architecture, like Engineering, is a *"design science"*, as opposed to the *"explanatory sciences"* such as physics and sociology (Aken, 2004). However, much of the Academic research in the field tends to be only *"description-driven",* i.e. it can unveil the structure of the problems, but it does not build solutions to overcome them.

Perhaps because Architecture is also an art, and thus easily seen as subjective, it has adhered to the use of scientific methods of other disciplines for its research, depreciating its own methods. The resulting descriptive research, if complemented with *"prescription-driven"* research (based on the paradigm of the *"design sciences"*) could result in *"field-tested and grounded technological rules"* (Aken, 2004). Duin (2008) proposes *"research by design"* as a method to achieve that purpose. The attempt to use design to look into design problems in this study, instead of only analysing them, finds its basis in definition of Duin (2008, p.3): *"[...] 'research by design' as a method to characterize design as a scientific activity. In general, three criteria apply to design as a scientific activity: the design should provide a solution for a class of problems, the modes of thought and rules used in the process must be documented and the design must generate new knowledge or alternate skills, or demonstrate how existing knowledge and skills have been used to generate a new and unique design".* Drawings are used in this research both to analyse case studies and to redesign their spaces, thus by both *"design research"* and *"research by design".*

The review of existing knowledge relevant to this spatial study, from practice, the research field of architecture and other scientific disciplines, was done to explore the current constraints and facilitators to the development of well performing spaces at station areas. In other words, this survey highlighted the limiting and catalysing implications of current social, economic and environmental paradigms on the spaces of contemporary station areas. By doing so, the first sub question was answered. Further, this appraisal provided the interdisciplinary context to this spatial research, defined a theoretical framework, and informed the development of the 'design recommendations'.

Following the theoretical framing, a series of surveys, (graphical) analyses and reflections were performed. Adding to the previous learning, they generated further relevant data for the development of the 'design recommendations'. They were structured around the 'node' and 'place' dimensions of station areas. As the balance of these dimensions creates the basis for the notion of spatial performance defined in this research, it was considered relevant to approach them individually. This enabled an understanding on their characteristics and on how to act upon them in order to improve station areas spatial performance.

For an introductory grasp on the evolution of the spaces of station areas as 'nodes' and 'places', a survey through the history of station areas was made. Main development periods were identified. Then, an exploratory approach to contemporary European HST station areas was also done, resulting in their general characterization and categorization into identified clusters. This led to the selection of a sample of six recently (re)built HST 'through'[27] station areas cases in European inner cities, which were further analysed and compared. These studies provided the answer of the second sub question.

How the case studies, with different spatial contexts and configurations, deal with the physical integration of the station in the city, necessary for liveability of station areas as acknowledged by Paksukcharern (2003) and Kusumo (2007), was then explored. The chosen cases encapsulate the most recurrent relative positions of the railway infrastructure and the station building, relevant for the discontinuity problem. They fall into three categories, identified on the preceding study: cases with railway tracks at ground, elevated and underground level. These categories were named respectively, 'bridge', 'viaduct' and 'tunnel' stations. For each category, two cases were examined: an 'adapted' station building and the other one built 'new'.
Their spaces' physical and functional 'node' and 'place' features were graphically surveyed at several scales and through history. The research concentrated the analyses on the scale of the station building and its immediate urban surroundings, which was complemented by the study of these features also at city and urban levels. This provided a contextualized understanding of their spatial transformations and their implications. The analyses detected the virtues and shortcomings of the spatial configurations of the case studies, offering an insight into a variety of approaches to the same problem. The third sub question was answered in this way.

The use of design in this research was done in two distinct moments. First in an initial preparatory moment through an explorative exercise with students, which helped to explore the field of research and clarify its focus. Second, in a final propositional moment in which solutions were sought for the spatial problems

[27] For detailed explanation on the choice of 'through' stations as case studies in this research, refer to subsection 4.1.1, and to note 81.

identified in the analyses of case studies. The case studies were addressed by redesign[28] to explore how their shortcomings could be overcome and their virtues enhanced. These drawings were thus an important contribution to structure the 'design recommendations', which were also based on the empirical lessons offered by the previous (graphical) analyses. In this way, the fourth sub question was answered.

As pointed before, both the graphical analysis and the redesign proposals of the case studies, which are tools within the domain of architecture, were used by this research in the search for solutions for the identified problem. The first one maps the 'node' and 'place' features of station areas, and the second explores the possibilities for their spatial improvement. To build these drawings, as well as for the overall research, a variety of sources, such as literature from several disciplines, direct observation on site, drawings, city (historic) maps, transport network schemes, websites, folders and newspapers, and informal interviews, were used. The research method did not include the use of formal interviews with stakeholders, especially in the study of cases. Previous research by the author on station areas from the planning perspective, which used profusely interviews, highlighted the need to address these areas from the spatial perspective, freed from the limits of practise. It was thus the intent of the research to learn from spaces themselves, from their characteristics (at each of the surveyed moments and scales) and how these can be experienced by users. Thus, direct observation on site was the preferred method to gather information.

The reason for choosing projects related with the HST, within the trans-European high-speed railway network, was their expected potential on the (re)conceptualization of station areas as balanced 'node' and 'places'; and thus, as being ground for research on potentially new station area spatial configurations. Also, it provides a common denominator when gathering a wide range of possibilities on how such potential is being materialized in Europe.

Another reason for this choice was the research initial objective of contributing to the discussion of the development of the Portuguese HST Network, namely on how station areas could be conceptualized in Portugal. The European cases were thus the most relevant for such discussion. Even though the Portuguese HST project is now stopped, the research's results are useful for HST redevelopments elsewhere in Europe, and possibly later on for the Portuguese process, which may eventually be resumed in the future. Finally, it is arguable that the outcome of this research can be extrapolated to stations without HST[29]. Therefore, this research can contribute to the support of the architectural design of stations in general and thus to that of Portuguese stations with or without HST.

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[28]Redesign is the term used in this thesis to refer to the process of adressing by design the (spatial) problems presented by the redevelopment projects of the analysed case studies. Some of the (spatial) problems were identified by the projects' promoters themselves and other stakeholders, who used redesign in search of solutions. This research has also used redesign to assess the virtues and shortcomings of the spatial options of the analysed projects and to investigate their possible improvement. For further details refer to 5.1.2.

[29] Cases like Bijlmer station in Amsterdam in The Netherlands, Le Mans and Gare d'Austerlitz in Paris, France, were also analysed during this research. These projects show that the transformation momentum is not circumscribed to HST stations. Also these station areas are changing and sustainability reasons seem to be the motor for the changes. They regard mostly economic sustainability, as more and more station authorities must generate income that can at least maintain the station operations. This is easier to achieve if the needs of passengers and users are satisfied within the station area spaces, and if energy saving and other environmental friendly measurements are taken. Therefore, even if marginally, social and environmental sustainability is also looked for. However, it is still at stations where HST calls at that these concerns and the resources to address them are more present. Even if they are not the only stations which are in mutation towards a new typology, they are certainly the ones where the social, technical, urban planning and

To define a relevant and manageable sized sample of cases for in depth study, several selection stages were taken. The categorization of a large number of European cases lead to the focus on three types of ‘through’ stations in an inner city context. This is further explained in chapters three and four.

1.5.2. Structure of the thesis

The thesis is organized in two parts, named respectively Analysis and Design, as a result of the methodological approach to answer the research questions. Each chapter, after the present introductory one, is organized around one sub question. The final chapter summarizes the research, answering its main question.

	Chapter 1	- Introduction
PART ONE -	**ANALYSIS** design research	
Review of existing knowledge	**Chapter 2** RsQ 1	- Spatial dilemmas of station areas - What types of factors can influence the spatial performance of station areas?
+ Surveys	**Chapter 3** RsQ 2	- From city's station to ‘station city’ - How did the spatial performance of station areas evolved?
+ Graphical analyses	**Chapter 4** RSQ 3	- Case studies - How are European HST station areas performing spatially?
PART TWO -	**DESIGN** research by design	
Redesign	**Chapter 5** RsQ 4	- Improving spatial performance - How can the spatial performance of HST station areas be improved by architecture?
	Chapter 6 **RQ**	- Conclusions **- How can architecture contribute to the improvement of the spatial performance of European HST station areas?**

Figure 1.1 - Thesis structure related with the research question (RQ), sub questions (RsQ) and methodology.

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architectural forces / developments come together and resources become available to allow innovative transformations. For these reasons the potential for change and improvements at HST station areas is higher. Hence, taking them as universe for case study choice is valid in order to explore the re-conceptualization of station areas spaces and innovative station typologies. Therefore, it was decided to resume the study of HST stations in Europe as a source of information to answer the research questions.

PART ONE – Analysis

Part One is dedicated to clarifying concepts and framing the problems involved in this research. Most importantly, it presents the analyses of case studies and their theoretical framework, which were the main basis for the development of the 'design recommendations'. The need to present an adequate report of the performed analyses of case studies in this thesis resulted in an extensive Part one, given their amount and degree of detail.

The existing knowledge, resulting from studies of diverse areas of science and from practice, considered relevant for the spatial framing of station areas, is reviewed in chapter two, which addresses the first sub question. The main concepts are defined.

Addressing the second sub question, chapter three focuses on the spatial changes that occurred in stations and with the relation to their surroundings, since the railway station's early days. Thus, it provides an introductory perspective on the spatial evolution of railway stations and its surrounding areas, as 'nodes' and 'places', from that initial period until the arrival of the HST. It goes on offering insight on the diversity of European station areas where the HST calls at and their characteristics. Subsequent to these studies, the deeper analysis of the selected case studies and their comparative study is described in chapter four, exploring the third sub question.

PART TWO – Design

Part Two presents the 'design recommendations', describing the use of design in their definition process, and concludes the thesis.

The contributions to the definition of the 'design recommendations' which resulted from *"research by design"* of station areas involving graduate students, and of the redesign of the analysed case studies, are described in chapter five. The 'design recommendations' are also presented in this chapter, addressing the last sub question.

The final chapter, chapter six, reflects on the results of the research. It offers overall considerations on the possible contributions of architecture to the improvement of the spatial performance of station areas, answering the main question. Additionally, it provides directions for further discussion and future research.

PART ONE - ANALYSIS

2. SPATIAL DILEMMAS OF STATION AREAS

This chapter offers a detailed look into station areas and their spatial problems. This reflection is essential in understanding what type of factors can influence their spatial performance, addressing the first sub question. Such knowledge is in turn fundamental in determining how the spatial performance of station areas can be improved. The text is built on the review of existing knowledge, stemming from studies of diverse areas of science and from practise, considered relevant for the spatial framing of station areas as envisaged in this research. This theoretical body frames the analyses described in the following two chapters, and together with them, contributes to the development of the 'design recommendations'.

The first section is dedicated to explaining in detail the concept of spatial performance of station areas. Towards this end, several other essential concepts are clarified. In the first subsection the station building and its surroundings are examined separately and their relationships explored, introducing their spatial dilemmas. Public space is presented as a connection element and the stage for spatial innovation in station areas. The second subsection departs from the implicit concept of balance of the *"node-place model"* (Bertolini, 1999) to explain the concept of spatial performance proposed in this thesis.

With the abovementioned concepts clarified, it is possible to go on exploring the factors that influence the spatial performance of station areas in the second section. The impacts of station area redevelopment projects' dynamics on the (re)definition of their spaces are discussed at 'planning process' and 'spatial design' levels[30]. The first subsection explores the external factors to the public space of station areas that can influence its spatial performance, i.e. those that can constrain or facilitate the laying out of public spaces that offer adequate support to the activities to be developed in them. The second subsection introduces the internal factors of the public space of station areas that can influence its spatial performance, i.e. the shortcomings and virtues of the spaces that can hinder or enhance their ability to offer adequate support for the activities to be developed in them.

2.1. Spatial performance of station areas

Before detailing what defines the spatial performance of a station area, it is important to detail what is understood here by station area's space. It can be defined that a station area is an extent of space, where a railway station building is located; an ensemble of the station building(s) and its immediate (urban) surroundings, comprising all built and open and spaces (including the transport infrastructure), as well as all their specific physical and functional characteristics. However, the boundaries of such an area are uncertain (Bajard, 2011, p.151; Bertolini & Spit 1998, p.11) as the influence range of stations is not clear.

The influence of stations may reach as far as the trains that call at their buildings, or further. Indeed, the (spatial) impacts generated by the activities accommodated at station areas' spaces, transport and non-transport related, can go far beyond the local level. And the specificities of their physical characteristics

[30] As further detailed in this chapter, a station area (re)development project encompasses 'spatial design' and 'planning process'. The latter refers to procedures that influence the spatial outcome of the project, but are not product of its 'spatial design'. This includes the station areas' physical, social and economic context framework, the interaction of involved actors and their strategies.

can also generate relevant spatial effects. These can be observed at city level, as highlighted by Cavallo (2008, p.4). Stations, railway tracks, viaducts, bridges, etc., can shape city's spaces both positively and negatively. But, such impacts can also be perceived on higher levels of scale, as the landscape that infrastructure crosses (Conceição, 2007; Terrin, 2011; Tiry, 2011; Trip, 2007). Connecting distant and closer locations, the station operates on, and brings together, different territory scales, crossing international, inter-regional, metropolitan and urban levels. Further, the station also relates all the dimensions these scales embody: transport, culture, and atmosphere (Trip, 2007).

Nevertheless, it is at the local level of scale, namely within the immediate surroundings of a station, that these spatial relationships might be more evident, complex and influential for people's (daily) use of space. For these reasons, it is at this scale that this thesis focuses in order to pursue its interest in the transformations of station areas' spaces and their spatial performance. Nonetheless, the research has also explored higher levels of scale to be able to contextualize the phenomena that occur at local level.

It is thus necessary to clarify the limits[31] of the station area. Inevitably, any approach[32] to define these limits can be discussable, as all have advantages and limitations. The *"walkable radius"* approach was elected as the preferred way to address such boundaries in this research. The interest of this research on the definition of space is unavoidably linked to the use people make of it and preferably on foot. Public space is produced for and by people (average users, planners, architects, etc.), who can profit the most from it when walking, standing or sitting in it.
Further, the space around the station combines areas that are part of the redevelopment project and others that are not. Both areas are within the same system, the city, and are perceived and used by people as a whole, independent of their characteristics. In fact, the redevelopment project limit is a line drawn in the plans, which is often not directly noticeable or influential in real space. The essence is that, if the project area and the areas surrounding it function as a whole rather than as separate areas, a larger diversity of functions and uses is achieved in the total area (Trip, 2007, p.73). Therefore, to delimitate a station area within a circle that represents roughly[33] an acceptable walking distance seemed appropriate. In this way, peoples' perspective of such spaces can be incorporated.
Additionally, the circle asserts the unavoidable fact that not all the realm can be analysed. Despite that, it should be noted that the spaces beyond the boundary also cannot be blindly cut off, risking the analysis to miss a lot of the whole picture. Thus, it is important to regard this analysis approach with some flexibility, and be aware of wider contexts in order to attenuate the limitations of the (circle) approach. Later on in this

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[31] The distinction between station area limits and station redevelopment project limits should be made here. Most of the recent station redevelopment projects go beyond the boundaries of the railway complex, embracing (part of) their surrounding areas. The limits set by these projects themselves depend on the areas that are available and are possible to (re)develop. Thus, they are obviously not circular and vary greatly in size and shape. However, the project area is part of a larger system, the city, from which it is not separated functionally. Further, when the question is about the projects' influence limits, then they get even blurrier (Bajard, 2011, p.151), as they can have effects at many different scales.

[32] Among the possible approaches, are: *"walkable radius"*; *"functional-historical elements"*; *"topographic"*; and *"development perimeter"*. For detailed descriptions see: Bertolini & Spit (1998, p 12).

[33] The term 'roughly' is used to draw attention to the fact that a *"walkable radius"* circle does not necessarily coincide with actual walkable distances. Not only are the distances people are willing to walk different, physical and psychological barriers will also disrupt the pureness of the circle assumption. Refer also to note 99.

thesis, on chapter four, the use of *"walkable radius"* circle in the research, as well as of other distances circles focused on the station area, is further detailed.

2.1.1. Station building, its surroundings and their connection: public space

It is now possible to focus on the aforementioned components of a station area, namely the (railway) station and its (urban) immediate surroundings.

The **station** building, in its origins a gate to a city and an intermediary space between it and the railway, was primarily a stopping[34] point of trains that grew to include other transport modes and functionalities. It has become a transport interchange (Edwards, 2011; Leemans & Ivokovic, 2011) or a multimodal hub (Terrin, 2011). Presently, it is making its way towards a different type of space which Tiry (2008) names as *"transport megastructures"*[35].

Interchange connotes shift, movement, changing between transport modes, and from them to the city and vice versa. It mirrors very well its dimension of *"transfer machine"*[36], but somehow shadows the stopping, pause, and sometimes even the stillness[37] dimension that these buildings also embody. Multimodal hub also brings the focus on the transportation function of these spaces. The term station evokes both the movement and stopping dimensions, either of trains (and other transport modes) or of people (flows) and goods. Therefore, it was considered that the term station better reflects this double role of these buildings, and thus, better represents the concept adopted in this thesis to designate and explore this complex space.

A station can be seen, in geographical terms, to exist at least within two different systems: the transport network and the city. Therefore, and as mentioned before in this thesis, it can be read as a **node** in the transport network and as a **place** in the city (Figure 2.1), as Bertolini (1996) points out. This understanding of the station emerged within the study of the redevelopment of station areas. It has been happening in the last few decades and is not circumscribed within the station building[38]. Thus, the term station can be interpreted as referring to the station area rather than only the station building, broadening its meaning. Even if in this research the term station, when used isolated, refers only to the building, the research assumes that station areas can also be regarded as 'nodes' and 'places'[39].

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[34] As Richards and MacKenzie (1988, p.14) note, *"the word 'station', which originally meant simply a stopping-place, has acquired over the years a more disciplinary, structural and organizational connotation."*

[35] This concept is further debated in the following chapter.

[36] The term *"transfer machine"* is translated from the Dutch *"Overstapmachine"* (Hermans & Spek, 2001) and connotes the transport interchange mechanical nature of processing passengers from one mode of transport to the next (as efficiently as possible).

[37] The station building as a stop point of trains, or as a place where one waits for trains or someone, for instance.

[38] Despite the recent origin of the station (area) 'node' and 'place' concept, these characteristics of station areas and their relationships, as well as their evolution, can also be recognized and tracked back in history (Paksukcharern, 2003, p. 59). This will be further discussed in the following chapter.

[39] In fact, 'node' and 'place' dimensions of station (areas) are acknowledgeable at several scales besides the one enclosed within the station area limits, as its influence goes way beyond them.

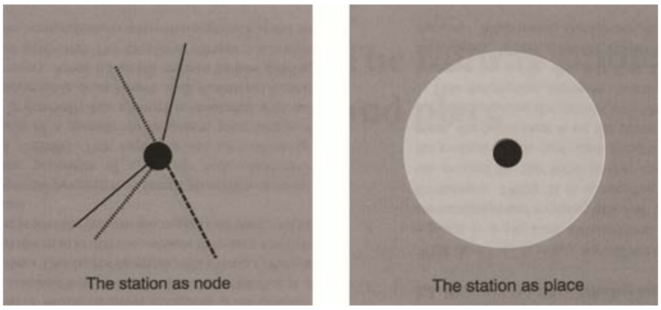

Figure 2.1 - The station as a node and as a place (Bertolini & Spit, 1998, pp.13-14)

The **urban surrounding**, just as the station, can also embody ‘node’ and ‘place’ dimensions. The ‘place’ dimension can be described with its buildings and open spaces, such as squares and gardens, for example. To a wider extent, the ‘node’ dimension is also acknowledgeable, when one regards the city as a crossing point of different network systems (both physical ones such as streets, sewers, communications, and virtual ones such as social, economic and cultural).

If in the early days of stations, these buildings were mainly placed on the outskirts of urban environments, they are now surrounded by them. But their spatial encounter is a difficult one, as is visible in the physical *scars* (Figure 2.2) of station areas spaces. The railway tracks and other railway infrastructure, together with the trains, represented an ambivalent novelty. If on one hand these technological progresses were appreciated economical boosters, on the other hand they were looked at with caution and were somehow unwelcome in the city.

The station itself has an ambiguous genesis. Intertwining the building and the railway infrastructure has been a difficult theme to approach since the beginning. In fact, in the beginning, the design of the station was faced as part of the transport infrastructure engineering project, and later on was separated into two realms. The passengers’ building facing the city was the job of the architect, and the train shed and transport infrastructure that of the engineer.
With time and the growth of the city around the station and the rail infrastructure, the question became even more complex. It was no longer a matter of how to design a station, it also became a matter of how to design its surroundings and their relations. Still the station and the urban area around it were not regarded as a whole for a long time. Projects for both were separated processes. Programs for stations were based on the transport (node) needs, and programs for urban spaces were based on ‘place’ needs. Further, in the realm of the definition of station area’s spaces, transport infrastructure, with its demanding technical aspects (among which is the necessary flexibility for future developments), has retained a prevalent role over time. The design of non-transport related spaces is greatly subjugated to the design of transport related spaces. This unbalance between ‘node’ and ‘place’ features perpetuates the spatial blight of station areas.

These issues were brought back into the spotlight by the recent railway station area redevelopment projects, calling for a new spatial approach to the problem. The redevelopment of stations widened to the urban area around, mainly to land owned by railway companies, used as a financial source. To this also concurred the interest of cities in these operations, seeing them as opportunities of urban fabric renewal, transport network reorganization and, on supra city level, as a sign of the city's socio economic vitality, competing with other cities (Pol, 2002). However, despite the efforts of planners and designers to relate the station with its urban area, their spatial structures are often not integrated (Kusumo, 2007), keeping their separate nature.

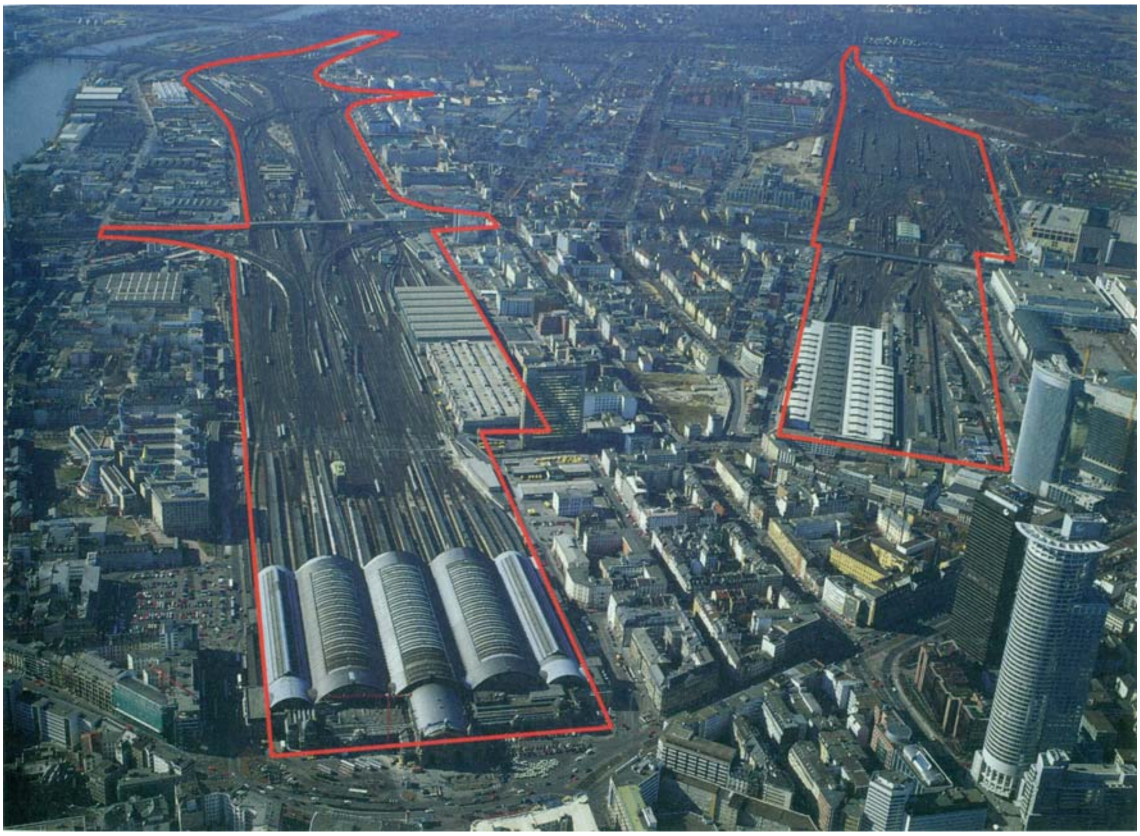

Figure 2.2 – Frankfurt railway barriers (Gerkan, Marg and partners, 1996)

The claim for 'node and place balance', (in)directly expressed by the recent station area redevelopment projects, represents the emergence of a new approach to the design of their spaces, and especially to those dedicated to 'place' activities. The understanding that there is much to gain if a station and its surroundings work together in a balanced way, as opposed to a hardly cooperative relationship, turns the focus towards the public spaces in and around the station building. **Public space**, the common and connecting element between the station and its surroundings, calls for its redefinition to respond to the need for 'node and place balance'. As previously defined (see note 1), in this research, public spaces are those areas that gather characteristics to be considered *"public domain"* (Hajer & Reijndorp, 2001, 11), that are thus able to fully achieve liveability, independent of being formally publicly or privately owned. Public space is therefore the place for change to occur in station areas, towards spaces that support and allow 'place' to happen[40] and develop, becoming effectively balanced with the 'node'.

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[40] This space for 'place' to happen is also occurring in situations where the transport infrastructure is devoid of its original function. See the case of The High Line in New York, in which the space of the former railway infrastructure was converted into a public space for the city.

It is an opportunity to rethink the spaces of station areas as a whole and not as an ensemble of separate elements, possibly leading to spatial innovation and improved spatial performance. Thus, this research focuses on this opportunity for spatial transformation.

2.1.2. From 'node and place balance' to 'spatial performance'

Stations, as integrated 'nodes' of transport networks and 'places' in the city can increase the possibilities for physical human interactions in and around them, which in turn feed social and economic activities that still require them (Bertolini, 1999). Therefore, the potential for liveability of station areas' spaces is high. Their high accessibility, fed by the transport provision, is a favourable condition for the development of diversified activities, for the probable concentration and interaction of different people in them. On the other hand, the intensification of activities increases the demand for connections. Thus, a balance[41] between these two dimensions – 'node' and 'place' - can generate social, economic and environmental benefits. In other words, it can improve the sustainability[42] performances of the station area.

> *"There is in these locations an enormous potential (albeit largely unexploited) for physical social and economic interaction, and this potential could be realized in a relatively sustainable way, as it could allow the clustering of trips and a more efficient use of land."* (Bertolini, L., 2000).

The realization of this potential for liveability (and sustainability) depends on the degree of balance between the two dimensions. Accessibility, in a broad sense, is the concept proposed by Bertolini (1999) which can enable this potential balance between the 'node' and 'place' contents of a station area. Bertolini (1999, p. 201) notes that to favour human interaction, accessibility of the *"transportation node ('how many destinations, within which time and with which ease can be reached from an area?')"* and accessibility of the *"place for activities ('how many, and how diverse are the activities that can be performed in an area?')"* are necessary. Additionally, the users[43] (who accesses the area?) are also important (Bertolini, 1999, p. 201). The enhancement of accessibility (of the 'node', which feeds the area with a broad range of users, and of the 'place', which provides the opportunities for these different populations to develop activities) facilitates the actual realization of human interaction and thus the liveability of station area.
The possible relations between 'node' and 'place' contents' intensities at station area, and their consequences for liveability of these locations, are depicted on the *"node-place model"* (Figure 2.3).

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[41] It is worthwhile to reiterate at this point that, in this thesis, balance is a dynamic one and not a static state of equilibrium, as explained before. Refer to note 6.

[42] Sustainability can be quite a wide concept. Further, nowadays it is so recurrently mentioned that it is sometimes devoid of meaning. The use of the term in this thesis is limited, as it does not aim to contribute further to the debate on sustainability itself. In this study, the term is only used to link the concept of spatial performance with the general idea of a conscious use of resources to satisfy social, economic and environmental needs of the current and future generations. There is no attempt to provide quantitative or qualitative indicators on sustainability.
For further elucidation on this general concept, see the contents of international documents such as 'Our Common Future' (World Commission on Environment and Development, 1987) and the 'Agenda21' (United Nations, 1992).

[43] Residents, commuters and 'city users' of different origins – social, geographic, etc. - find in the station area one of the few contemporary physical spaces where these heterogeneous communities can still meet.

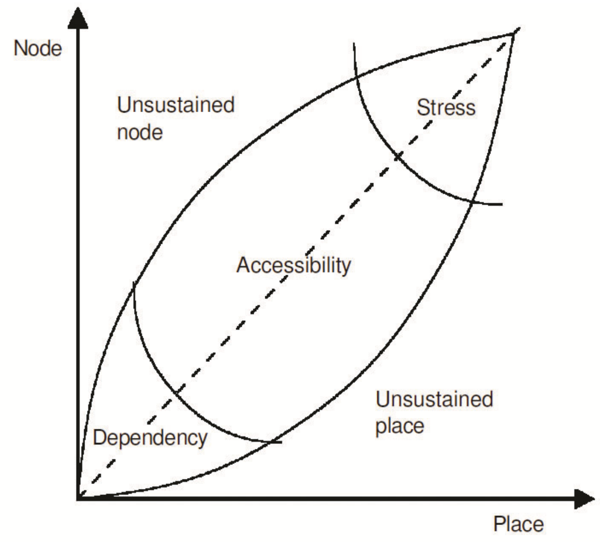

Figure 2.3 – The node-place model (Bertolini, 1999)

> *"In the diagram, the y value corresponds to the node-content of an area, or to the accessibility of the node, and thus to its potential for physical human interaction (following the reasoning: the more people can get there, the more interaction is possible). The x value corresponds to the place-content of an area, or to the intensity and diversity of activities there, and thus to the degree of actual realisation of the potential for physical human interaction (according to the idea: the more activities are there, the more interaction is actually happening)".* (Bertolini, 1999, p.201).

When the provision of transport and activities in a station area is balanced, or in other words 'node' and 'place' accessibility is optimal, the location will occupy a position along the middle diagonal line of the diagram. In this case, two situations between the following extremes can occur: If the concentration of transport and non-transport activities reach levels that are too high, conflicts may happen (many claims on limited space); if, on the other hand, their amount is very limited they may not be enough to create synergies. The 'node' and 'place' combination can also be unbalanced, when a station area has more transportation than activities or vice-versa. These four ideal-typical situations that can be distinguished are identified and characterized in the *"node-place model"* as: areas *"under stress"* and *"dependent areas"*, the extremes of balanced locations (areas where 'node' and 'place' are equally strong), and *"unsustained nodes"* and *"unsustained places"*, the extremes of unbalanced locations (areas where 'node' or 'place' prevails over the other) (Bertolini, 1999, p. 201, 202).

The model allows thus for the assessment on the degree of liveability of a station area, and ultimately to the degree of sustainability. As Zemp, Stauffacher, Lang, and Scholz (2007) note, the diagram is the only known approach which explicitly links the analysis of (transport and non-transport related) activities at station areas, with the potential of the latter for sustainable development. These authors state that the balance proposed by the *"node-place model"* can be a first criterion for accessing sustainability at the station area regarding spatial development patterns and infrastructure.

Balancing 'node' and 'place' dimensions of a station area is, in fact, fundamentally a spatial problem (Paksukcharern, 2003). Additionally, as Kennedy et al. (2005) suggest, it is necessary to explore the 'spatial dimension'[44] in order to pursue sustainable solutions for current problems of stations and urban surroundings. However, the *"node-place model"* does not give indications on how to reach this balance spatially, as it relates transport and non-transport related activities present at the station area, but not their physical support. It is thus necessary to address 'node and place balance' in spatial terms.

In fact, 'node and place balance' does not depend only on the access to transport and non-transport related activities on a given location, or on the diversity of their users. The space that supports these activities and allows users to realise them also contributes decisively to the balance (Figure 2.4). The space must provide the best conditions for the development of the 'node' and 'place' activities, giving room for the physical human interaction to happen, ultimately to improve social, economic and environmental performances, and thus liveability (and consequently sustainability).

The physical environment is one of the factors that influence the activities that take place in it, to a varying degree and in many different ways (Gehl, 2001). The quality of a space relates with the type of activities users are willing to perform in them. In a poor quality space people tend to do only the strictly *"necessary"* activities[45]. While in a high quality space a wide range of *"optional"* and *"social"* activities occur.

Figure 2.4 – Relationships between 'node and place balance', liveability and space

When station areas have spatial problems, the range of activities facilitated by them is fairly narrowed to *"necessary"* activities, such as the transportation related ones. In this way the 'place' dimension of the station area has fewer conditions to thrive than the 'node' dimension, which nevertheless, would better develop in quality spaces. Thus, balance has less chance of occurring and so does liveability.

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[44] The spatial dimension, or the space as expression of the social, economic and environmental dimensions of sustainability, is not seen as separate from the three, but rather as their synthesis (Conceição, 2007). The 'spatial dimension' is seen here as the physical translation in space of the social, economic and environmental dimensions, bringing them together in it. Because changes in space have repercussions on the social, economic and environmental performances, to manipulate spatial configurations (forms and land uses arrangement in space) can lead to sustainability (Frey, 1999; Williams, Burton, & Jenks, 2000).

[45] Refer to note 18.

This reiterates the need for spaces that facilitate the 'node and place balance' at station areas, for quality spaces, for spaces that perform well; allowing for human physical interaction and thus good economic, social and environmental performances. 'Space accessibility' (how a space supports the development of transport and non-transport related activities) is thus as necessary as 'node and place accessibility' is to stimulate human physical interaction, and thus (spatial) balance at station areas.

Within this framework, the manner in which spaces of station areas facilitate 'node and place balance', is referred in this this research as spatial performance. A station area's space that supports 'node and place balance' (contributing to sustainable performances at social, economic and environment dimensions) performs (spatially) well. Further, in this line of reasoning, it can be said that space quality can be seen as an indicator of good spatial performance. For balance to happen, the layout and relationships of station area spaces should be such that the activities (transport related or not) they support do not hinder, but mutually benefit from, each other. The spatial discontinuities of station areas should be mitigated, as the physical integration of the station in the city is desirable (Paksukcharern, 2003; Kusumo, 2007) in order to reach a good spatial performance. However, how to achieve this goal does not seem to be straightforward.

2.2. Factors influencing the space of station areas

The reconceptualization of station areas is a debate that is going on for several years now, stimulated by the dynamics of recent station area redevelopment projects. Sometimes it acquires passionate contours, like the opposition to the project in Stuttgart (Peters & Novy, 2012b), or in Rotterdam against the Alsop Plan (Alsop Architects & Projectbureau Rotterdam Centraal, 2001; Kooijman & Wigmans, 2003). Station operators, passengers, countries, cities, users, communities of residents and politicians have put forward their views on how station areas should develop. Transport and land development issues are at the core of most of these visions[46], as well as of many of the scientific analysis of these projects (a few examples are: Bertolini & Spit, 1998; Peek, 2006; Pol, 2002; Trip, 2007).

The role of space in the reconceptualization of station areas is less discussed, even though its importance is recognized (Kennedy et al., 2005; Trip, 2007). In fact, spatial quality[47] is cherished by all stakeholders, but seldom achieved, and often mistakenly interpreted (almost exclusively) as an image issue (Conceição, 2007). Allegedly in search of quality, many famous star architects[48] were involved with the planning and

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[46] The case of Stuttgart is illustrative of the multiplicity of visions for the station area. The official project (see: Bahnprojekt stuttgart–ulm, n.d.) raised protest movements, which mobilized citizens, groups and institutions, to contest it and defend alternatives (see: Verkersclub Deutschland, n.d.; www.kopfbahnhof-21.de).
To learn more on how these projects are envisioned by governmental bodies see for example the Dutch six *"Key Projects"* (Schaap, Verhave, & Verdonk, 2003). For the positions of rail infrastructure and transport operators, see for example the documents issued by UIC (UIC & BB&J Consult, 2010; Leemans & Ivokovic, 2011).

[47] Trip (2007) discussed the presence of quality of place on these station area redevelopment projects. The concept he proposes is grounded on the ideas of Florida (2005) and embraces much more than just space itself. Indeed, it includes quality of public space as one of the criteria to access *"place quality"* (Trip,2007). Without losing sight on this wider context of quality, this thesis focuses on public space's quality.

[48] Just to mention a few examples: Santiago Calatrava was responsible for Gare do Oriente in Lisbon, Gare Guillemins in Liège and the Station for Reggio Emillia; the team Cruz&Ortiz designed Santa Justa in Sevilla and Basel Hbf.; Norman Foster designed Dresden Hbf. and Firenze Belfiore; Delicias station in Saragoza was designed by Carlos Ferrater; and Napoli Afragola by Zaha Hadid.

design of several station area redevelopments, coupling their reputation with the image of the project. However, this wasn't enough to grant spatial quality to the projects, as many factors contribute to its achievement. Thus, further reconceptualization was needed.

> *"The end of the 20th century saw the re-establishment of the 19th century tradition of monumental station architecture, reinstating the station as a monumental gateway to the city and symbol of the city's presence in the high-speed Network. Just like it had a century earlier, this was used to justify architecture choices, and more or less explicitly, urban choices. Changes in the modal split and new transit systems expectations made this approach inadequate: what does one offer customers, users, information seekers and citizens who have lost their bearings in the city in order to make high-speed train station into an element and instrument of urban renewal?"* (Segratin, 2011, p.176).

Several spatial issues relevant to the reconceptualization of station areas were the focus of their redevelopment projects. The barrier effect of the tracks, specifically the *front* and *back sides* of stations has been in the centre of attention in the design of recent projects. This shows the interest on (re)connecting the station with its surroundings in order to mitigate their (spatial) problems. To achieve this, efforts were made to convert the *back* of the station into a new *front.* The *back side*, an area usually originally devoted to industrial uses, often had a cluttered urban growth and nature. Nonetheless, the blight of station areas is not restricted to the *back side*. Renovation efforts were also devoted to the *front side*, the (monumental) *city gate* that also acquired signs of neglect. Further, the articulation between different transport modes and other functions, within and around the building, was also approached with solutions achieving differing levels of success.

To the spatial successes and failures of these projects, and thus to its spatial performance, contribute both their 'planning process' and 'spatial design'. In fact, they are both two faces of the same coin, the station area redevelopment operation, and their influence on their spatial outcomes. The definition of spaces depends ultimately on 'spatial design' specification, but it is not immune to the 'planning process' inputs. Thus, it is necessary to understand both, in order to find ways to improve the spatial performance of station area's spaces.

This research does not explore in depth the factors bounded with the 'planning process' and their influence[49] on the design of spatial layouts of station areas. Even though factors of the 'planning process' can influence station area space, they are external to the latter. The control of architecture over them is limited or even inexistent, thus they were not deeply inquired in this research. That is why the case studies analyses presented in chapter four don't explore these factors extensively.

The major interest of this research is to approach the internal factors of public space of station areas that can influence its spatial performance; those bounded with 'spatial design', the specific domain of architecture in a station area's redevelopment project. Such factors are the ones architecture can

[49] The influence of the 'planning process' in the definition of the spatial layout of station areas was explored in the author's Master dissertation (Conceição, 2007).

influence/control, and thus are relevant for the contribution it can give towards the improvement of spatial performance and reconceptualization of station areas. They are deeply explored in the following chapters.

In addition, both the ‘planning process’ and the ‘spatial design’, as well as their relationships, are briefly introduced in this section. These are portrayed in the matrix (Figure 2.5) presented below. This matrix was built on the basis of a literature review and results from interviews with stakeholders and researchers in the field of station area redevelopment. It was proposed to analyse station areas redevelopment plans from a planning perspective, on a previous study by the author (Conceição, 2007). Then, it became clear that the role of ‘spatial design’ in these projects was underexplored, while the role of the ‘planning process’ was more extensively documented and discussed.

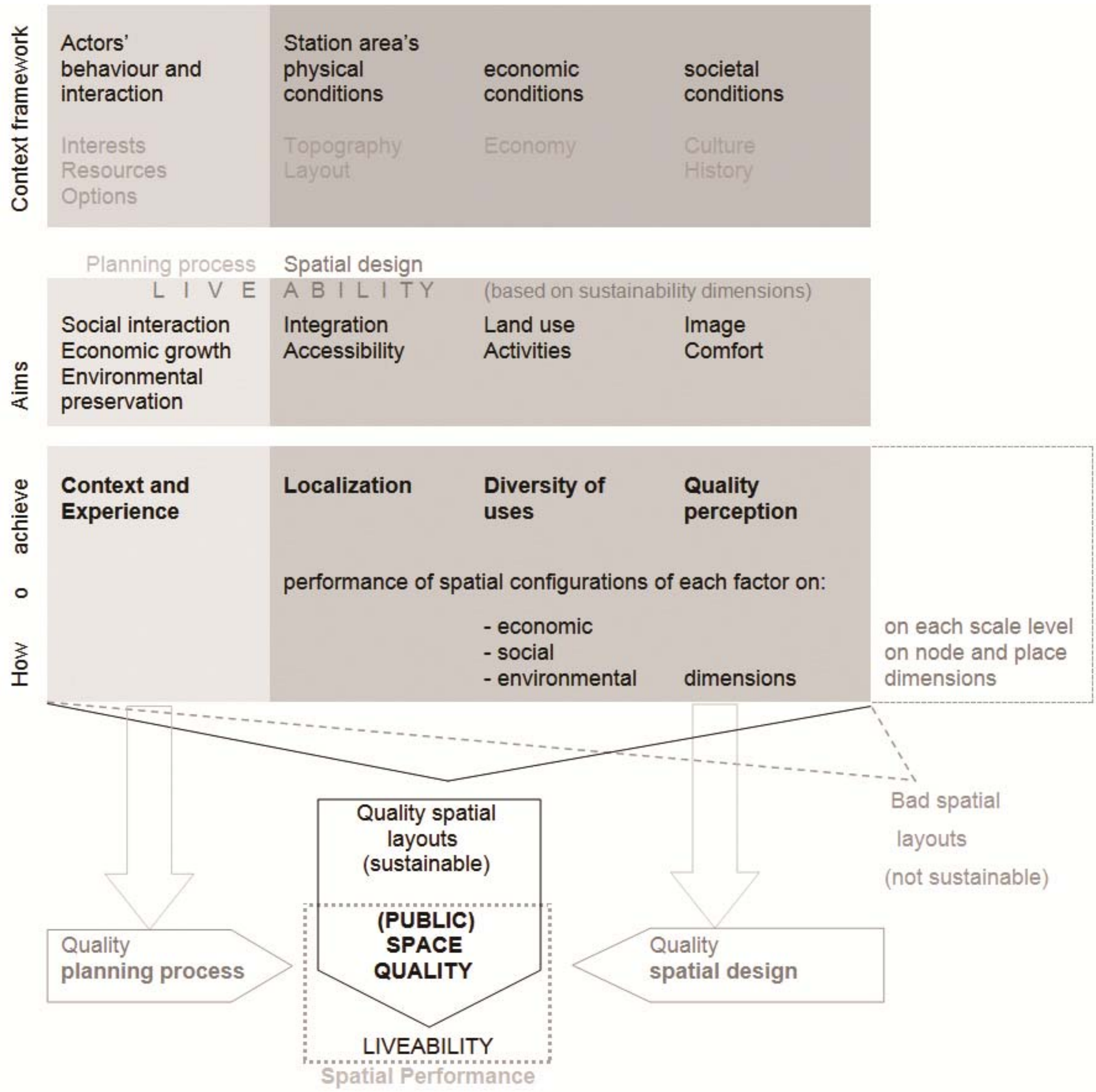

Figure 2.5 - Adapted Analysis Matrix - Methodology to analyse spatial layouts of station areas (Conceição, 2007)

As stated before in this thesis, to achieve liveability it is necessary that a good level of spatial quality is granted to the designed spaces. To reach quality, design must understand the city's context where it operates. The knowledge of the context (subjected to change in time) of a station redevelopment operation is essential. It is important to know who are the actors involved, what are their interests, resources and options, but also the city's culture, history, layout, topography, economy, etc.

For spaces to become liveable ones, able to promote and support social interaction, economic growth and environmental preservation, station area redevelopment operations should set a spatial program aiming to grant: good integration of spaces and accessibility (in strict sense); efficient land-use, and transport and non-transport activities; and a positive image and comfort of the spaces. To attain such aims spatially, a good steering of all variables of the project's context, as well as their adequate formalization in space are crucial. Granting a quality 'planning process' and a quality 'spatial design' leads to quality spatial layouts and space quality. If the process is not well conducted and the spatial layouts are not well designed, neither quality nor liveability will be achieved. Therefore, the options of design on the 'localization of elements', the 'diversity of uses' and the 'quality perception', and the steering of the 'planning process' should ideally lead to the creation of spaces that support sustainable performances[50]. These can be attained at different scales, as different spatial consequences of design options occur and are recognizable at different levels. For example, locating a station on a given position in the city has effects on the station, but also on its urban surroundings.

2.2.1. 'Planning process'

The factors bounded with the 'planning process' which can constrain or facilitate the performance level of station areas' spaces, here named **'context'** and **'experience'**, result from the way the context framework of a station area project is dealt with.

The specific characteristics of the station area play an important role. These can be said to reunite three types of conditions: physical conditions (topography, urban fabric, buildings, infrastructure, and also the changing spatial requirements generated by the contemporary transports and communication technologies); economic conditions (resources, financing capacity); and societal conditions (history, culture).

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[50] Frey (1999) states the *"significant contribution urban planning and design can and should make towards urban development and living by improving the city's form and structure and, as a consequence, making the city a more people-friendly place and reducing its destructive environmental impact"*. Therefore, providing quality to spaces is relevant to sustainability.

It can thus be proposed that the quality of spatial configurations can be assessed through sustainability parameters, as spaces have quality if they provide satisfaction for the needs of present and future generations. But if it is clear that form can affect sustainability, even if how it does is not as clear. The complexity of urban systems and their relations with sustainability lead to a *"multiplicity of potential sustainable urban forms"* (Williams et al., 2000, p.353).

"*This viewpoint sees sustainability as a process rather that an end state, and therefore suggests changes in urban forms should be open to adaptation over time, as more information is gathered, and social, economic and environmental changes occur*" (Williams et al., 2000, p.353). "*Changes in form alone will not achieve sustainable cities. Supportive transport, environmental, economic and social policies are also required alongside shifts in attitudes and lifestyles. Sustainable urban forms will only be achievable if they are underpinned by a policy background which commits to global sustainability goals, but leave room for local formation and implementation of solutions*" (Williams et al., 2000, p.355).

How these characteristics are manipulated by the actors of a station area redevelopment project, depends on their behaviour and interaction. These can be as diverse as the actors in these projects: (inter)national Administrations; regional and local authorities; railway companies and other transport authorities; private investors; residents; commuters; city users, tourists[51]. Actors' behaviour changes space and it can be changed by space. Many studies draw conclusions on these issues, particularly related to travel behaviour (Boarnet & Crane, 2001; Bruton & Brindle 1999; Dieleman, Dijst, & Burghouwt, 2002; Handy, 1996; Krizek 2003; Ritsema van Eck et al., 2005; Stead & Marshall, 2001; Timmermans et al., 2003).But not only travel behaviour can have impacts on space. How actors perceive and pursue their interests, their resources, incentives and actual power[52], also play a role. In fact, the 'experience' of the several actors, preceding and acquired during the redevelopment process, influences the way actors (inter)act. The investments of each type of actor are comprised within their budgets. Therefore, a clear understanding of the context, a clear vision of aims agreed among all steered by a clever leadership, are needed (Pol, 2002) to contribute to the definition of well performing spaces.

Bertolini & Spit (1998), note that two strategies for the (re)development of station areas can be adopted: a property-led station development (stimulated primarily by changes to the 'place') and a transport-led development (stimulated primarily by changes to the 'node').The strategy to pursue is connected to the city's context. Pol (2002, p.2) distinguishes two types of city that choose different strategies for station development: the *"cities in transition" - "often old manufacturing or port cities striving to diversify their economic structure by efforts to attract new economic activities and inhabitants"* -, and the *"international service cities" - "competitive edge in the international service and knowledge economy, because of their high-grade (international) facilities, attractiveness and accessibility"*. This author showed that *"cities in transition"* tend to invest first in the 'node' and then in the 'place', and that *"international service cities"* tend to do it in the opposite way.

Independently of the adopted strategy, to reach good spatial performance at station areas, it is crucial that actors understand the project's context and what means are available. Aims should be set within the range of what is sustainable (economically, socially, and environmentally) for the group of actors and the territory itself (adequacy of objectives to the context reality – country, city, economy, culture, etc.) (Conceição, 2007). A clear vision must be set and followed with strength, yet with flexibility for conciliation of interest and changes introduced with time. Imaginative solutions, which are great allies to deal with a changing context and adversities, can also emerge out of public participation. Involving the public can, grant greater acceptance because the solution is inevitably closer to the users. Such 'planning process' framework can produce balanced spatial programs, which can be translated into the space if ways to effectively work integrated with 'spatial design' are found (Conceição, 2007).

If this does not happen, the spaces produced by the station area redevelopment projects hardly match all the expectations they generated (Conceição, 2007). As noted before, spatial configurations are many

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[51] For UIC (a transport related entity) the station is seen as a four actor meeting point, namely the passenger, the city, the HST operator and the infrastructure manager (Leboeuf, 2011). This position emphasises the 'node' dimension of the station, despite considering the city also as an actor. Residents, or city users (not necessarily transport clients) are not mentioned, but it might be assumed that their interests are defended by the city. Nevertheless, the business opportunities of extending the station domain beyond the station building limits are acknowledged.

[52] For a detailed account on this see Pol (2002, p. 43-63).

times regarded merely from a functional or an image perspective. However, the space isn't just passive scenery; it interferes with economic, social and environmental performances. If all interests are combined into a common program for the project, all stakeholders will improve their yields, as station area spaces will support them adequately. Finding common aims and pursuing them together brings benefits to all, facilitating the spatial performance of station areas. However, such consensuses are very difficult to achieve and maintain, especially during long time spans as those of these types of projects. The complexity of the planning process can indeed constrain the achievement of good spatial performance at station areas.

2.2.2. 'Spatial design'

The spatial layouts of station areas encompass their 'node' and 'place' features. Three types of factors influencing the layout of station areas' spaces, regarding 'spatial design', were identified (Figure 2.5): **'localization'** (of elements), **'diversity of uses'** and **'quality perception'**, concerning thus and respectively the physical configuration, the functionality and the intangible characteristics of space. Together they have repercussions on the overall quality of space and on liveability. For instance, an easy readable layout adds quality to a space from the safety, security and comfort perspectives. Such features can improve the social, economic and environmental dimensions. They can facilitate shopping during a time gap between trains, saving users time and (car) trips, lowering pollution levels, while increasing commercial gains and social satisfaction, and so forth.

The 'localization' of elements in a station area, essential to the configuration of its spaces, influences how people read and use them to perform the desired activities. For example, the location of different functions (transport related and other amenities), how they are connected and their level of accessibility. Which activities and land uses are available and how they are mixed is also relevant for the spatial layout, as their functional requirements imply specific spatial features.

'Diversity of uses' is necessary for a lively urban space, as it can cover peoples' daily needs. The multiple and intensive use of space (Dobbelsteen & Wilde, 2004; Wilde, 2002) can be a solution for an optimal balance of the use of space, as it allows environmental, economic and social gains, to be felt at different scales. It implies the use of space in second, third and fourth dimensions respectively, by functions diversification, their layering (turning space and distances more compact) and use in time. This can have implications on the amount of space that is necessary to develop. However, it also can lead to conflicts and disequilibrium. Where the frontier lies between balance and collapse is difficult to define, as personal and cultural features interfere with an objective quantification (Wilde, 2002). Thus, it is important to understand the needs of an area and complement them, making the area closely-knit.

'Quality perception' depends on the comfort that the spaces are able to grant as well as on their image. According to Peek & Hagen (2002), this corresponds with the highest level of the station users' requirements. The authors identified costumer's requirements and wishes for stations, based on inquiries to station users in The Netherlands, relating them with the Maslow's hierarchy of human needs. At the base of the pyramid are *"safety and reliability"* (minimal requirement and absolute prerequisite for station operations). *"Speed"* is then the first wish of a station user (no time lost or hassles), to which *"Ease"* on transport transfers follows. To have *"comfort"* on waiting times by sheltered sitting spaces and amenities comes next. On the top is the *“experience”* of the journey, which adds value to the utility of the trip by a pleasant visual environment. Maslow’s hierarchy was also used by Frey (1999) for establishing criteria for a more sustainable city in form and structure. The author relates the human needs with what a *“good city”* should provide, and how that should be done in a sustainable way.

To better match peoples’ needs and expectations with the space provided to meet them, participation of all actors in the processes is an important factor, which refers again to the influence of the ‘planning process’. Also, flexibility and adaptability are required to guarantee that quality is available in the short and long term at station areas (Wilde, 2002). Both the demands of passengers and neighbours of the station areas will evolve in time. So will transport infrastructure technology requirements. In order to match these demands and continuously respond with pleasant and safe spaces in and around the station, design must incorporate flexibility and adaptability from the start.

Bounded with the ‘planning process’, the ‘context’ and ‘experience’ of the redevelopment project’s city and actors, are the external factors to public space of station areas that can influence its spatial performance, i.e. the constrains and facilitators which can hinder or enhance the laying out of public spaces that offer adequate support for the activities to be developed in them. Bounded with the ‘spatial design’, the ‘localization’ (of elements), ‘diversity of uses’ and ‘quality perception’, are the internal factors of public space of station areas that can influence its spatial performance, i.e. the shortcomings and virtues of the spaces which can hinder or enhance their ability to offer adequate support for the activities to be developed in them.

How these factors, and especially those bounded with ‘spatial design’, are influencing station areas’ spatial performance was deeply explored with the analysis of case studies, explained in chapter four.

3. FROM CITY'S STATION TO STATION CITY

The spatial origins and evolutions of station areas are further examined and detailed in this chapter. Here the second sub question is addressed, and the preceding chapter's reflection on the factors that affect the performance of station area's spaces is supplemented. Additionally, this chapter forms the basis for the choice criteria of the case studies analysed in this research.

The text reports on the spatial changes that have occurred in stations, as well as with the relation to their surroundings and cities, since the station was *"created as the solution to a new architectural problem"* (Meeks, 1975, p.26), until the most recent interventions. This historical account of the physical and functional patterns of station areas spaces builds the understanding of their changing spatial characteristics and performance. This learning can also help in proposing improved scenarios, inferring from the found problems and solutions that may have parallels with the current situation.

The first section provides an introductory evolutionary perspective, ranging from the pioneer station buildings that welcomed the steam trains, to those that are witnessing the arrival of the HST. In the first subsection, the spatial developments of station areas are examined. The layouts of stations and of its surroundings, as well as their spatial relationships, in some ways reflect the technological and societal paradigms of each period. These periods and links are here identified. Also, the physical and functional patterns of station area layouts are described, regarding 'node' and 'place' dimensions. In the second subsection, the focus turns towards the most recent developments in station areas, namely the introduction of the HST and the impact it is bringing to station area spaces. A short incursion into new technologies and ideas is made to reflect on the future of station areas' spaces.

The second section offers insight on the diversity of European HST station areas and their characteristics. The 'HST redevelopment projects survey' describes an overview of the variety of (re)conceptualization of HST station area spaces in Europe. A deeper analysis of selected cases is done in the following chapter.

3.1. Station area spatial evolution

Cities, in all periods of history, have been the support to human life and its needs, a location to get food, shelter, safety, other goods, social encounter, entertainment, etc. Even though there is a great concentration of activities and goods in cities, not everything takes place or is to be found within them, but is expected to be within reach from them. The concentration of people and facilities however hasn't only brought benefits. Conflicts of all natures occurred and continue to occur. A continuous search for (spatial) balances is continuously fed and challenged by technological and societal advancements, which have pushed the transformation of the configurations of cites' spaces over the centuries[53]. Additionally, the changes operated on the functional and physical organization of layouts of cities introduce not only

[53] With a quick overlook one can see some of these relationships. Housing buildings, for example, changed typologies together with lifestyles. Streets became wider to accommodate cars and other motorized vehicles, integrate sidewalks, and incorporate more and more infrastructure (public lightning, sewers, etc.), all of which became imperative for life in cities. Some elements of cities are concrete translations of these types of phenomena, of which railway stations are a paradigmatic example.

innovations but also new problems to solve, which in turn generates new ways of looking at and designing these spaces.

As crossing points of communication networks, usually organized around rivers, near seas, or on road intersections, cities were always associated with accessibility and mobility on a broad sense. Cities are 'nodes' and 'places' of these systems, as they are at the same time their common stopping and connection points. Movement and stillness come together in them. At stations this is more evident than at other spaces of cities. Therefore, they strongly represent this urban condition.

Considerably influencing each other, transport and land use (Ewing & Cervero 2001; Handy, 2005; Newman & Kenworthy, 1989; Priemus, Nijkamp, & Banister, 2001; Wegener & Fürst, 1999), can have quite complex (spatial) relationships. Since the early days of their encounter, *"railways and cities formed a complex relationship and influenced each other in many ways"* (Roth & Polino, 2003, p.xxx). Station areas, are thus challenging parts of cities, coupling heavy transport infrastructure, industrial and even living areas, with their conflicting activities and requirements. The spatial integration between railway and city has always been difficult. In the beginning, conflicting feelings about railways kept stations at a safe distance from cities. The excitement of some for the railway's potentials was counterbalanced by the distrust of others (Meeks, 1975). There were moments of enthusiasm about the railway and other public transport systems, but also of its discredit in favour of private transportation. Only more recently, has the importance of both private and public transport complementing each other surfaced. It is thus no surprise that dealing with station areas has never been an easy issue, being both magnets and repellents of city life.

Until the arrival of the railway and its stations in the early 19th century, roads and canals (the latter preferred when existing, as they allowed for faster travel) were the mobility infrastructure influencing the city layout and life. After the advent of the steam train, airplanes and the democratization of the car brought other infrastructure onto the scene, namely airports and motorways. Presently, *virtual ways* are also shaping cities (Bertolini, 2000; Castells, 1996). The rise of these networks and their social implications has shaken the liveability of station areas' spaces. However, in recent years stations and their surroundings endeavoured renovation processes. The characteristics of the periods of spatial growth and decay of stations as 'nodes' and 'places' are discussed in this section.

3.1.1. 'Node' and 'place' developments at station areas through time

> *"The changing role of the station through the years:*
> *The railway station used to be: A place to Leave (Just a place to depart or arrive; At the edge of the inner city).*
> *The railway station is becoming: A place to Be (A place to spend useful time, diversity; In the centre of the new city development)"* (Mulder, 2008).

The lines above summarize the station (area) evolution, according to the view of contemporary station redevelopers. Even if, in a general form, these affirmations are correct regarding the intentions of the current period of station area redevelopment, the evolution of station (areas) since the introduction of the railway hasn't been this linear. Further, as noted before, the large investments on transforming station areas into more than 'nodes' is not a guarantee of the successful development of balanced 'nodes' and 'places'.

In the early days of the railway there was a mix of enthusiasm for the potential and fear of the unknown consequences of the new technology. But all in all, after an initial period of experimentation and acquaintance, the benefits seemed to overcome the downsides. The excitement around stations grew exponentially, as did their spaces, requirements and problems.

Regarding the architectural features of railway stations, Meeks (1975) identifies five distinct periods until 1956, when his book was first published. The several phases correspond with changes in the architectural approach to the station building in the sequence of technological and societal demands. He names and circumscribes these periods as follows: *"functional pioneering"* (1830-1845), *"standardization"* (1850's), *"sophistication"* (1860-1890), *"megalomania"* (1890-1914), and the *"twentieth century style"* (1914-1956). The first period corresponds to the initial experimental years of the railway, in which diverse transport technologies and station layouts were intensively tested. In the second period, the most successful solutions tested in the former one became standards in station projects. The third period brought technological innovations which increased safety, speed and luxury of rail transport. The growing enthusiasm around railways and their stations reached unprecedented levels in the fourth period. Stations became increasingly bigger, handling much more passengers than before. In the last period defined by Meeks (1975) the elimination of architectural ornaments brought by the International Style is perhaps the most noticeable feature.

In the following years a decline of the railway and of the spaces of station (areas) was to be witnessed, to which succeeded the railway renaissance.

> *"Notes to the second printing: [...] In the eight years which have intervened since this book was first printed, the decline of the railroads has been swift and the destruction or vulgarization of stations has been deplorable. What began as a history has become an obituary."* (Meeks, 1975, p. viii).

If in his work Meeks (1975) focused on the station building itself, Tiry (2008) when identifying another period of development from 1990 until 2000, does not detach the transport building from its surroundings. She, as well as the author (Conceição, 2007), regards the station as a structure that operates at a multiscalar level, namely influencing the territory at several scales, local, urban and even going beyond the city where it is located. The proposal of Tiry (2008) of typological classification of these contemporary *"transport megastructures"*[54] regards the stations and their influence reach. She defines three categories of *"transport megastructures":* the *"hyperpole, or the big metropolitan equipment",* the *"urban connector, or the renovator big equipment"* and the *"extended hub, or the infrastructure serving the public space"*[55]. The

[54] Term used by Tiry (2008) referring to contemporary stations, translated from the French *"mégastructures du transport"*.

[55] These terms, used by Tiry (2008), are translated from the French *"hyperpôle ou le grand équipement métropolitain"*, *"connecteur urbaine ou le grand équipement réparateur"* and *"nœd déployé ou l'infrastructure au service de l'espace public"*, respectively.

first type refers to stations whose influence range goes far beyond the local scale, and that conform themselves as urban centres (cities within cities), for example, Kyôto station. The second refers to projects that are used (also) to regenerate and connect urban fragments separated by the railway tracks, such as the case of Gare Lille-Europe in Lille. And the last type (re)constructs the urban landscape of the area where the transport infrastructure is located, (re)stating its (pre-existent) logic, and somehow fusing the transport infrastructure with the building. To illustrate this last type Tiry (2008) gives as example the Gare du Flon in Lausanne.

As this research focuses on the station area, and not exclusively on the station, it was considered necessary to proceed with a regrouping (see Figure 3.1) of the periods listed above. The categorization of the different stages of architectural development of the station building by Meeks (1975) does not correspond directly to notable changes in the station area. It must be noted, however, that these regrouped periods are not self-contained, as it is almost impossible to establish exact dates to frame the distinctive characteristics of a period. The simultaneity of different types of cases distorts an unequivocal classification.

1830 - 1850 ORIGINS	until 1900 EXPANSION Bustling developments	until 1950 MODERNIZATION	until 1970 DECLINE	until 2000 RENAISSANCE	… future CONSOLIDATION
Station>Node	Station>Node+Place	Station>Node+Place Surroundings> Place	Station> Node Station+Surroundings> Non Places	Station+Surroundings> Node+Place	Station+Surroundings> Node+Place
Experimentalism (Airport like)	Accent on Image Terminals Era			Accent on Image (Airport like - in the city)	Accent on Integration
Outside the city		Inside the city			*Fusion* with the city
Polarization Railway as a development factor of city			*Front and back side syndrome* Railway as an obstacle to city development		Interwoven Railway as a development partner

Figure 3.1 – Development periods of station areas

The first period defined in this thesis is named **'Origins'**, spanning from 1830 to 1850, and refers to the initial estranged relationship between the station and the city. In this period, stations were mostly isolated buildings at a respectful distance of the city. The two initial periods Meeks (1975) defines as *"functional pioneering"* and *"standardization"*, both concerning transformations circumscribed to the station building, are incorporated into this single period. Since the appearance of the first purpose-built station in 1830 (Richards & MacKenzie, 1988) until around 1850, the relation between the building and the urban area was a distant one. In those days, parallels between railway and air-line operations could be found. Passengers would be transferred from central locations in the city to remotely located stations and vice-versa, similar to what occurs with airports. The station was essentially a building with transport related functions, a 'node'. It can only be regarded as a 'place' in the sense that, in its location isolated from the city, it was a (public) space created to be used by people.

The second period defined in this thesis congregates the *"standardization"* and *"sophistication"* periods defined by Meeks (1975). It is named **'Expansion'** and spans from 1850 until around 1900. In this period, stations were characterized by exuberant architectural features and daring engineering proposals, namely on the design of train-sheds. Cities, railway companies and designers competed for a forefront ranking of their *city gate*. During this phase the railway started to become absorbed by the cities, which were undergoing expansions. The station area, as defined in this thesis, was forming. Stations housed more and more non-transport activities, becoming the place where travellers and locals of all backgrounds would converge, producing a bustling atmosphere (Parissien, 1997). A real link between the station and the city was germinating, even if it was mainly a social one at this stage. The station was no longer only a transport 'node', it was also a 'place'.

Two different approaches on how to deal with the definition of the then new architectural type, the station, and integrate it with the city, emerged (Meeks, 1975). In France the presence of the new daring world of technique was assumed in the station façade, looking for a novel architectural expression of contemporary events. Gare de l'Est (Figure 3.2), which would become the model station of the head type (Meeks, 1975, p.61; Richards & MacKenzie, 1988, p.21) is a good example of this. Contrasting with the French attitude, the English were hiding the train shed behind the station buildings, dissimulating stations in the city. One can see this by looking at Paddington, Cannon street, Charing Cross or St. Pancras (Figure 3.3) stations. Independent of the approach to their façade, these buildings were becoming 'city's stations'.

Figure 3.2 - Gare de l'Est in Paris (www. stephanekirkland.com)

Figure 3.3 - St. Pancras station in London (Andrew Nash, 2014)

The three principal types of stations defined during the 'Origins' period (one-sided, two-sided and head), evolved in this second period. The head type became the preferred type, housing an increasing number of non-transport functions, among which there were sometimes hotels. This type presented advantages for travellers as they could easily access trains without crossing the railway tracks. Further, the integration of the headed railway (station) with the city was easier than that of the other types. The railway tracks didn't fully cut the urban fabric into two sides, inflicting a softer barrier into the city. The operational efficiency of the one-sided stations was increased with the addition of pedestrian tunnels under (and perpendicularly to) the railway tracks. The possibility to cross the railway tracks from one side of the city to the other through the station softened their confrontation. The two-sided type gained a third building connecting the original two. This addition concentrated most of the new functions, especially in buildings that also gained another level. In this situation, the building perpendicular to the tracks was placed at ground level, while the other two and the tracks were on an elevated level (Meeks, 1975, p.80). The confrontation of such buildings with the city became somehow similar with that of the head type.

The last period proposed by Meeks (1975), the *"twentieth century style"*, coincides with the third one adopted in this thesis. It is here named **'Modernization'** and spans from 1900 until around 1950. In this period between the two World Wars many stations were damaged or destroyed, which brought a need to rebuild them. Additionally, the steam railway was progressively replaced by the electrical system, presenting new requirements to the spaces of stations. The new technologies, as well as the need to (better) connect the station with other transport modes, namely underground, trams and busses, triggered many adjustment and expansion works. The architectural design of new stations was then much more linked to utility, and less concerned with representative matters. The modernist style was adopted expressing the desire for innovation of the post war society. Amstel station in Amsterdam (Figure 3.4) and Santa Maria Novella station in Florence (Figure 3.5) are remarkable examples of this period. This phase was also one of intensive production of proposals for the station for the modern city, most of which never left the drawing board (Conticelli, 2012).
At that point, most of the stations were no longer outside the city; the city had grown around them. The station area, as the combination of a station and urban surroundings defined in this thesis, was in effect then. Still, the station was mostly working as a transport 'node', and the urban surroundings as a 'place'. Non-transport related functions like shops, restaurants or bars, inside the station were reduced to a minimum, in order to keep operation's costs low (Paksukcharern, 2003).

Figure 3.4 - Amstel station in Amsterdam (M.M.Minderhoud, 2005)

Figure 3.5 - Santa Maria Novella station in Florence (Freepenguin, 2008)

The **'Decline'** period ranges from 1950 until around 1970. In this fourth period, the decay of the station area became evident. The blight of these areas increased, fed by the barrier effect of the tracks and other railway related infrastructure[56]. The city urban fabric was developing differently at both sides of the barrier, which only allowed its connection at few specific points. Physical, functional and social problems accumulated in the station area. Further, this phase corresponded with the rise of road and air transport,

56 The areas dedicated to marshalling areas, goods yards, goods transfer areas, workshops and maintenance posts, passing places, shunting yards and points, depots, power stations and other operational facilities, were considerable.

affecting rail travel negatively. Therefore, at this stage, both the station and its surrounding urban area became *no go* areas.

The fifth period defined in this thesis, named **'Renaissance'**[57], spans from 1970 until around 2000. It corresponds to the genesis and first steps of the ongoing redevelopment projects of station areas.

The rail transport, through the HST, was rediscovered as a faster, cheaper, environmentally friendly mode, conveniently linking the city centre with local, regional, national and international destinations. The road traffic congestion played a crucial role in this too, and so did other problems derived from 'urban sprawl development patterns'. Therefore, the interconnection of different (new) modes at the station area was also encouraged, reinforcing the 'node' role of the station area. The transport 'node' can encompass the train, busses, trams, metro, private and sharing cars, bicycles, boats and direct connections to air transport.

In addition, great extents of brownfields at station area's locations made available large spaces in the inner city that could be redeveloped. These spaces were created by the extinction or deployment of a great amount of railway infrastructure out of the city. Their redevelopment was expected to generate profits for the recently created real-estate branches of former European railway companies. The opportunities lead to extensive plans for urban redevelopment at station areas, strengthening their place dimension.

The vision of station areas as 'nodes' and 'places' feeding each other, boosted redevelopment projects. These operations used the (glamour of the) HST as a catalyser. Further, they made considerable investments in their image, putting architectural design at their service (Segratin, 2011), similar to what had happened in the 'Expansion' period.

The experimental character of this 'Renaissance' period seems to have contributed to the need to improve the performance of contemporary station areas.

The last period defined in this thesis, is regarded as the span of time devoted to the improvement of the performance (and rethinking) of station areas' spaces. Therefore, the **'Consolidation'** period is considered in this research as occurring approximately since 2000 and spanning into the future.

The typologies identified by Tiry (2008), epitomise possibilities for the development of station areas, as attempted in the 'Renaissance' period. The *"hyperpole"* concentrates the 'node' and 'place' dimensions of station areas inside the station building. It can be seen as a 'station city' enclosed into itself, similarly to the 'airport city' model (Güller & Güller, 2001), or to the Asian model of stations. It is comparable with the stations of the two first periods[58]. In Europe, the station area redevelopments seem to have concentrated on the *"urban connector"* typology, or on relating existing urban fragments by regenerating the station and its urban surroundings. Is the next step the *"extended hub"*, or the *"beginning of a new hybrid model where the limits of the High-speed station district finally blur with those of the central territory."* (Tiry, 2011, p. 200)? Is this a truly 'station city', in the sense of an open and cooperating system between the station building and its urban surroundings? Is this the future of the original city's station?

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[57] As mentioned before, Renaissance is a term also used by several authors (see sub section 1.3.1) when referring to this period.

[58] Despite the changes brought by the introduction of the HST to station, there are many similarities with the bustling and glamorous early stations. Some of the early stations were also somehow 'station cities'. These were even more similar to the current 'airport cities', as they were located far away from the city centre.

3.1.2. Towards of a new kind of space?

The spatial innovations occurring during the 'Renaissance' and 'Consolidation' periods, are closely linked to the introduction of the HST, and are identifiable beyond the station (area) level.

The Trans European High Speed Network[59] growing in each country sets ties with its neighbours. It is expected to further fade away European borders, as national peripheral cities become European centres (Berg & Pol 1998). Additionally, because the HST reduces travel times between cities, the distances between them latter are "shortened"[60]. In this way the European map changes (Figure 3.6). Some cities grow in accessibility and are perceived differently on mental maps. This dynamic motivates countries and cities to develop their connection to this network

At the local level, the redevelopment projects catalysed by the introduction of the HST, seek ways to regenerate urban fabric and station buildings. In order to maximize the profits of these operations, space quality allied to the classy image of the HST are highly valued. The range of the transformation energy of HST redevelopments is remarkable, but also perplexing.

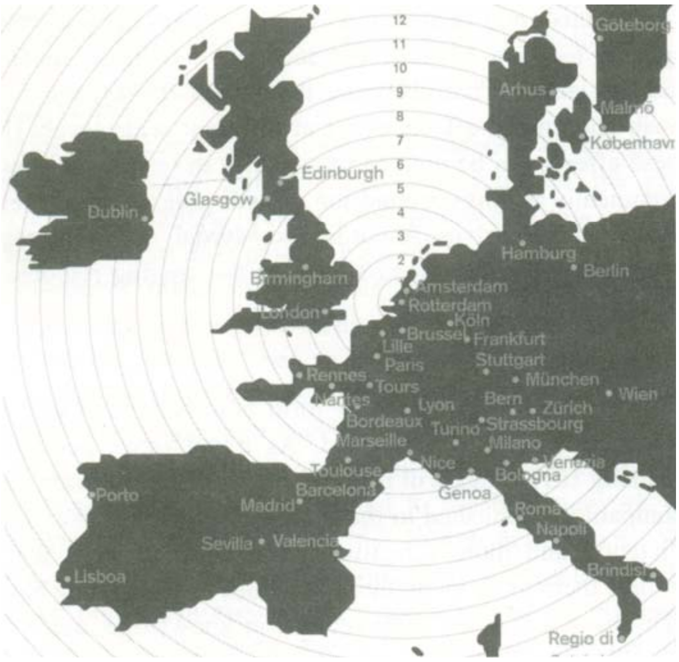

Figure 3.6 - A changing map of Europe with the developing HST network
(NAi, 1999 in Pol, 2002, p. 20)

The concentric rings shown tune in hours by HST from Rotterdam.

[59] *"The programme for the trans-European transport network (TEN-T), as introduced under the Treaty of Maastricht and defined in Decision 1692/96/EC in 1996 (2), is designed to guarantee optimum mobility and coherence between the various modes of transport in the Union. The main priorities of this policy, which accounts for a large part of the White Paper on transport policy in the EU (3), are to establish the key links needed to facilitate transport, optimise the capacity of existing infrastructure, produce specifications for network interoperability and integrate the environmental dimension. The TEN-T focuses very closely on the development of high-speed transport. Of the 30 priority projects put forward under this programme, no fewer than 14 concern high-speed lines. [...]*

(2) Decision 1692/96/EC of the European Parliament and of the Council of 23 July 1996 on Community guidelines for the development of the trans-European transport network (OJ L 228, 9.9.1996).

(3)White Paper — European transport policy for 2010: time to decide" (European Commission - Directorate General for Mobility and Transport [EC-DGMT], 2010).

[60] For further information on HST effects see Berg & Pol (1998) and Pol (2002).

> *"A HST is just a train running at a higher speed on new lines. Nevertheless, it is similar to a conventional train when it is inside a station. So, why should High Speed Rail specifically change the station?*
> *HSTs have one only specificity: they run faster. However this capability brings two major changes in: - the perception of time by the passenger - the rail traffic volume. Both changes lead the 4 actors to envision differently the station.*
> *Both for the city and the station, High Speed Rail is seen as an opportunity and a potentiality. [...], HSR have brought huge changes at the city level. Passengers, operators, infrastructure managers and city planners, have benefited from the improvements. These changes may sometimes occur in cities out of all High Speed context, [...] but the converse never happens: HSR without any significant change. Since there is a kind of causation effect between HSR implementation on one hand and the city and the station evolution on the other hand, [...] it is worth deepening this relationship in order to identify guidelines for further development of the HS network."* (Leboeuf, 2011).

The renovating energy of the HST is indeed bringing some changes to the station (area). A clear example is the amount and diversity of non-transport functions offered at stations, which has increased dramatically. Commercial activities and services are occupying more and more space in stations. They are claimed to meet the expectations and needs of commuters, travellers, tourists, residents, workers or visitors from the surrounding area, providing convenience and increasing efficiency. The offer ranges from supermarkets to reading material shops, sandwich shops, gift shops, flower shops, perfumeries, pharmacies, tourist information desk, cash dispensers, Post agent, ironing shops, job offices or bicycle service points, carsharing services, crèches[61], or even temporary events like concerts of exhibitions.
The station turned shopping centre is not circumscribed to Europe. In Japan, for example, the proliferation of these facilities made the word *ekinaka*, meaning inside the station, enter the Japanese lexicon to refer to them (Japan Echo Inc., 2011). In this country, the station has become nearly a self-sufficient little city inside the city (Tiry, 2008; Xue, Ma, & Chuen Hui, 2012). In China, this self-sufficient character is displayed by the dimension of the stations and their secluded positions towards the city centre. Parallels between Chinese HST stations and airports can be drawn regarding their (transport operation's) characteristics. The example of Shanghai south railway station (Figure 3.7) is paradigmatic of this[62].

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[61] The Belgium railway group (SNCB -Holding) argues that the offer of additional services in or around the station that can save time to the customer can be the deciding factor for choosing the train. Crèches fit perfectly into that picture. SNCB-Holding (2010) states that in a recent survey on mobility by Peugeot, 11% of respondents chose the car for their daily commute because they must bring or pick up their children from school before or after work. In October 2010 SNCB-Holding opened its first childcare, and has more plans for kindergartens in or near stations (SNCB-Holding, 2010).

[62] For further information on this project, designed by AREP, see Browne (2008, p119). Other examples, featuring similar characteristics are the projects for Wuhan station (Browne, 2008, p67) and Beijing south station (Browne, 2008, p81) in China, also designed by AREP.

Figure 3.7 - Shanghai south railway station (in Browne, 2008, p122)

Contrary to this Asian model, the European model is marketed as a mix between a well-organized mobility 'node' and a pleasant 'place' with shops and services, integrated in the city where it is located. It should congregate diverse transport modes, promoting seamless transitions among them, the use of public transport and alternatives like the bicycle and carsharing. Ideally, the surrounding area of the station should consist of a mix of housing, offices and social and cultural facilities. The railway tracks barrier is to be eliminated, re-joining separate neighbourhoods, and the station should no longer have a *front* and a *back entrance*, but *two front doors*. These principles are heralded by diverse railway related companies, who created brands and test commercial concepts. As examples, see the cases of *"Het Station"* in Belgium (NMBS, n.d.), *"Rail City"* in Switzerland (SBB/CFF/FFS, n.d.a, n.d.b, n.d.c), or the *"Proef Station"* in the Netherlands (ProRail, 2010). This considerable focus on the commercial dimension is noticeable, and raises the question of which direction the station (area) redevelopment is actually aiming toward. The experimental character and eagerness of the recent redevelopments draw similarities with the early days of the railways. The movement is *on rails*, but where will it go to?

The concept of *"moving platforms"* proposed by Priestmangoode, a British transport design company (Frearson, 2011), suggest radical changes might be ahead. If ever adopted, this idea can bring effective changes to the high speed transport, and consequently to its stations. To an extreme, this idea could mean the end of HST calling at conventional (fixed) stations. The company advocates that *"it is hugely inefficient to run a new 21st century high tech, high speed train service on a 19th century infrastructure that was invented for steam trains"* (Priestmangoode, n.d.). To change this, the company proposes the concept of *"Moving Platforms…a totally inter-connected rail infrastructure where local trams connect to a network of non-stop high speed trains enabling passengers to travel from their local stop to a local address at their destination (even in another country) without getting off a train"* (Priestmangoode, n.d.). The transfer of passengers to other trains or local transports such as trams would be done in movement. A HST would slow down at the proximity of a city and the other modes could then dock to it allowing for the passenger transfer without disembarking.

"[...] an ingenious solution that can potentially revolutionize the rail industry the way the internet revolutionized the way we communicate". (Priestmangoode, n.d.).

This would mean that stations for HST would be the other transport modes themselves, instead of the conventional stations. They would be *moving stations*, or *"moving platforms"* as they were called by the creators of the idea. Nevertheless, if that happens, other transport modes would still require conventional stations. With or without such radical change, conventional stations demand an urgent spatial reflection.

3.2. HST stations in Europe: high speed changes on European station areas?

Exploring the spaces of the station area in European urban areas can imply the study of a great amount of cases with different characteristics. In order to get an overview of them, and to build a manageable and reliable sample to study and compare, the survey presented in this section was created.
The survey was limited to stations with HST[63]. The potential of the redevelopment projects of HST station areas to optimize the performance of their spaces lead to this choice. Further, this choice provides a common denominator, while gathering knowledge on the wide range of (possibilities for the) materialization of this potential in Europe. Different approaches to the spaces of station areas and their performance could be framed in this way. Still, there are many station areas of different sorts where HST calls at in Europe. Therefore, to facilitate the choice for a representative sample of cases to be further analysed, station areas were categorized according to general 'node' and 'place' characteristics, in several selection stages.

3.2.1. Focusing on station area transformation in the urban context

For the initial survey, a database was made with 360 station areas in several European countries. The considered cases were either built, in the process of (re)building or had a project in an advanced stage. In this way, a general understanding on diverse redevelopment approaches, their (spatial) characteristics, as well as their evolution and the most recent reflections on the spaces of station areas, could be included in the study. Cases from the following countries were chosen (Figure 3.8): France and Germany, which have the biggest European implemented networks; Spain, also with a wide number of operating stations; Italy, which is expanding its network and promoting new projects; the United Kingdom, with a small network exploring new possibilities; The Netherlands, Belgium, Austria and Switzerland, smaller countries crossed by HST services of their neighbours and interested in *reinventing* their central station areas; and Portugal, which was still developing its HST Network at the time of this survey.

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[63] This study was done in 2008. Thus the HST does not stop anymore at some of the considered stations, and stops at other stations that were not considered. Also, the Portuguese project of HST is stopped, as a result of the implemented austerity policies chosen to deal with the current crisis. However, it was considered not useful to redo the whole study because of these changes. The amount of cases in the referred conditions is not noteworthy, thus it wouldn't bring significant changes to the results. Additionally, the mentioned changes do not affect the case studies that were selected based on this survey, nor their relevance for this research purposes. Nevertheless, there was an effort to update the report to the current situation, especially in terms of references.

For each country, the stations where HST called or would call at were listed. The cases were sorted by several categories, as explained below. A first approach to the station areas' 'node' and 'place' characteristics, as well as their comparative study, was made, allowing to downsize the sample of cases to be further analysed.

Figure 3.8 – The (360) surveyed European HST station areas

To approach **'place'** characteristics, three categories were defined concerning the **position of the station in relation to the city** (Figure 3.9): **'inner city'**, **'boundary'**, and **'outside'**. The first one gathers stations that are within traditional centres. These are mostly consolidated urban areas, which in some cases are decaying. The second category gathers stations located in areas away from the city centres, which may be aspiring to become new centres in the city or not. Some of the stations in this category are part of the intended urban consolidation of the peripheral areas they are located in. Others, were placed outside the city, and weren't really absorbed by its expanding urban fabric. The third category gathers stations that are not part of an urban scenery.

Regarding **'node'** characteristics, three categories were defined to classify the **type of station** (Figure 3.10): **'terminal'**, **'through'**, and **'mix'**. To distinguish to which type a case belongs to, the heavy railway main lines (for suburban, regional, national and international train connections) were considered. They are always present at stations, even if some of them converge with other transport modes using railway lines, such as metro, light rail and trams. The cases with heavy lines that are exclusively ending at their station, belong to the first category. The second category gathers cases with heavy lines going through their stations. The last category encompasses cases which mix the first two types of heavy lines. These include former 'terminal' stations to which 'through' heavy railway lines were added, and cases in which two or more sets of through heavy railway lines cross each other.

To have a perception on the influence of HST on the (re)structure of station areas, the **type of approach** to the station (Figure 3.11) was also observed. Three categories were defined: **'existent'**, **'modified'**, and **'new'**. The first two refer to stations that already existed before the HST arrived to them. On the first, little (soft) adaptations were done to the station buildings. On the second, deep (heavy) transformations happened, either by addition of new (parts of) buildings or by demolition of existing ones and their replacement by new ones. The last category implies the construction of completely new dedicated buildings. Most of them are placed along existing heavy railway lines, at former stops for other trains.

The analysis of the general survey on Europe HST Stations' relation to city, type and intervention approach, by country and their comparative study follows.

Portugal

At the moment in Portugal, the HST implementation is suspended. The current Government stopped the project in the context of the on-going crisis. Before this decision, it was known which cities would have a HST stop. However, the exact location of stations was only publicly announced for two of them. In Porto, at Campanhã station (Mateus, Ferreira, & Carreira, 2008), and in Lisbon, at Oriente station (Lusa, 2007). Both stations already house the fastest trains operating in Portugal. The Alfa Pendular trains which use titling technology, reaches speeds of 220km/h (Railway Technology, n.d.). For the introduction of HST it would be necessary to have both stations 'modified'. In Porto, the station was undergoing renovation works when the studies for the introduction of the HST put them on standby. In Lisbon, the necessary restructure of the layout of the station was commissioned to the same architect who designed the station, Santiago Calatrava. Both stations have a 'boundary' position in their cities, and are 'through' stations. The position in relation to their cities of other stations in the Portuguese HST Network was not decided. However, the studied hypotheses were for locations 'outside' cities.

Spain

In Spain the HST arrives in 21 stations (ADIF, n.d.). Most of them are in the 'inner city' and near its 'boundary'. Some are built new 'outside' the city borders, as they are intended to serve a region rather than a single city. Such remote locations shorten the distance and the travel time between stations within the HST network. These stations follow the French model of the *"gares-betteraves"*[64].

In the big cities, stations with HST are either existing stations which are 'modified' or built 'new'. The stations in smaller locations suffer minor changes. The stations are mostly of the 'through' category. In the big cities the HST railway tracks tend to be underground. This position of the tracks allows a few stations, some of them new ones, to be 'through' stations with a head layout towards their surrounding areas. This is the case, for instance of Seville and Cordoba, the latter being a new station built beside the old one.

France

France has the biggest HST network in Europe, and by far the largest number of stations, more then 180[65], endowing it with a great variety of cases. A great amount of stations are located in the 'inner city' and near its 'boundary'. The so called *"gares-betteraves"* are 9% of the total of stations served by HST. They are built new only for this service, and represent 72% of the buildings built from scratch on the French HST network. Most of the stations are 'through' stations on the ground level and 'existent' ones. Of the few 'terminals' the majority are 'existent' and in 'inner city' locations. Major changes to stations are done mostly in the big centres, where complex connections are at stake, like at Gare du Nord in Paris, for instance.

Belgium

In Belgium, the analysed three stations with HST, Brussels, Antwerp and Liège, all allow through traffic of trains. Brussels is a 'through' station, and Antwerp is a former 'terminal' transformed into a 'mix' station by the addition of a through railway tunnel. Liège-Guillemins, also a 'through' station, is part of a wider operation involving the urban restructure of the peripheral area of the city where it is located (Spi+, 2005). It was built new beside an existing station, which was demolished when the new building started to operate.

The Netherlands

In the Netherlands, HST runs, even though not at full speed. Dedicated lines were built and the stations are being redeveloped. Six stations were considered by the government as *"Key Projects"* (VROM, 2004). They are Amsterdam Zuidas, Rotterdam Centraal Station (CS), Den Haag CS, Utrecht CS, Arnhem and Breda.

In this country most of the stations are in the 'inner city'. The exceptions are Zuidas in Amsterdam and Breda, located on 'boundary' areas of their cities. The area where Zuidas is located has been redeveloping as a business centre. In Breda, there is also a project for the renovation of the area (Gemeente Breda,

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[64] *"Gares-betteraves",* or in English *beetroot stations,* is an expression coined by Jacques Santrot which refers to isolated TGV stations (ISIS, Ingénierie du trafic et des Systèmes d'exploration, Ernst&Young, & ADIELOR, 2004, p.33). The nickname is used in France for stations located away from town and city centres, whether in the vicinity of beet fields or not.

[65] 180 stations here considered correspond to the French HST (TGV) network until 2008 (SNCF, 2007).

Other destinations are currently, or will be in the future, reachable. For a full map of the French TGV network see SNCF (n.d.a). For a map featuring the international destinations reachable from France, see SNCF (n.d.b).

n.d.). While Zuidas station is planned to be a 'new' complex, all the remaining cases are undergoing very heavy restructure, which involved extensive demolition of the existing buildings. All the cases are 'through' stations except Den Haag CS, which is a 'terminal'. Most of the cases involve bigger areas to develop than the station itself, as it is the intention of the *"Key Projects"* policy. In Amsterdam it is not clear yet whether the HST will cease to stop at Amsterdam CS when Zuidas comes in use. Therefore, Amsterdam CS, a historic building being renovated, was also considered in this survey adding to the six key stations.

Germany

As in France, most of a total of 114[66] HST (ICE) stations in Germany is located in the 'inner city' and near its 'boundary'. Stations that are 'outside' cities are mostly located on airports. Most of the stations are 'existent' 'through' stations on the ground level and elevated in many big cities. Major changes to stations are done mostly in the big centres, where complex connections are at stake, developing multilevel solutions. The projects of the Deutsch-Bahn (German railway company) for the renovation of stations and their surroundings in major cities in Germany, proposed a reflection on what would be the 'station of the future'. This work was shown, in the mid-nineties of last century, in an itinerant exhibition and a catalogue under the title *"Renaissance of Railway Stations: The City in the 21st Century"* (Gerkan et al., 1996). It compiled designs for Berlin, Cologne, Dresden, Leipzig, Hanover, Nuremberg, Münster, Hamburg, Kassel, Bielefeld, Frankfurt, Erfurt, Stuttgart, Mannheim, Essen, Bonn, and Potsdam. The 'terminals' were to be changed by means of tunnels into 'through' stations, and some would receive large real-estate operations on the free space left by the sinking of infrastructure. This didn't happen however in all cases. Frankfurt is one example of this (for a detailed account see: Speck, 2012).

Austria

Austria *"railjet"* (Deutsch-Bahn, n.d.) is the HST of the Austrian Railways (ÖBB) which was introduced in 2008. These trains join the Germany ICE trains which already run in Austria. Most of the 9 stations[67] here surveyed are in the 'inner city' or near its 'boundary', and they are all 'through' stations. There is only one station 'outside' the centre, but it is in between two small towns very close to each other. All stations existed and some of them are being 'modified' by the railway real-estate company. This institution is developing large projects to restructure the stations and the surrounding areas, which it owns. In Vienna the project is called *"BahnhofCity"*[68], clearly indicating their determination to adhere to an idea of a 'station city'.

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[66] The considered 144 stations are according to the map of the ICE network for 2008 (Deutcsche Bahn, 2008). In 2011 there were 10 extra stops for the ICE (Deutcsche Bahn, 2011). Fourteen stations were added to the network, and the ICE no longer stopped at 4 of the stations considered in this study.

[67] In 2012 the number of stations raised to 10.

[68] The project's promoters explain it as follows: *"Vom Bahnhof zur BahnhofCity: Die ÖBB folgen mit der Errichtung der BahnhofCity einem internationalen Trend: Die Erweiterung der Verkehrsstation zu einem multifunktionalen Raum. Hier findet man den Bahnhof mit Shoppingmeile, Büros, Parkgarage und Hotel. Bei entsprechender Nachfrage sind auch Entertainment- und Gesundheitszentren sowie einladende Wellnesszonen möglich. Dieses Angebot kommt sowohl Bahnkunden als auch Anrainern zugute."* (ÖBB-Infrastruktur AG, n.d.). Translated in English: *"From Station to station City: The ÖBB followed the establishment of an international trend, the Station City: The expansion of the transport station to a multi-functional space. Here you will find the station with shopping mall, offices, parking*

Switzerland

Switzerland does not have its own HST, and the speediest trains in operation are the Pendolino tilting trains operated by Swiss Federal Railways (SBB) and Trenitalia. In this country, the French TGV, the German ICE and the Austrian railjet provide HST services. The examined 5 stations are all in the 'inner city'. Most are 'through' stations and 'existent'. The main cities' stations, some of which the HST calls at, have undergone major changes with the *"Rail City"* initiative of the SBB. Their development alludes to a 'station city' concept. These spaces are described as *"where the railway station becomes a market place"* (SBB/CFF/FFS, n.d.b), emphasizing the strong commercial drive of these operations.

Italy

In Italy 15 cases were analysed. There are HST operating to main 'existent' stations, some of which are 'terminal' stations and are being 'modified' by the Grandi Stazioni SpA [69], a company owned by the Gruppo ferrovie dello Stato Italiane (Italian railways) and other (international) partners. Additionally, there are projects for 'new' 'through' stations which will receive HST, designed by famous architects: Napoli Afragola, by Zaha Hadid; Firenze Belfiore, by Norman Foster and partners; Reggio Emilia, by Santiago Calatrava; and Bologna, by Arata Isozaki, an addition to the existing building.

United Kingdom

The HST stations in UK are four within the Eurostar line to France. St. Pancras is in the 'inner city' of London, two others are somewhat peripheral to their cities and one is located 'outside' as a *"gare-betterave"*. After several unsuccessful projects for further implementation of HST in the UK, a wide discussion is now going on, debating 'wheel-on-rail' and 'maglev' technologies[70].

Comparative

Based on this first analysis, some general conclusions on the 'place' and 'node' characteristics of these areas could be drawn.

The majority of stations are in the 'inner city' (Figure 3.9), especially in the bigger centres. Smaller countries like Switzerland, the Netherlands, Austria and Belgium have almost 100% of their stations in an 'inner city' location. Italy and Spain, which have bigger networks, have around 60%. France and Germany follow with some 48%. In United Kingdom there is one case, St.Pancras, and in Portugal there is none. However, some of these station areas, especially in smaller cities, still have a periphery character. This is due to the fact that their locations were initially outside the city (Arles is one example) or linked to coast harbours (Dunkerque is one example). The redevelopment of stations is mostly held in bigger cities, but they are also arriving to station areas in some of these smaller cities, such as Le Mans or Strasbourg.

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garage and hotel. If there is demand, also entertainment and health centers, or inviting wellness zones are possible. This offer will benefit both the transport network clients and residents".

[69] The main objectives of this company are to requalify, enhance and manage the main Italian stations. For further information see www.grandistazioni.it.

[70] For further information see www.greengauge21.net and www.500kmh.com.

The choice for central locations highlights the importance of their advantages for intermodality and urban cohesion. Nevertheless, the technical, economic, social and environmental difficulties they present to restructure operations, especially within traditional centres are considerable. Substantial efforts are required to overcome these obstacles. Therefore, only very few of these cases are stations built 'new' (Figure 3.11). Of all the stations in the 'inner city' category approximately 85% are 'through' stations, 10% are 'terminal', and 5% are 'mix' stations (Figure 3.12). Most are 'existent' or heavily 'modified', about 96% of the 182 cases, Germany having the most of these later ones.

Pure 'terminal' stations (Figure 3.10) are few in the sample of stations served by HST and most of them are 'existent' on 'inner city' locations (Figure 3.13). Many are in smaller cities, mostly in French harbour areas. In big cities they often coexist with 'through' stations like in Lille, Turin, Florence, Rome and Naples. Other cases are Den Haag CS, Paris Est and Paris Montparnasse.

Investments to modify 'terminals' happen mostly in big cities on 'inner city' locations. Some of the 'terminals' were or are being transformed into 'mix' stations by the addition of tunnels, which provide the 'through' functionality: for suburban trains like in Paris; for HST like in Antwerp; or both like in Stuttgart. These solutions can overcome some of the difficulties of central locations and enhance their opportunities, as they avoid the placement of the HST station outside of the city. This implies high investments that only few cases have the conditions to do. The 'mix' type, even though a smaller percentage, can also be a cross multilevel station as in Berlin central station.

Another big percentage of cases fall into the 'boundary' category (Figure 3.9). Also here, of all the types, the largest amount of cases is 'existent', many of which are in smaller cities. The 'through' station type has again the majority. It gathers the greatest amount of the 'boundary' stations which are 'modified' or 'new' (Figure 3.13). Some examples are: Gare do Oriente, in Lisbon; Delicias, in Zaragoza; Santa Justa, in Seville; Gare Lille-Europe, in Lille; Liège-Guillemins, in Liège; Zuidas, in Amsterdam; Reggio Emillia; Belfiore, in Florence; and Afragola, in Naples.

The 'boundary' condition facilitates the construction of new buildings or modification of existing ones, as well as the promotion of the redevelopment of wider areas than the station itself. Many cases are connected with real estate operations. In the Iberian countries, there are explicit links of station's redevelopment with specific events, namely with the expositions Expo 92 in Seville, Expo 98 in Lisbon and Expo 2008 in Zaragoza. In most of the cases station design is assigned to famous architects, seemingly with an attempt to boost the image of the project by the association to a well-known professional.

Some cases in Germany are 'mix' cross stations: Osnabrück, Messe Köln / Deutz and Berlin-Südkreuz.

A smaller percentage represent the cases 'outside' cities (Figure 3.9). Mainly they are stations exclusively dedicated to HST built 'new' to serve several cities, and are therefore located in none of them (for examples see Figure 3.14); or linked to airports (for examples see Figure 3.15). Of these 'new' stations 'outside' cities, France has the highest number of them, sixteen representing 9% of the national total, and Spain, with five of these stations, has the biggest percentage of them 24% within its national context. Most of these stations are, in both countries, *"gare-betteraves"*. Germany has the most of its new stations 'outside' urban context connected with airports.

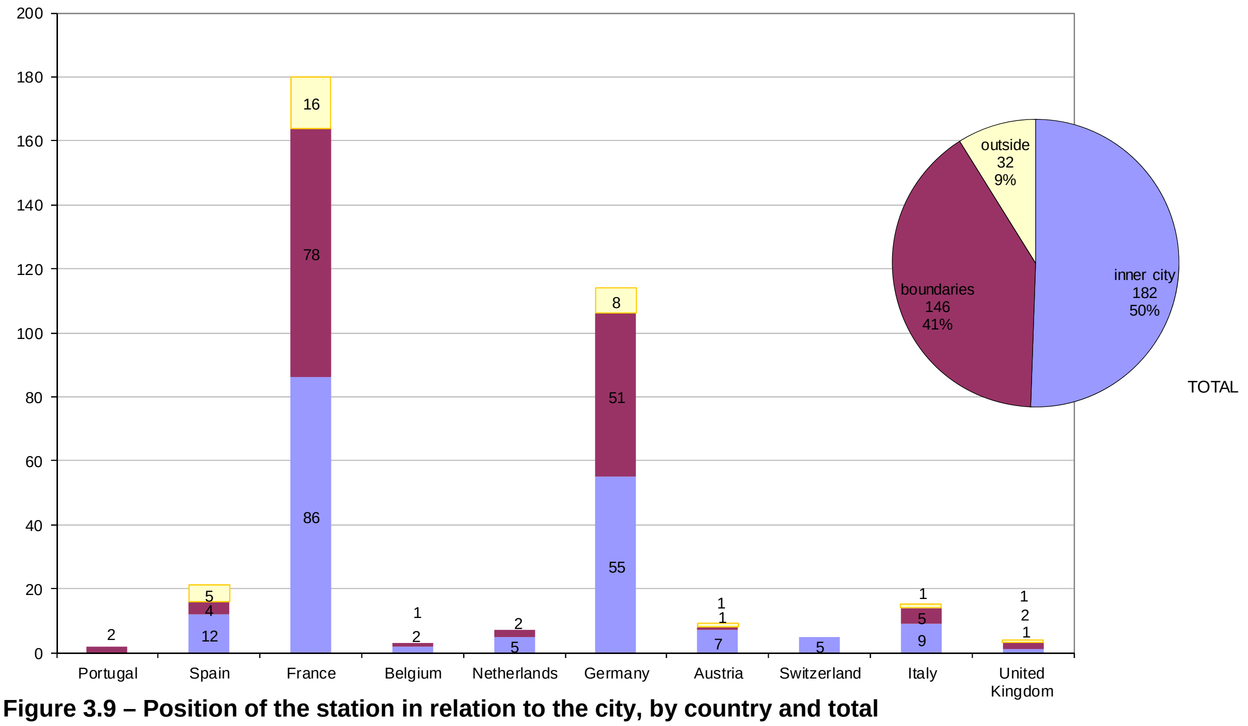
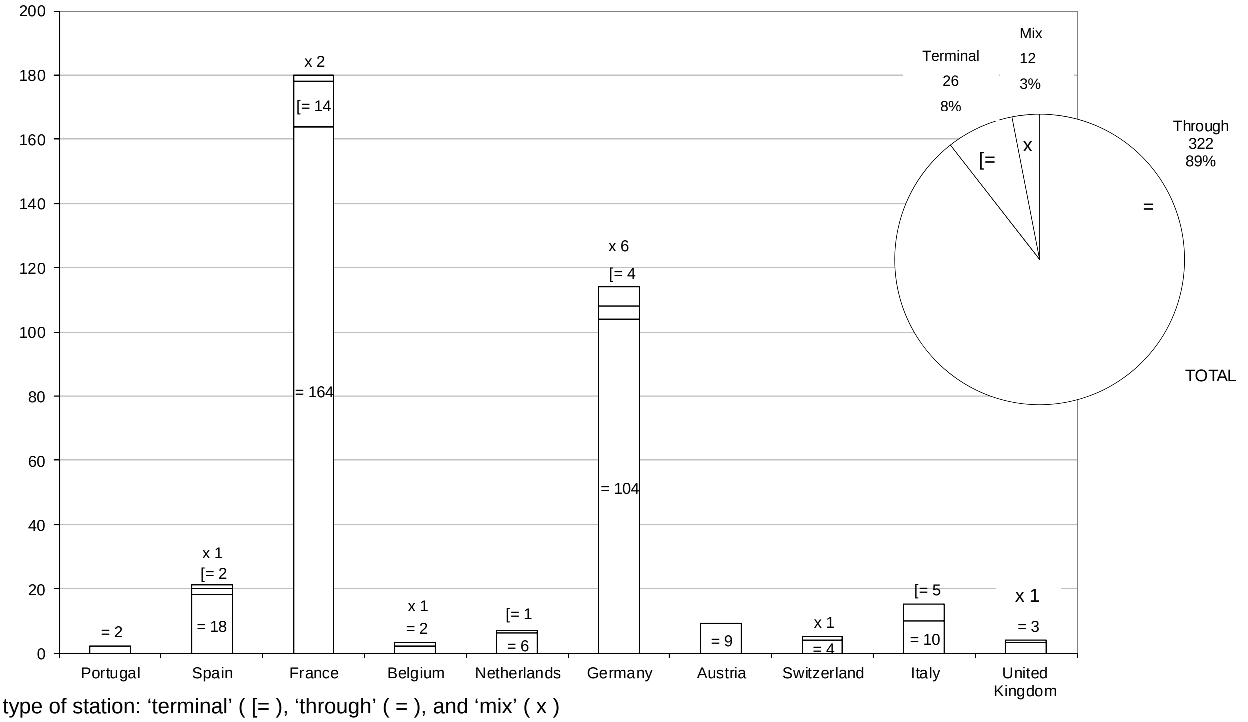


Figure 3.9 – Position of the station in relation to the city, by country and total



type of station: 'terminal' ([=), 'through' (=), and 'mix' (x)

Figure 3.10 – Type of station, by country and total

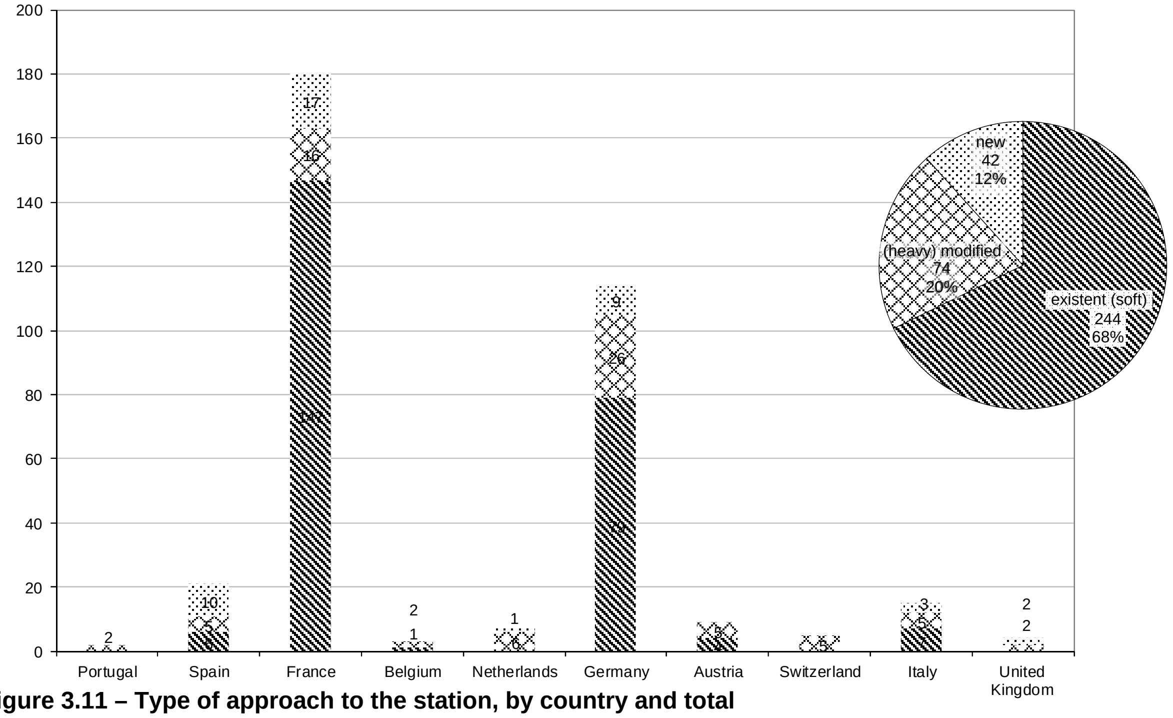
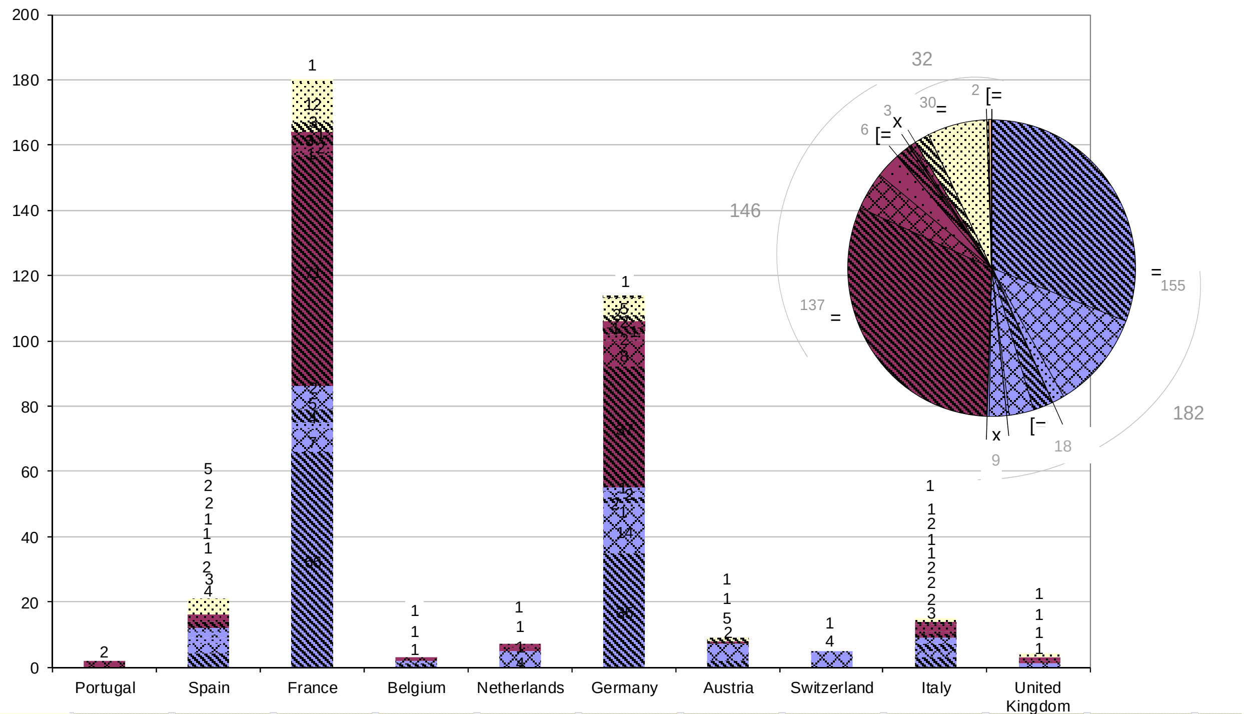


Figure 3.11 – Type of approach to the station, by country and total



new				5			12	1								5									1			1			24	1		25
modified																																		0
existent							3									2	1		1												6	1		7
outiside				**5**			**15**	**1**								**7**	**1**		**1**						**1**			**1**			**30**	**2**		**32**
new				2			2						1			2									2			1			10			10
modified	2						1	1		1			1			8		2							1			1			15	1	2	18
existent				2			71	3								37	1	1	1						1	1					112	5	1	118
Boundary	**2**			**4**			**74**	**4**		**1**			**2**			**47**	**1**	**3**	**1**						**4**	**1**		**2**			**137**	**6**	**3**	**146**
new				2	1		2									1		1													5	1	1	7
modified				3	1	1	7	5	2			1	4	1		14		2	5			4		1	2	2				1	39	9	8	56
existent				4			66	4		1						35	2		2						3	2					111	8		119
Inner city				**9**	**2**	**1**	**75**	**9**	**2**	**1**		**1**	**4**	**1**		**50**	**2**	**3**	**7**			**4**		**1**	**5**	**4**			**1**		**155**	**18**	**9**	**182**
type	=	[=	x	=	[=	x	=	[=	x	=	[=	x	=	[=	x	=	[=	x	=	[=	x	=	[=	x	=	[=	x	=	[=	x	=	[=	x	Total
Total	2			21			18 0			3			7			11 4			9			5			15			4			**TOTAL**			360

Figure 3.12 – Comparative, by country and total

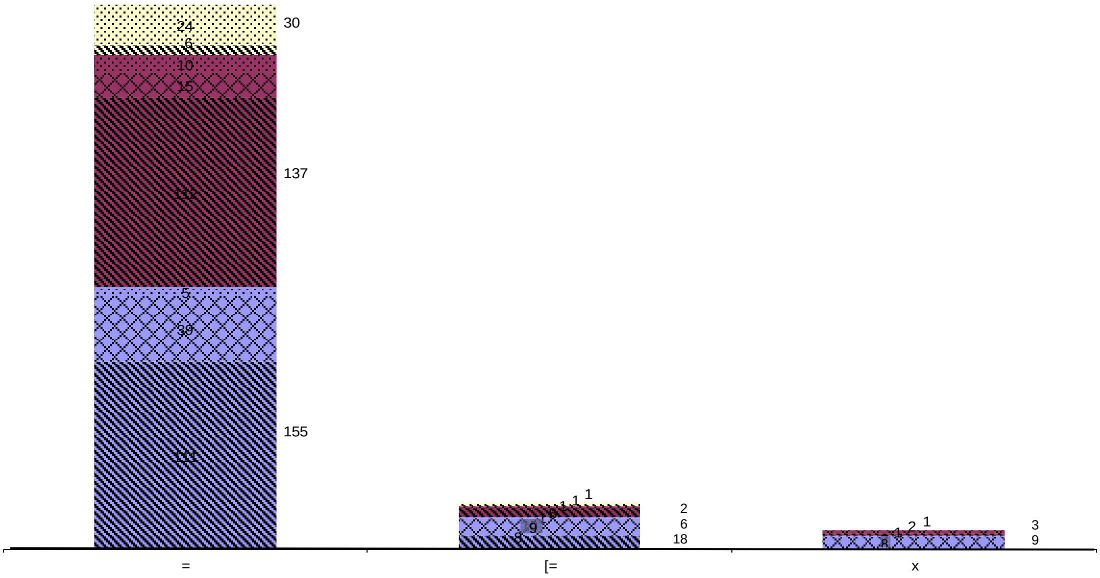


Figure 3.13 – Comparative: total by type, relation to the city and approach

Gare Haute-Picardie (www.hautepicardie.com)

Valence TGV (www.ledauphine.com)

Figure 3.14 – Examples of 'new' stations 'outside' the city linked to highways

Frankfurt Fernbahnhof (www.thesquaire-events.com)

Gare Lyon St Exupery (www.pointsdactu.org)

Figure 3.15 – Examples of 'new' stations 'outside' the city linked to airports

Gare de Nîmes (www.fr.wikipedia.org)

Gare d'Angoulême (commons.wikimedia.org)

Figure 3.16 – Examples of 'existent' stations

The results of this survey support the pre-selection of 40 cases made out of the initial 360, in order to deepen their study. Table 3.1 summarizes this pre-selection, grouping all the surveyed stations by 'relation to city', 'approach' and 'type'. The excluded cases are marked in grey. To distinguish (re)built cases from the ones on project or (re)building phase the first are marked in bold. The selection criteria are detailed below.

There are a considerably large number of stations within an urban context in the initial sample, as opposed to the reduced amount of cases 'outside' the city. This made clear that this research should focus on cases within an urban context. The possible findings resulting from their study support a larger number of future redevelopment projects of station areas. Additionally, because the interest of the study is to contribute to the improvement of spatial performance of station areas, the cases to be analysed should have a good potential for the balance between their 'node' and 'place' dimensions. This is not the case with stations 'outside' the city, whose 'node' dimension is in many cases poorly developed, and whose 'place' dimension hardly exists. Few transport modes converge to these stations (besides the train, there are private cars, eventually busses and taxis, and sometimes the plane), and the variety of non-transport functions is even scarcer (with an exception made to airports, whose 'place' dimension is mostly embodied by an isolated commercial facility). Therefore, all the stations 'outside' urban environments, such as *"gare-betteraves"* and airport stations were automatically excluded.
Another excluded group is the one of 'existent' stations, either at 'inner city' or 'boundary' locations. The HST arrival did not bring significant changes to these cases. No significant attempt to improve their spatial performance was made, therefore they were considered not to be relevant for this study. Most of them are 'through' stations in France (for examples see Figure 3.16) and Germany, and some are 'terminals', mostly in French smaller harbour cities.

These two groups, 'outside' and 'existent', include a total of 269 stations which are excluded, almost 75% of the 360 initially considered. From the remaining categories another 51 stations were excluded from this first pre-selection. Most of them are cases that do not suffer major changes, mostly located in smaller cities. It is the case of many of the 'terminals', some 'through' stations, as well as the 'mix' cross stations which were only identified in Germany. From the latter only Berlin Lerther bahnhof is selected for its exceptional situation of being such a complex case built 'new' in the 'inner city'.

Table 3.1 – Pre-selection

		Node Terminal [=	Through =	Mix x Terminal > Through	Cross (through)
Inner city	new	SP Huesca	SP Barcelona Sagrera SP Cordoba FR Lyon Part-Dieu FR **Lille-Europe** DE **Kassel-Wilhelmshole**		DE **Berlin**
Inner city	modified	FR **Paris Montparnasse** FR Marseille NL Den Haag IT Roma Termini SP Malaga FR Paris Est FR Saint Malo FR Tours DE München DE Frankfurt IT Milano Centrale	SP **Barcelona Sants** SP Puertollano SP Lleida FR **Strasbourg** FR Antibes FR Montpellier FR Poitiers FR Nantes FR Angers FR Rennes BE Bruxelles DE **Dresden** DE **Koln** DE **Hannover** DE other 11 stations CH **Basel** CH **Bern** CH Lausanne CH Geneve NL Amsterdam CS NL Rotterdam NL Utrecht NL Arnhem AU Wien AU 4stations IT Torino Porta Susa IT Bologna	UK **St Pancras** SP **Atocha** FR **Paris Nord** FR **Paris Lyon** BE **Antwerp** DE Leipzig DE Stuttgart CH Zurich	
Inner city	existent	FR Lille-Flandres FR Brest (Port) FR LSd'Olonne (Port) FR Arcachon (Beach) IT Torino P. Nuova IT Firenze	SP 4 stations FR 66 stations DE 35 stations AU 2 stations IT 4 stations		
Boundary	new		SP **Saragoza** SP **Sevilla** FR Avignon TGV FR Futuroscope DE Montabaur DE Siegburg IT Firenze Belfiore IT Napoli Afragola GB Ashford		
Boundary	modified	FR Lannion DE Warnemünde (boat) IT Napoli	PT Campanha PT **Oriente** * FR S Pierre dCorps (Tours) NL Amsterdam Zuidas NL Breda DE 8 stations BE **Liège-Guillemins** IT Roma Tiburtina GB Stratford		DE Osnabruck DE Berlin Sudkreuz DE Messe Koln Deutz
Boundary	existent	FR Le Havre (Port) FR Le Croisic (Port) FR Bourg-StM (Mountain)	SP Catalayud SP Toledo FR 71 stations DE 37 stations AU Brengenz IT Foggia		
outside		FR Vendôme DE Puttgarden	SP Gualad/Yebes SP Camp de Tarragona SP Segóvia guiomar SP P Genil / Herrera SP Anteq/ St Ana FR Airp CDG FR MarneVallee/Ch FR Haute Pic FR Calais/Frethun FR Breaute FR St-Gervais FR Landry FR Lyon S Exupery FR Valence TGV FR Aix-en-Provence TGV FR Champagne-arde TGV FR Lorraine TGV FR Meuse TGV FR Le Creusot TV FR Macon TGV DE L-Halle airport DE Baden Baden DE Frankfurt airport DE Wittlich DE Limburg sud DE Kon Bonn airport DE Dusseldorf airport AU Landeck-Zams IT Reggio Emilia GB Ebbsfleet		

(PT) – Portugal (SP) – Spain (FR) – France (BE) – Belgium (NL) – Netherlands (DE) – Germany (AU)– Austria (CH) – Switzerland (IT) – Italy (UK) – United Kingdom

The cases of 'mix' stations that were former 'terminals' conforms a special group, which was kept at this stage of selection. The few pure 'terminals' with deep interventions, situations which occur in 'inner city' areas of big cities, were also kept. Of the gross amount of 'through' stations, the choice was also made to keep cases in which 'new' buildings are built or existing ones are subjected to deeper changes.

3.2.2. Identifying patterns

It was considered necessary to further categorize the 40 pre-selected cases, in order to further reduce the sample and enable its deeper analysis. This smaller group of cases should be representative of the current diversity of solutions of HST station within an urban area in Europe[71]. The reduction of the sample of cases, presented in the next chapter, was based on the identification of patterns among them presented in this subsection. A closer observation of the cases led to the definition of new categories to systematize them, which are summarized on Table 3.2 and Table 3.3, and explained below.

At this stage of the analysis, the cases were examined without a concern to link them with the specific characteristics of the countries where they are located. The same pattern can be identified for cases in different countries. Nevertheless, the reference to their origin was kept.

The first obvious observation is that the 40 pre-selected cases are, in their majority, in the bigger cities. At the moment, the investments on the transformation of urban station areas in Europe lie mainly in bigger cities. It is in these cities that the biggest transformations are needed, due to the pressure of growing transport demand, passenger and users flows, of property value, and social, economic and environmental impositions. The result is not surprising, as the considered stations are connected to the HST, which tends to link only major cities. In smaller cities where HST calls at, because they are important centres at regional level or by political options or other reasons, the pressure is not so high and therefore voluptuous investments do not happen often. In some of them, little adjustments, such as the enlargement of platforms to fit to the length of the new trains, are done. The case of Breda in the Netherlands, is one exception to this.
Another observation is that four tendencies are identifiable in the cases: (a) to transform stations into multimodal hubs; (b) to diminish the barrier effect of the railway tracks; (c) to transform the station into a multifunctional pole; and (d) to involve in the station redevelopment of wider areas than the station itself. These tendencies are recognizable mainly in the big cities, but some cases in smaller cities also start to follow them.

Even if each case is unique, as its context is, it is possible to define clusters of cases regarding their spatial options. In order to do so, 'place' issues were analysed isolated from 'node' issues. Such division is somewhat artificial, as both simultaneously influence the station area's space at building and urban level. However, the exercise can be done, and helps to define the clusters. The cases were thus analysed as Places – Multifunctional poles and redevelopment areas, and Node – Multimodal hubs and infrastructural barriers.

[71] It is important to keep in mind that the possible diversity of solutions, when intervening on a HST station within an urban area, might be wider. The analyses here presented refer only to the cases considered in the sample.

Place – Multifunctional poles and redevelopment areas

The 'place' characteristics of the station and the surrounding urban area of the cases were looked at independently of the type of station ('terminal', 'through' or 'mix') and the transport modes that concur in it (Table 3.2).

Table 3.2 - sorting cases by stations' and surroundings' characteristics

Surrounding urban area		Stations Adaptated heritage	 modern	 New disposal	 scratch
inner city (Traditional centre)	Consolidated	[= (FR) **Marseille** X (SP) **Atocha** X (FR) **Paris Nord** X (FR) **Paris Lyon** X (BE) **Antwerp** X (CH) **Zurich** X (DE) **Leipzig** = (FR) **Strasbourg** = (DE) **Dresden** = (DE) **Koln** = (DE) **Hannover** = (CH) **Basel** = (NL) **Amsterdam CS**	[= (FR) **Montparnasse** [= (NL) **Den Haag** [= (IT) **Roma Termini** = (SP) **Barcelona Sants** = (CH) **Bern**	= (NL) **Rotterdam** = (NL) **Utrecht** = (NL) **Arnhem** = (IT) **Torino Porta Susa**	= (DE) **Kassel-Wilhelmshole**
inner city (Traditional centre)	In con.	X (UK) **St Pancras** X (DE) **Stuttgart** = (IT) **Bologna**			X (DE) **Berlin** = (FR) **Lille-Europe** = (SP) **Barcelona Sagrera** = (AU) **Wien**
Boundary	In con.	= (PT) **Campanha**	= (PT) **Oriente** *	= (BE) **Liège-Guillemins** = (NL) **Amsterdam Zuidas** = (NL) **Breda** = (IT) **Roma Tiburtina**	= (SP) **Sevilla** = (SP) **Saragoza** = (IT) **Firenze Belfiore** = (IT) **Napoli Afragola**

[= Terminal station = Through station X Mix station (transformed terminals and multiple direction tracks

(PT) Portugal (SP) Spain (FR) France (BE) Belgium (NL) Netherlands

(DE) Germany (AU) Austria (CH) Switzerland (IT) Italy (UK) United Kingdom

* Oriente station must be adapted to receive HST.

Concerning the **station building characteristics**, the cases were grouped into new categories. Instead of the categories previously defined regarding the 'type of approach' (the previously excluded 'existent' cases, the 'modified' cases, and the 'new' cases), it seemed at this stage more appropriate to distinguish two big groups.

The **'adapted'** stations, which includes buildings that are kept and adjusted to the present situation with (apparently) light interventions. It refers to many 19th or early 20th century's original stations, and some mid 20th century ones. The former were labelled 'heritage'[72], and the latter 'modern'[73]. The **'new'** stations, which includes buildings built from scratch, or which result from heavy or total demolitions of existing stations. In this case, the former were labelled interventions from 'scratch', and the latter interventions after 'disposal' of existing constructions.

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[72] The term 'heritage' is used in this thesis, from this point on, to distinguish buildings which were built contemporary to the implementation of the railway in the 19th century and in the early years of the 20th century. The fact that a building is listed was not a criteria.

[73] The term 'modern' is used in this thesis to distinguish buildings built from the mid 20th century, many replacing an older station building. Some of them are or could (have) be(en) listed.

In the first group, 'adapted' stations, the identified architectural solutions are: the almost surgical cleaning of additions to the original building over time, many with low quality; the reorganization of flows (passengers, other users, transports); and the placement of different functions (transport modes, retail, etc) inside the building and creating relationships with the outside. These sometimes require modern additions, which tend to try to be respectful to the existing space and even highlight some of its spatial features.
In the second group, 'new' stations, there are fewer barriers to innovation because either pre-existences are considered not relevant and therefore disposable, or they do not exist. The design of 'node' and 'place' layouts is in this way freer.

At this stage it was not clear, however, if one group offers the better conditions for innovative concepts of stations than the other. Nor was the criteria to decide whether a building (or part of) is or not disposable. Thus, it was considered necessary to proceed with the analysis of cases of both groups in order to explore what are the possibilities for innovation in both contexts.

Before going into the categorization of the characteristics of the surrounding urban area of the station, it is important to make a note. Not all cases have redevelopment projects covering wider areas than those of the station complex[74]. Therefore, they do not integrate the redevelopment of the surrounding urban areas of the station. Still, the station is located within an urban area with specific features.
Regarding the **characteristics of the surrounding urban area** of the station, the cases were grouped into the **'inner city'** and the **'boundary'** categories. The urban areas of the first group are either consolidated or in consolidation, while those of the second are in consolidation.
When the cases are located in the 'inner city'[75], and this is a consolidated area, it is mostly common that only the station, and sometimes the immediate urban public space, is redeveloped. However, there are also cases located in these 'inner city' locations that lie on areas in consolidation. These cases can expand their redevelopment out of the railway station's and yards' limits. This mainly happens when there are disaffected railway areas; or, as in the case of Gare Lille-Europe in Lille[76], where vast vacant spaces in the 'inner city' existed, allowing for new edifications. This is though, an infrequent situation. Such operations are normally possible in cases with 'boundary' locations, as these tend to have areas needing rehabilitation or free spaces to develop.

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[74] The extension of the (re)development of the urban areas around stations depends on several factors. Besides space availability, political will, and financing capacity, can be reasons for the differences among cases. Most of the projects however seem to be concerned with the quality of the link of the station building complex and its urban surroundings. This common denominator and the interest of this research, determined that the attention here was to be on the building and on its link with the urban surrounding. Thus the explored levels in this research are those of architecture and urban design, rather than planning, which is approached to frame the projects.

[75] Here the term 'inner city' is more associated to the traditional centre, which refers to areas related with the city's (historical) core. Most of these areas are consolidated urban ensembles, but some of them are undergoing consolidation processes, as they have available spaces for redevelopment for different reasons. The boundary areas are those away from the city core, which are being redeveloped, normally as an alternative city centre.

[76] The HST station of Lille, as well as other buildings and public spaces developed within the Euralille project, were erected on areas formerly reserved for military purposes.

A strong relation between the station building complex and the character of its surrounding urban area is identifiable. 'New' buildings often fall in a 'boundary' location and the cases of 'adapted' buildings into an 'inner city' location. A consolidated urban area normally inhibits solutions with 'new' buildings and the redevelopment of wide surrounding urban areas. Such solutions demand very complex planning and management at these locations. Space availability, identity and integrity of the building and urban ensemble of the location are important issues. Even though the adaptation of old buildings represents a considerable challenge (requiring for example complex technical solutions), it is a recurrent solution in consolidated urban areas. It can improve existent spaces rather than create completely new ones, avoiding resources depletion.
On the other hand, an area in consolidation, normally outside traditional centres, gathers more incentives to build from 'scratch' than in a consolidated one, where the constraints are bigger. In general, cases in urban areas in consolidation favour the redevelopment of wider areas than the station complex, which is generally built 'new', while consolidated areas do not (see Table 3.2).

Most of the cases that are adaptations of old buildings in traditional city centres are in Western Europe[77]. Many are in France and Germany, but also in Switzerland, Belgium and the Netherlands. Even though Spain and Italy also have such cases, these Southern European countries, have more cases of newer buildings outside traditional centres. Such cases can also be seen in Germany, France and Austria. The Netherlands' approach is somewhat an exception to this, as many of the pre-existent buildings, located in inner city locations, were demolished to build new ones on the same location. The Portuguese cases were both adaptations of existent buildings outside the traditional centres.

Node – Multimodal hubs and infrastructural barriers

The type of station and the transport modes that concur into the station area were looked at to inquire on the 'node' characteristics of the analysed cases.

The crossing of several modes of transport in station areas is present in every case to different degrees. Some only link the train with taxis and private cars, others add busses, metro, tram and bicycles. In the most complex cases there is an effort to link all modes under *one roof*. The way transport modes and their infrastructures are linked and distributed in the space of a station area can grant more or less comfort to commuters. Additionally, it can also affect the layout of non-transport related functionalities, as well as other users of the station area. Their arrangement differs among cases. Normally, the layout of the main railway lines, the heaviest infrastructure and the hardest to change, triggers barrier effects in the urban surroundings.

Focusing on the effort to overcome the negative impacts of the railway barrier on the city, it was analysed how the cases deal with their *front and back side syndrome*. The *back side* or the *other side of the tracks*

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[77] Following the United Nations Statistics Division definitions, which groups countries for statistical convenience without any political or other affiliation assumption, Western Europe is the group formed by Austria, Belgium, France, Germany, Liechtenstein, Luxembourg, Monaco, Netherlands and Switzerland (United Nations Statistics Division, 2013). The other countries studied in this research fall into the Southern Europe group (Portugal, Spain and Italy) and to the Northern Europe (United Kingdom).

of 'terminal' or 'through' stations, are both expressions bearing a negative connotation, linked to blighted spaces, which projects hope to attenuate. The railway tracks position has a great impact on the city layout and consequently on its social and economic networks. As mentioned before, if a station is more integrated with the urban surrounding it might benefit from its social and economic environment, and vice-versa, generating also ecological benefits. Such benefits are stated by some of these projects when presenting several spatial solutions to overcome the barrier effect.
If in principle 'terminals' can integrate better in their urban surrounding as their tracks only cut the urban fabric on their *back side*, offering the building at least three possible franc contact points with their urban surroundings; they can also inflict big wounds on the urban fabric when the width of the group of railway tracks becomes considerable (allowing the manoeuvres of a greater amount of trains). The latter difficulty makes these stations, as 'nodes', harder to manage. On the other hand, 'through' stations, which are less problematic with regards to this feature, present more problems with their relation with the city. Their tracks cut it in half, often originating the *good* and the *bad* side of the tracks, the former being the main entrance side of the passengers' building.

The idea that to put tracks underground or build over them are the best ways to deal with the negative impacts of the barrier effect is very strong. There is a general tendency to follow this concept, which is done when those costly operations are possible[78]. That is the case with 'terminals', which are transformed into 'through' stations in big cities by the addition of tunnels. It is not however the only way to achieve this transformation. If one looks at the example of Dresden hauptbahnhof (Hbf) (Figure 3.17), we can foresee that elevated viaducts could be a solution. Nevertheless, such a proposal has important challenges on air rights management and at noise, pollution and visual impacts. Therefore, and especially in consolidated urban areas, the option is often for tunnels. In fact, not many of these stations remain pure 'terminals', and even in that case they are multimodal nodes with metro.

Figure 3.17 - Dresden Hbf (Hullbr3ach, 2006)

[78] One can look at the case of Delft station in The Netherlands (as an example without HST) that succeeded in gathering the necessary funding to relocate the rail tracks underground. Or to the case of Frankfurt (one of the Deutsch Bahn projects for the ICE stations) in Germany, which did not succeed in laying the tracks underground.

In some 'through' stations, the railway tracks are on a lower level than that of the station entrance. It is the case, among others, for example of Barcelona Sants, Seville or Bern, where (semi)underground tracks solutions, either by tunnel or bridge like constructions over them are used. In some of these cases the layout of the 'through' station acquires features of the layouts of 'terminals', benefiting from the advantages of both types. Instead of one entrance, the building can relate with the surroundings from all sides. But even when the railway tracks do not go underground, there is a tendency for the building to have at least one entrance at each side of them. That can be done in different ways. In Basel, where the tracks are at ground level, a wide bridge over the tracks connects the old existent building to a new entrance on the other side of the tracks. In Rotterdam, where the tracks are elevated, the attempt is to achieve such connection by means of a passage under the tracks.

In a generic form one could say then that both 'terminals' and 'through' stations are converging into a *fusion type* that tries to profit from the advantages of both. The scheme in Figure 3.18 shows this possible evolution and summarizes some of the characteristics of both types. Namely, the possibilities to overcome the railway tracks and connect the two parts of the urban surrounding area, as well as the possibilities for direct contact between the station building with its surroundings.

It is a simplified scheme, as only the main typical and more recurrent situations are considered. If the identified positions of railway tracks, buildings and surroundings described below are combined among them, many other layouts are possible. Especially if topographic issues are considered and the ground level of the surroundings is not flat as considered on the scheme.

Regarding the railway tracks position in relation to the street level of the surroundings, only three positions are considered, of the four identified by Wilde (2006). Elevated, ground level and underground positions, the latter being merged with subsurface position, as their barrier effect is quite similar. The position of the station building in relation to the railway tracks can be above, under them, on their end or on their sides. As most of the cases here analysed are 19th century original buildings or transformations of them, two positions were considered for the scheme: the end of tracks for 'terminals', and the side for 'through' stations. In fact, most of the other possibilities are variations on these two positions. Also, it is possible to have more than one group of tracks. In the case of Dresden, both elevated, or in the case of Berlin and some 'terminals' turned into 'through' stations, on several levels.

On a first moment the possibilities to pass the railway tracks barrier, which was on ground level, were to go over or under it. In this situation, 'terminal' buildings had more contact points with their urban surroundings than the 'through' stations. Most of the stations of the 19^{th} century were like this. In the same century in some cases, normally bigger cities, the railway tracks became elevated. On this second moment the possibilities to pass the barrier in relation to its position were the same. But the under connection became more fluid and the buildings of 'through' stations could then relate with both sides of the railway tracks. On a third moment the railway tracks went underground and the barrier disappeared, allowing the building to connect on all sides to the surroundings. The classical example for such a 'terminal' is New York central station. On a fourth moment, 'terminals' and 'through' stations become a mixed type, which is, in its essence, a 'through' station. Such *fusion* is possible to achieve with underground, but also with elevated or ground level railway tracks.

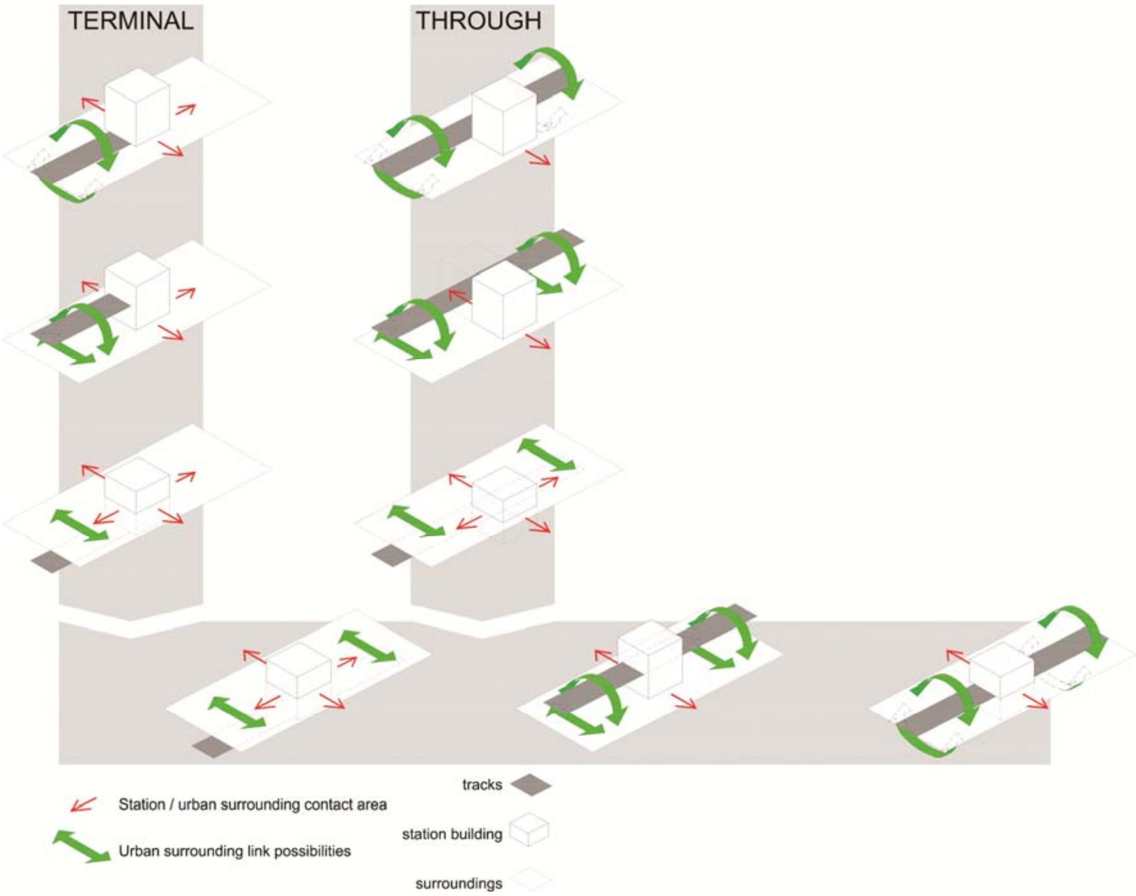


Figure 3.18 – Evolution tendencies of the relations of 'terminal' and 'through' stations with their surroundings

The railway tracks position influences the spatial solutions that can materialise this *fusion*. To have an overview on the range of that influence, cases were sorted (Table 3.3) by their railway tracks and station building positions towards each other. The cases were also ordered according to the characteristics of its surroundings and its station building complex, to give an insight on how these can relate with the railway tracks position.

Regarding the **railway tracks and station position**, five groups were identified. Two main groups were distinguished, the **'terminals'** and the **'through'** stations. The first group refer to stations that remain 'terminals' for the main railway lines, even if most of them also have metro lines providing them with a somewhat mixed character (as defined in sub section 3.2.1). The 'through' stations group was subdivided into four groups: the buildings that remain essentially traditional 'through' stations, with the building located on one **side** of the ground level railway tracks; cases with tracks also on the ground level, but which stations are built **above** them on *bridge like* solutions, having sometimes tunnels under the tracks; cases with **elevated** tracks and buildings developing below them, having in some cases aerial passages over the tracks; and the cases with **underground** tracks with buildings above them. Stations with underground heavy railway lines may also have heavy railway lines at other height levels, and some can be experienced as terminals at the surface level of their urban surroundings.

The concern of overcoming the track barrier is more recognizable in the cases in the three last groups. These *fusion* stations, present spatial strategies to overcome the barrier effect of tracks. Their buildings, either by developing above or below the tracks, fulfil this purpose, connecting with the urban surroundings.

Most of the cases fall in the last group - underground tracks. It gathers the wider variety of exemplars of different characteristics and on different entourages. The elevated tracks group follows, and after that the ground level one. The two first groups gather cases that didn't evolve to the *fusion* type. However some of these cases also present some innovation on the approach to their spaces.

It is noticeable that pure 'terminals' are mainly in the traditional centre, while the other types are not especially bounded to a specific type of surrounding urban area.

In the next chapter the choice of cases to be further examined and their analysis is presented.

Table 3.3 - Sorting cases by rail track / station relation (keeping stations' and surroundings' characteristics)

		Terminals	**Through**			
*****			Ground		Elevated	Underground (and other levels)
**			Side	Above	Below	Above (various)
Adapted stations	Heritage	C (FR) Marseille	C (FR) Strasbourg I (PT) Campanha	C (CH) Basel	C (DE) Dresden C (DE) Koln C (DE) Hannover C (NL) Adam CS	C (SP) Atocha C (FR) Paris Nord C (FR) Paris Lyon C (BE) Antwerp C (CH) Zurich C (DE) Leipzig I (IT) Bologna I (UK) St Pancras I (DE) Stuttgart
	Modern	C (FR) Montparnasse C (NL) Den Haag C (IT) Roma Termini			I (PT) Oriente	C (SP) Barcelona Sants C (CH) Bern
New stations	Disposal		C (NL) Arnhem	C(NL) Utrecht I (IT) Roma Tiburtina	I (NL) Rotterdam I (BE) Liège-Guillemins I (NL) Breda	C (IT) Torino Porta Susa I (NL) A'dam Zuidas
	Scratch			I (IT)Napoli Afragola	I (AU) Wien	C (DE) Kassel I (DE) Berlin I (FR) Lille-Europe I (SP) Barcelona Sagrera I (SP) Sevilla I (SP) Saragoza I (IT) Firenze Belfiore

* Level of the rail tracks

** Station position in relation to the racks

4. CASE STUDIES

In order to understand how European HST station areas are performing spatially, case studies were examined. Their 'node' and 'place' features were carefully studied to investigate how the factors identified in chapter two, and especially those bounded with 'spatial design', are influencing station areas' spatial performance. Several scales and (historic) moments of analysis contextualize this assessment.

This chapter reports on the selection of the case studies, their analysis and comparative study. The first section contextualizes the analysis of the case studies. Its subsections describe the process of choosing the case studies, introduce the cities where they are located, and explain their analysis framework. The three following sections describe the analysis of the case studies. Each section refers to a category of station (area), as defined below, and has two subsections. Each of these subsections is dedicated to the analysis of, respectively, an 'adapted' and a 'new' (re)built station (area) belonging to the category debated in the subsection. A final section discusses the results of the analyses by comparing them.

4.1. Contextualizing the analysis of case studies

Before going into the analysis of case studies, it is important to explain why they were chosen, the structure of (the presentation of) their analysis, and briefly familiarize with the cities where they are located. This framework introduces the analysis, making it more understandable.

4.1.1. The choice of cases

The choice for cases of HST stations in an urban context, was supported by the results of the survey on European HST station (areas) presented in the preceding chapter (see section 3.2) and the most recent literature review (see Peters & Novy, 2012a). Inner city located stations are the most recurrent choice to receive the HST. This is a result of it having advantages for passengers and other users; and consequently for station authorities, transport companies, retailers, and other services' providers, that come together at stations. The combined accessibility to transport and non-transport functions can offer advantages for many actors, but it can also lead to problems. A central position within a city can hinder the integration of the additional transport modes and other facilities in the station area.

> *"[...] high level of accessibility may provide the critical mass of demand for development of particular activities. In turn, a high density of activities may induce the necessary support for the development of transportation networks. On the other hand, dense patterns of use can make a location's transport infrastructure difficult to expand and adapt. In the same vein, optimization of a station's accessibility by all modes may negatively affect its liveability, and thus its attractiveness."* (Bertolini & Spit 1998, p. 9)

Nevertheless, it seems to be logical to choose the city's main station to be the stop for the HST, which in most cases is in a central location. In the long-term perspective, this choice seems to be the most sustainable, financially and functionally, for transport provision, the building and the city. Even if it can mean heavier investments, these are likely to be paid off in the long term.

As shown in the preceding chapter, to develop a station on a central location in the city normally implies the adaptation of an existing station. The majority of the time, a 'heritage' building is **'adapted'**, whereas the adaptation of 'modern' buildings is scarcer. On the other hand, there are also situations in which a **'new'** building is built at a central location. This can happen when the space is available, or it is possible to make it available (when, for example, the existing station building is not considered adaptable).
These two approaches are likely to provide different spatial solutions to the same the problem. This is because there can be more constraints to the achievement of adequate spatial performance when adapting existing constructions than when building new ones. Another feature that can decisively affect the conformation of the public spaces of station areas is the position of the railway tracks relatively to the station building and its surroundings. As these features can impact the spatial performance of station areas, the choice of cases was structured around them.

The chosen case studies have the most recurrent relative positions of the railway infrastructure and of the station building towards their direct built environment, identified in the preceding chapter. Cases with railway tracks at (a) **ground** level, (b) **elevated** level and (c) **underground** level, were examined. These categories were named respectively, **'bridge'**, **'viaduct'** and **'tunnel'** stations, alluding to the positions of the station building in relation to the railway tracks. For each category, two cases, featuring an 'adapted' station building along with one built 'new', were analysed at 'city', 'urban area' and 'building' scales. Their mapping identifies the virtues and shortcomings of their spatial configurations, capturing a variety of approaches and solutions in the pursuit of the adequate public space of station areas. The case studies' choice criteria and the methodology of their analysis are here further detailed.

The case studies were chosen out of the 40 pre-selected ones (see Table 4.1), described in the preceding chapter. For a manageable analysis to be made possible, the sample was downsized to 6 cases (marked in bold black). These cases were considered representative of the categories defined above, allowing an exploration of the main approaches to the design of the public space of the station and its urban surrounding area. The selection process is discussed below.

Preference was given to cases that are built or in advanced stage of completion. The access to information on these cases is simpler, and it is possible to learn through observation on site. Case studies on a project phase were not considered for the final choice. For some of these such cases it was possible to collect enough material to proceed with their analysis in the terms described in the following section. However, their analysis would be a very speculative exercise, as the probability of the final constructions differing a lot from the current plans is higher than with built cases. The complexity of these projects and the long time span of their planning and building processes could introduce many changes. These problems can also occur in cases in advanced stage of completion, however it is less likely. Thus, it can be assumed, for research purposes, that these cases will reach completion following the current plans.

On Table 4.1 the case studies are organized according to the categories defined on the preceding chapter (see Table 3.3). Regarding the approach to the station building, the ‘adapted’ group gathers ‘heritage’ and ‘modern’ buildings that were modified. The ‘new’ group gathers cases that were built from ‘scratch’ and ‘modern’ buildings which were replaced by new ones. Regarding the relative positions of the railway tracks and station’s building towards each other, the cases are classified as ‘terminals’ or ‘through’ stations. The latter is subdivided into the categories of cases with railway tracks at ground level, elevated level and underground level. The first category is further subdivided into two groups. Both have the railway tracks at ground level, but the station is either positioned along their side or above them.

Table 4.1 – Chosen case studies

	Terminals	**Through**			
*		**Ground**		**Elevated**	**Underground** (and other levels)
**		**Side**	**Above**	**Below**	**Above** (various)
Adapted stations	FR Marseille	FR Strasbourg PT Campanhã	**CH Basel**	DE Dresden DE Koln DE Hannover **NL Amsterdam CS**	SP Atocha (a) FR Paris Nord (a) FR Paris Lyon (a) **BE Antwerp** (a) CH Zurich (a) DE Leipzig (a) IT Bologna UK St Pancras (a) DE Stuttgart
	FR Montparnasse NL Den Haag IT Roma Termini			Oriente	SP Barcelona Sants CH Bern
New stations		NL Arnhem	**NL Utrecht** IT Roma Tiburtina	**PT Oriente** NL Rotterdam BE Liège-Guillemins NL Breda	**IT Torino Porta Susa** NL A’dam Zuidas (b)
			IT Napoli Afragola	AU Wien	DE Kassel-Wilhelmshole DE Berlin FR Lille-Europe SP Barcelona Sagrera SP Sevilla SP Saragoza IT Firenze Belfiore
***			BRIDGE	VIADUCT	TUNNEL

* Level of the rail tracks
** Station position in relation to the racks
*** Category of station (area)
(a) Stations with (new) underground tracks, that also have tracks above ground, and are thus experienced as terminals at the surface level of their urban surroundings.
(b) Since this categorization was made, authorities decided in the meantime that this station will not have an underground railway. The tracks will remain at the current level. Therefore, this case would now have been placed on the elevated category.

As shown in the preceding chapter, most of the cases fall into the group of buildings that have railway tracks underground. This type of buildings has some or all of the railway tracks below ground level. It can be said that they grant the *softest* relationship with the urban surroundings, as their railway tracks do not interfere with the public space at street level.

Within this group of **‘tunnel’** station (areas), the chosen **‘adapted’** case study was **Antwerp** station (area). It belongs to the group of ‘terminals’ converted into ‘through’ stations. Many of these cases are ‘terminals’

transformed into 'through' (multilevel track) stations, by the addition of tunnelled railway tracks. Often the original position of the railway tracks is also kept, either at ground or elevated levels. An exception to this is the project of Stuttgart Hbf. This case uses the old building as part of the new station complex, but completely discards the terminal railway tracks, replacing them by through tracks placed underground (on a perpendicular position to the former ones). In this case the barrier of tracks disappears completely from the surface urban space under the station roof, which is also a garden at street level. The cases of Atocha station in Madrid, Leipzig Hbf, Gare du Nord and Gare de Lyon in Paris, St. Pancras station in London, and Zurich Hbf, are also part of this group. In fact, of the 'heritage' cases with railway tracks underground, only Bologna was not a 'terminal' station. And because it does not conform a group it was also left out.
From the group of **'new'** buildings with railway tracks underground **Turin** was chosen. The way this case attempts to connect to its urban surroundings led to the choice. The group is large and has many interesting cases which were left out, such as Berlin Hbf, Bern Hbf, and Lille-Europe. The case of Lille has become a well-known and studied reference of station area redevelopment. Some of the cases are still in project or initial building phase, for instance Amsterdam Zuidas, Barcelona Sagrera and Firenze Belfiore. Other cases are built, but the less comprehensive way that the surrounding public spaces and the pedestrians were taken into account on their design led to their exclusion, even if some have interesting buildings. Delicias in Zaragoza, Santa Justa in Seville, Kassel-Wilhelmshole and Barcelona Sants stations are examples of this.

The cases with elevated tracks are less than the previous ones, but still a considerable amount. The station areas within the **'bridge'** group have a *less soft* approach towards the urban surroundings.
Amsterdam Centraal, now in advanced (re)building stage, was chosen among the **'adapted'** group. The difficult access to information on the other cases, and namely the barrier that the German language of most of the data concerning the cases of Dresden, Hannover and Koln represents to the researcher, were a factor in the selection.
Gare do Oriente was the chosen from the group of **'new'** buildings with elevated tracks. At the beginning of this research, this station in Lisbon was a 'modern' building which would be 'adapted' for the HST arrival. This is no longer the case, as the HST implementation in Portugal was cancelled, and so was the adaptation of the station building. Nevertheless, at the moment the fastest trains operating in Portugal stop there. The Alfa Pendular trains can be considered to be the Portuguese HST, considering their (possible) operation speeds. As Oriente station was apt to receive them from the first day, this case study can actually be considered a 'new' building instead of an 'adapted' one. Additionally, it was considered relevant to include in the choice a station building with the open structure[79] of this one. The ability to access information by the researcher was also relevant for the choice.

When the railway tracks are at 'ground' level, the interference with the urban area is obviously not as soft as in the preceding cases. The number of such cases, here named **'bridge'** station (areas), in the considered sample is again less than those of the preceding types. Nevertheless, it seemed relevant to consider an 'adapted' case and a 'new' case for the analysis. Railway tracks at ground level are, in

[79] The open structure of Gare do Oriente, with no doors between the inside and the outside of the station, is also to be seen in the case of Guillemins station in Liège Belgium. These two stations were designed by Santiago Calatrava. The first railway station designed by this author, Stadelhofen in Zurich, also features this openness towards its urban surroundings.

general, very common. Further, the possible HST stations in Portugal have railway tracks at this level, and one of the aims of this research is to contribute to the Portuguese situation.

The building of ‘through’ stations with railway tracks at ground level can relate to one or both sides of the urban fabric separated by the infrastructure. The choice was made to study cases that relate to both sides of the surrounding urban fabric. In **Basel SBB** station, the chosen **‘adapted’** case, this connection is possible through a bridge-like construction over the railway tracks which was added to the existing ‘heritage’ building.

Utrecht Centraal was the choice for a **‘new’** building in this category of tracks at ground level. It is currently being built and is basically a ‘new’ building on the location of the existing one, which is being totally demolished. Both the existing building and the new one use a bridge structure to overcome the railway tracks.

Typically the HST arrives to ‘through’ stations or, as mentioned before, to former ‘terminal’ stations to which tunnelled through tracks were added at some point (Peters, D. & Novy, J., 2012c). Pure ‘terminals’ are not common as HST stations. Of the 40 cases in the pre-selection sample, the HST has terminal stop at nine stations, and only four of them are pure ‘terminals’. Furthermore, ‘through’ stations are preferred by train operators, as they allow a more efficient train operation. For the urban designers ‘through’ stations represent a bigger challenge than ‘terminals’. Their railway infrastructure cuts the urban fabric into distinct parts, conforming a separating barrier that is hard to overcome. In this respect, ‘terminals’ are easier to integrate into the city despite the considerable widths their ensemble of railway tracks[80] can reach. Thus, the integration of a ‘through’ station in an urban context is a more complex task then that of a ‘terminal’. Additionally, it has been less studied in this regard[81]. It was therefore determined that ‘terminals’ would not be included in the case studies selection.

4.1.2. The cities

To introduce and contextualize the analysis of the chosen case studies, their six cities, located in different European countries, were looked at. In this subsection, a brief comparative overview of the case studies cities is offered, introducing the study areas. This was done with schematic maps (Figure 4.1 to Figure 4.6) and a short description of the cities.

[80] Necessary for manoeuvring trains in and out of the station

[81] Paksukcharern (2003), who studied eleven mainline railway terminus areas in central London examining their relation with the urban surroundings, argues that this type of station is more important in terms of architectural, urban and social significance and has more critical effect on the urban girds than the ‘through’ station. She notes that ‘terminals’ tend to be located in densely built areas, gathering a greater number of passengers, attracting significantly more movement then ‘through’ stations. However, when there is a HST connection, ‘terminals’ are often transformed into ‘through’ stations, and such urban context’s characteristics of ‘terminals’ are kept. Additionally, not all European cities (contrary to London or Paris) have ‘terminals’, or former ‘terminals’, as their main central stations.

On the other hand, Kusumo (2007) studied the ‘through’ stations of Leiden and Delft in the Netherlands, and Turi and Kota in Surabaya, Indonesia. This sample does not allow for the European comparison attempted by the present study. Thus, within the framework of this study, it was important to focus the analysis on ‘through’ stations.

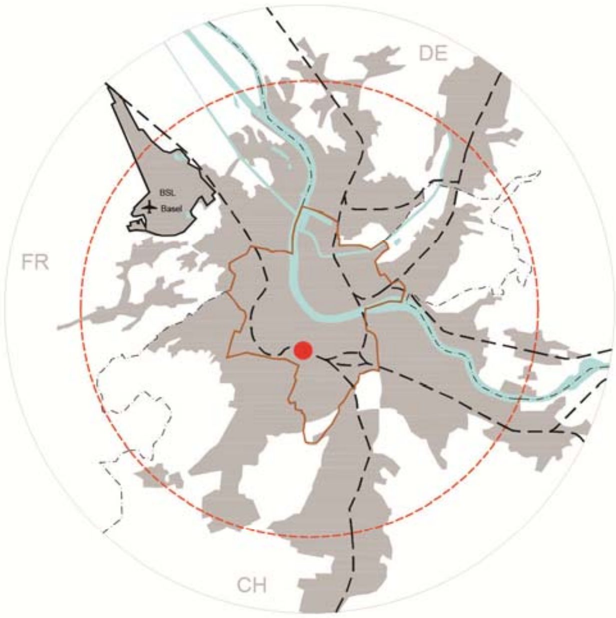


Figure 4.1 – Basel

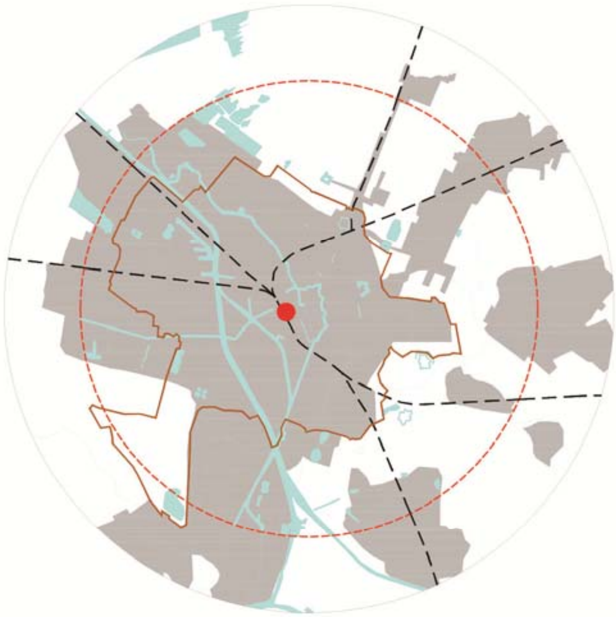


Figure 4.2 – Utrecht

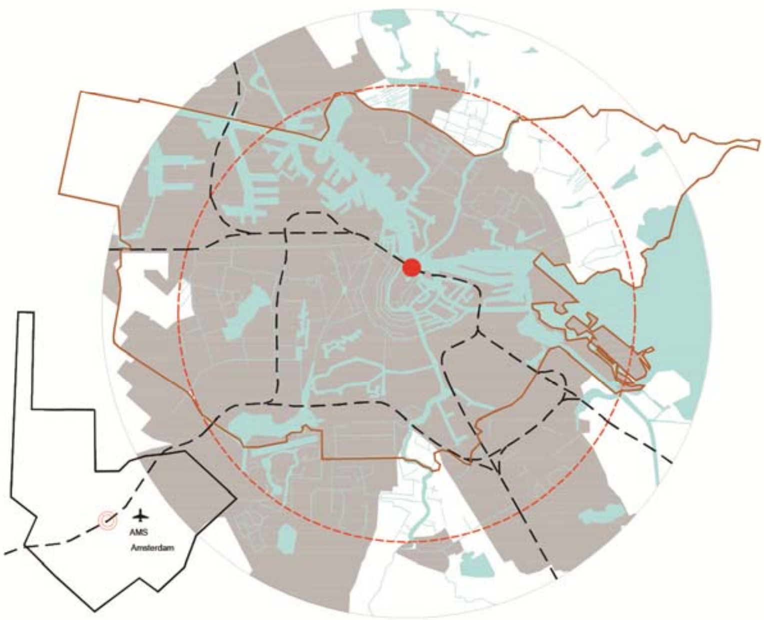


Figure 4.3 – Amsterdam

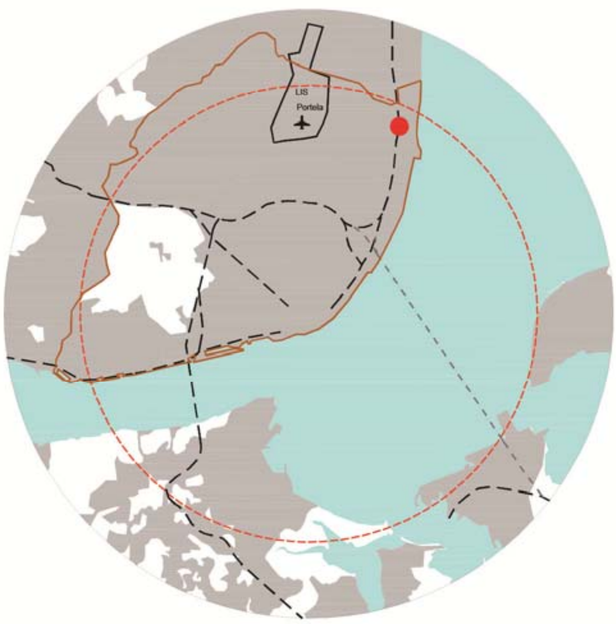


Figure 4.4 – Lisbon

The cities' maps presented here, mirror general morphological characteristics of the territories where the case studies lay, highlighting some of their differences and similarities. To allow their comparison, the maps were drawn with the same coding and scale. They present a 15km diameter circle (red dotted line), whose centre coincides approximately with the city's centre. The circle captures the main core of the agglomeration and corresponds with the area covered by the 'city level' analyses of the case studies, which is explained and presented in the following subsections of this chapter. The maps feature the cities' administrative boundaries (brown line), their built-up areas (dark grey) and the case study station location (red dot). Additionally, the airports and the (HST) railway infrastructure that serve the studied cities were also marked in the maps. When existing, the railway station serving the airport was also marked. As the HST is on the edge of being competition to airplanes[82], namely for distances until 500km (Berg & Pol, 1998), it was considered relevant to see how airports (when existing) are positioned in the several cities, as opposed to the location of their HST stations.

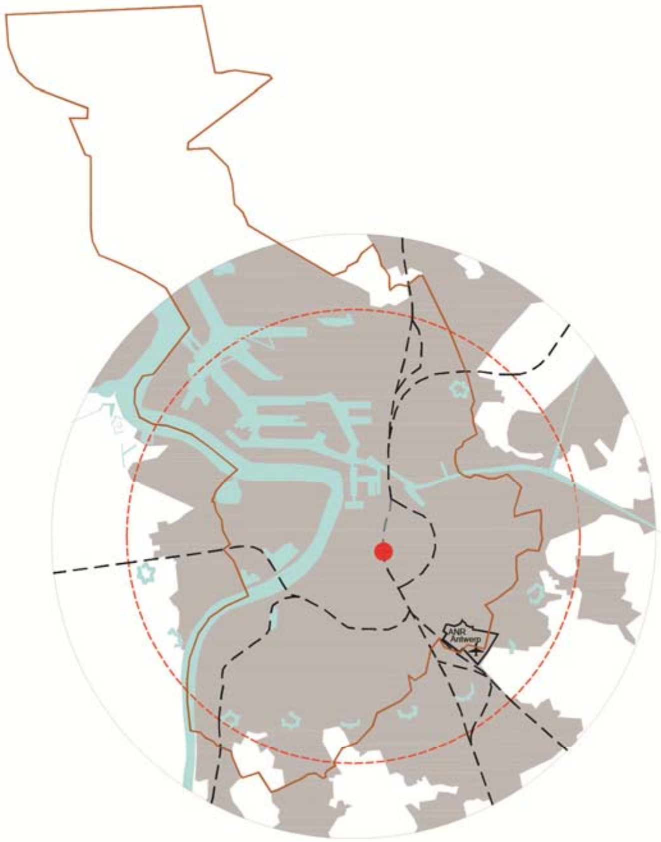


Figure 4.5 – Antwerp

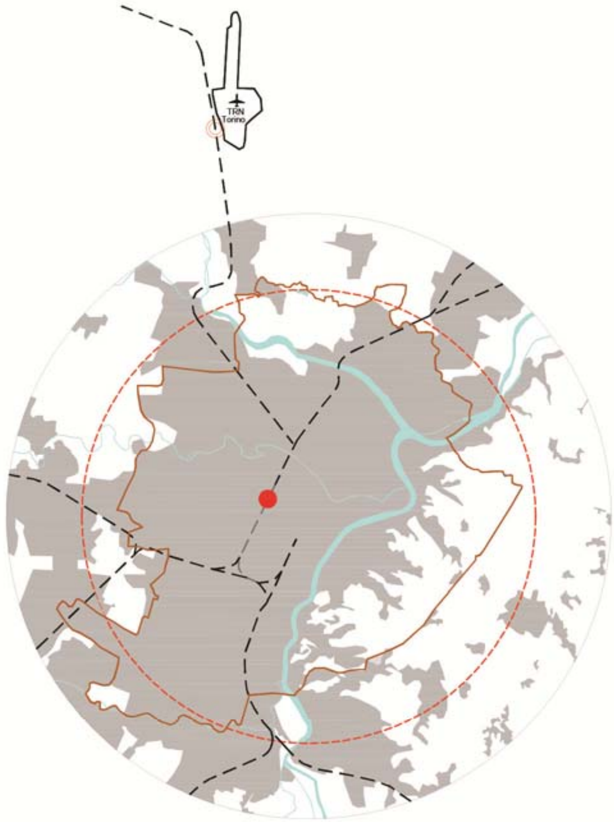
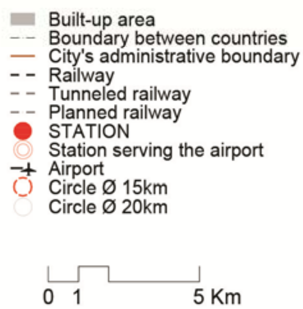


Figure 4.6 – Turin



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[82] "*Under present conditions, the aircraft and the train compete over distances between 500km and 1000km. Under 500km, a study by the European Commission concluded that rail has distinct advantages over air for the consumer, especially in relation to travel times. While flying to a destination has a shorter direct travel time, rail can offer: easier access: most stations are located in city centres and are well connected to local public transport networks. In contrast, airports are often located several tens of kilometres outside of a city, often with poor public transport provision; shorter check in times: without the need to check in and out with baggage, trains can be boarded minutes before departure, with onward travel to the final destination commencing immediately after disembarking; greater flexibility: it is not always necessary to book rail tickets in advance, and trains provide more frequent connections; greater scope for the business traveller to use their time productively: few trains have restrictions on the use of mobile telecommunications and electronic equipment*." (Aviation Environment Federation [AEF], 2000)

When trying to determine the cities' limits, in order to proceed with their comparative analysis, one is confronted with a disparity of definitions. The different perspectives adopted by each country complicate the appraisals. Thus, a common definition was searched for.

It is possible, and is often the case, that the administrative border of the city does not necessarily coincide with the border of its built-up area. In fact, in many cases the *"de facto city"* [83] has expanded far beyond the *"de jure city"*. The delimitation of urban and rural has become less clear or even lost its sense. In some cases, this is reinforced by the overlapping of built-up areas of neighbour cities, and functional relationships among them, making it difficult to clearly define their limits. Further, the built-up areas can have considerable extensions in the territory.

For these reasons, the border of the built-up area of a city is not easy to delimitate, while an administrative border can be clearly defined. This research considers the built-up area of a city as the physical urbanized space in continuity with the city core, as well as the physical urbanized space of the non-contiguous cores belonging to the same functional urban area[84].

The *snap-shots* depicted in the maps confront the administrative border with the current built-up area of each city. The non-stationary character of built-up areas, the difficulty to border them clearly and the great extension that some of them have, lead to the decision to limit their representation in the maps to a circle of 20km of diameter, within which is the circle of 15km diameter of the 'city level' analyses mentioned above. For the contextualizing purposes of these maps, this was considered sufficient. It is observable that the administrative border line does not mark the limit of the built-up area. The built-up area continues into the territory of contiguous municipalities, and or does not fully fill the area delimited by the municipal border.

The built-up area corresponds with different populations and densities among case studies, as their territories are necessarily geographically different. For a better understanding of the sample of case studies Table 4.2 was created. It depicts the area, the population and density of the territories related with each case study. Four scale levels were considered for this contextualization of the cities, respectively the country, the region, the metropolitan area, and the city[85].

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[83] The term city can refer to the *"de facto city"*, i.e. the physical or socio-economic realities, approachable through either a morphological or a functional definition (European Commission - Directorate General for Regional Policy [EU-DGRP], 2011), denoting a certain urban (population) density. But it can also refer to the *"de jure city"*, i.e. the area within the city's administrative boundaries.

[84] This concept corresponds with that of a metropolitan area, seen as a conglomerate of a densely populated urban core and its less-populated surrounding territories, sharing functional and physical (infra)structures. A metropolitan area normally comprises several territorial jurisdictions. The concept of metropolitan area is alternative, but comparable to the *"Functional Urban Area"*. *"A Morphological Urban Area (MUA) depicts the continuity of the built-up space with a defined level of density. A Functional Urban Area (FUA) can be described by its labour market basin and by the mobility patterns of commuters, and includes the wider urban system of nearby towns and villages that are highly economically and socially dependent on a major urban centre."* (EU-DGRP, 2011, p. 1).

[85] The European Union's NUTS (Nomenclature of territorial units for statistics) system was used in the creation of this table, as it allows to compare similar territories within the European Union. *"At the beginning of the 1970s, Eurostat set up the NUTS classification as a single, coherent system for dividing up the EU's territory in order to produce regional statistics for the Community."* (European Commission - Eurostat, 2013). Even if a direct correspondence of physical and functional delimitations among the analysed cases might be hampered by different national conceptions, this is the most reliable and comparable information available about the analysed territories. Still, the comparability of the gathered data seemed to be limited at the metropolitan level (NUT III). The disparity of the data for Basel and the remainder cases could hamper comparisons. Further, the coincidence of the data for Utrecht NUT II and NUT III also

Table 4.2 – Comparative Table of population, area and densities of the studied cases

	GROUND		ELEVATED		UNDERGROUND	
	Adapted	New	Adapted	New	Adapted	New
	BASEL	**UTRECHT**	**AMSTERDAM**	**LISBON**	**ANTWERP**	**TURIN**
Country	Switzerland	Netherlands	Netherlands	Portugal	Belgium	Italy
Area (Km^2)*	41.284,60	41.540,40 33.783,39(land)	41.540,40 33.783,39(land)	92.211,90	30.528,00	301.336,00
Density (Pop./ Km^2)*	197,80	494,50	494,50	114,50	364,30	201,50
Population **	8.039.060	16.730.348	16.730.348	10.562.178	10.839.905	59.394.000
Region (NUTII)	Nordwestschweiz	Utrecht	Noord-Holland	Lisboa	Antwerpen	Piemonte
Area (Km2)*	1958,30	1449,10	4090,90	3001,90	2867,00	25402,50
Density (Pop./ Km^2)*	551,6	890,2	1011,1	940,5	637,4	175,6
Population**	1.091.302	1.251.266	2.737.540	2 821 876	1.793.377	4.446.230
Metropolitan area (NUTIII)	Basel-Stadt	Utrecht	Groot-Amsterdam	Grande Lisboa	Antwerpen	Torino
Area (Km2)*	37,00	1449,10	896,80	1.376,7	1000,00	6.830,30
Density (Pop./ Km^2)*	5.016,30	890,20	1.776,30	1.484,60	1.056,40	337,40
Population**	187.425	1.251.266	1.302.030	2 042 477	1.017.197	2.297.598
City	Basel	Utrecht	Amsterdam	Lisboa	Antwerpen	Torino
Area (Km2)***	23,91	99,21 94,33 (land)	219,32 165,76 (land)	83,84	204,51	130,34
Density (Pop./ Km^2)	7.150,65	3.352,86	4.766,53	6.533,08	2.483,55	6.895,50
Population***	170.972	316.275	790.100	547.733	507.911	898.759

* Data for 2011 (Eurostat, 2011a, 2011b).
** Data for Switzerland - 2012 (Office fédéral de la statistique, 2013a)
Data for The Netherlands - 2012 (Centraal Bureau voor de Statistiek, 2012a)
Data for Portugal - 2011 (Instituto Nacional de Estatística, 2012)
Data for Belgium – 2013 (Direction générale Statistique, 2013)
Data for Italy - 2012 (Istituto nazionale di statistica, 2012)
*** Data for Switzerland – 2012 (Office fédéral de la statistique, 2013b; Basel-Stadt Statistisches Amt, 2013)
Data for The Netherlands - 2012 (Centraal Bureau voor de Statistiek, 2012b)
Data for Portugal - 2011 (Instituto Nacional de Estatística, 2012)
Data for Belgium – 2013 (Direction générale Statistique, 2013)
Data for Italy - 2012 (Istituto nazionale di statistica, 2012)

Basel, Utrecht, Amsterdam and Antwerp, are located in relatively similarly sized countries, Switzerland, The Netherlands and Belgium, respectively. Turin is located in the biggest country of the sample, Italy, which is about eight times bigger than the other countries. Portugal's territory, where Lisbon is located, is three times smaller than Italy, and has about double the size of the other countries.

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raised questions about the reliability and pertinence of the metropolitan level of comparison. On the other hand, the comparability of the data at city level seems to be more reliable.

Italy also has the biggest population, yet not the one with the highest density, amounting to 201,50 inhabitants per Km^2. The Netherlands and Belgium have much higher densities, respectively 494,50 and 364,30 inhabitants per Km^2; the Netherlands comprising of almost 17 million inhabitants. Belgium, Portugal and Switzerland's populations range between 8 to 11 million. The two latter countries have lower densities, with Portugal comprising of 114,50 inhabitants per Km^2.

Zooming into the regional level, the Italian case continues to stand out in terms of territory and population size, counterbalanced with the lowest density. The Dutch and Portuguese cases have quite high densities and the Swiss and Belgium ones follow.

At the metropolitan area level, the highest density belongs to the tri-national agglomeration of Basel[86], which has the smallest territory and population of all cases. The remaining territories have comparable sizes and densities, Amsterdam and Lisbon bring the most dense cases. Turin region is again the largest in area, but the least dense.

At the city level, Basel has again the highest density, closely followed by Turin and Lisbon. Amsterdam and Utrecht follow, and Antwerp is the least dense city, while having the largest territory (with a considerable part of it dedicated to harbour activities) of all the analysed cases. The second largest territory belongs to Amsterdam. Turin comes next, then Lisbon and Utrecht, and Basel with the smallest area of the sample. The cities of Turin and Amsterdam have the largest populations, closely followed by Lisbon and Antwerp. Utrecht comes next and Basel last. Lisbon, whose area is similar to that of Utrecht, has almost the double of the population.

These numbers offer a perspective on the dimensions of the studied territories, however, they do not suffice to characterise them. Therefore, a short introduction to the general characteristics of each city is made below. Following these descriptions, the main differences and similarities that came out of this comparison exercise are summarized.

Basel

The location of Basel provides it with its historical economic strength and its cultural diversity. The city lies on the Rhine, one of Europe's most important waterways, and at the meeting point of the borders of Switzerland, Germany and France. The intersection reaches further to the Northern European countries of Italy and Austria. This central position in the European (water, road, rail and air) transport networks continues to feed this longstanding prosperous business centre, whose origins date back to the Roman period. The service industries such as trade, finance, company services, education and healthcare, most

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[86] The city of Basel is functionally and physically linked to the neighbouring towns in France and Germany. There is a long tradition of cooperation between these territories. *"The EuroAirport Basel-Mulhouse-Freiburg* [opened in 1946] *is testimony to the beginnings of this cross-border cooperation after the Second World War. The tri-national cooperation has become increasingly important with the foundation of the Regio Basiliens is association in 1963 in Basel and similar associations in the two neighbouring countries. Today, the tri-national cooperation is of great significance for the Canton of Basel-Stadt. The Governing Council of the Canton of Basel-Stadt wants to ensure that the metropolitan area of Basel grows together as an integrative living environment and economic area and that existing border barriers are broken down."* (Kanton Basel-Stadt, 2013). For further information see also: www.eurodistrictbasel.eu.

notably its powerful position in the top segments of the pharmaceutical and chemical manufacturing, strengthen the importance of this non major metropolitan area at European and international levels (Eisinger & Schneider, 2003). It is Switzerland's third most populated city and is classified as a *"sufficiency"* city [87] by the Globalization and World Cities Research Network (GWCRN, 2011). The studied station area in this city is located on a 19th century expansion area.

Utrecht

The city, which has been in the past the first, is now the fourth most populated of the Netherlands. Positioned right in the centre of the Netherlands, Utrecht is a major crossing point of the road and rail infrastructure of the country, and is part of the Randstad conurbation. The city is home to the largest University of the country, cultural facilities and the well known Jaarbeurs (business fair) and Hoog Catharijne shopping centre. With all of these characteristics, it retains an important position at a national level. At a global level, it is considered to be a *"high sufficiency"* city (GWCRN, 2011).

Utrecht's origins date back to Roman times, but its preserved medieval structured core and its canals are perhaps its most distinctive features. The city has grown considerably after the Second World War with the construction of several new areas. The station area itself is a close neighbour of the historical core. In fact, part of the station's surroundings and the station building itself were replaced in the 1960's by a controversial brutalism style complex. The station was combined with the then new Hoog Catharijne shopping centre, and part of the ancient canal structure was transformed into a highway (with tunnels).

Amsterdam

Amsterdam is the capital of the Netherlands, despite not being the seat of the Dutch government, and is its most populous city. Like Utrecht, it is part of the Randstad. It is considered to be an *"Alpha"* city (GWCRN, 2011), or in other words a *"global city"*, a term popularized by Sassen (1991), connoting a significant production point of producer services[88] that make the globalized economy run. It is thus an important financial centre, with a service-based economy. Many global companies have headquarters there. It is very well connected by rail and road infrastructure, and also has an important port and Schiphol airport, the latter being one of the most important European airport transit hubs.

Most commonly, the city is perhaps best known for its UNESCO World Heritage historic centre with its canals. Among other attractions, many cultural facilities are also available, like the Rijksmuseum, the Van Gogh Museum, the Stedelijk Museum, the Hermitage Amsterdam, the Anne Frank House or the

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[87] This classification is on the listing of the Globalization and World Cities (GaWC) Research Network, *"The World According to GaWC 2010"*. In this ranking *"cities are assessed in terms of their advanced producer services [...]"* and classified accordingly as alpha, beta, gamma or sufficiency cities, of different levels. The first group gathers highly integrated cities, filling in advanced service needs, as well as "v*ery important world cities that link major economic regions and states into the world economy.* Beta cities *"[...] are important world cities that are instrumental in linking their region or state into the world economy".* Gamma cities *"[...] can be world cities linking smaller regions or states into the world economy, or important world cities whose major global capacity is not in advanced producer services. Cities with sufficiency of services [...] are cities that are not world cities [...] but they have sufficient services so as not to be overtly dependent on world cities."* (GWCRN, 2011).

[88] *"Producer services are intermediate inputs to further production activities that are sold to other firms, although households are also important consumers in some cases. They typically have a high information content and often reflect a "contracting out" of support services that could be provided in-house. Producer services comprise the following International Standard Industrial Classification (ISIC) Rev. 3 sub-groups: business and professional services; financial services; insurance services; real estate services."* (OECD, 2001).

Amsterdam Museum. Not surprisingly, a large amount of (inter)national tourists visit the city. The studied station is located on an island, built specifically for the purpose of housing it in the course of the 19th century, in between the city's historical centre and its waterfront.

Lisbon

The city is the biggest in Portugal and is its capital where the country's administration is centred. Lisbon is also recognized as a *"global city"*, raking as *"Alpha-"* (GWCRN, 2011), for its importance as a financial, commercial, cultural and educational centre.

Its location at the estuary of Tagus river meeting the Atlantic Ocean, has fed its economy, as well as its social and cultural history, since its pre roman origins. Besides the port, the city has an airport, and the main national rail and road networks connect it to the rest of the country and abroad. It is a well-known city tourism destination for its historical urban areas (the centre and Belém), UNESCO classified monuments, and the hills overlooking the river. It is also an eventful place, having hosted the European Cultural Capital 2004 and Expo98 exhibition. Gare do Oriente, the Portuguese case study, was built within the area of Expo98, which has become a new centrality in the city since then.

Antwerp

Antwerp is the second most populous city in Belgium, and is located on the river Scheldt. It has one of Europe's largest ports, which granted it an important economic position in the region and internationally. In fact, the city has been linked to trade since its early days. In the 16th century it became the richest European city and an international economical centre. Currently it is considered to be a *"Gamma+"* city (GWCRN, 2011). It houses an important amount of petrochemical industries, but the main motor of its economy is the diamond trade.

The city is also an important cultural centre of the region. The historic centre, the port, the central station and the zoo next to it, as well as museums are some of the city's landmarks. The port, rail and road infrastructure connect the city at both national and international level.

Turin

Located in northern Italy, on the Po riverbanks, and surrounded by the western Alpine arch, Turin is the third biggest Italian city, a regional important business and cultural centre and the capital of Piedmont. It was the first capital of the country in 1861, and at that point a major political centre. It became a major manufacturer centre, namely related with companies like Fiat, Lancia or Alfa Romeo, of the automotive industry, but also with the aerospace industry. It is also home to institutions like the University of Turin and the Turin Polytechnic. In 2006 the XX Olympic Winter Games was hosted by the city. It is ranked as a *"Gamma-"* city (GWCRN, 2011).

The city is connected by rail and road infrastructure, as well as by air. It has a regular pattern of boulevards perpendicular to each other, featuring palaces, museums, churches, etc., as well as squares, gardens and streets and buildings bordered with galleries. The latter of which become a distinctive architectural feature (Figure 4.63) that comes back at different periods of the city history. Since the early nineties of the last century, an extensive urban redesign programme named the *"Spina Centrale"*, made possible by the lowering of the rail infrastructure[89], is being implemented (Ciocchetti, Corsico, Rosso, & Bocconcino, 2011). The case study of Porta Susa station (area) is a flagship project of this massive operation.

Comparative

The connection of all the studied cities with waterways is a common unavoidable feature. The economic role the water has on the cities, at least at some point of their developments, is noticeable. While in Antwerp, Amsterdam, Lisbon and Basel, the ports still carry an important economic weight, in Utrecht and Turin the waterways are not as relevant. The studied stations in Amsterdam and Lisbon have a very similar location relative to the water, of very close proximity.

All of the cases are related with airports. Schiphol airport near Amsterdam is the biggest airport related with the studied cities. Trains connect it directly to Amsterdam Centraal and Zuidas stations[90], as well as to Utrecht. Antwerp airport is the smallest of the analysed case studies. It has no train connections to the city. Instead, busses connect to the city centre and to Antwerpen-Berchem station. Basel airport serves three countries, Switzerland, France and Germany, and also does not have train connections. Busses connect to the city of Basel and the studied station. Lisbon airport is partially inside the city and very close to the station here analysed, to which it connects by bus and metro. Turin airport is the furthest away from the city and has a railway connection to the Dora railway station. All of them are reachable by bus, taxi and private transport.

A noteworthy observation is that all cities are part of the rank of *"global cities"*, indicating their vocation for trade and interest on projecting themselves as important international centres. Both cases with tracks at ground level, Basel and Utrecht, are within the *"sufficiency"* cities group. The cases of Amsterdam and Lisbon, with railway tracks at an elevated level, are both *"Alpha"* cities. And the cases with underground railway tracks, Antwerp and Turin, are both *"Gamma"* cities.

4.1.3. Analysis' framework

The 'node' and 'place' spatial features of the case studies were mapped at several scales and moments (in history), to explore the factors that influence the spatial performance of station areas. The survey expected to identify the main spatial dilemmas of each category of station area and to identify the most recurrent problems and solutions, as well the reasons behind them. By doing so, new scientific knowledge could be developed and form the basis for the 'design recommendations'.

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[89] The lowering of the rail infrastructure, best known as the *"Passante Ferroviario de Torino",* resulted from the agreement for the harmonization of needs of the railway junction of Turin with the guidelines for the *new "Piano Regolatore Generale"* (General Plan of Turin) in June of 1991, between the Italian Railways, the Piedmont Region, and the City of Turin (Comune di Torino, 2012). The project follows the *"Progetto del Piano Regolatore del Nodo Ferroviario di Torino"* (Project Plan of the railway junction of Turin) of the early 1980's. Refer to chapter 4, subsection 4.4.2..

[90] Schiphol airport has a station within its complex. This station is connected to the country's railway network, thus Amsterdam and Utrecht are directly connected to Schiphol by train. For further information on the connections from and to this airport see: www.schiphol.nl. For further information on the connections from and to the airports serving the other case studies' cities, namely Antwerp, Basel, Lisbon and Turin, see: www.antwerp-airport.be; www.euroairport.com; www.ana.pt; www.aeroportoditorino.it.

Four Sets of graphical analyses (hereafter also named Sets of drawings, or simply, Sets) were produced for each case study to survey their physical and functional characteristics. Each Set groups the analyses done on the station areas' past and present situations, at one of the three considered scale levels: 'city', 'urban area' and 'building'. Further, each Set features the same coding, drawing styles, scales and delimited circular areas[91], to allow their mutual comparison. Each scale level contextualizes the successive one, allowing to overcome the limitations of the circular delimitation approach adopted for the mapping of the case studies.

The Sets at 'city', 'urban area' levels, and the first Set at 'building' level, are presented within the subsections dedicated to each case study. The second Set at 'building' level is presented in the concluding section of this chapter, which is dedicated to the comparison of the case studies.
The framework of these graphical analyses (Figure 4.7) is detailed in this subsection.

The **'city'** and **'urban area' levels** of analysis concern, respectively, the city and the urban surroundings of the studied station area. At these scale levels, each case was subjected to a 'historical evolution' analysis and a 'current situation' analysis of its 'node' and place' spatial characteristics. This mapping of the 'node' and 'place' features of the studied station areas makes visible the evolution of the relationship between their (railway) transport infrastructure and their territory throughout the time, contextualizing their current spatial performance. At each of the two scales, the 'historical evolution' analysis complements the 'current situation' analysis. The former, by providing an illustration of each case study's background evolution, enriches the reading of the latter. The 'current situation' analysis is more detailed, thus the 'node' and 'place' features of each case study are unfolded into two schemes, while in the 'historical evolution' analysis they are merged.

The **'building' level** of analysis is actually not confined to the interior of the building envelope. It incorporates the direct exterior of the building as well, allowing the examination of its connections with the surrounding urban area. The main analysis focus of the research is on the 'building' level, as it is at this scale that the spatial performance of the station area is more tangible and influential for people's (daily) use of space. Therefore, the series of drawings at this scale is more detailed, encompassing two and three dimensional images. At 'building' level, each case was subjected to the analysis of its 'node' and place' spatial characteristics, 'before' and 'after' the HST redevelopment project. The purpose was to understand what spatial changes occurred with the implementation of the project, and what benefits and problems (virtues and shortcomings) these solutions brought.

The circular approach is used in all of the analysed scales. As suggested before, the area circumscribed by a circle is somewhat artificial as it hardly coincides with the boundaries of the influence zone of a station building, a station area, or a city. Furthermore, the definition of the influence zone is unclear, and so are its boundaries. However, comparing several case studies with different realities requires the use of a common method. The circle facilitates the comparison by establishing similar areas of study for all the case studies.

[91] This circular delimitation approach to the mapping of the station area, previously referred in chapter 2, section 2.1., is further detailed in this subsection.

In this way, the sizes of their buildings, station surrounding urban areas, or cities, can be compared. The physical and functional characteristics of their spaces can also be compared. The criteria used to define the delimitated area of the circles at each scale are necessarily different. This criteria and how the schemes were created is described below.

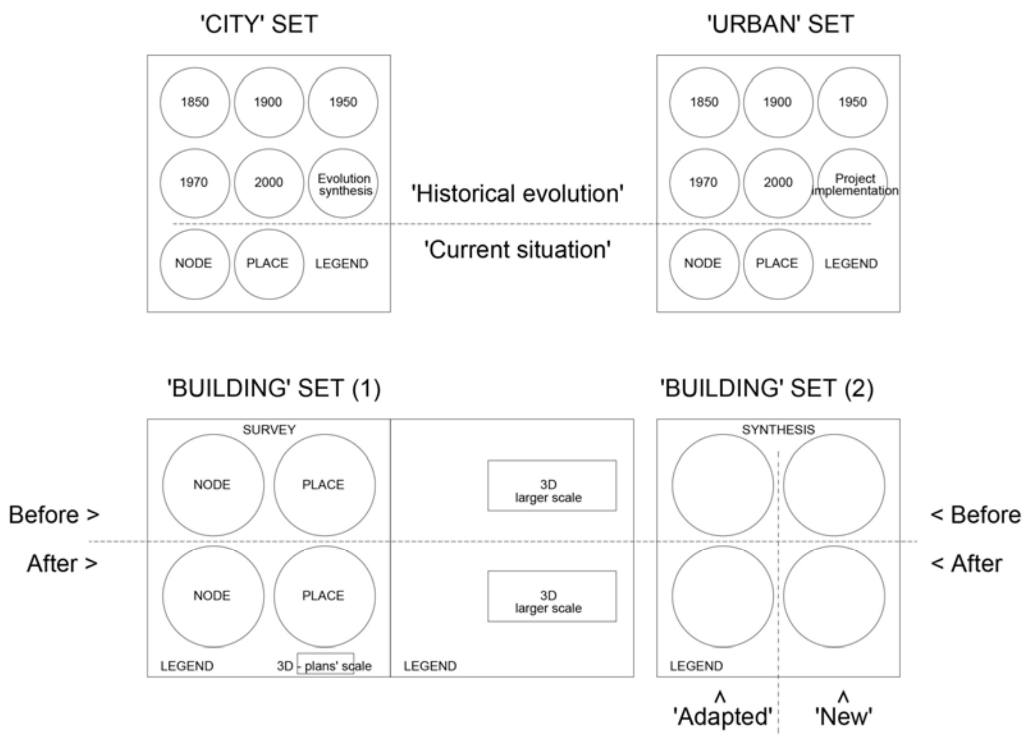

Figure 4.7 – Structure of the Sets of drawings for the analyses of the case studies

'City' level

At the 'city' level of scale, the series of maps of the **'historical evolution'** analysis depicts the development of the built-up areas and of the railway infrastructure since its introduction in each case study city. The maps were made following a similar methodology to that used by the research *"5x5 Projects for the Dutch City"* (see: Pané & Diesfeldt, 2008). In *"5x5 Projects for the Dutch City"*, all the buildings of the studied cities were represented and given the colour of the expansion period they belong to. In this research the built-up area[92] of each period is identified, but the buildings and the urban fabric pattern are not detailed. Railway tracks and stations are marked, but other transport infrastructure, such as roads, high ways, etc, is not. This is because the interest of the research at this scale was on the relationship between railway infrastructure and urban fabric, and a more detailed analysis was not relevant. However,

[92] As explained in the preceding subsection (4.1.2), and regarding the mapping of the studied cities, on the 'historical evolution' maps the built-up area was also marked irrespective of the municipal borders. The city is considered as a physical functional (socio-economic) unit, instead of an administrative one. Its built-up area includes all the urbanized territories in continuity with the core of the city, and it was mapped in this way for all of the considered time periods.

the source map in which the analysis of each period was based, is kept visible as background in grey[93]. Therefore, the urban pattern as well as the other infrastructure is perceptible behind the coloured areas.

The considered periods are the described in chapter three (see Figure 3.1), covering approximately the same periods exposed in the *"5x5"* maps[94]. The built-up area and railway infrastructure is thus shown for: until 1850; from 1850 until 1900; from 1900 until 1950; from 1950 until 1970; and from 1970 until 2000[95]. As defined, the 'origins' period refers approximately to the period of the introduction of the railway infrastructure. In some cases the railway was introduced after 1850, thus the 'expansion' period encompasses this, as well as the bustling developments on other cases. After this 'expansion' phase, followed the last three periods displayed on the maps. These correspond approximately, and respectively, to the phases of 'modernization' developments, 'decline' and 'renaissance' of the railway networks in Europe. Each period is represented by a colour, respectively: dark grey, green, red, yellow and violet.

The series of 'historical evolution' maps at 'city' level also includes one synthesis map, in which the several periods are superimposed. Thus, while the maps of each period offer a *snap-shot* of the state of development at the considered times, the synthesis map summarizes the evolution towards the current built-up area and rail infrastructure situation. In the synthesis map it is possible to distinguish which parts of the current situation appeared in the course of time. The railway lines and stations that were dismantled are also displayed.

The **'current situation'** schemes examine the layout of the transport infrastructure and the built-up area of each of the studied cities in 2012[96]. The 'node' scheme shows which transport networks are present, and which are their relative positions in space. The main railway, metro, tram and light rail, and road networks are indicated, as well as the studied station and other main stations, when existent. The 'place' scheme highlights the position of the city's main centres of activity, its traditional centre as well as relevant new ones. The built-up area[97] of the functional socio-economic agglomeration is indicated in darker grey.

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[93] It was not possible to obtain all the maps that serve as basis to the analysis featuring the same drawing styles. This is the case as they are drawn in different countries and in different years. Bringing them down to the same scale and grey colour was considered enough to introduce the necessary uniformity and allow comparison.

[94]The covered periods, in both the present research and *"5x5"* research (Pané & Diesfeldt, 2008), were defined considering relevant changes in the relationship of the city with the railway. This research did it at the European scale, while the *"5x5"* research did it at the Dutch scale. The specificity of the Dutch context led to the definition of the following periods: until 1850; from 1850 until 1910; from 1910 until 1940; from 1940 until 1970; and from 1970 until 2000.

[95] When it was not possible to find maps for the exact dates, other maps with approximate dates were used as basis to build the analysis map.

[96] The largest amount of data on which the graphical analyses were based was gathered in 2012. However, the analyses presented here are also based on information gathered in 2013. This is because it was considered pertinent to discuss some more recent developments, as for example the rejection of a project for the station area of Basel proposed by citizens. Still, not all pertinent recent developments were considered, because the author only had access to this information posterior to the elaboration of the graphical analysis, redesign proposals, design recommendations and thesis' conclusions. This is the case in the construction of two extra pedestrian tunnels under the railway tracks at Amsterdam CS. These tunnels will have shops and won't have access control gates, allowing the pedestrian connection of the city with the IJ.

[97] As shown in the preceding subsection (4.1.2), the built-up area might not coincide with the city's municipal administrative boundaries. The difference between these two boundaries can be recognized in the maps presented on the preceding subsection (Figure 4.1 to Figure 4.6), which introduced the analysed cities.

Further, the (main) railway stations are marked on the schemes, taking into account that they are (potential) important public spaces in the city.

All the maps in the 'city' Set were drawn within a circle of 15km diameter, which was chosen to circumscribe the area studied at this level. The circle is approximately centred on the historic city centre, and captures the main core of the agglomeration. This was considered to be sufficient to introduce the contextualization of the station area. The circles are presented at scale 1:250000.

'Urban area' level

The series of maps of the **'historical evolution'** analysis at the 'urban area' level depicts in more detail the development of the built-up areas for the urban extent under analysis. This is done for the same periods considered on the previous level of scale, and using the same colours to label them. The last map illustrates the (expected) situation by the end of the station area redevelopment project implementation. To gather information on the presence and positions of different transport modes, other than the railway, in the station area through time, was not possible for all the cases. Thus, such information on the 'node' dimension was discarded at this scale. Only the areas concerning the railway infrastructure were considered and are shown in the maps.

On the **'current situation'** schemes, the 'node' and 'place' situation in 2012 is portrayed. The indicators described by Bertolini (1999), which build the 'node' and 'place' indexes allowing to position a station area on the *"node-place model",* were used as basis for the analysis. An attempt to represent similar indicators in a graphical way was made. Some adaptation was required, as the indicators are not directly translatable into graphic notations.

'Node' accessibility is presented by marking the positions of the different transport modes in the area. Thus, the areas ascribed to each transport mode's infrastructure and stop points are marked, as well as organized parking. 'Place' is presented by marking the positions of different categories of activities in the area. Thus, the areas of each activity are discernible. A correspondence and adaptation of the four economic clusters considered by Bertolini (1999), was made, defining the following categories as space uses: Commercial (retail / hotel and catering); Social facilities (education / health / culture); Administration (administration and services); industry (industry and distribution). Other categories of spaces that didn't fit the economic clusters, but are relevant for the 'place' definition as considered in this thesis, were introduced: housing, mixed use, open air public space, and brownfield spaces (including also empty areas).

The assignment of the uses to the spaces in the scheme was done as accurately as possible, based on gathered data[98] and visits to the sites. However, it must be noted that uses continuously change over time. Possible changes of use will not likely affect the results of the research greatly. Therefore, general

[98] Before the visits, a provisory scheme was made for each case study, based on the data gathered mainly through zoning and transport network maps of the cities, Google Maps and Street View. The direct observation on site allowed for confirming the accuracy of the information, and fine-tuning the schemes.

qualitative criteria were followed. The use of a building at ground floor level was the prevailing one to be assigned to it on the scheme, because it is the most accessible from the public urban space. However, if there were more uses in the building, their relative proportion was taken into account. Thus, if the remaining floors had different use(s) from that of the ground floor, the building was considered to have mixed use. If the proportion of the use of upper floors was much more expressive than the ground floor one, then the latter was overlooked. As an example, areas of residential use with few shops on the ground floor were considered housing, and not mixed or commercial.

The analysed area at the 'urban area' level is the same which is considered as a reference area by Bertolini (1999, p. 202): *"within a `walkable radius' of 700 metres*[99] *from the main pedestrian entrance*[100] *to the public transportation node".* Thus, the 'urban area' analyses were done within a 700 meter radius circle, presented at scale 1:25000. This circular limit, as mentioned before, even with limitations, has the advantage of incorporating people's perspective into the analysis. This perspective was introduced in the analysis by complementing the collection of documental information for each case study with direct observation during a walk within the defined circle areas.

'Building' level

As mentioned above, at the 'building' level, there are two Sets of drawings (Figure 4.7). Both Sets display the 'node' and 'place characteristics of the case studies, **'before'** and **'after'** their redevelopment project. The first Set comprises a series of two dimensional schemes and another of three dimensional sections. Like the Sets presented above for the other scales of analysis, this first Set at 'building' level is presented in the subsection dedicated to each case study. The second Set is presented in subsection 4.5.3 of this chapter, which is dedicated to the comparison of the case studies at 'building' level. The displayed schemes refer to two case studies: the 'adapted' and the 'new' case study of each category of station area.

The first series of the **first Set** encompasses four schemes. These schemes survey the 'node' and 'place' spatial characteristics of the station and its immediate surroundings, 'before' and 'after' the redevelopment project. The 'node' schemes show the positions of the existing transport offer at each of the moments. The 'place' schemes show, at each of the moments, the publicly accessible spaces in the analysed area, inside and outside the station. Pedestrian accessible areas, such as the station halls, tunnels or bridges to overcome the railway tracks, the urban squares and sidewalks, and outdoor green areas were marked. Within these areas, level changes, via stairs or ramps are discernible. Publically accessible facilities within (station) buildings, such as shops and services are also distinguished. Additionally, the restricted access areas were also marked.

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[99] Other distances for (and methods to define) the *"walkable radius"*, advocated by other researchers, could be assumed. The 700 meters radius approach was considered of appropriate detail level for the 'urban area' scale analysis of this research. Some examples of other approaches are the *"Walkability Catchment"* or *"ped-sheds"* mapping, or the isochrone maps. These methods are based on a walking time distance from a given location. They allow the depiction (an estimation) of the actual areas of equal travel time

[100] In the new cases it is hard to distinguish a main entrance, or even not possible, as for example in the case of Turin. In this case the circle was centered in the middle of the station, given the similarities among its several entrances.

For a better understanding of the buildings themselves and to allow their comparison later, their plans and sections were collected and mounted on the same scale. Based on this group of drawings, two three-dimensional sections, perpendicular to the (main) set of railway tracks, were drawn for each case study. They present the 'before' and 'after' situations of each case study, conforming the second series of the drawings of the first Set at 'building' level. These sections introduce the third dimension in this analysis, which is largely based on (two dimensional) maps. They show the relationships between the station's different spaces, also vertically. Further, they offer an understanding of the overall size of the station building of each case, as well as of its complexity. Presenting the three-dimensional drawings at the same scale as the (two dimensional) maps would not allow displaying in them the necessary information. For this reason, they were drawn at a bigger scale. For comparison reference, the same three-dimensional drawing, but at the scale of the maps, was placed next to their legend.

The **second Set** at 'building' level encompasses 'before' and 'after' synthesis schemes of two cases, grouped by category of station area. These schemes merge the 'node' and 'place' schemes done in the first Set of drawings at 'building' level. The schemes show the contrast between the publicly accessible and non-accessible spaces within the analysed area, irrespectively of being indoors or outdoors. Accessible public spaces are represented in white, while the non-accessible ones are represented in black. In addition, a category of spaces with conditioned public access was considered, and marked in grey, when existing.

'Node' related spaces like the railway platforms, and 'place' related spaces like shops were considered limited access areas, and thus marked in black. The access to platforms is many times subjected to the possession of a valid train ticket. The access to shops and services is also a conditioned one, for their opening hours or admission policies. Other semi-public spaces, like the station halls, pedestrian tunnels or bridges were marked in white. Despite the fact that these spaces might also have conditional access, their opening hours are generally wider than those of shops and services. Further, their character is closer to that of the outdoor urban spaces, while shops and services are closer to the domestic scale. Only when access to such semi-public spaces is permanently conditioned to the possession of a valid transport ticket, were they marked in grey to highlight that situation. 'Node' related spaces like the streets designated for motorized traffic, are also marked in white. Even if not designed for pedestrians, they are crossable and open spaces. Only when such spaces are not possible to cross by pedestrians, due to physical barriers, were they marked in black.
The simple graphic convention of these schemes allows for an unequivocal perception of the spatial performance of the station area at 'building' level. Further, they convey an understanding of the station, not as a separate entity, but as an embedded element in its immediate urban surroundings. In these respects the schemes are similar to the *"Nolli Map"*[101].

[101] The map of Rome by Nolli, *"[...] provides an immediate and intuitive understanding of the city's urban form through the simple yet effective graphic method of rendering solids as dark gray (with hatch marks) and rendering voids as white[...]". "Nolli's map conveys an understanding of the city's topographic and geo-spatial structure, the patterns of private and public buildings, and their relationship to the entire urban ensemble. This encourages an understanding of the building, not as isolated event, but one that is deeply and intrinsically embedded in the fabric of the city."* (Tice, 2005).

For all of the schemes within the Sets at the 'building' level, the studied area is presented circumscribed in a circle of 350m diameter, at scale 1:8000, focusing on the station complex and its direct exterior. At this scale this was considered more relevant than to center the circle on the main entrance of the station. As noted before, to distinguish a main entrance is not possible in some cases. In other cases, to distinguish a main entrance would leave out of the circle considerably large parts of the station.

The distance of 350m, which represents roughly a five minute walk, was considered an acceptable extension of space and time to cover on foot when commuting from one means of transport to the other, or to move from a (non)transport related activity to another. However, due to the considerable dimensions of some of the stations, some parts of them fell outside of this circular delimitation. Therefore, a wider circle of 700m diameter circumscribes the circle of 350m diameter, capturing the whole building. This circle coincides with the 700m diameter (350m radius) circle of the 'urban scale' graphical analyses. Only in the case of Antwerp was it necessary to reposition this circle in order to fit the whole station.

The three-dimensional section, which complements the schemes on the first Set, is presented approximately at scale 1:3000, as representing it on the same scale as the schemes wouldn't be readable. However, a three-dimensional section at the scale of the schemes is also presented on the 'building' level set, to offer a perception of the scale difference.

The produced drawings, at all of the described levels of scale, are created on the basis of (historic) maps of the areas, zoning and other planning documents, information on cities (centres) boundaries, transport networks, bicycle paths maps, car sharing and parking companies, etc. This information was gathered through direct contact with institutions, via the internet and direct observation on site. Further, it is important to mention that there were differences in the level of detail and the notations in the obtained maps. Despite the effort made to overcome the difficulties the situation poses to a uniform analysis of the cases, the results built on the information the maps provide are conditioned by it. Thus, the presented analysis results only from the available information provided by the sources. If the area of a source map was smaller than the analysed area, for example, then the results are obviously limited to the area depicted in the source map.

The apparent simplicity of the schemes as opposed to the complexity of the reality might seem reductive. However, in order to understand such complex realities it was deemed necessary to untangle the several layers that compose them. The graphical schemes display information such as the dimensions and shapes of the spaces, their uses and relations. Complementing these schemes, information on the amount of users, facilities and transport modes, as well as their types and destinations, is described in words and in tables. This makes the features of the complex reality understandable.

In the following sections, the analyses of the case studies are presented. After an introduction to the general characteristics of each station area's category, the analyses of its 'adapted' and its 'new' case studies are described, each in a subsection. In turn, the subsection begins with an introduction to the railway (station and its area) in the city and the redevelopment project. Mapping of the station area then follows, which supports the analysis of the case study's 'node' and 'place' features. A synthesis of the observations finalizes the subsection.

4.2. ‘Bridge’ stations - ground level railway infrastructure

In this research a station building that spans (or one which has an important part of it spanning) over the railway tracks placed at ground level, is named a ‘bridge’ station. The interior space of these covered bridges encloses the main pedestrian streams inside the building, providing access to train platforms, other transport modes, retail and services, as well as a connection between parts of the surrounding urban area.

Pedestrian bridges, usually built over water, but also above roads, have housed many different functions throughout the history. In fact, some of the earliest examples even had housing (Baus & Schlaich, 2008). The cases of Ponte Vecchio in Florence, the Rialto Bridge in Venice, or the Kramer Bridge in Erfurt, show the role of these structures as a complex urban system.

> *“Covered bridges are often also necessary in densely populated cities: When buildings are to be joined above a roadway, the bridge becomes a de facto continuation of building space: to the foyer, corridor, conference room.”* (Baus & Schlaich, 2008, p.149).

The bridge pavilion designed by Zaha Hadid for the Expo2008 in Zaragoza is a contemporary example of the possibilities of these types of structures. The use of bridge like constructions to serve as (part of) a station building is apparent in some contemporary examples. Such is the case in the Basel and Utrecht stations analysed in this research, but also of Roma Tiburtina station in Italy and Afragola station in Naples (also designed by Zaha Hadid). Built to span over the railway tracks, these buildings house not only the obvious access to trains and the pedestrian connection between the two separated parts of the city, but also a variety of other functions such as shops and services. A much simpler example is the footbridge of Arnhem Centraal in the Netherlands (Figure 4.8). Its function is indeed to provide a pedestrian access to the trains. Further, it provides the connection between the two sides of the railway tracks. However, there is only one space designated for one (snack) shop at the bridge’s anchoring point with the *back side* of the station.

Figure 4.8 – The pedestrian bridge of Arnhem CS (2012)

Figure 4.9 – Aerial view of the station area of Basel (www.luftbilder-der-schweiz.ch; Schweizer Luftwaffe; Geographisches Institut der Universität Zürich, 2012)

4.2.1. Basel

The railway (station and its area) in the city

In 1844 the first railway line arrived to the Swiss border city of Basel, connecting it to Strasbourg in France (Bärtschi & Dubler, 2011). Its 'terminal' station[102] was built in the following year, within the city walls (SBB/CFF/FFS, 2013a). Until the first station at the current location of Basel SBB was opened in 1860, other lines[103] and stations were put into operation in the city. These lines would connect among each other, and connect the city to other Swiss and German cities. This first station at the location of the current Basel SBB, the Centralbahnhof, was the joint Swiss and French station for passengers and goods.

In the subsequent years, the station would undergo several modifications, enabling it to deal with the introduction of new railway lines and the increase of traffic. However, by 1898 it ran out of capacity and a new building became necessary. The railway tracks were lowered to overcome the many level crossings with the local road network in 1901 (SBB/CFF/FFS, 2013a). The railway ring was repositioned and freight operations transferred to another location. The new building, designed by Emil Faesch and Emmanuel La Roche, would be inaugurated in 1907 (Huber, 2004). It includes a customs facility for the international transit traffic.

The current station complex (Figure 4.9) comprises this last building, as well as the changes and additions made to it throughout the years. The last big operation in the station complex was the addition of the Passerelle, the pedestrian bridge above the railway tracks, linking the tracks and the both sides of the city they separate. This element, designed by architects Cruz y Ortiz and Giraudi Wettstein, is part of the station redevelopment project.

The redevelopment

In 1981 SBB announced its plans to increase the transport capacity within the international, national and local network, and to profit from the development of their centrally located property (SBB/CFF/FFS, 2013a). The city was also focusing on the station area as a potential space to accommodate activities of the service sector, which would benefit from the integration with the transport interchange, thus boosting the city's economy (Bertolini & Spit, 1998). Common objectives gathered the city, the SBB, the county administration, and also the Swiss Mail company, on the elaboration of the *"Master Plan"* for the area in 1983. In the time reaching the mid 1990's the initial participative approach of the studies for the plan was gradually reduced. The real-estate market and financial context had changed, motivating adjustments to

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[102] The Elsässerbahnhof or the Alsatian Station was the first station in Switzerland, and it was part of the first cross-border line ever (Scholz, Stauffacher, Bösch, & Krütli, 2005). This station opened three years before the commissioning of the line between Zurich and Baden (SBB/CFF/FFS, 2013a).

[103] The Basel-Liestal line went in operation late in 1854 from the second 'terminal' station in Basel. This line was intended to establish an international connection through the Gotthard to Italy. In 1855 the line Mannheim-Constance linked Baden to the city of Basel, establishing a third station, this time a 'through' station. In those days, no rail connection existed between the two existent 'terminals' and the new station. (SBB/CFF/FFS, 2013a).

the initial ideas, namely giving priority to public transport. To facilitate its implementation, the project was subdivided into 21 projects, and was renamed to *"EuroVille"*[104] (Mazzoni, 2006).

Several (mainly service dedicated) buildings, like the Peter Merian-Haus, the Jacob Burckhardt-Haus, and the Elsässer tor or the Südpark, were built next to the station. The two later were designed by Herzog & de Meuron. The renovation and construction of (pedestrian) bridges above the railway, the creation of a new street south of the railway tracks, and some other works were realized. The station itself was renovated, and the Passerelle was opened to the public in 2003, replacing the old underpasses below the tracks. This new element houses shops and allows the access to the tracks as well as its crossing, ending at a new entrance and square on the south side.

A new tower bordering the south square, designed by Herzog & de Meuron, and a new underpass linking this square to the other side of the railway tracks (Figure 4.11), are the next steps leveraged by the SBB (Wüest, 2013). These latter plans, and a popular referendum held by the city in September 2013, put definitively aside the citizens' initiative proposal for the construction of a *"Central Park"*[105] over the tracks (Figure 4.10). This *"Central Park"* aimed to diminish the barrier effect and to increase the no longer sufficient capacity to handle users flows through the Passerelle (Ambühl, 2012). However, according to SBB, it would limit possible railway infrastructure expansions and was deemed to be too costly.

Other projects are emerging in the area, in the way of new office buildings, public spaces and the rebuilding of the Hilton Hotel by the Baloise Group (Baloise, 2013). One example is the recently implemented redevelopment of the Markthalle (Weber, 2011) with a mix of uses, ranging from shopping, working, entertainment, to housing. The later in the form of a fourteen storey pentagonal high-rise apartment block, designed by Diener & Diener.

The station has 135000 users[106] a day, 17 train platforms on the Swiss part of the station and another 4 on the French part. In total, there are about 37 train lines reaching several destinations in France, Germany, Italy, and cities like Amsterdam, Praha or Moscow. Seven tramlines stop at the station, as well as 4 bus lines. The indoor car parking capacity in the area rises above 500 spaces, while the indoor bicycle parking is of 1650 spaces (see Table 4.3).

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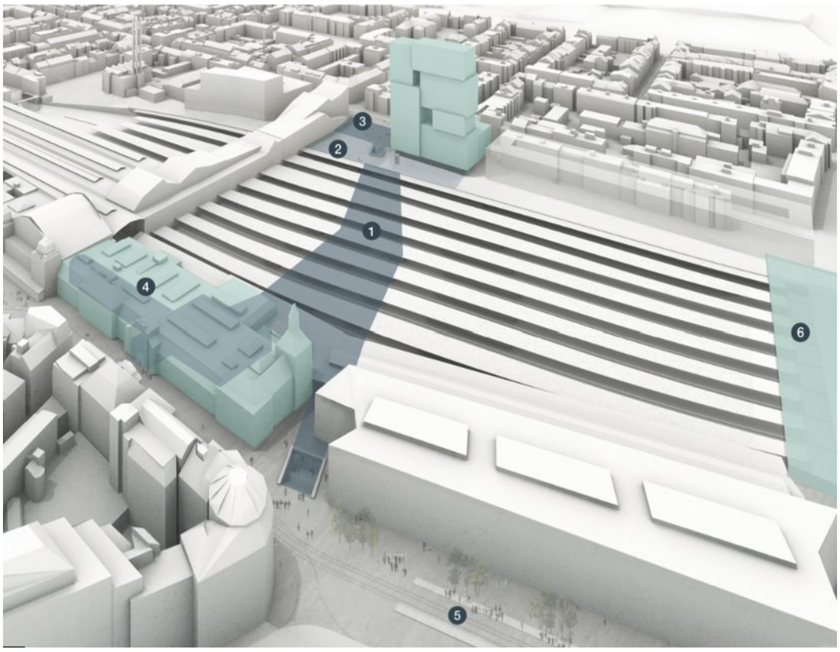
[104] For further information on this project see also Bertolini & Spit (1998).

[105] For further information on this project see: www.centralparkbasel.ch

[106] These users are, according to SBB/CFF/FFS (2013c, p.18): *"rail/public transport passengers, customers using shops and other outlets at stations, passers-by"*.

Figure 4.10 - Three-dimensional simulation of the "Central Park Basel", proposed by citizens' initiative (Jacob Planung, 2009)



1) New west pedestrian underpass

2) Underground logistics center

3) Meret-Oppenheim Square (south square) with skyscraper by Herzog & De Meuron

4) Renovated west wing

5) Tram stops

6) Access from the train platforms to the Margarethen bridge

Figure 4.11 - Three-dimensional simulation of the current project from SBB for the west side of the station complex (SBB/CFF/FFS, 2013).

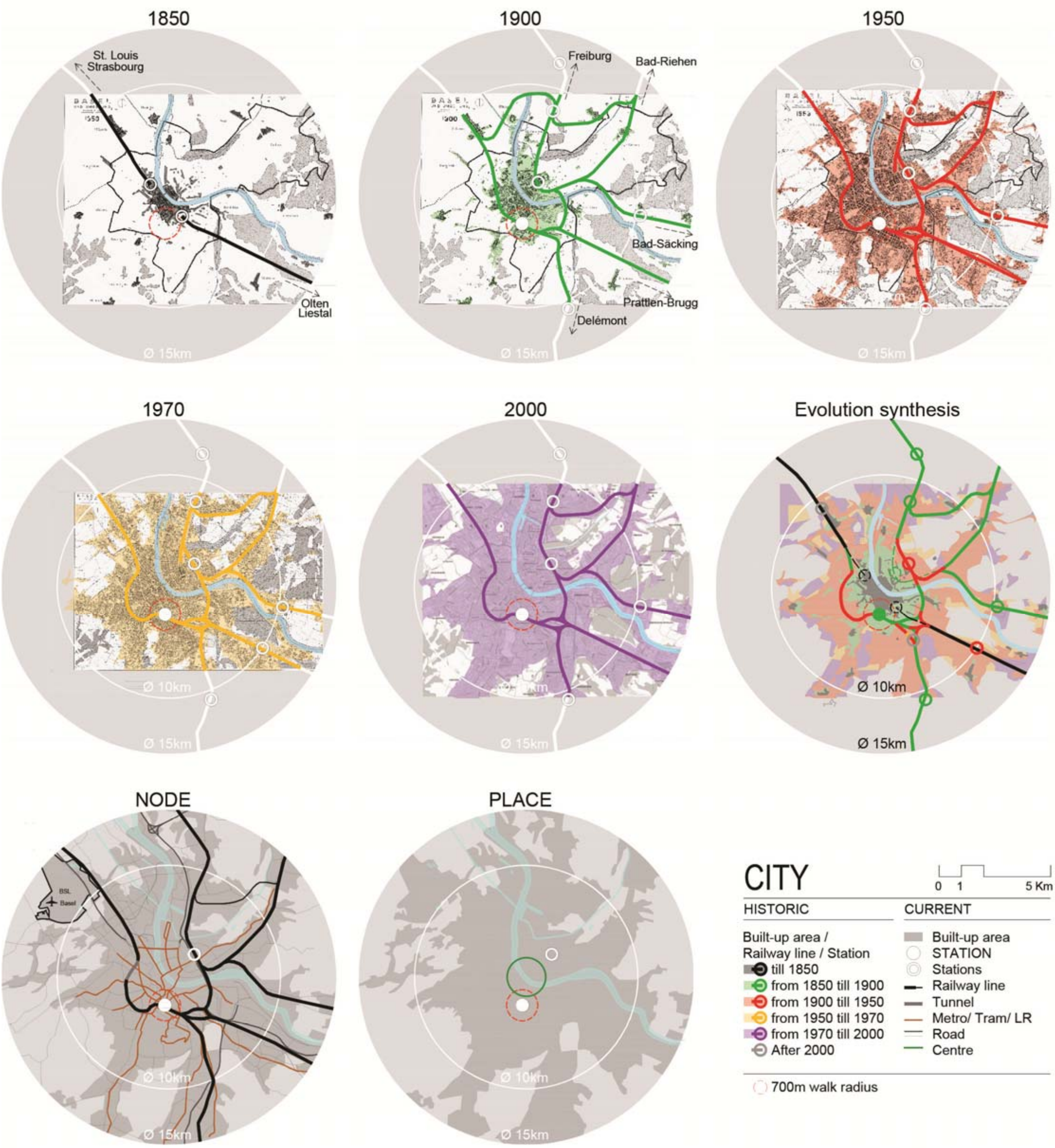


Figure 4.12 - 'City' Set of Basel case study

Mapping the station area

'City' analyses (Figure 4.12)

Historical evolution

As the analysis maps show there were many developments in the railway infrastructure of Basel throughout time. Most of them are concentrated in the 'expansion' and 'modernization' periods.

The city's first two stations, 'terminals' of its two first railway lines, the French line and the line to Olten, disappeared before the beginning of the XX century, as well as sections of these lines. The same would happen with the first ('through') station of the lines to Germany in 1913. By 1855 Basel had these three stations isolated from each other. Five years later the French line was linked to the Olten line and the first central station was built at the current location. The German line was also connected to the central station. New lines were built to Delémont and Prattenlen-Brugg until 1900, as well as new connections among existing lines and freight areas.

In the 'modernization' period, due to the increase of traffic, the central station was rebuilt and inaugurated in 1907. The French line was lowered and relocated around the city in the form of an arch, avoiding level crossings. Since then some sections of the railway were closed and others added, mainly adjusting to changes in the freight areas.

Until 1850 the city was mostly confined within its walls. In the 'expansion' period, the city's built-up areas were mostly circumscribed by the railway tracks. During the 'modernization' period the city grew beyond the railway tracks and along them. Since then, the city has kept growing, however at a slower pace.

Current situation

Node – The transport infrastructure of the city is quite complex, as is its territory. The international crossing nature has a big role in this, as well as the multilevel topography of the city. Variety is perhaps one of the most eminent characteristic of this region, and that is observable in the implantation of the transport network. Tramlines and roads are interlinked with the city's built-up areas.

Place – There is a clear historic centre of the city around which it has grown. The station is on the edge of it, but has become very central in the agglomeration. The station area is becoming itself a new centre, in connection with the historic one.

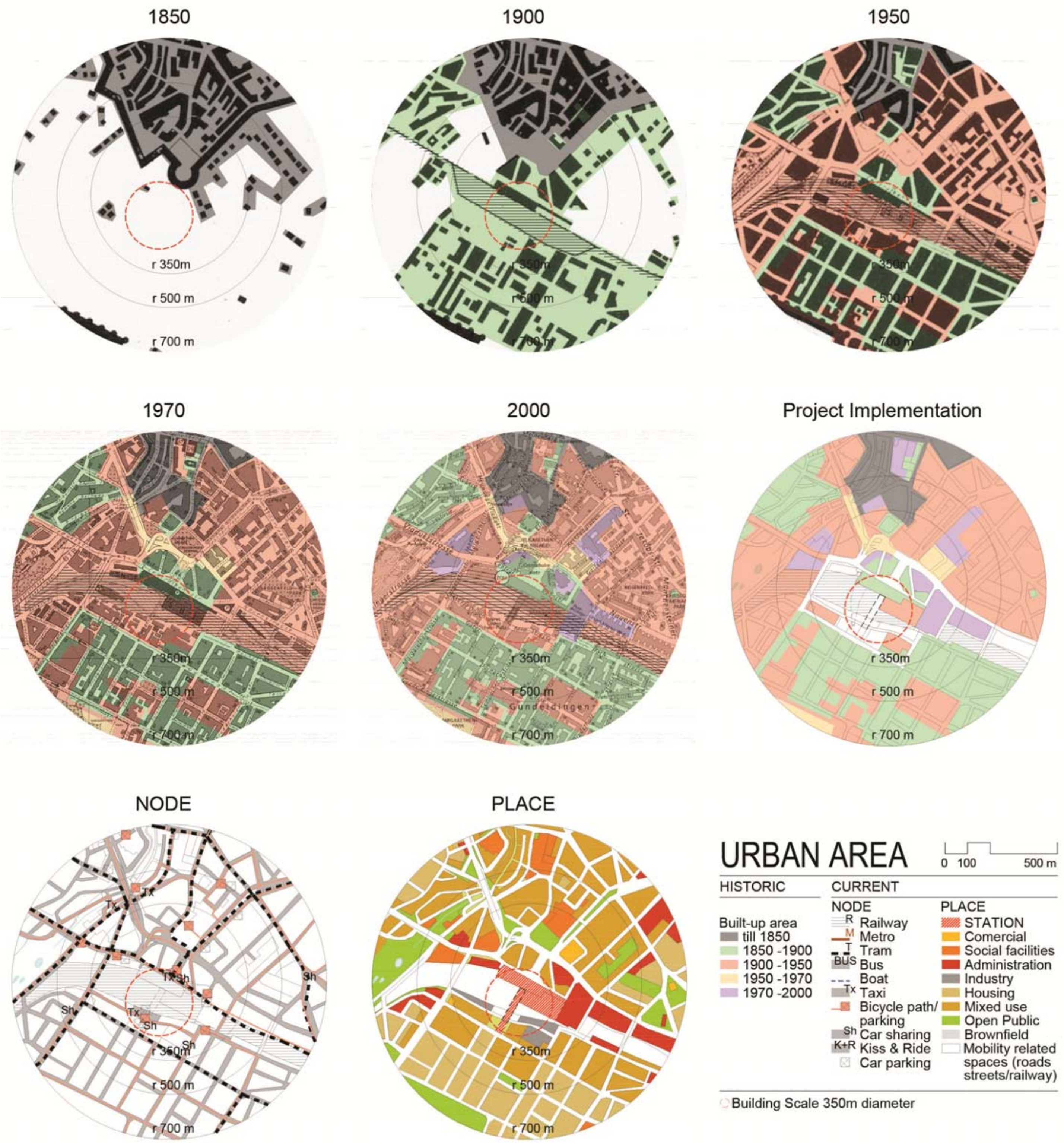


Figure 4.13 - 'Urban area' Set of Basel case study

‘Urban area’ analyses (Figure 4.13**)**

Historical evolution

Built just outside the walls of the city in 1860, the station and its railway infrastructure marks one border and a barrier between the historic centre and the XX century expansions. South of the railway tracks, industrial and residential neighbourhoods developed. North of the railway tracks, in the city centre, more cosmopolitan functions were kept. A great deal of reconstruction is noticeable in the area, especially on the north side of the tracks and in the last two periods analysed. This is evident in the implementation of road viaducts and tunnels, and some particular buildings like the Bank for International Settlements (BIS) headquarters or the Hilton Hotel, and later on, also the buildings of the EuroVille redevelopment project.

In the last few years, the reorganization of the transport networks and the limitations to car traffic in the area, has made it more pedestrian and cycle friendly. Still, the railway barrier and some wasteland remains, waiting for adequate redevelopment.

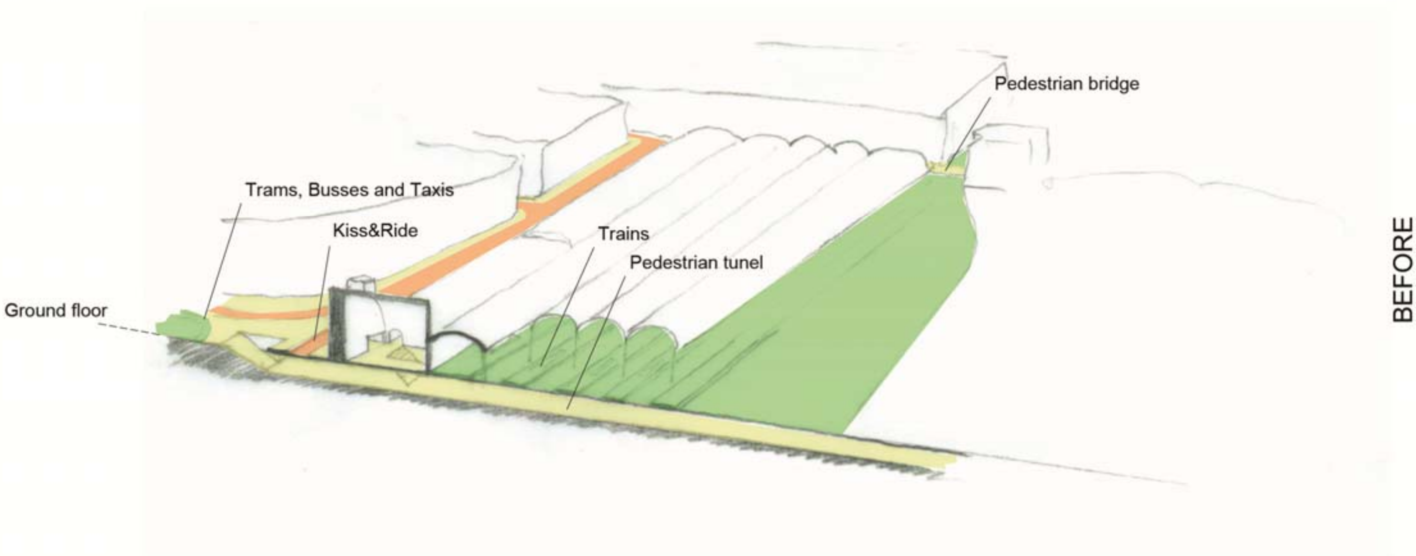
Current situation

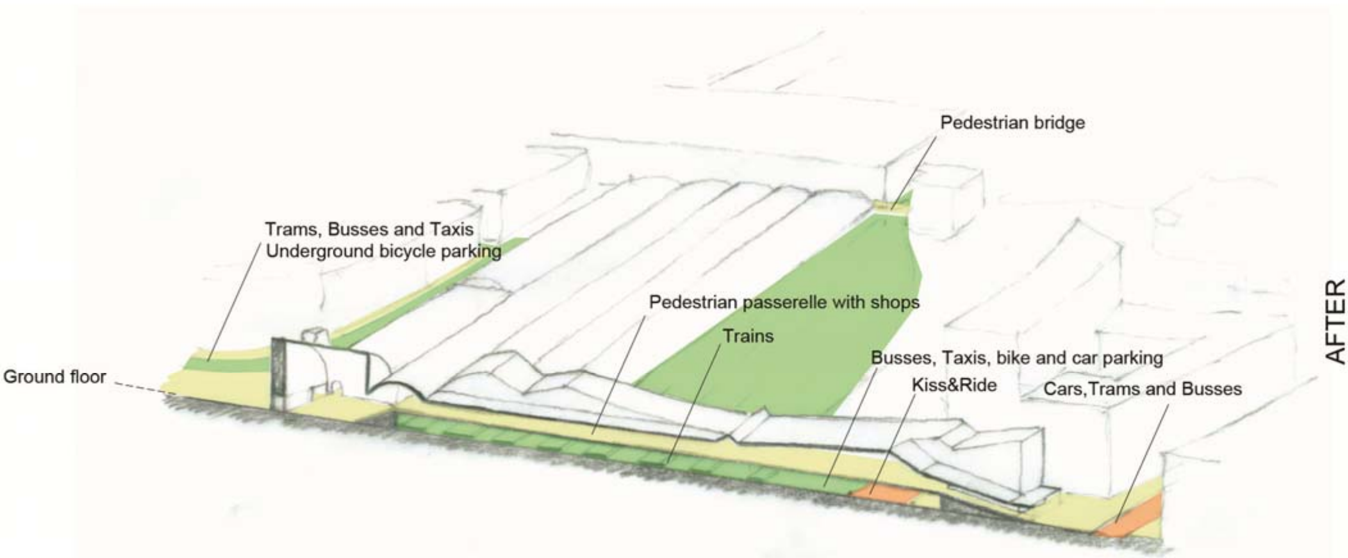
Node – The station is mostly an interchange of trains, where also buses, taxis, carsharing and private cars converge. There is also a significant investment done to promote bicycle transportation with the construction of indoor bicycle parking right in the main square in front of the station, and the implementation of bicycle paths in the area.

Place – There is some variety of uses of the buildings in the area. The buildings closer to the historic centre have more mixed uses or are dedicated to social facilities. South from the station, the predominant use is housing. The uses on the administrative cluster are mostly placed directly around the station in the redevelopment project new buildings. There are also some green areas within the 700 meters radius reach from the station.

The urban surroundings are very fragmented, a result of the historical evolution, but also of the strategy of implementation of the station area redevelopment project. The latter consisting of a group of autonomous projects, developed along a relatively long time span.

Figure 4.14 - 'Building' Set 1 of Basel case study





0 10 50 m

- Pedestrian / public space
- Public transport
- Private transport
- Water

'Building' analyses (Figure 4.14)

Before the redevelopment project

Node – The station area was a busy saturated 'node', with a high pressure demand for transport within a limited development space. The main square in front of the station, the Centralbahnplatz, was crossed by trams, busses, taxis and private cars, hampering pedestrians' movements. On the south side of the station, the transport offer was more limited. Additionally, the main pedestrian connection between the two sides of the railway tracks was an underpass used to access trains. The space for pedestrian flows inside the building was almost limited to this passage. There weren't dedicated bicycle infrastructures and car parking was relatively limited in the whole area.

Place – The station area had become a relatively degraded area, especially on the industrial south side. Pedestrians were confined to limited areas in and outside the building: the sidewalks; the Centralbahnplatz, which was shared with motorized traffic; and the pedestrian underpass. The non-transport public functions offered, were also not very varied and mostly composed by the restaurant sector, with the station's popularly known buffets.

After the redevelopment project

Node – The station area continues to be a busy 'node', however some improvements were introduced alleviating its saturation and functioning.
The Centralbahnplatz is now free of private cars. The pedestrians share the space with trams, taxis and bicycles. There are bus stops and carsharing on both sides of the tracks and the kiss and ride is located on the south side. New railway tracks, a tramline and bicycle paths were added. The parking capacity for cars was increased and bicycle parking was created under the Centralbahnplatz. An open-air facility for bicycle parking on the south side under the Passerelle was also added. The access to trains is currently granted by the Passerelle, but has proven not to be sufficient for the amount of users of the station (Ambühl, 2012), leading to the proposal of complementary solutions.

Place – The public spaces in and around the station building have improved with the redevelopment intervention. Pedestrian movements were facilitated by the Passerelle. The experience of crossing the area now has a higher quality, as opposed to that offered by the former darker underpass. The reorganization of the existing square, and the creation of a new one with a clear new entrance to the station, contributes to diminishing the *front and back side syndrome*. However, it doesn't seem to be enough yet, as the dimensions of the spaces do not accommodate the needs it must respond to. The introduction of a varied offer of shops and other services in the Passerelle and in other spaces of the interior of the building, brought with it a larger variety and number of users whose interests tend to conflict in the small space. The necessary level change, provided by stairs and ramps at both ends of the Passerelle, exacerbating the problem, strangulating the pedestrian flows (Figure 4.15). Further, the floor of both entrance squares is asphalted on the same colour as streets are, making it hard to distinguish the areas destined to motorized traffic and pedestrians (Figure 4.16 and Figure 4.17).

Most of the shops are related with food, but there are also books and magazines, shoe and clothing shops, florist shops, supermarket, hairdresser, mobile telephones and an electronic appliances anchor shop. Besides the travel related services, such as ticketing, travel information, baggage and WCs, there is a police station, a pharmacy and even a clinic with dentist, gym and physiotherapy, as well as conference rooms in the upper floor of the old building.

Synthesis

The redevelopment of the station area has improved its spatial performance, despite some persistent problems. The created spatial conditions better support the modal interchange needs. The compact distances between the different modes have an important role in this. Additionally, the project introduced a renovated 'place' notion in the area, and a dynamic that is generating more redevelopment initiatives aiming at further improving the liveability of these spaces. Within the building scale, the Passerelle did became a connecting element of the two city parts at physical and functional levels.

Nevertheless, the project was not able to overcome all the challenges. There are still relevant discontinuities in the area that limit its spatial performance. Besides the railway crossing not being fully resolved, and thus the connection of the two parts of the city not being optimized, the south wastelands and the barrier effect of the Nauenstrasse need to be addressed. The publicly accessible shops and services do have some continuity in the compact area of the station and its closest vicinity. However, the penetration towards the neighbouring areas, and namely in direction of the historical centre, is hampered by the Nauenstrasse, which is only crossable at the Centralbahnplatz on two crosswalks or underground using the bicycle parking access.

Figure 4.15 - The Passerelle's interior: level change at the old station's hall; shops and access to trains on the elevated level; level change towards the south square at ground level (2012)

Figure 4.16 - The south (Meret-Oppenheim) square entrance (2012)

Figure 4.17 - The Centralbahnplatz: seen from the station towards the city centre and vice-versa (2012)

Figure 4.18 – Aerial Three-dimensional simulation of the implementation of the Utrecht CS project. (Benthem Crouwel Architekten BV bna)

4.2.2. Utrecht

The railway (station and its area) in the city

The first railway line in the city of Utrecht was the one connecting it to Amsterdam. This line and the station were opened in 1843. By 1845 the railway connection to Arnhem was also ready. Shortly after the railway line to Rotterdam was opened in 1855, the station was remodelled for the first time. Since then, several renovations, extensions and rebuilds were made until 1989, when the last building before the current redevelopment was erected, under the design of architect H.C.H. Reijnders.

The second renovation was subsequent to the construction of the railway to Zwolle in the 1860's. In those years, the Buurtstation, a station from where local trains would depart, was built nearby the existing station. These buildings were connected with a pedestrian passage over the canal that separated them. With the opening of the railway line to Hertogenbosch in 1870, another station would be built southwards from the older station. This last station would close some four years after and the Maliebaan station would open. The city's railway connection to Hilversum came in 1901 and then its link to the Buurtstation in 1921, which ultimately contributed to close Maliebaan in 1939. From 1936 to 1939, the then renamed central station, was rebuilt merged with the Buurtstation and rebuilt again after a fire.

The 1970's brought structural changes to the station area, in the sequence of a plan proposed to the city by a private initiative in 1962 for the construction of the Hoog Catharijne shopping, office and housing complex, demanding the demolition of part of the existing urban fabric. Additionaly, the Jaarbeurs business fair would be moved across the railway tracks, and a motorway ring replacing the Catharijnesingel waterway would be built. These plans encountered resistance among local groups, but went ahead anyway. The city centre became linked to the new Jaarbeurs placed across the railway tracks, through the new shopping labyrinth, the new (first) elevated station building and a pedestrian crossing over the railway.

The redevelopment

In spite of the economic success of the Hoog Catharijne development, the complex failed to integrate with its surroundings. Successive plans would try to address these problems (for a detailed account see: Bertolini & Spit, 1998), as well as the increasing demand pressure on the site for transport and quality expansion space for the city. In 1997 the station was used daily by 110000 people, a number that rose to 284000 at present and is expected to go to 360000 in 2025 (Gemeente Utrecht, Corio, ProRail, NS, & Jaarbeurs, 2012).

The current redevelopment (Figure 4.18) is framed by the six *"Key Projects"* and the city Masterplan of 2003 for the station area. The project, of which the station is designed by Benthem Crouwel Architects, aims at reorganizing the whole area, promoting its integration as a new city centre with the historic core. The area should become a strong logistics hub, with high quality public space and architecture, promoting the experience of a safe and pleasant environment for residents, travellers, shoppers and workers.

About 31 train lines on 14 platforms, 35 bus lines, and one tramline, are operated in the station. A generous provision of car parking and bicycle parking is implemented and is set to grow to more than 1500 and 16700[107] spaces respectively. Car sharing is also available. From the station it is possible to reach a considerable variety of international, national and local destinations.

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[107] The bicycle parking under the station's east square (Stationsplein Oost), designed by Ectorhoogstad Architecten (Figure 4.25) is said to be the biggest covered bicycle parking complex in the world with 12500 places. The square will link the Hoog Catharijne shopping centre to the station at the elevated level, and will make the transition of this elevated level to the ground level on the east side of the tracks. For further information see Ector Hoogstad Architecten (2011). Another covered bicycle parking with 4.200 places is being built on the west side of the tracks under the stairs, which links the new elevated station's west square (Stationsplein West) to the Jaarbeursplein (Figure 4.26) at ground level (www.cu2030.nl).

Figure 4.19 - 'City' Set of Utrecht case study

Mapping the station area

‘City’ analyses (Figure 4.19)

Historical evolution

The first railway lines and station in Utrecht were placed just outside the city walls. By the beginning of the XX century the city had grown significantly outside of its defence lines, and so had the rail infrastructure. All the railway lines in existence today were in existence then. Since those days, little changes are observable at ‘city’ scale. Among these are the closure of the Maliebaan station to regular railway services[108] in 1939, the creation of Overvecht station along the line to Zwolle in 1968, and the creation of the stations Zuilen, Leidsche Rijn and Terwijde along the lines to Amsterdam and to Rotterdam, in the last decade.

The growth of the built-up areas of the city, on the other hand, was quite expressive. Utrecht Centraal has gained a very central position in the agglomeration throughout time. The last three mentioned stations are linked with the city expansions of the last few years in their areas.

Current situation

Node – The railway infrastructure is now embedded in the city, which grew around it. For the local public transport network the bus is more relevant, and so is the road infrastructure. The city has a ring and many dedicated lanes for public transport. The tram line to Nieuwegein from the Central station, set 30 years ago (Bestuur Regio Utrecht, n.d.), accompanied the residential urban growth towards the south. A new tram line is planned to connect the station to the University Campus (Projectorganisatie Uithoflijn, n.d.).

Place – Utrecht ‘s medieval historic centre with its waterways is very well preserved, and is a very lively area. Except for the part which was transformed into a motorway, next to the Hoog Catharijne, the waterways that bordered the city’s walls have been kept. This historic area, along with the station area and the Jaarbeurs site, are now the geographic and functional centre of the agglomeration.

[108] The station is currently the Dutch Railway Museum, opened in 1953. It is possible to reach it by train from Utrecht Centraal (Spoorwegmuseum, n.d.).

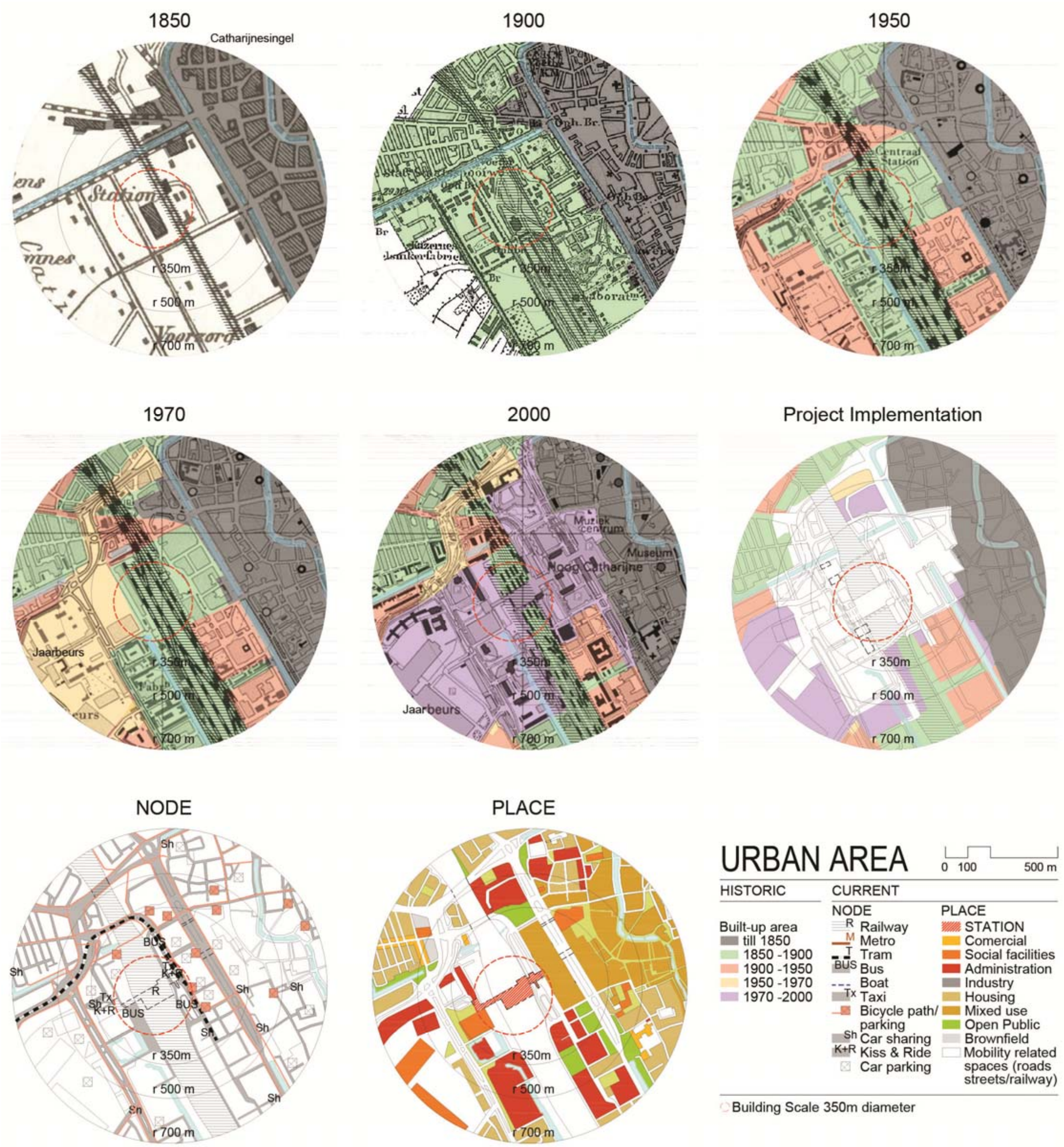


Figure 4.20 - 'Urban area' Set of Utrecht case study

'Urban area' analyses (Figure 4.20)

Historical evolution

Located outside the city walls in its beginnings, the railway station area has become part of the centre of Utrecht throughout time. The area here analysed is divided in two by the railway lines since those early days. A second relevant division line is marked by the Catharijnesingel, which would be transformed into a motorway in the 1970's. While the medieval historic centre hasn't changed so much, the territory westwards form the Catharijnesingel has suffered some changes over time. Until 1900 the expansion was mostly related with the railway implantation itself and new residential neighbourhoods. The most significant changes came mainly after the 1970's; the developments of the Hoog Catharijne, the motorway replacing the Catharijnesingel, the new Jaarbeurs and the station bridging over the railway tracks. Currently, the station area is undergoing redevelopment works.

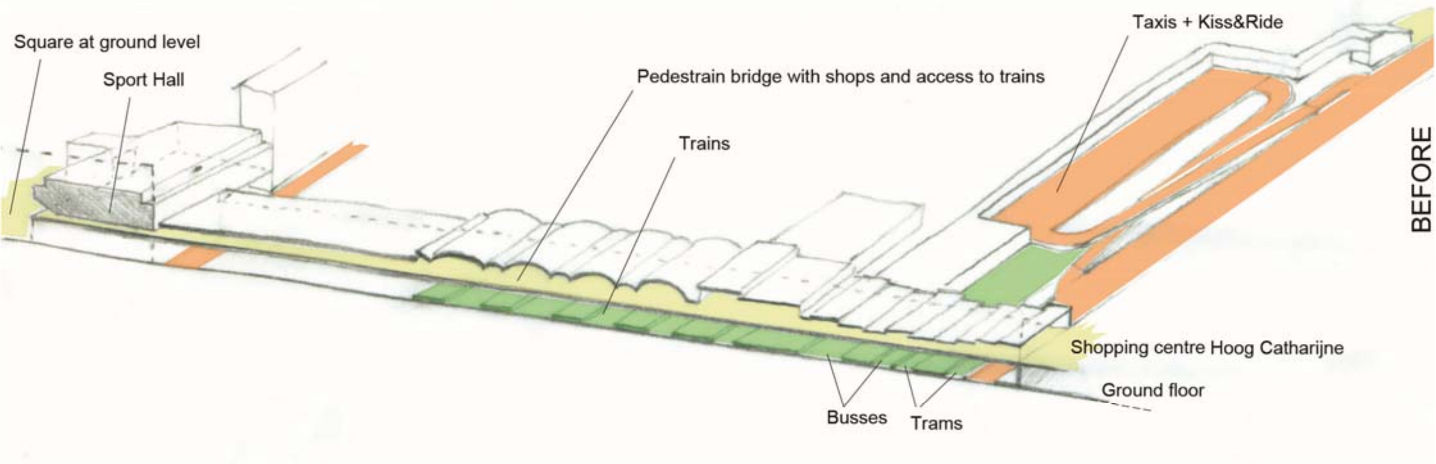
Current situation

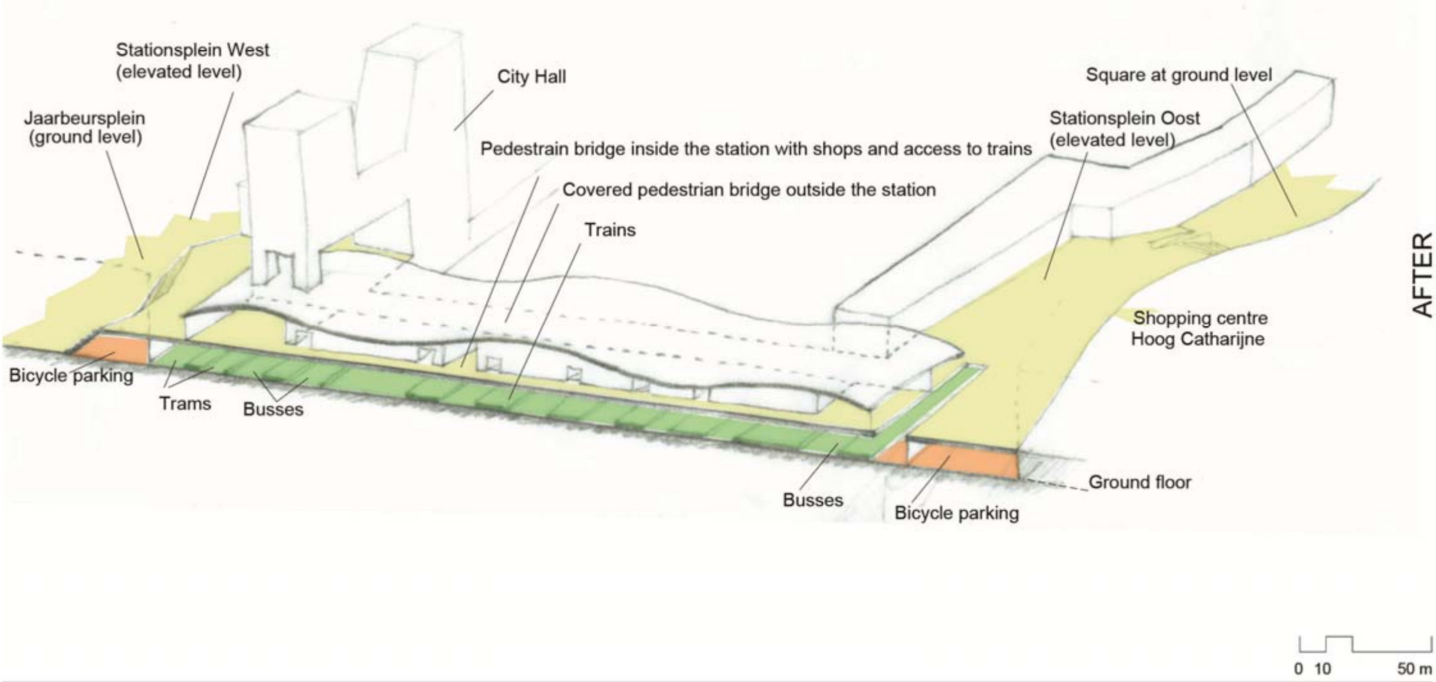
Node – The station is the main railway hub of the Netherlands, to which converge locally, buses, taxis, trams, private cars and bicycles. It is quite a complex station because of its size, the amount of transport modes offered and users, as well as its patchwork features, which result from successive additions. In the area around the station there are many dedicated lanes for public transport and bicycles. There is also a big provision of car and bicycle parking.

Place – The station area is a very busy location, for its transport offer, but also for its non-transport functions. The lively and mostly pedestrian (and cycle-able) historical centre has a great variety of commercial and cultural offer. The station itself has some shops, mostly food related, but this offer is largely extended by that of the Hoog Catharijne. The two buildings are directly linked as the shopping centre serves as the most common passage to reach the historic centre from the station. To this contributes the lack of quality alternatives and the limited perceptibility of other existing ones. Further, pedestrians are almost excluded from accessing the ground floor of the area in between the two lines identified above, which is mostly reserved for motorized traffic.

On the Jaarbeurs side, the life is mostly confined within buildings, as the uses in that area imply. The exhibition fairs, theatre, institutional and office buildings dominate the area. In the vicinity of the railway lines there are many offices, many of those on the east side being railway related companies.

Figure 4.21 - 'Building' Set 1 of Utrecht case study





Pedestrian / public space
Public transport
Private transport
Water

'Building' analyses (Figure 4.21)

Before the redevelopment project

Node – The station is quite a complex one, a result of its extension, successive adaptations and additions. Distances between the different transport modes can be quite large. All transport modes are at ground floor, while the access to them is done from the bridge station, the pedestrian noordertunnel or the middentunnel under the railway tracks. The middentunnel only serves the train tracks and the bus station in the east, while the noordertunnel has entrances at both sides of the tracks. Cars for kiss & ride and taxis could go up to the elevated level using ramps on the east side of the station. On this side there was also the tram stop, as well as the stops for regional and local busses. On the west side, on the Jaarbeursplein, there were also spaces for taxis, busses at ground level. Many bicycles and bicycle paths crossed the closer environment of the station.

Place – The patchwork character of the station, as mentioned before, with different architecture styles and many uninviting spaces, such as the tunnel like bus and tram station on the east side, was not a very pleasant space. Even with a varied offer of shops it worked mainly as a 'node', moving large amounts of people. The previously mentioned connection with the shopping centre was more of a labyrinth hindering travellers then a pleasurable place. It was a sort of obstacle race track to get to and from the historical centre to the station. The connection to the Jaarbeursplein, a long elevated corridor with low ceiling, had no other use than allowing people to move across the tracks. To find one's way in the station hall could also be a difficult job, given its considerable dimension and uniformity (Figure 4.22).

After the redevelopment project

Node – The new station is expected to be clearer for travellers and other users. Distances between different transport modes will be shortened by compacting their relative positions. All transport modes will be kept at ground floor, and cars and taxis won't be allowed at the elevated level anymore. The access to transports will be done from the new enlarged bridge station, the renovated noordertunnel and, to trains only, from the middentunnel. Part of the bus station and the tram stop is relocated to parallel platforms to the railway tracks on the west side. The new Stationsplein Oost (Figure 4.25) will break the former connection between the Hoog Catharijne and the station (Figure 4.24). Under this square the biggest bicycle parking of the project is going to be built. On the west side, another bicycle parking is located under the stairs that make the transition between the Stationsplein west and the Jaarbeursplein (Figure 4.26). The bicycle paths are slightly reorganized and new bridge for bicycles and pedestrians over the tracks will offer a new connection between the east and west sides.

Place – The spaces designated for travel and those for non-transport uses in the building area become more clearly distinguishable. The elevated level is clearly for the pedestrians and the ground floor for the transport modes. Further, the new station is going to be clearly separated from the buildings that surround it, to which it was indistinguishably connected in the former situation. The creation of two elevated squares that create the transition to the ground level adds to this. On the Stationsplein West the city hall is being built, and other buildings with mixed uses and car parking are planned for the Jaarbeursplein. On the east side, the Hoog Catharijne is being renovated with much clearer interior corridors, which allow for an easier pedestrian crossing of the area towards the historic centre. Another commercial building and office buildings are to be built on this side composing the Stationsplein Oost. Connecting both squares will be the station itself, which also provides a covered outdoor *street* with shops on its north façade and a balcony with a view over the trains. The station's interior (Figure 4.23) will also have many shops and become clearer to move across.

Figure 4.22 – The former hall of the station (2006)

Figure 4.23 – The new hall of the station (2013)

Figure 4.24 – The former connection between the station and the Hoog Catharijne complex, towards the historic centre (2013)

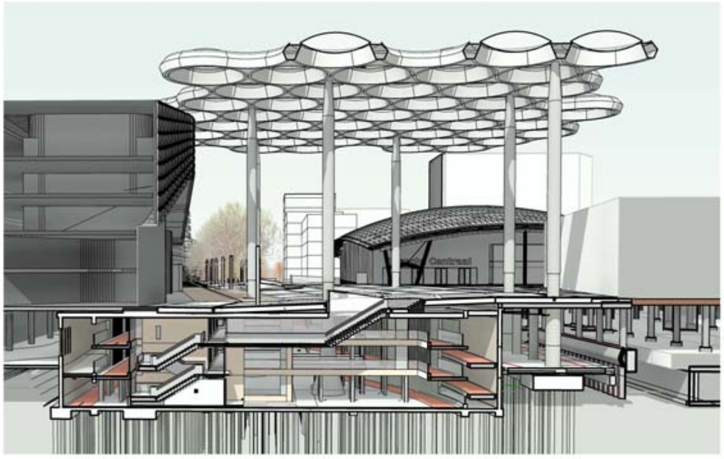


Figure 4.25 – Three-dimensional simulation of the new elevated east square (Stationsplein Oost), connecting the station entrance (right side) with the Hoog Catharijne complex (left side) towards the historic centre. (Ector Hoogstad Architecten, 2011)

Figure 4.26 – The Jaarbeursplein, its connection to the new elevated west square (Stationsplein West), with the new City Hall and the station entrance (2013)

Synthesis

The redevelopment of the station area is a vast and intensive operation in the case of Utrecht. Almost the whole urban area analysed is redesigned. There is a strong emphasis on improving the public spaces for the pedestrians. The recreation of the Catharijnesingel and other waterways, and the dismantling of the motorway barrier, will hopefully contribute further to this. On the north side a new library will be built and a garden renovated. Further, a new 'music palace' is being built. These projects reinforce the cultural life of the area and thus its 'place' dimension quality.

The defragmentation of the area seems to be achievable with the station area redevelopment project. The Historic centre, the station building complex and the Jaarbeurs area can become somehow a unit. This unit is not provided by the merge of buildings, but by the pedestrian space continuity created in between them. It is thus likely that the overall spatial performance of this station area will be improved.

4.3. ‘Viaduct’ stations - elevated level railway infrastructure

A station with train platforms at a higher level than the ground level of its urban surroundings is named a ‘viaduct’ station in this research. The elevated railway tracks can be supported by an embankment or a viaduct. The cases of Amsterdam and Lisbon, analysed in this section, are examples of these two possibilities.

The spaces of these stations develop mostly under the tracks and, or to its sides. Cases like Rotterdam Centraal in the Netherlands or Guillemins station in Liège Belgium, also present pedestrian passages over the tracks, which mainly serve the commuting function of the station (Figure 4.27). However, the most common access to train platforms is the pedestrian passage under the railway tracks, which may or not contain other functions such as shops (Figure 4.28).
Less common is the case of Breda Centraal in the Netherlands, which besides developing below and to the sides of the railway tracks, also develops above them with a more extensive program than a pure pedestrian connection. Car parking will be the overall cover of the station building.

Figure 4.27 – Liège-Guillemins train station’s pedestrain passage over the railway tracks (Jeroen van Nieuwenhuizen, 2012)

Figure 4.28 – Liège-Guillemins train station’s pedestrian passage under the railway tracks (2012)

The elevated position of the tracks also allows the ground level urban space to develop underneath them in continuity with that of the surroundings. This can diminish, to some extent, the barrier effect of the railway infrastructure on the urban fabric. However, in most of the cases, there is a limited amount of points along the railway infrastructure line where both sides of the city can connect. These are normally reduced to viaducts over roads that cross the railway.
The case of Amsterdam Bijlmer ArenA station, designed by Nicholas Grimshaw, is an example where widening these punctual tunnel like connections, along with other features, brings benefits to the effective connection of the urban surroundings fabric (Conceição & Nieuwenhuizen, 2008).

Figure 4.29 – Aerial three-dimensional simulation of the implementation of the Amsterdam Centraal project (Benthem Crouwel Architekten BV bna, 2005)

4.3.1. Amsterdam

The railway (station and its area) in the city

The first Dutch railway infrastructure arrived to the city of Amsterdam in 1839, connecting it to Haarlem. Later, in 1843 the city was linked to Utrecht (Cavallo, 2008). Two 'terminal' stations at the boundaries of the built-up area of the city, Willemspoort and Weesperpoort, were the endpoints of these railway lines. Amsterdam Centraal emerged from the need to connect these two lines in order to provide coherence to the National railway network (NS, ProRail & Gemeente Amsterdam, n.d.). It was designed by P.J.H. Cuypers and A.L. van Gendt, and opened to the public in 1889. It was placed on new land claimed to the lake IJ, connecting the two railway lines and separating the city from its waterfront.

In the 1920's the station underwent expansion works. New platforms and a second train shed were added, to respond to the growing number of passengers and trains. Also then, the eastern wing was demolished and replaced by a post building designed by the son of Cuypers. In the following decades other changes were introduced, such as the metro line station, reinforcing its role as the main public transport hub of the city.

The redevelopment

The Project (Figure 4.29), currently under construction, stems from the 'Urban Program of Requirements' (Stedenbouwkundig Programma van Eisen), set in 2001 by the City of Amsterdam. The zoning plan (Bestemmingsplan) was approved in July 2005, and a Masterplan (Gemeente Amsterdam, Nederlandse Spoorwegen, ProRail, 2005) was set in November of the same year. It is expected that by 2020 the redevelopment of Amsterdam Centraal will be complete.

The project, designed by Benthem Crouwel Architects and Merkx+Girod Architects, aims to renovate the station building, preparing it to handle efficiently the expected growing passengers' flows from the connection to the new metro line (Coördinatie Stationseiland, 2004) and the HST. The reorganization of the existing transport modes, routes and connections, and the urban surrounding space it preconizes, also targets at improving the quality of the area, and of the connection between the city centre and its waterfront, through the station building.

Per day, the station brings together about 250000 users (ProRail, n.d.), expecting to rise up to 300000. Adding to about 26 lines calling at 12 platforms of this station, there are: more than 30 bus lines; 10 tram lines; 4 metro lines[109]; car parking with 434 spaces in the immediate vicinity; and the indoor bicycle parking adding up to 10000 spaces[110]. In addition, carsharing is available, as well as bicycle rentals. International (to mention a few: Basel, Berlin, Warsaw, Copenhagen, Prague, Brussels, Paris, London, Antwerp), national, regional and local destinations can be reached from the station.

[109] To the 3 lines in operation, which end together at central station, a new north-south line is being added. The new line passes under the station building and the IJ, and is perpendicular to the former lines. Plans for this line date back to 1968. However, it has been a controversial project, and only in 2003 did the construction work begin (Gemeente Amsterdam, n.d.).

[110] This number might rise up to 14000 or even to 17500 places by 2020, as estimated by the city in the *"Long-term Bicycle Plan 2012 – 2016"* (Gemeente Amsterdam - Dienst Infrastructuur Verkeer en Vervoer, 2003).

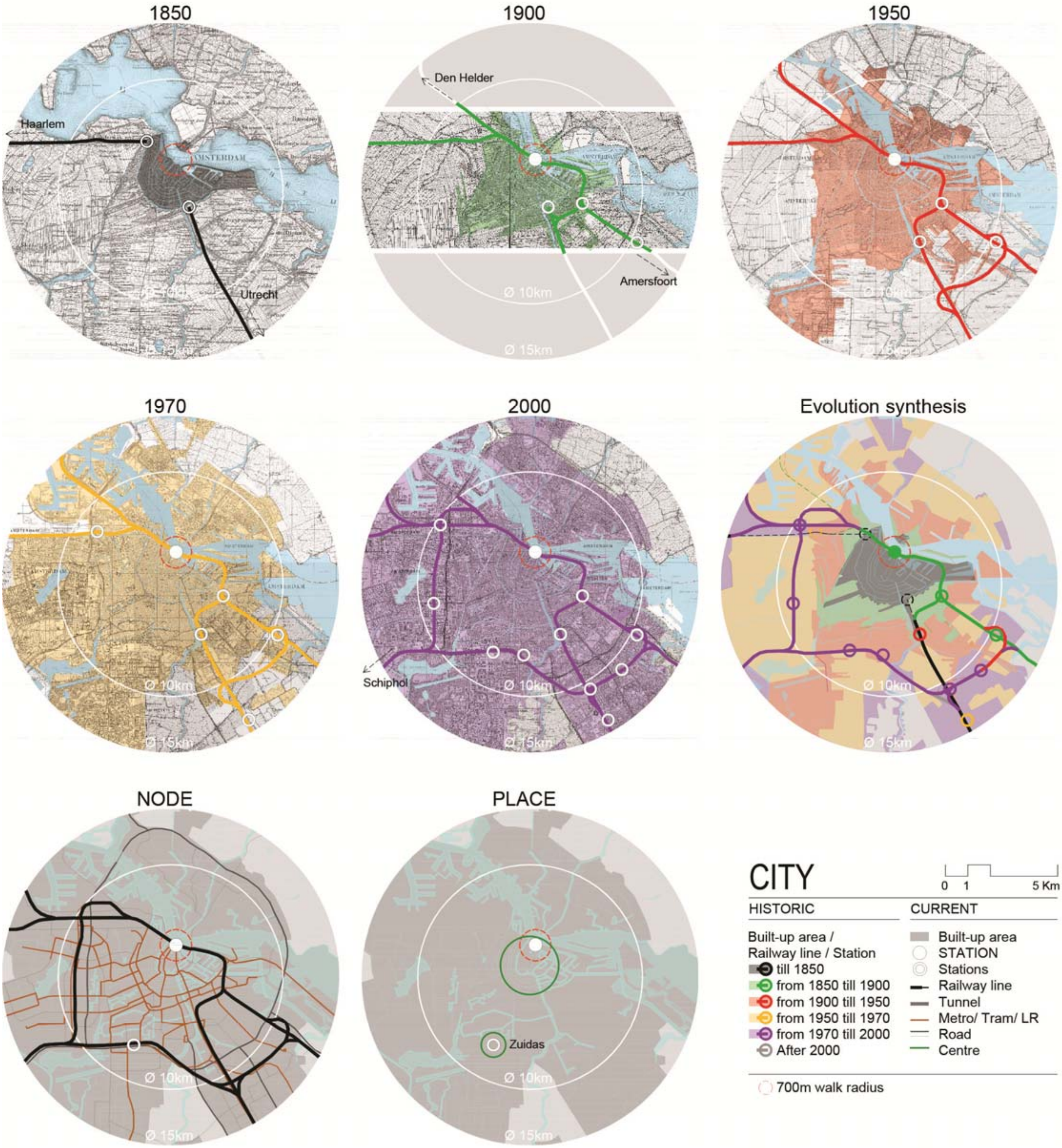


Figure 4.30 - 'City' Set of Amsterdam case study

Mapping the station area

‘City’ analyses (Figure 4.30)

Historical evolution

After the implementation of the railway in Amsterdam, the city grew both to the north and south, as did the railway connections. By the 1900’s two new railway lines, one in the direction of Amersfoort and another in the direction of Den Helder, were laid, as well as lines to serve the harbour areas. By the 1950’s the lines to Amersfoort and Utrecht would be connected and new stations built. The built-up areas kept growing, mainly to the south. Until the 1970’s, when the ring road was established, there were not many changes on infrastructure. The metro project would be implemented afterwards, under a lot of controversy and with many problems and postponements.

In the last years, the project for the redevelopment of the IJ waterfront in Amsterdam has been developed (Gemeente Amsterdam - Projectbureau Zuidelijke IJ-oever, n.d.). Obsolete harbour and railway yard areas underwent deep transformations, returning them to the city and the public. Also, a new railway line connecting Schiphol airport was added. The latest addition to the railway network is the HST line, for which a renewed Zuidas station was planned to be the main stop in the city (Gemeente Amsterdam, 1998; VROM, 2004). It is likely that, at least until Zuidas is operational[111], Amsterdam Centraal remains the main station of the city.

Current situation

Node - The clear structure of the city’s historic centre has a strong influence on the city development, which generally is organized radially. The urban transport networks follow this pattern and are complemented by a ring road and a ring of railway. The new NoordZuijdlijn, a metro line linking the north and south areas of the city, is under construction. It will cross the IJ and enable several mode interchanges along its trajectory.

Place – As mentioned above, the city is structured in a radial manner. The ensemble of canals and antique buildings of the historical centre, is perhaps the city’s most distinctive feature. Tourism is an important activity in this area. Besides the historic centre, where Amsterdam Centraal is located, other centres have emerged. It is clearly the case of Zuidas, which is developing as a financial core.

[111] Zuidas’ project encompasses the redevelopment of the station and a large surrounding urban area. It is expected to reach completion in 2040 (Gemeente Amsterdam - Dienst Zuidas, n.d).

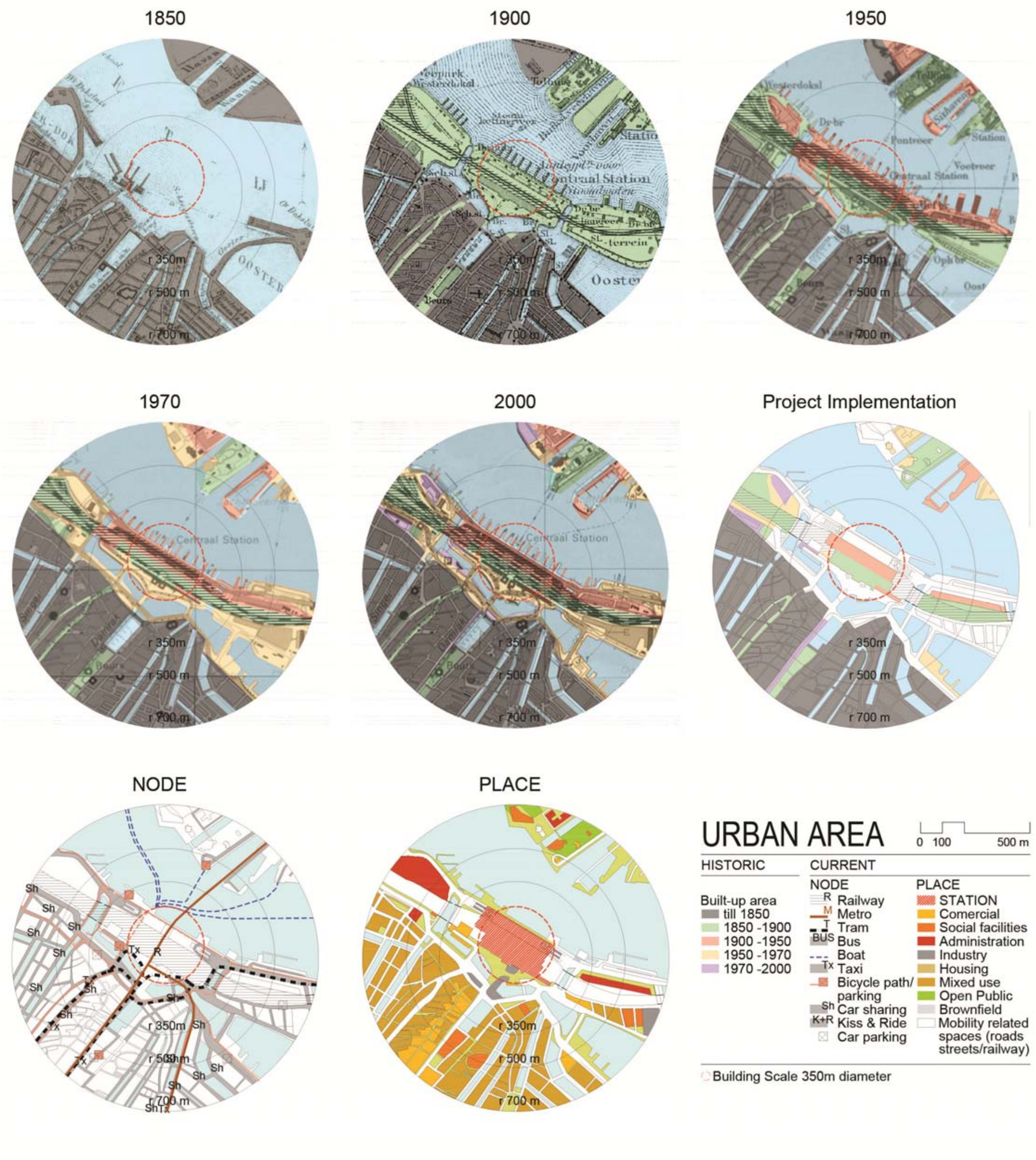


Figure 4.31 - 'Urban area' Set of Amsterdam case study

‘Urban area’ analyses (Figure 4.31)

Historical evolution

Situated between the city’s historic centre and its waterfront at the north of the city, the station imposed a barrier between the two entities. The course of the years brought the expansion of the harbour areas as well as the densification of railway lines and car traffic. Despite that, the historic built core has remained quite resilient through the analysed years. Many streets have become closed to motorized traffic, giving priority to pedestrians, and thus to public space. More recently, in an effort to bring the city closer to its waterfront, deactivated harbour areas have been redeveloped, by placing residential and public buildings in these locations. The station renovation and additions take part in that movement.

Current situation

Node – In the area many transport modes concur and come together at the station: traditional trains, HST, trams, busses, taxis, boats and metro. There is an impressive amount of bicycles, bicycle parking, touristic and public transport boats, and bicycle taxis. There is also carsharing and car parking.

At present, because of the station rebuilding works, the transport layout changes regularly. But its main structure is still close to the pre-existing one. Trains are at the elevated level. The traffic of private cars is still allowed at surface level on both sides of the station, thus between the building and the IJ and the city’s centre. Trams stops are placed on the south square (Stationsplein). The taxi stand is also located on the Stationsplein. Some busses are located at ground level on the south side of the station, while others have been relocated to the new elevated platforms inside the station. Many streets on the way from the station to the centre are dedicated to pedestrians. Bicycle paths are also widely available in the station area.

Place – The uses of the buildings in the area are very mixed and a lot is dedicated to retail and public social facilities, increasing the ‘place’ notion. Such is the case of the new city public library and other public facilities developed in former harbour areas. These new facilities, the water on both sides of the station, and the stimulating built surroundings, convey a sense of ‘place’ to the area. On the other hand, the dispersion of temporary structures in the area, such as the ticket sale point for touristic boats and others, lower the spatial quality of the station area.

The already existing restrictions to car traffic in some of the streets in the area facilitate the connection between the station and the centre. However, the whole area is so intensively used by pedestrians, private cars, bicycles and public transport that many conflicts arise. The size and complexity of some roads around the station also contribute to these tensions.

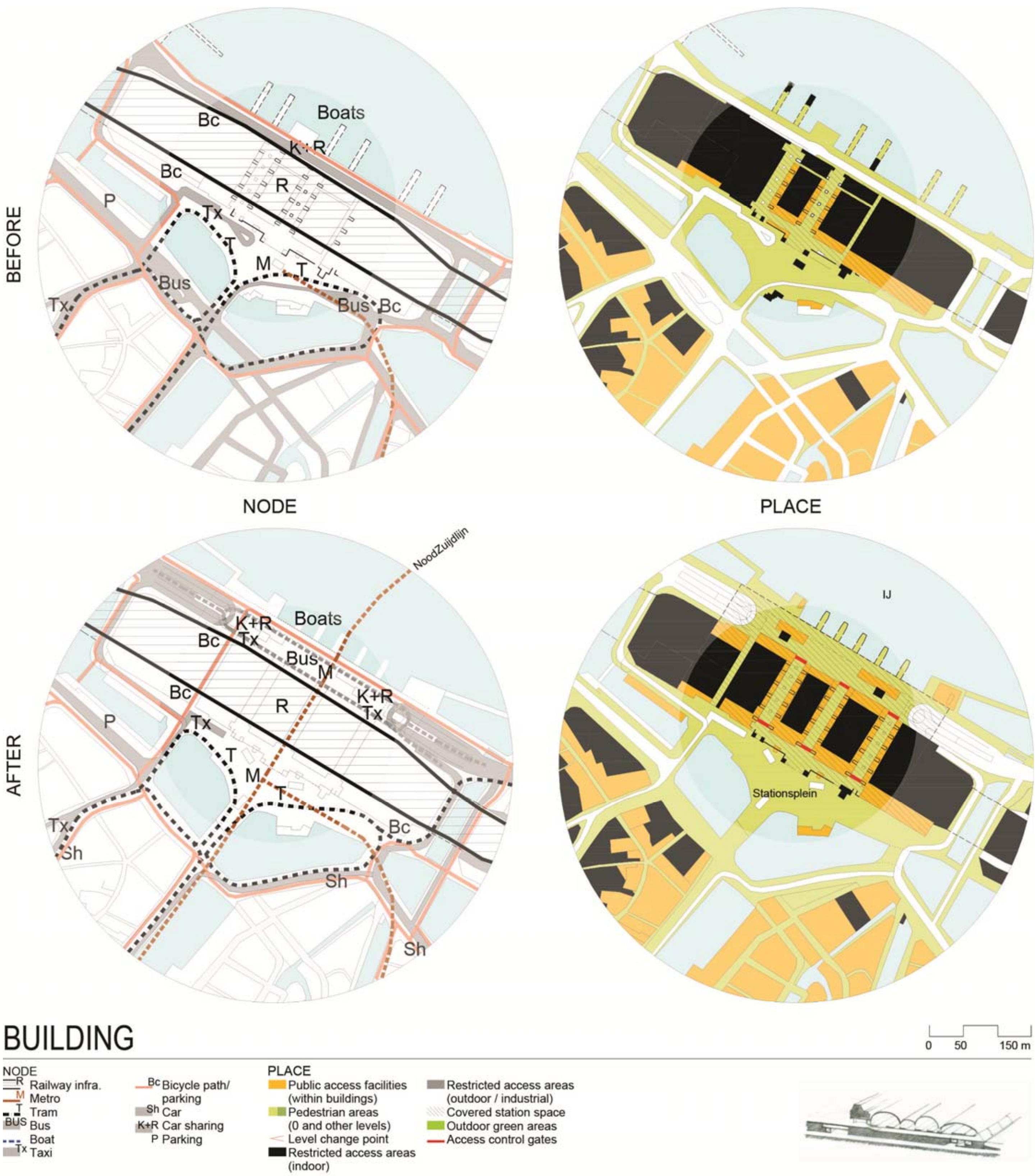
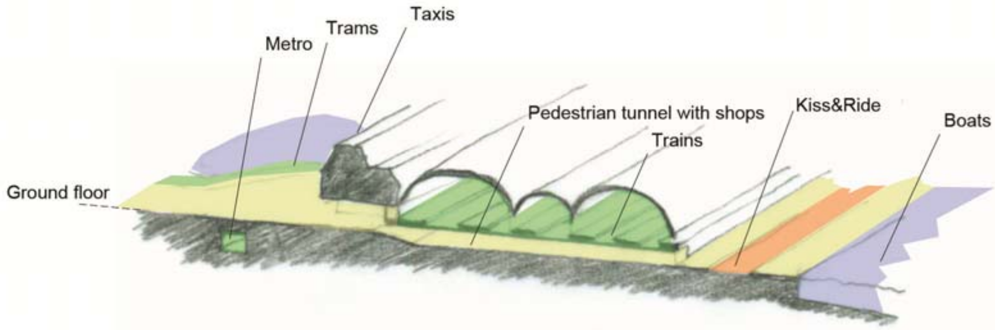


Figure 4.32 - 'Building' Set 1 of Amsterdam case study



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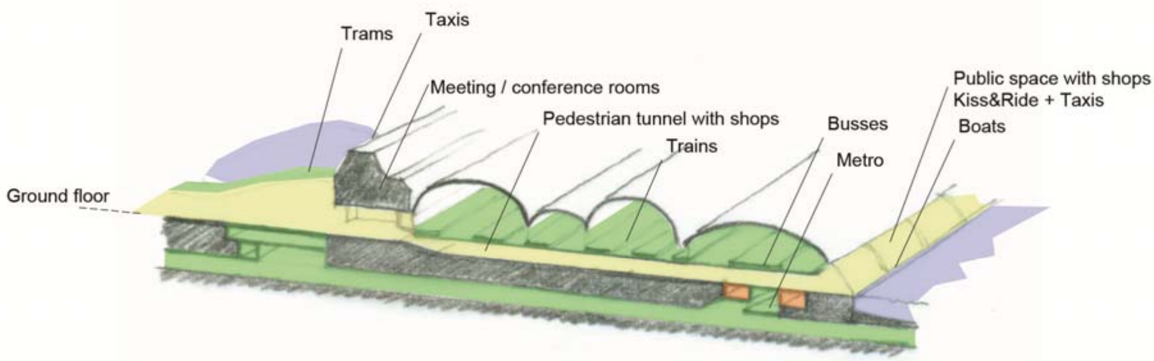


AFTER

0 10 50 m

Pedestrian / public space
Public transport
Private transport
Water

'Building' analyses (Figure 4.32)

Before the redevelopment project

Node – This highly pressured 'node' had a somehow scattered layout. The lack of available space on the station islands did not allow for compact distances among all the transport modes. The private car was allowed between the station and the IJ and the city historical centre. These two car traffic barriers between the IJ and the historic centre of Amsterdam added to the railway infrastructure barrier.

Busses, trams, taxis, the metro entrance, and many bicycles occupied the Stationsplein in front of the station building. On the IJ side, there were the boats, and kiss and ride was possible. Three pedestrian tunnels, two wide and one narrow, stairs and a few elevators allowed access to the trains on the elevated level. The pedestrian connection between the IJ side and the Stationsplein was provided by the tunnels. The stairs connecting to the underground level of the metro were placed outside the building on the Stationsplein. Indoor bicycle parking was possible at ground level, but it was not sufficient. Besides the unordered parking spread all over the area, floating provisory solutions on the IJ side, as well as on the south side were created.

Place – The 'place' dimension of the station was quite disregarded. It was mainly used as an arrival and departure point, despite the interesting features of the area, such as the waterfront, the historic center, or even the station itself. The frenzy caused by so many people and transports crossing each other, and the lack of conditions for a calm stay, hindered its 'place' potential. Even with the existence of about 23 shops, of which around 80% are restaurants and cafés. The other shops sell media (newspapers, magazines, books, and music), body care and pharmaceutical products, and flowers. Most of these shops were located on the western tunnel, and some on the first railway platform. Other facilities are public toilets, lockers, ticket and information desk. There was also a Hotel next to the railway tracks.

After the redevelopment project

Node – The location of transport modes within and around the reorganized station will have a very clear and compact layout for the users. It interferes much less with pedestrian flows than the existing situation. This is especially true for cars, whose access to the area becomes more limited at both sides of the station. On the north side, cars are tunnelled and only allowed at the surface for kiss & ride purposes. On the south side, many streets will become car free. Only taxis and kiss & ride will be allowed at ground level. The Stationsplein (Figure 4.33) is cleared of busses, which get their own platform (Figure 4.34) parallel to and at the same level of the train tracks.

Stairs and elevators link the platform level of trains and busses to the transfer area at ground floor and will link to the existing and new metro lines underground. The ground floor pedestrian tunnels and halls give access to the trams and taxis at the Stationsplein, and to the boats, taxis and kiss& ride, at the IJ side. Bicycle parking is possible at ground and underground levels. A tunnel will be built on the west side under the railway tracks allowing an extra connection of the bicycle paths of the city centre to the one on the IJ.

Place – The renovated Stationsplein and the hall created on the IJ side aim to improve the bonds of the station with the surroundings, by taking advantage of their spatial qualities. Both spaces will have terraces allowing the users to enjoy them. To complete these bonds, the three pedestrian tunnels under the platforms are being renovated, enlarged and will all have shops. They are the walkable physical connection between the city centre and the IJ. However, there will be ticket control gates at both ends of all tunnels, by imposition of the railway company, making this passage slightly less natural than was intended. Besides the growth of shopping facilities and the existence of public toilets, lockers, ticket and information services, the hotel has been enlarged above the railway tracks, and there will be conference rooms in the upper floors of the station.

Figure 4.33 – The Stationsplein towards the historic centre (2012)

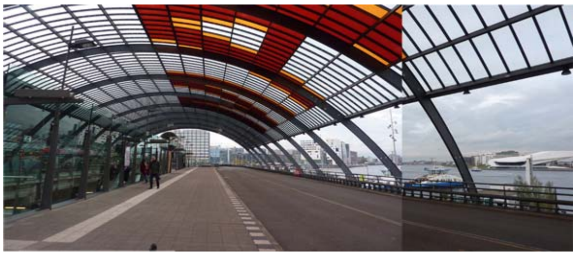


Figure 4.34 – The new bus platforms with view to the IJ (2012)

Synthesis

Amsterdam CS stands on a privileged place, between the IJ and the old city centre. In the early days the station was feared as a barrier to the port activities, for its placement between the city and its waterfront. Nevertheless, the harbours kept developing after the implementation of the station, but its spatial barrier was a fact and kept growing.

The station and its surroundings underwent a considerable amount of changes throughout the years to accommodate the growing pressure of travellers' needs. Time built up a puzzle of additions and some degradation, increasing the difficulties for users, and downgrading the area's spatial quality.

The new project has a vision of the whole, both building and surroundings, and proposes a cleaning and reordering of their spaces. It aims to return these spaces to the city and its users as 'places' that connect transport modes as well as their privileged settings, highlighting their beauty. It does so by deleting barriers in pedestrian routes, and linking the area more clearly to the rest of the city and the IJ. The new positions of transport and non-transport related functions, and the clear and compact connections between different transport modes, allowed also by the elevated level extension, make it more understandable to travellers and other users where to go in the station complex and its surroundings. These changes contribute to the improvement of the spatial performance of the station area. However, this is jeopardized by the current location of the access control gates at both ends of each of the three pedestrian tunnels inside the station. These gates, when put in operation, will restrict the crossing of the building to those users with a valid train ticket. Therefore, in truth, these tunnels will not provide a real connection between the city and its waterfront (see note 96).

Figure 4.35 - Aerial view of Gare do Oriente and its urban surroundings (Grupo Elevo, 2013).

4.3.2. Lisbon

The railway (station and its area) in the city

The first Portuguese railway line was opened in 1856, connecting Lisbon to Carregado. It was the first section of the line that would later on connect to Spain. Santa Apolónia terminus, the first station in the city, was built next to the river to allow the easy boarding of goods transported by rail (Pinheiro, 2008). Until 1865, when the building was opened, a provisory construction served as the station.

Most of the railway serving the city today was developed until the end of the XIX century. The railway ring line (linha de cintura), as well as the lines to Sintra and Cascais with their 'terminal' stations, respectively Rossio and Cais do Sodré, had been built. Only in 1999 would the railway connection to the south bank of the river Tagus be opened.

The 1998 World's Fair held in Lisbon, Expo98, triggered the large scale reconversion project of a former degraded industrial area of the city (Velez, 2008). Gare do Oriente (Figure 4.35) was built at that time along the North railway line.

The redevelopment

Before the construction of Gare do Oriente and the redevelopment of the area, there existed a small station that was demolished.

The Expo98 was planned with the intention of converting it into a city district after the exposition was finished[112]. Parallel to it, and opened almost simultaneously, several structural projects were launched, among which included the Gare do Oriente designed by Santiago Calatrava, a new metro line, and the Vasco da Gama bridge linking the city to the south bank of the river. The station became the biggest and most complete transport interface of the city, and it houses a number of non-transport related activities. It is directly connected with the lively former Expo98 site, now called Parque das Nações.

The decision to incorporate the HST into the station produced redevelopment plans for both the station and its surroundings. New railway lines and four new train platforms would be constructed, implying several changes in the station building (see Figure 4.46). To frame these interventions, and to structure and regulate the development of the station surroundings' area, still largely undeveloped especially towards the west, it was decided to elaborate an Urbanization Plan. The plan, proposed by Joan Busquets under the initiative of the Portuguese HST network infrastructure company (the now extinct Rede Ferroviária de Alta Velocidade, SA - RAVE) and the city, aimed to consolidate the area as a lively new city centre, largely walkable and cycle-able. Its preliminary proposal (Câmara Municipal de Lisboa, 2010) had been approved by the city, under political criticism (Boaventura, 2009). However, the current economic situation has halted the completion of these plans.

Currently, the station is used by 150000 people per day (Mourato, 2013). Some 14 train lines call at its 8 train platforms. Further, there is a metro line, which was recently extended to the airport, and about 37 bus lines covering local, national and international destinations. There is a large offer of covered car parking in the area, of which about 2750 spaces are available alone in the station.

[112] The main buildings were designed to be usable after the closure of the Exhibition. The areas occupied by the countries' pavilions, which were temporary constructions, and the large open-air car parking areas, during the exhibition, were later used for real-estate development. The main objective was to prevent the area from becoming again a degraded one, and avoiding what happened in Seville after its Expo92.

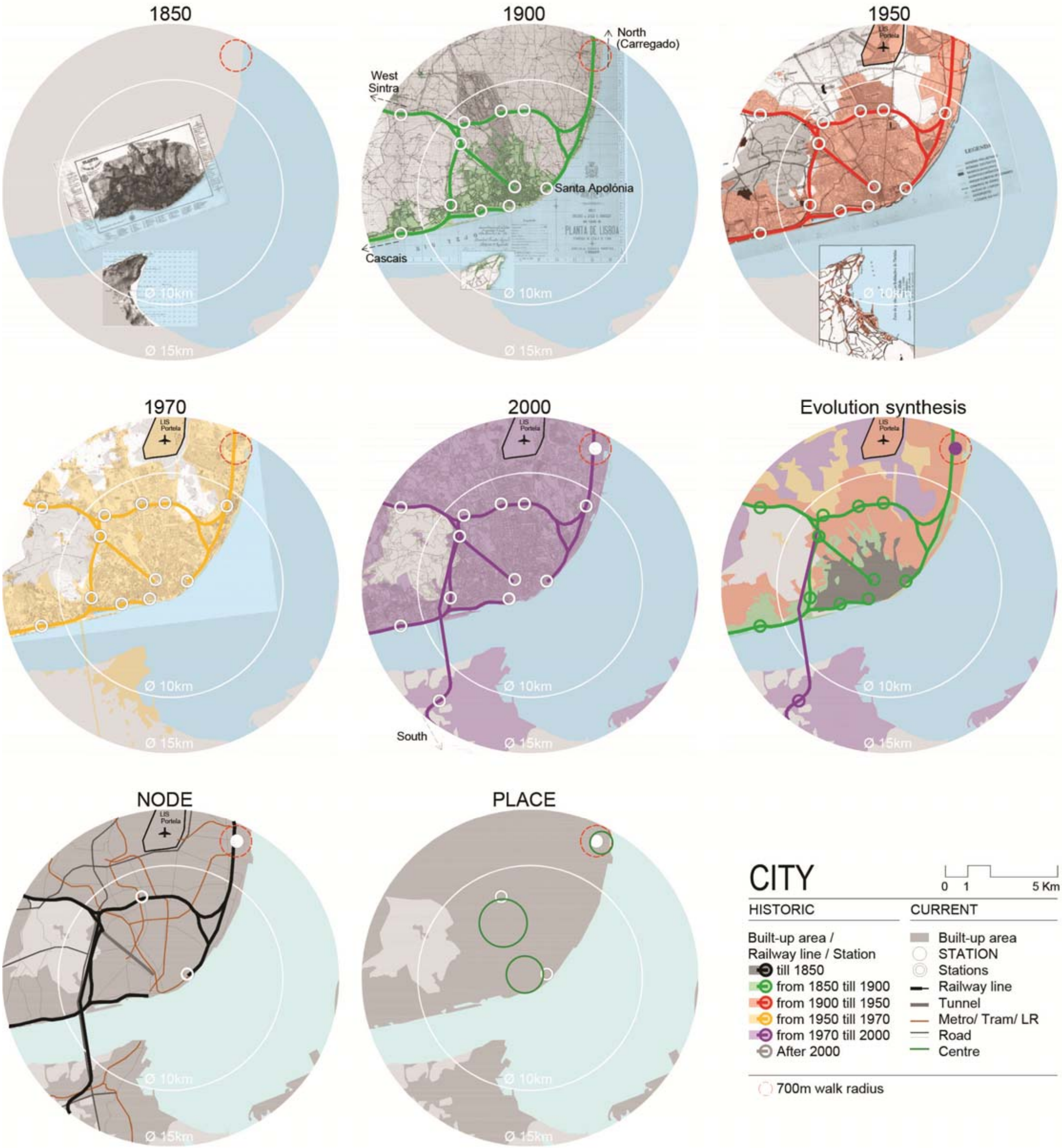


Figure 4.36 - 'City' Set of Lisbon case study

Mapping the station area

'City' analyses (Figure 4.36)

Historical evolution

The introduction of the railway in Lisbon is part of the modernization efforts of the end of the XIX century and into the beginning of the XX century. Until then, and since the reconstruction after the 1755 earthquake, the city hadn't experienced many changes (França, 1989). The city expansion plans, under the coordination of Engineer Ressano Garcia (Henriques da Silva, 1989), would structure the city's growth northwards along a main axis of new avenues articulated with runabouts (Avenidas Novas). Ressano Garcia was also involved in the construction of a section of the ring railway line (linha de cintura). This ring line, opened just before 1900, connected the North railway line with the West railway line. Besides the three 'terminal' stations in the city centre, other small stations were opened along the ring.

The population growth would continue in the following years, as well as the growth of the city's built-up areas. The latter developed along the transport infrastructure lines, mainly north from the river. The construction of the 25 of April Bridge, opened in 1966, would favour the growth of the already expanding agglomerations on the south bank of the river. Reinforcing this growth direction is the new bridge Vasco da Gama and the new railway line in the old bridge.

Current situation

Node - The river Tagus has been and is still important for the agglomeration's economy, but its considerable width has also been a problem for the mobility in the region. Despite that challenge, in the last few years the transport networks have improved greatly. The connection between the North and South railway networks has contributed to that improvement. Further, there was a significant effort made in improving the interchange points between the several modes of transport. This is especially true for the connections of the railway with the metro network, which has also grown substantially. New highways complement the existing ones, forming a ring road in the metropolitan area, which crosses the river at both bridges.

Place – Despite being positioned on the north river bank, Lisbon's historic centre has become the geographic centre of a large agglomeration, which grew northwards, but also southwards across the river. Even if in a somehow degraded state at present, the central city spaces still have a great appeal for people, especially tourists. The efforts to reconnect the city's urban fabric to the river (Figueira de Sousa & Fernandes, 2012), done in the last few decades encourage this. Some examples are the Expo98 site or the docks near the 25 of April bridge. More recent examples include the refurbishment of the Ribeira das Naus area and Terreiro do Paço square, which is now mostly a car free zone with commercial spaces in its arcades.
Other centres have emerged in the city. It is the case of the Expo98 site, where Gare do Oriente is located. A wide offer of administrative, cultural, commercial and residential is available in this new area.

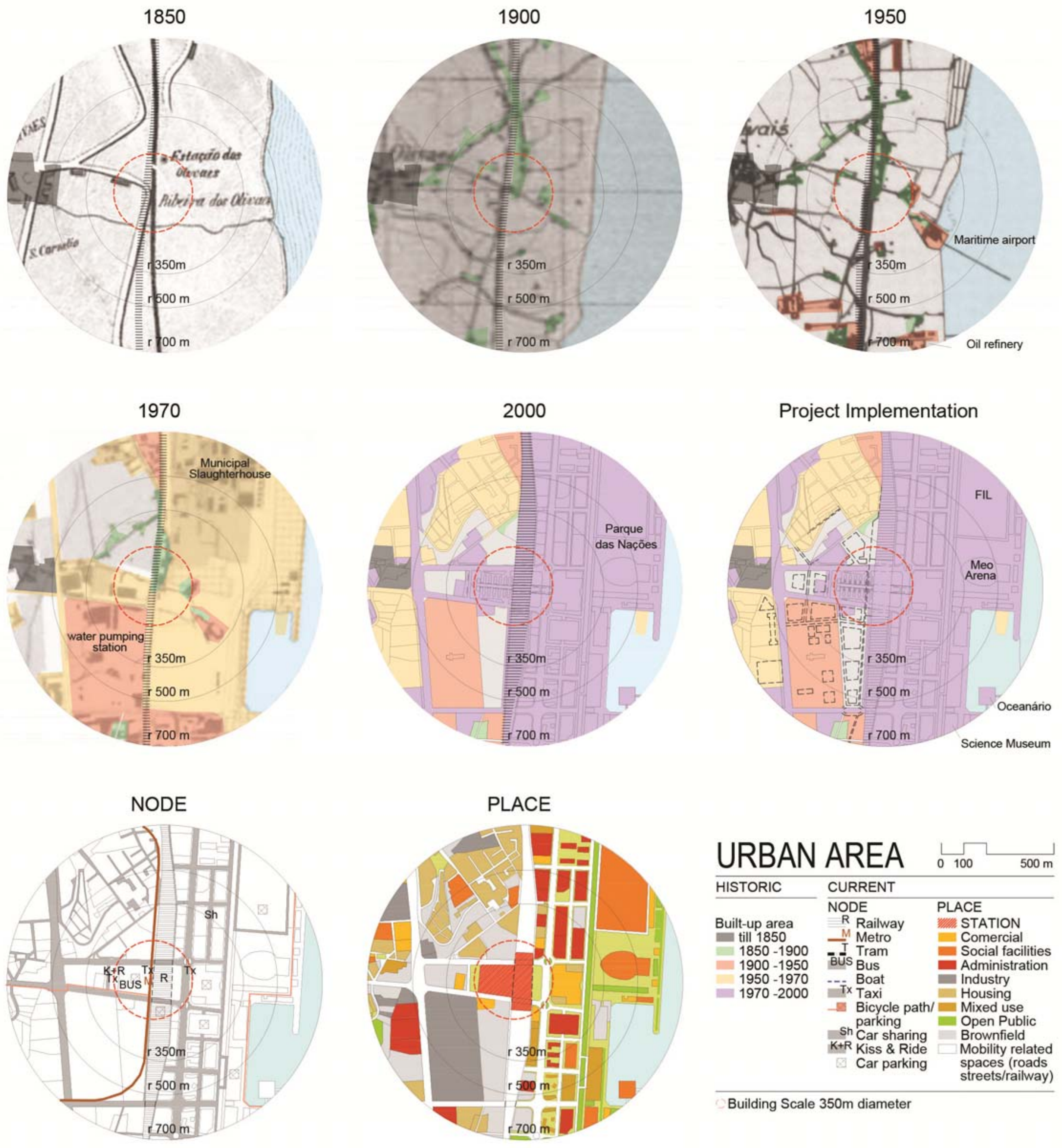


Figure 4.37 - 'Urban' Set of Lisbon case study

'Urban area' analyses (Figure 4.37)

Historical evolution

The origins of the area where Gare do Oriente would be built date back to the end of the 14th century (Silva Dias & Silva Dias, 1993). By 1856, when the initial section of the first Portuguese railway line was inaugurated, passing through the territory of the parish of St. Mary of Olivais, and establishing there a station (Gomes & Gomes, 2006), the area had a mix of rural exploration lands and some industry.

The improved accessibility brought more industry to the area. Around the 1940's, an oil refinery (Carvalho, 2012), and maritime airport (Mendes Pinto, 2003) were established in the area. In the 1990's, shortly before the redevelopment project of the area for the implementation of the Expo98, the zone was an ensemble of deactivated industrial premises, degraded housing, and a landfill.

The redevelopment of the whole area east from the railway line transformed it into a new modern piece of the city. The area was able to keep itself lively after the exhibition event was finished, and has even become highly popular real-estate.

The Urbanization Plan, created when it was decided to adapt the station to receive the new HST, proposed the reorganization of the largely undeveloped areas on the west side of the railway line. This plan however has not been developed further.

Current situation

Node – The station is a big interchange of public transport on the edge of Lisbon municipal limits, with trains, busses, taxis, and metro. The metro connects the station to the city's historic centre, as well as the other locations served by this transport network. The recent extensions of this line have also established a connection with the airport. Trains and busses offer access to local, regional and international destinations.

The main avenues crossing the area are linked to important axes in the road network of the city, namely the ring road, the Infante Dom Henrique Avenue along the river, the access to the airport, and the highways to the north and south of the country.

Place – The area of Parque das Nações, is a 'place' in its own right. The attention given to the design of the public spaces and buildings in the area, as well as their proximity to the river, contribute to its spatial quality. The space in direct contact with the river has become quite popular among pedestrians and cyclists. Many cultural facilities like the aquarium (Oceanário), the science museum, the Meo Arena (a multipurpose pavilion), and even the International Fair of Lisbon (FIL), are available in the area, in addition to many green and pedestrian areas. There is also a large offer of shopping facilities, some of them inside the station itself. Hotels and offices complete the mix of uses on the east side of the railway. On the west side, there are still many deactivated industrial areas, some office space and a lot of housing, which largely existed before the Expo98.

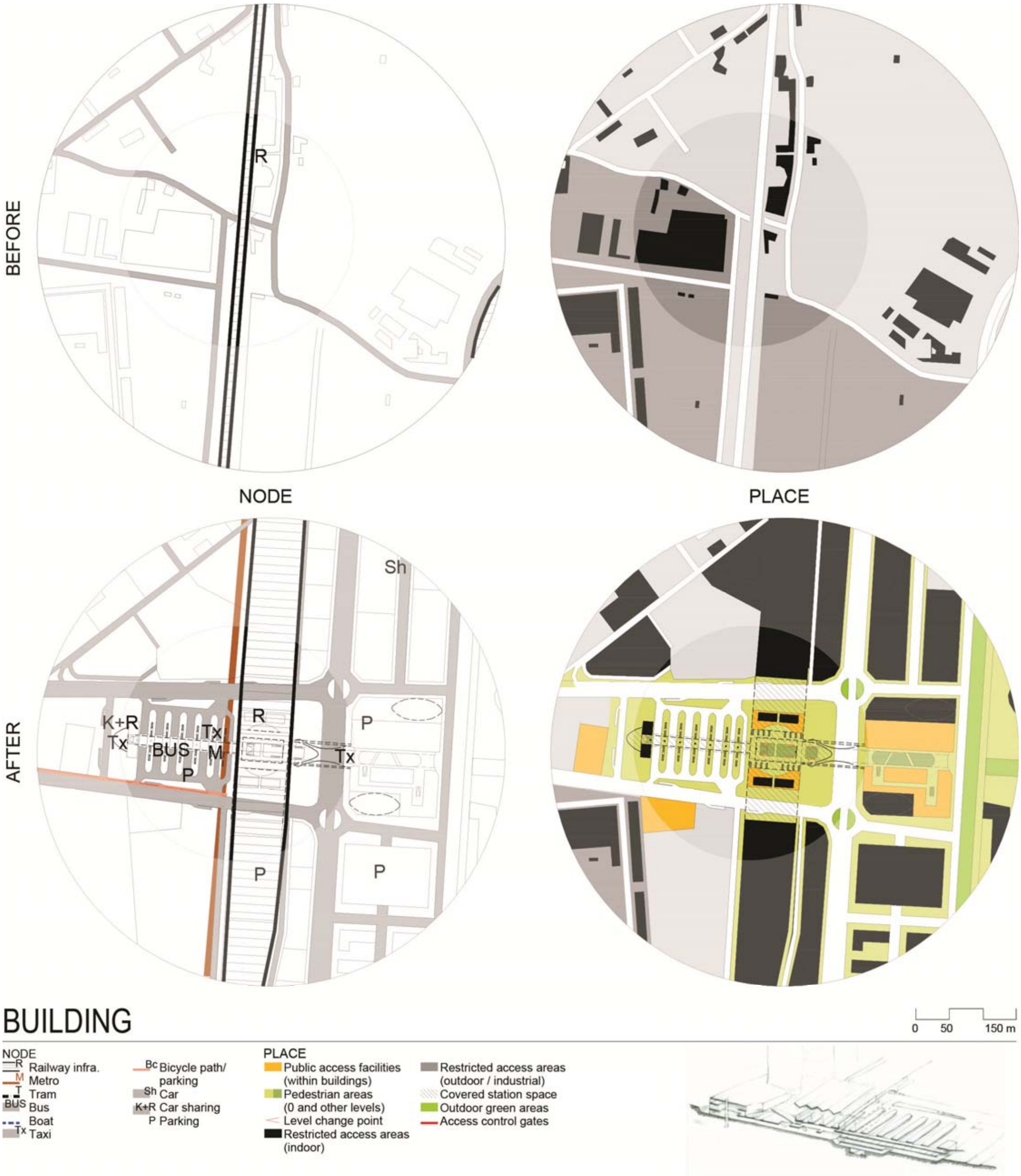
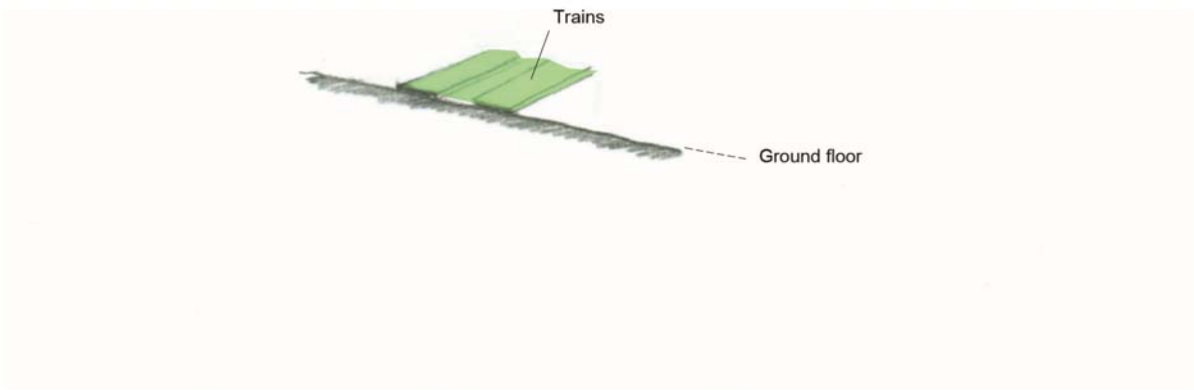


Figure 4.38 - 'Building' Set 1 of Lisbon case study

BEFORE



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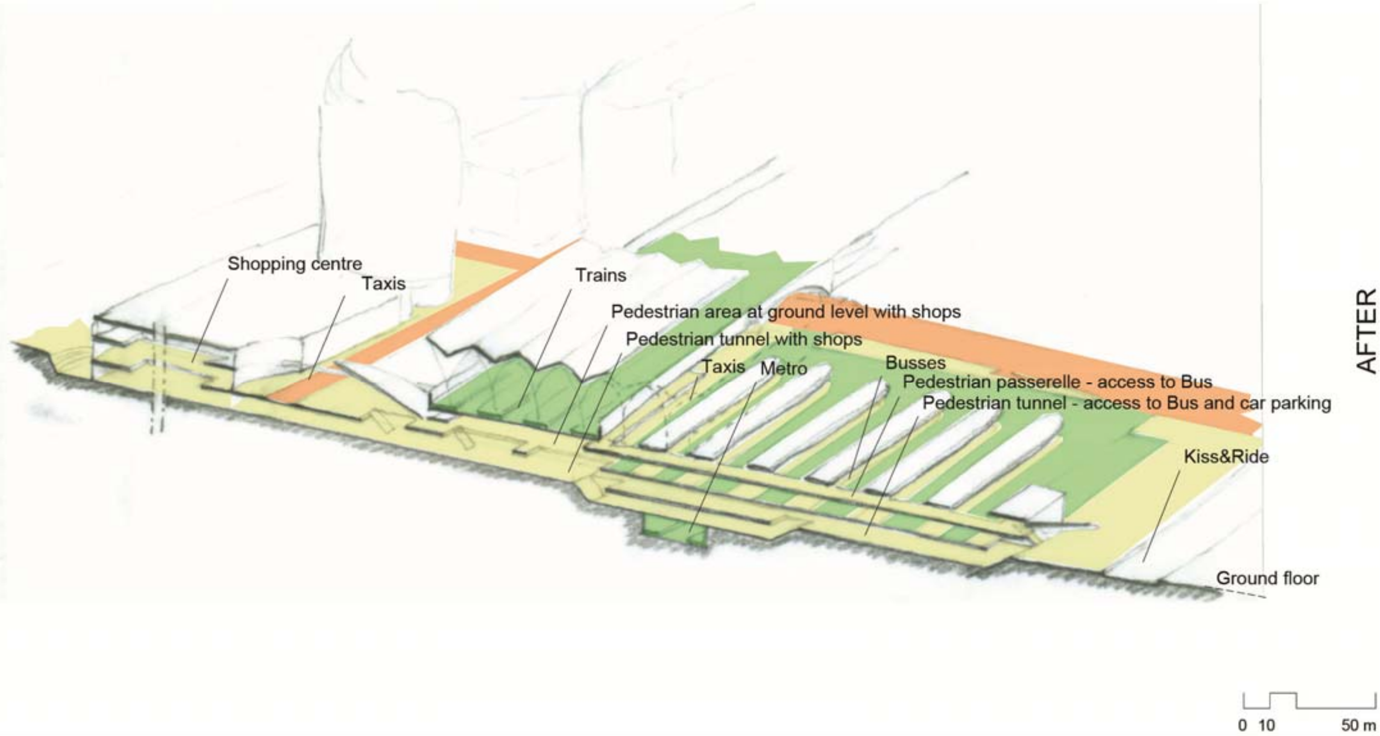


Pedestrian / public space
Public transport
Private transport
Water

'Building' analyses (Figure 4.38)

Before the redevelopment project

Node – The former Olivais station was a very small one before its demolition for the construction of Gare do Oriente in the 1990's. It was just a secondary stop of trains. Thus, it is not accurate to call it a 'node'.

Place – The station area before the Expo98 redevelopment was a *non-place*. Not so much in the sense of the notion coined by Augé (1995) of a homogenised location in which we spend so much of our time like airports, railway stations, superstores, motorways or international hotel chains. It was a *non-place* in the sense that it was a degraded area with hardly any life.

After the redevelopment project

Node – The station building is a quite compact one. All the transport modes that converge in it are located within the 350 meters diameter circle of analysis, making transfers very efficient. Adding to this efficiency is the organization of the station on several levels connected with stairs and elevators (Figure 4.40, Figure 4.41, and Figure 4.42). The trains are on the highest level, while busses and taxis are at ground level. The travel related services (ticket and information, waiting rooms, WCs, etc.) are located on the level in between. From this level, trains are accessible by going up stairs, and busses or taxis by going downstairs. Further underground is the metro station. The car parking and the bus platforms are accessible from the pedestrian tunnel under the bus station. Car sharing is still underdeveloped in Portugal, but there is one location in the vicinity of the station at a reasonable distance. The daily use of bicycles is also rare in the city, thus it is not surprising that the station does not have dedicated facilities for bicycle parking.

Place – With many non-transport related activities, the station also has a strong 'place' dimension. On the immediate level below the train tracks there are cafés (Figure 4.45). At ground floor (Figure 4.44), there are cafés, supermarket, banks, temporary office space, rent a car, etc. At underground level, and open to the levels above, is a very wide square (Figure 4.41) This space is bordered by a great variety of shops and other facilities, including shops for clothing, shoes, sport articles, mobile phones, but also a health clinic and dentist, restaurants, cafés, a police station, WCs, lockers, pedestrian entrances to the car parking pedestrian, etc. Events take place in this square on weekly basis[113]. A pedestrian tunnel (Figure 4.40) under the square and the road parallel to the railway tracks on the river side (Figure 4.39), provides continuity of this square with that of the neighbour shopping centre, and further on with the former Expo98 site. This tunnel is in continuity with the square inside the station (Figure 4.41) and the tunnel under the bus station (Figure 4.42), providing a pedestrian crossing of the whole station complex at a lower level. The pedestrians have in this way a few alternatives to move around the area and benefit from the opportunities provided there.

[113] Every Sunday there is a different thematic fair in this space. The first Sunday of the month is dedicated to books, stamps, coins and other collections; the second to Portuguese crafts; the third to antiques; and the fourth to plastic arts (Turismo de Lisboa, 2013).

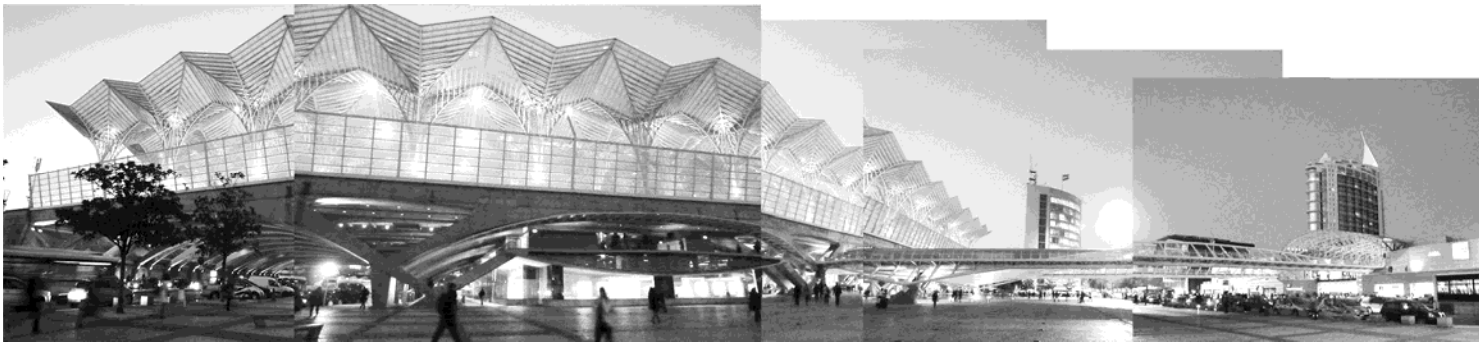


Figure 4.39 – Square (and street parallel to the railway tracks) connecting the station to the shopping centre (in the former Expo 98 site) towards the river side (2012)

Figure 4.40 – The tunnel connecting to the shopping centre on the river side (2012)

Figure 4.41 – The square inside the station with the different levels (2012)

Figure 4.42 – The several levels of connection to the bus station side (2012)

Figure 4.43 – The station entrance on the west side facing the vacant terrains (2012)

Figure 4.44 – Shopping areas at ground floor (2012)

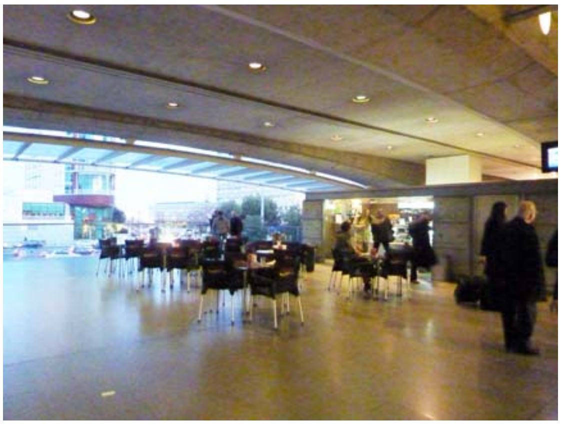


Figure 4.45 – Cafes below the train platforms (2012)

Figure 4.46 – RAVE's proposal for the restructure of the station to receive the HST (RAVE, 2008)

Synthesis

There was hardly any 'node' or 'place', and consequently no balance between the two, before the redevelopment project of this station area. Thus, the spatial performance of this case has certainly improved enormously. Nevertheless, some problems remain. The location of the station area on the edge of the city, relatively to its main (historic) core, and its large empty undeveloped areas, are features that hinder its spatial performance, especially regarding its 'place' dimension.

Nevertheless, the implemented spaces do give a wide quality support to the transport and non-transport related activities, and are prepared to establish continuities with future developments. The station and the area eastwards (Figure 4.39) from the railway line are quite lively and connected. Despite some criticism made by users of the comfort levels that the station provides, especially regarding the lack of protection against wind and rain on the train and bus platforms, it can be said that in general the station works well as a 'node'.

The station area at city level has also become a reference 'place'. However, at the urban level, for an optimal spatial performance in the station area, it is indeed necessary to redevelop the west side (Figure 4.43) of the railway line, which is still a sort of hiatus in the urban fabric.

The open character of the station building in some ways allows it to merge with its surroundings. The continuity of pedestrian spaces, resulting from this openness, reinforces the building's integration and thus its 'place' dimension. The clear assignment of spaces to 'node' and 'place' functions allows for a good balance between the two. Both are interconnected but do not hinder each other.

4.4. 'Tunnel' stations - underground level railway infrastructure

In this research, a station that develops over railway tracks placed in a tunnel, even if not exclusively, is named a tunnel station. Underground railways are normally associated with metropolitan lines, which firstly appeared in London in 1863 (Day & Reed, 2010). Underground tracks for long distance trains are scarcer. Recent redevelopment projects, and especially those linked to the implementation of the HST, are changing this, as many operations involve covered tracks. Some of the reasons to do it are: the difficulty to implement new railway lines located in heavily dense city centres; the desire to diminish barrier effects; or to profit from the real-estate development of freed or created land by, respectively, the tunnelling or the covering of railway tracks. A series of German projects during the early 90's adopted this vision (Gerkan et al., 1996). However, the costs of tunnelling the railway tracks surpassed the local real-estate dynamics ability to overcome them (Peter & Novy, 2012a). Without a firm political and consequent financial support, initiatives like Frankfurt21 and Munich21 did not materialize into the urban real estate mega developments they heralded.

Tunnelling tracks to transform 'terminal' stations into 'through' stations is in fact an identified trend (Peter & Novy, 2012a). The case of Antwerp, here analysed, as well as the projects of Stuttgart21 in Germany or Bologna in Italy are former 'terminals' that gain new tunnels for the HST. In the case of Stuttgart (Figure 4.47), the tracks will fully disappear under a new park and real-estate developments, while in Antwerp aboveground tracks are also kept. Railway tunnels were also added to many other 'terminals'. Some examples are Atocha station in Madrid, Paris Nord and Paris Lyon, Zurich Hbf, Leipzig Hbf, St Pancras station in London, Barcelona Sants and Bern Hbf. Covering the tracks has comparable effects to tunnelling the tracks. The case of Paris Rive-gauche project114 is a good example of this.

A considerable number of newly built HST stations adopt railway tunnels. The case of Turin, here analysed, Barcelona Sagrera, or Firenze Belifiore are some of them. The case of Berlin is another recent example that combines also a set of tracks at elevated level. The early case of Lille-Europe also uses a railway tunnel, which nevertheless failed in avoiding a barrier effect at its location (Conceição, 2007). The design of public spaces, very much oriented to the car instead of to the pedestrians, and encompassing great distances to overcome on unfriendly environments, contributed to this. Thus, tunnelling or covering tracks alone is not a guarantee of a successful urban (public) space.

Figure 4.47 – Stuttgart 21 project (Bahnprojekt Stuttgart-Ulm, 2011)

[114] 'Paris Rive Gauche' is the name of the reconversion project of railway and industrial areas in Paris bordering the river. It comprises the construction of a new ground level over a great part of the railway tracks in the area, and above it, new avenues, streets and buildings (Wilde, 2006, p. 74-76). For further information refer to www.parisrivegauche.com.

Figure 4.48 - Aerial view of the Antwerpen Centraal (©Antwerpen Stadsplanning)

4.4.1. Antwerp

The railway (station and its area) in the city

In Antwerp, the first railway infrastructure was laid on the de non aedificandi zone around the city walls in 1836, connecting it to Mechelen and Brussels. It ended at a wood station building located on the space that would later become Koningin Astridplein (Vink, Vandenbroecke, & Somers, 2010). Shortly after, the line was continued to the north and the 'terminal' became a 'through' station. By 1843 the garden, which would later become the Zoo, came into existence.

Between 1859 and 1869 the city walls were demolished, giving space to build the boulevards according to the plan of van Bever (Sclep, 2011). From 1868 until 1880 most of the streets in the area were built. With the purpose of solving the barrier effect of the north segment of the railway line, this segment was replaced by a ring railway line in 1873. The station became once again a terminus. In 1896 the southern section was elevated on a viaduct and the station canopy, which was designed by the engineer C. Van Bogaert, opened for service in 1899 with ten terminal tracks (Sclep, 2011). By 1905 the current station, designed by Louis De la Censerie was opened.

In those days and those that followed, the station area was a vibrant place, with many theatres, hotels, grand cafes, the Opera, cinemas, shops, and the growing cluster of diamond trade, but also prostitution. Following the damage provoked by the Second World War's bomb attacks, came a phase of progressive decline of the station's area and building. In the 70's, the rise of the automobile, the departure of many companies to the city outskirts, the large-scale works of the pre-metro construction leaving many vacant lots, and the accumulating social problems, contributed to the further degradation of the area.

The redevelopment

With the aim to re-establish the north-south railway connection and modernize the station, plans were made for the building demolition and the construction of a viaduct for the new railway lines towards the north. These plans were abandoned and any demolition aspiration cut off when the station building was classified as a protected historical landmark in 1975. Despite that, funds were not available for its rehabilitation, and the restoration of the train shed would only start in 1986.

In 1989 the railway company decided that the station would become a stop on the HST line which would connect also to the Netherlands (Autonoom Gemeentebedrijf Stadsplanning Antwerpen [AGSA], stad Antwerpen, AG VESPA, KMDA, & NMBS Holding., 2011). The construction of the North-south tunnel connection, which begun in 1998, would mark the start of the station renewal, turning it into a 'through' station. The project by Jacques Voncke (Figure 4.48) expanded the station and reorganized its surrounding squares and streets. The momentum was picked up by the city, which is developing a considerable number of projects in the area under the motto: *"De Stationsomgeving: De motor van de stad"*, or in English *"the station surroundings: the motor of the city"* (AGSA et al., 2011).

About 33641 people use the station per day. Some 25 train lines call at 14 platforms of this station, reaching destinations in Belgium, France and the Netherlands. Five premetro[115] lines, 3 tram lines and 8 bus lines stop at the station. Further, there is covered parking for more than 1600 cars and 2000 bicycles accessible from both entrances of the station on Astridplein and Kievitplein.

[115] The Premetro is a tram network operating in tunnels, prepared for a future conversion into metro trains. In the case of Antwerp, the first tunnel of this system was built in the 1970's.

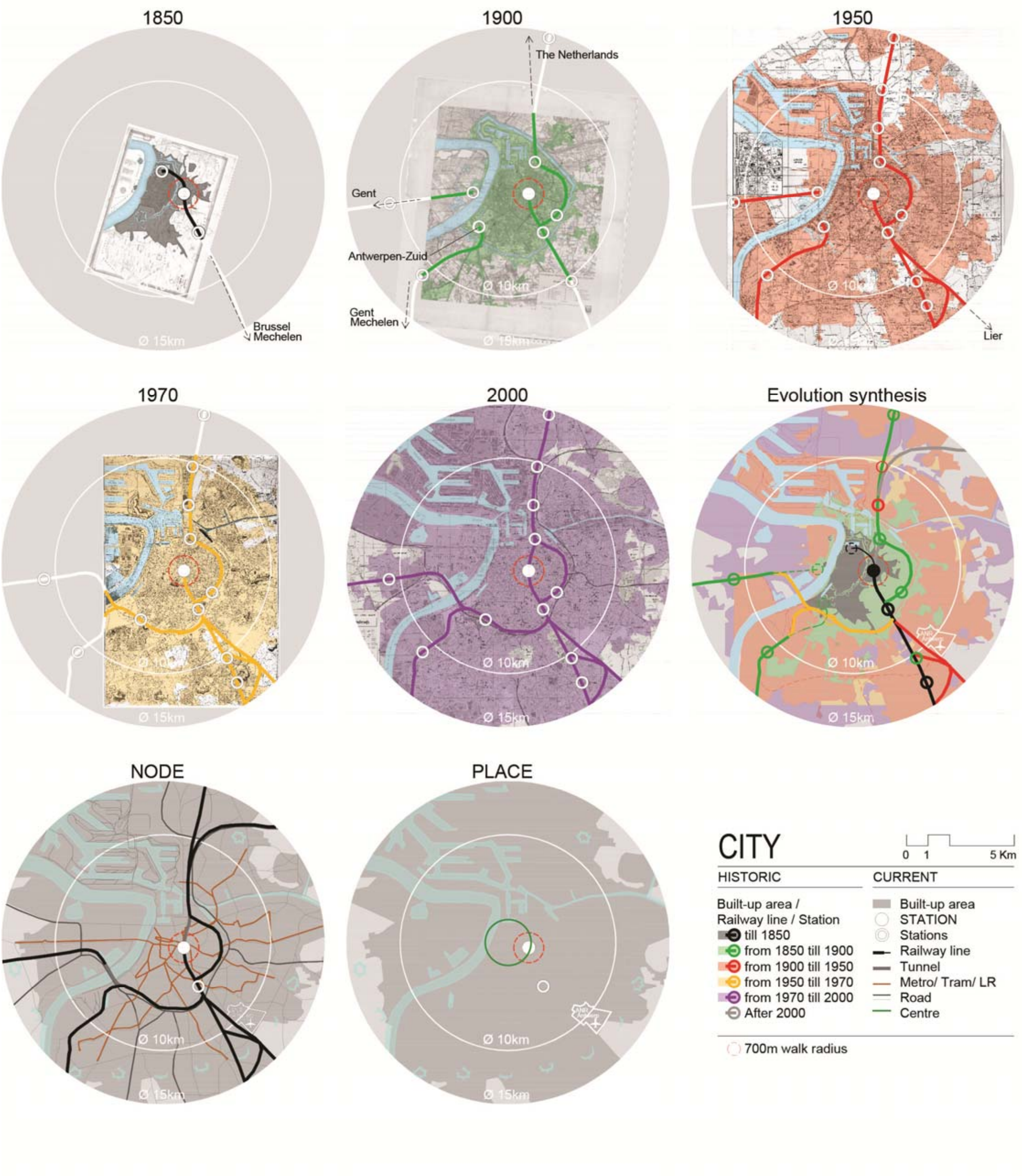


Figure 4.49 - 'City' Set of Antwerp case study

Mapping the station area

‘City’ analyses (Figure 4.49)

Historical evolution

By the end of the ‘origins’ period, the city of Antwerp was mostly confined within its walls. The railway line and the station were located outside the city’s defensive walls. In less than 40 years, the station, which was at first a ‘terminal’, would become a ‘through’ station and a ‘terminal’ station again. The later transformation occurred with the creation of a railway ring (bypass) to continue with the railway line towards the north. This, and the construction of two new lines and respective stations, would happen during the ‘expansion’ period. By then a second defence line of the city had been built bordering most of its built-up area. In the following periods, while the city kept expanding outside of these borders, the railway infrastructure did not change, with exception to its constant mutation in the city’s port. By 1970 the ‘terminal’ station of the line to Gent, and the ‘terminal’ Antwerpen-Zuid were made extinct, and their railway lines connected with the remaining ones along the city’s second defence line. It was also along this line that the ring road would be built. The construction of the HST line towards the Netherlands would start in 2000 and open for service in 2009.

Current situation

Node – Besides the trains, the transport network of Antwerp counts on a considerable number of tram lines, some of which are actually part of the premetro system. The city’s main road network is structured with the Leien and city’s ring road. The layout of the sequence of boulevards crossing the city from north to south, named Leien, is roughly the same as that of Antwerp’s oldest defence line. The layout of the ring road corresponds roughly with that of the second defence line of the city. From these lines, the roads exiting the city grow radially. The built-up areas are consequently interlinked with the transport network.

Place – The city is organized around the river, mostly eastwards. Its port, located in the northern area, occupies a considerable part of its territory. Antwerp has a clear and lively historic centre with plenty of interest points, such as heritage constructions, public spaces, cultural facilities and commercial offer. The station area is located on the edge of the historic centre, but still remains inside the main core of the city and is very central in the whole agglomeration. The city’s built-up area is extensive.

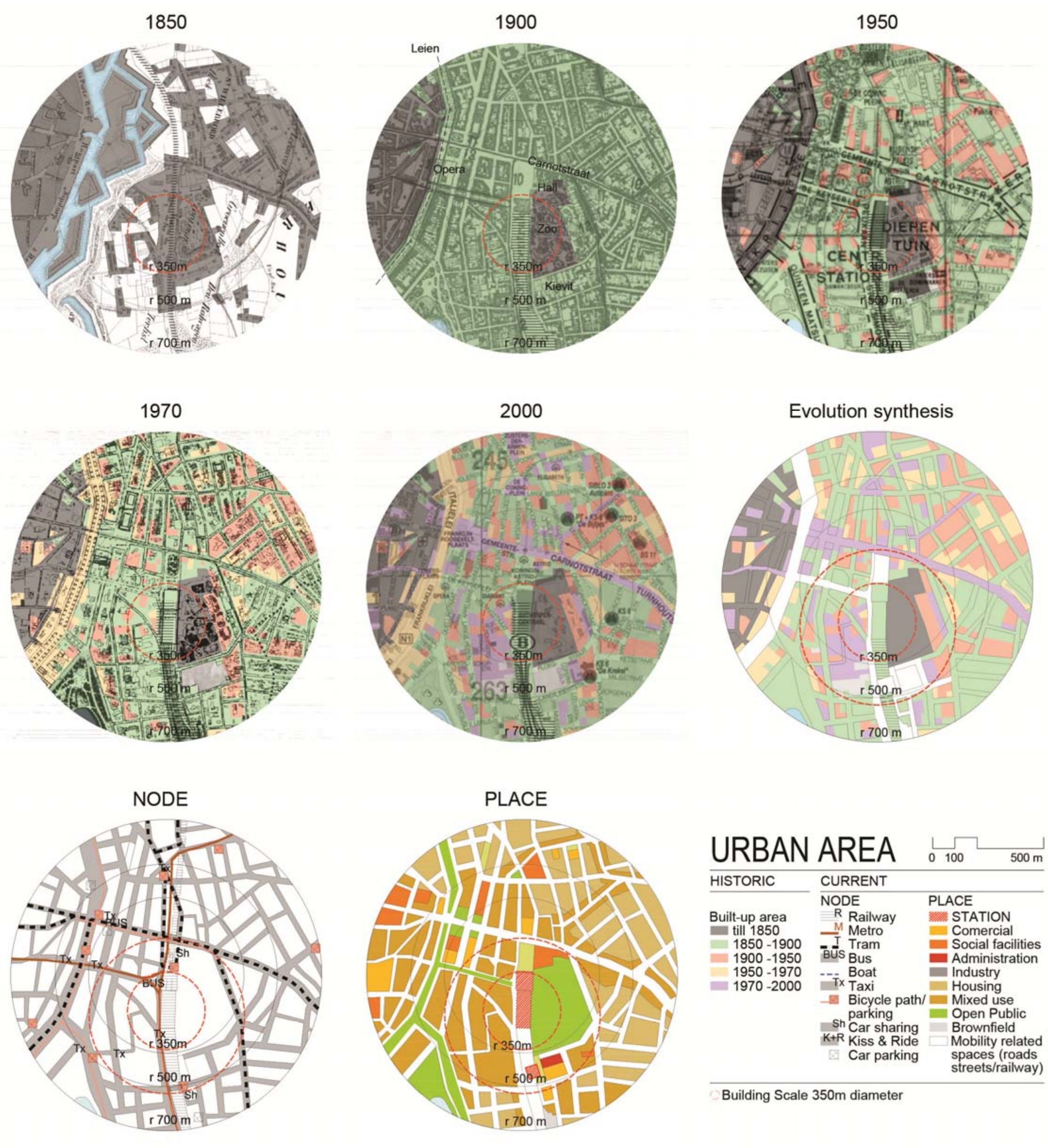


Figure 4.50 - 'Urban area' Set of Antwerp case study

'Urban area' analyses (Figure 4.50)

Historical evolution

Developed originally on a de non aedificandi zone, by 1850 the station area was not much more than a group of scattered buildings, the zoo garden, undeveloped land and a railway line crossing it. By 1900 the defence lines gave way to a sequence of wide avenues, the Leien. The Opera building, the Zoo entrance and Hall, and the new 'terminal' station were built then. The whole area was urbanized and the railway line did not divide it into two parts anymore.

In the following periods the railway infrastructure would hardly change in the area. On the other hand, the built-up area would transform. The street pattern was kept, but many buildings were replaced or disappeared. Buildings related with the diamond trade, but also with entertainment kept appearing. In the 1970's, the Leien were remodelled and two reference buildings built, the Theater building and the Antwerp Tower. The Second World War bombings left some scars, and so did the premetro construction works later on. Until 2000 the Carnotstraat axis would also be reprofiled.

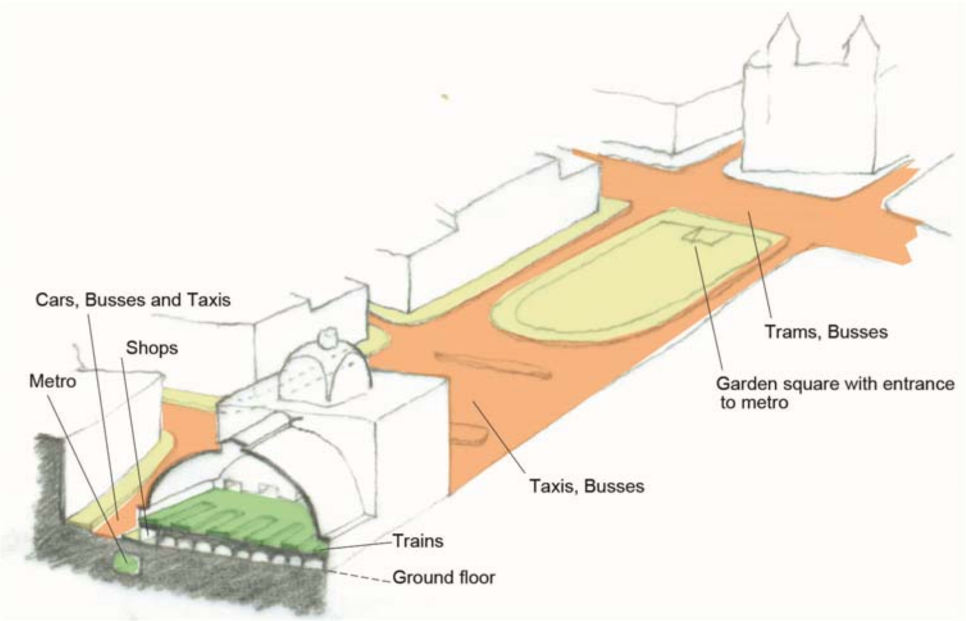
The major changes to the rail infrastructure came with the station's redevelopment project. This included the reorganization of some of the streets and squares around the station building, and created a new entrance, buildings and outdoor public spaces at the Kievit area. This development resulted in an urban renovation dynamic in the area.

Current situation

Node – In the station area, besides the trains, there are trams, premetro, busses, taxis, carsharing, bicycle sharing, car and bicycle parking, as well as bicycle paths. All modes converge at Astridplein, while at Kievitplein the options are reduced to taxis, carsharing, bicycle, and kiss and ride. The Franklin Roosevelt square, at the crossing of the Leien with the Carnotstraat, is also an important interchange of busses and trams in the area.

Place – In the last few years the area has been experiencing a renovation momentum, especially since the start of the station redevelopment project. Around the station and towards the city historic centre the uses are very mixed. There is a considerable offer of entertainment and shopping facilities. The diamond trade has a central role in the area, as well as the zoo, whose entrance (Figure 4.53) is next to the main entrance of the station. The Stadspark and the Leien offer open air arborized public space. Northwards and south-eastwards of the station the uses become essentially residential. The recent redevelopment of the De Keyserlei (Figure 4.54 and Figure 4.55), the street linking the station to the Leien, and the street in its continuity towards the historic centre, provides a connective pedestrian route bordered with shops and spaces to see and be seen. The current city's redevelopment plans for the area aim at creating a quality urban space in order to recuperate its liveability.

Figure 4.51 - 'Building' Set 1 of Antwerp case study



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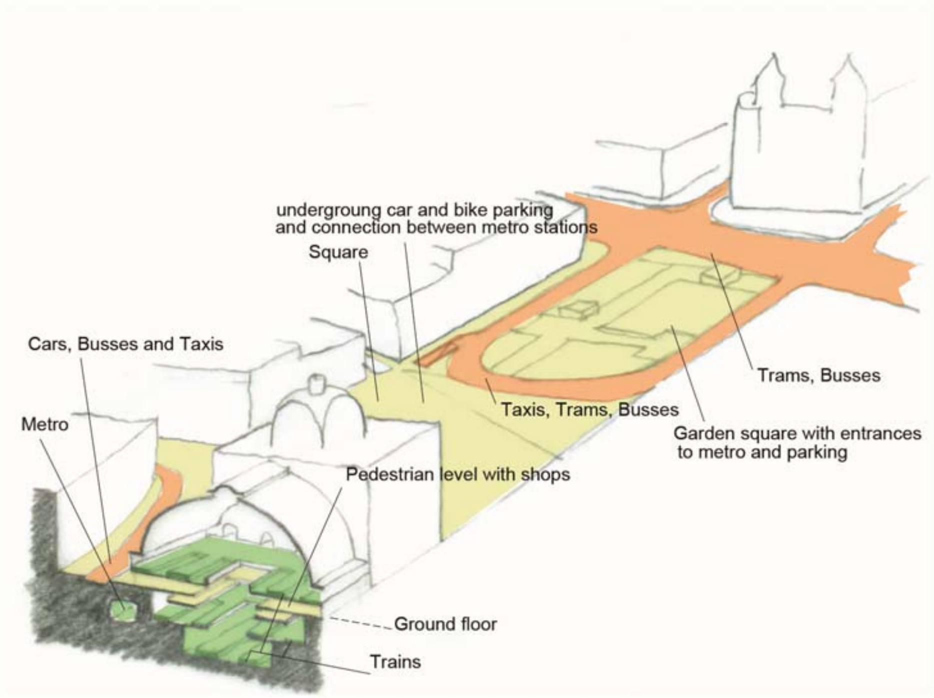

AFTER

0 10 50 m

- Pedestrian / public space
- Public transport
- Private transport
- Water

'Building' analyses (Figure 4.51)

Before the redevelopment project

Node – The station had become a dangerous building for its users. Its degradation and consequent accidents motivated plans for its closure (Sclep, 2011). This would eventually pressure the decision towards its rehabilitation and extension. By then the 'terminal' station was a listed building with falling bricks stones and glass from the train shed. There were 10 tracks at the elevated level of the viaduct that brings the railway lines into the city. At Astridplein, busses trams, taxis, and cars, came together. The access to the premetro was also at the square. Private cars were allowed in the vicinity of the building.

Place – The physical degradation of the station building, as well as of its vicinity contributed to the social degradation of the station area, making it a *no go* place.

After the redevelopment project

Node – The listed station building with its train shed were fully restored, and a tunnel for the passing through HST railway line was built under it. Inside, under the original train shed, a new hall allows daylight to reach the new underground train platforms (Figure 4.56). There are now three levels of platforms, one on the original level with six platforms, another below ground floor level with four platforms, and another four platforms at the tunnel level. The premetro is accessible from inside the station. Astridplein (Figure 4.52) was also renovated. It is now dedicated to pedestrians and public transport such as trams, busses, taxis and carsharing. Under the square, new car and bicycle parking were built, as well as a pedestrian connection to the two premetro stations. (Voncke, 2003). Additionally, a new south station entrance (Figure 4.58), in the Kievit area, with car and bicycle parking, carsharing, taxis and kiss & ride, was created.

Place – The complete restoration of the old building, its extension and the new south entrance have changed the station. At ground floor, there are now a big variety of shops utilizing the space in between the two entrances of the station. In this shopping area, one can buy food products, but also newspapers and magazines, flowers, mobile phones, etc. It is, however, the number of jewelry shops in the *"diamond gallery"* section of the shopping area that catches one's attention. This unusual ensemble gathers some 36 shops. Still, it is only a part of the jewelry shops in the station area, which mainly concentrate around Pelikaanstraat, somehow in continuity with the station ones. The entrance at Kievitplein (Figure 4.57) also allows the light to penetrate to the lower levels of the building. In the new square, public spaces and buildings for offices, housing and services have been erected. Inside the new entrance there is a big hall housing events on a regular basis. Events are also a constant at Astridplein.

> *"Inside the station, cultural events are taking place practically every week. Amongst them, visitors have already come to enjoy a sports initiation event of basketball or rope skipping, or a tango salon or salsa demonstration. And all of this at no charge! Likewise, there is room for conferences. The easy accessibility and the unique historical character of Antwerp Central is a considerable asset to event organizers"* (Sclep, 2011).

There is a continuity of pedestrian spaces, bordered by commercial offer, in and around the station building at ground level.

The plan (Stad Antwerpen, 2007) for the Pelikaanstraat quarter, which has several vacant lots, considers pedestrian and cycleable crossings of its interior space, as well as the creation of a square.

Figure 4.52 – Astridplein, in front of the old station building (2012)

Figure 4.53 – Zoo entrance next to the old station building (2012)

Figure 4.54 – The (pedestrian) connection between Astridplein and De Keyserlei (2012)

Figure 4.55 - De Keyserlei (2012)

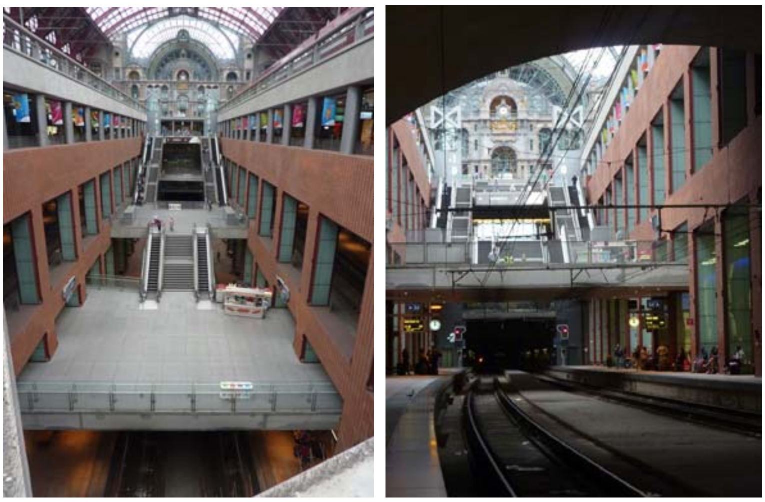

Figure 4.56 – The old station interior's several levels (2012)

Figure 4.57 – The new station entrance interior at Kievitplein (2012)

Figure 4.58 – Kievitplein and the new south entrance of the station (2012)

Synthesis

The station area of Antwerpen Centraal has greatly improved its spatial performance, and the plans still to be implemented aim at continuing to improve it. Regarding the 'node' dimension of the station area, the effort spent on the creation of areas exclusively dedicated to public transport and pedestrians is recognizable[116]. This, in addition to the new train platforms and accesses to them, as well as the creation of the new entrance, diversifying the locations for public transport stops in the area, are perhaps the most significant changes to the 'node' organization.

The continuity of pedestrian spaces in and out of the station building makes the area more preamble. However, as the redevelopment project of the surrounding urban area is subsequent to that of the station rehabilitation, the main improvements regarding the 'place' dimension of the urban area are still in progress.

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[116] This effort reflects the city's approach to mobility. *"The city bases its multi-modal mobility policy on the STOP principle, which takes into account every mode of transport. In the field of safety, flow and comfort, however, priority is given to pedestrians, cyclists, public transport and private vehicles in that order*". (Stad Antwerpen, 2012, p.137).

*"The STOP principe - zoveel mogelijk **S**tappen, **T**rappen (fiets), het **O**penbaar vervoer gebruiken en pas in laatste instantie de **P**ersonenwagen inzetten."* (Provincie Antwerpen, n.d.). In English: The STOP principle - walk whenever possible, pedal (bicycle), use public transport, and only use the Car as last resort.

Figure 4.59- Aerial view of Porta Susa station and its urban surroundings (Urban Center, 2012)

4.4.2. Turin

The railway (station and its area) in the city

The first railway line in Turin was the one connecting it to Moncalieri, opened in 1848 (Pieri, 2009, p 197). This was the initial section of the line to Genova, which would be concluded in 1854 (Cavicchioli, 2009, p.71). A provisory building built in wood, and then shortly after replaced by a brick one, would be the first station of Turin. The current building at Porta Nuova would only open in 1864.

Following heated debates on the position the new lines and a possible second station should have in the city, it was decided to locate Porta Susa Station on the west side limit of the city at the time. The station, with modest architectonic ambitions, opened in 1856 (Pieri, 2009, p. 205) on the line to Milano.

The city's expansion plans of 1851-1852 are substantially contemporary to the debate on the location of the railway lines and stations. The city grew, turning the railway lines position into a central one. However, city and rail infrastructure were not integrated. On the contrary, the railway lines, as well as the industry (later on, turned into wastelands) that surrounded them, represented a cut between the old and the new parts of the city's urban fabric. This railway infrastructure, existent in the city by the beginning of the XX century, corresponds largely to the current one. However, a structural change of the relationship between the city and the railway is happening.

The redevelopment

The project of the *"Passante Ferroviario de Torino"*[117], originated in the 1980's, proposed to burry underground the north south railway axis, allowing the integration of the two parts of the city separated by the former barrier (Comune di Torino, 2012). This restructuring, represented a shift from the 'private car policy' to the 'integration of public transport' one. It allowed the doubling of the infrastructure, to prepare for the introduction of the HST, and it freed space on the surface for new developments. The city seized the opportunity to redesign the whole area and reorganize its transport network[118], while leveraging its image at the same time.

The General Development Plan, approved in 1995, integrated these intentions, giving body to the desired shift from a car industrial city towards a culture and international events' city. The *"Spina Centrale"*, as the project is best known, designed by Vittorio Gregotti and Augusto Cagnardi in close collaboration with the city, considers thus the burying of the railway tracks, and the transformation of the new spaces at the surface. The new boulevard ('Spina')[119], replacing the former railway lines, is flanked by existing, renovated and new buildings, dedicated to culture and services (Ciocchetti et al., 2011). Among them is the new 'underground' Porta Susa station (Figure 4.59), designed by AREP with Silvio D'Ascia and Agostino Magnaghi. In its vicinity are La Provincia, the courthouse, the Radiotelevisione Italiana (RAI), fiscal services, government offices, but also the twin office towers[120] at the station site, the rehabilitated old Officine Ferroviarie Grandi Riparazioni into a cultural centre, and the extension of the Politecnico di Torino (Ciocchetti et al., 2011; Tiry, 2011). The project is still being implemented and the station has already been opened to service.

The station is currently used by 15000 people per day (Ciocchetti et al., 2011). The new building has 6 train platforms from which national destinations can be reached, as well as some French cities, such as Paris and Lyon. There is a metro line station integrated in the building. Trams, busses, carsharing and bicycle sharing are available in the station area. Further, there is covered car parking amounting to about 1050 spaces in the station.

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[117] This project somehow echoes much older projects to restructure the railway going back to the 1880's, also with the intention of joining the two parts of the city separated by the railway infrastructure. For a full account on this see Pieri (2009). The building works of the *"Passante"* started in 1987, and went in full operation in 2012.

[118] The creation of a metro network was also part of this transformation effort. The first line has been built and has a stop at Porta Susa. A second line is planned, using part of the deactivated freight railway line of Vanchiglia (Pieri, 2009, p.227).

[119] *"Spina Centrale"*, is (in English) the 'central backbone' of the city's urban transformation largest project. It is structured with a long and wide boulevard, composed of the avenues that bordered the now buried railway. These avenues (Corso) were renovated and enlarged over the buried railway. In this thesis this boulevard is referred as the 'Spina '.

[120] One of the twin towers, the Intesa San Paolo, is designed by Renzo Piano. The other tower is part of the new station project and is designed by AREP with Silvio D'Ascia and Agostino Magnaghi.

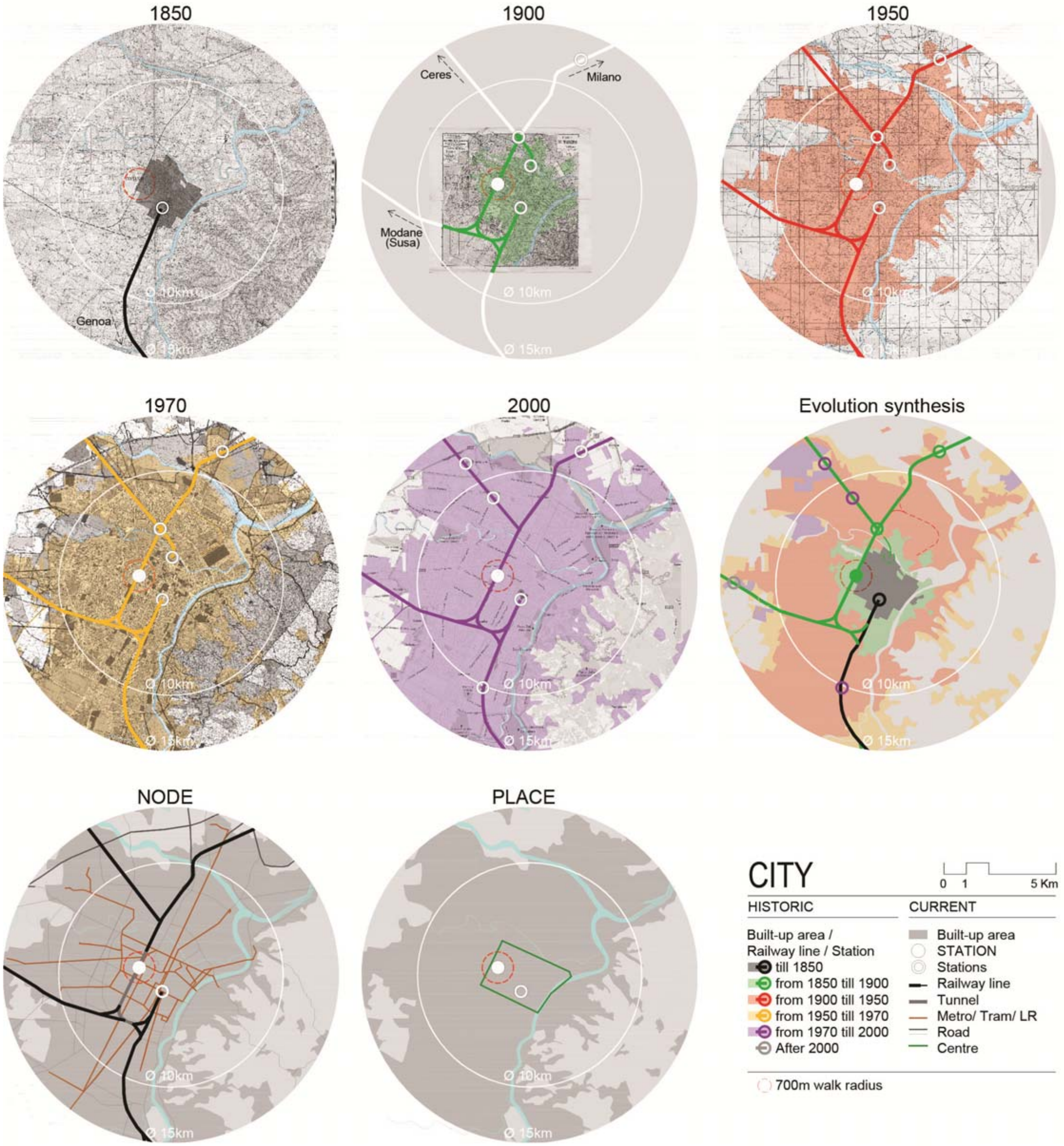


Figure 4.60 - 'City' Set of Turin case study

Mapping the station area

‘City’ analyses (Figure 4.60)

Historical evolution

When the first railway line arrived to Turin its ‘terminal’ station was positioned at the south edge of the city. This is still the current location of Porta Nuova, the main station of Turin. It is only one kilometre away from the city’s main square in front of the Royale Palace. These spaces are connected by Via Roma, a straight axis fully bordered by covered galleries with shops. In the following years, the expansion plans for the city and its railways gave way to the implementation of more lines and the growth of the built-up area. It was then that Porta Susa station was built on the railway line to Milano. This line represented, until its repositioning underground in the last few years, a barrier to the continuity between the old and the new city. It was this project, associated with that of the *“Spina Centrale”*, that brought the most significant changes to the analysed territory. With the reposition of the railway lines sections underground, new stations have been built and old ones deactivated. The freed space at surface level is being redeveloped.

Current situation

Node – The transport network restructure was the driving force behind Turin’s renovation dynamics, brought on by the interdependent projects of the *“Passante”* and the *“Spina Centrale”.* Thus, in the last decades the city has endured important transformations at ‘node’ level, encouraging public transport use. Besides the (underground) railway lines, the city of Turin also has a new metro line and several tramlines covering its territory. There is also a bus network and bicycle sharing.

Place – located on the Po river valley, near the mountains, most of the city has a flat landscape. Its historical orthogonal street pattern and the arched galleries bordering its boulevards are quite distinctive features of the city. Turin has a lively historical centre, on the edge of which Porta Susa station’s area is located. With the growth of the city, this location became the geographical centre of the agglomeration.

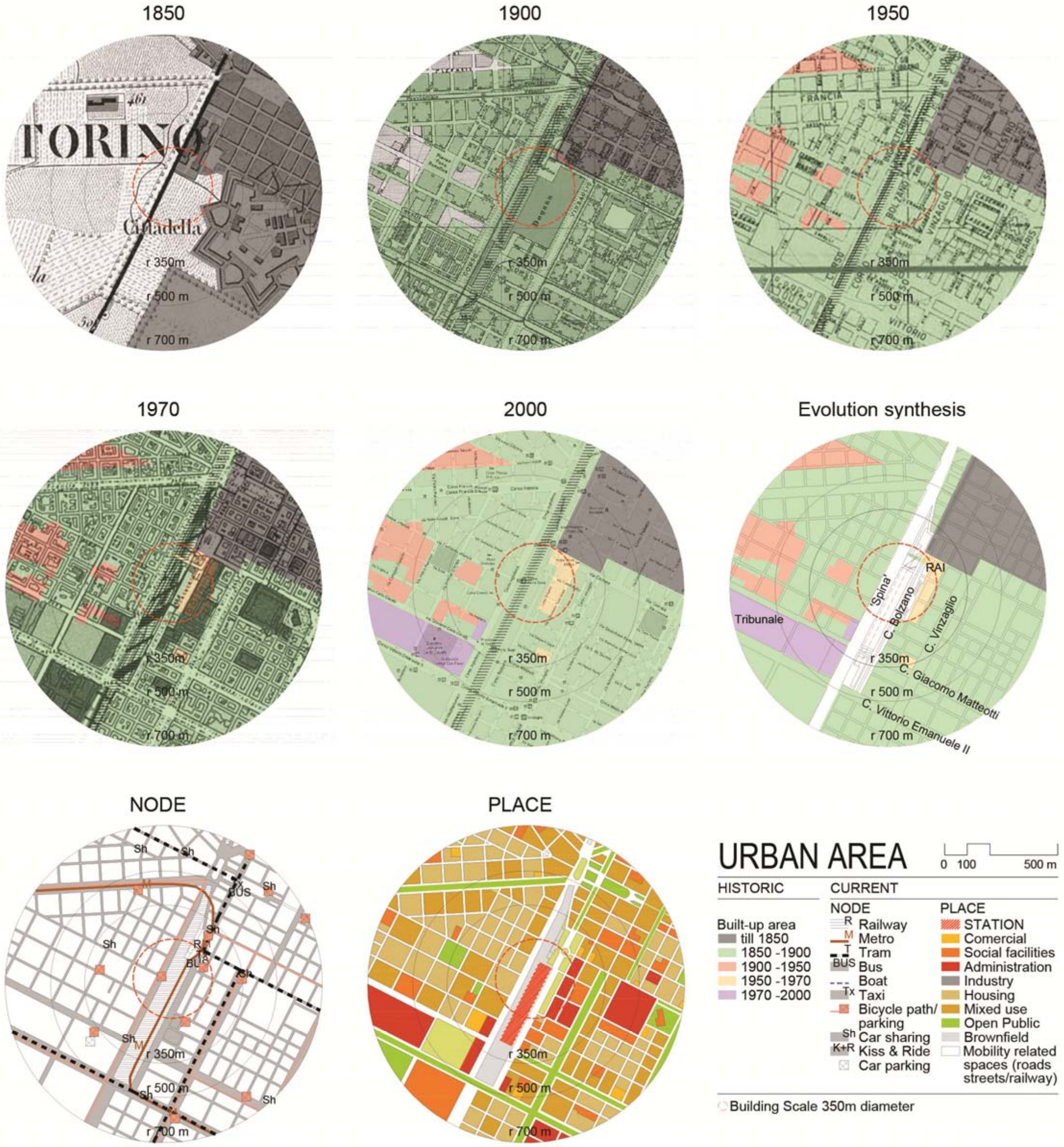


Figure 4.61 - 'Urban area' Set of Turin case study

‘Urban area’ analyses (Figure 4.61)

Historical evolution

Originally placed on the edge of the city, the station and its railway infrastructure would mark a dividing line of the city’s urban fabric. The station area developed within the city’s expansion, which began in the 19th century and continued throughout the 20th century. In this time, the area was punctually connected by a bridge right next to the station, built in the 1950’s.

Before 1970, a few buildings were built. The tower building of the RAI was one of them, built in the square in front of the station. The implementation of the *“Passante”*, as well as the construction of buildings like the Justice complex (Tribunale di Torino), would mark the years until 2000. The new station was partially open to use in 2008, and since then other sections have been put in operation. The railway is now completely underground in the area.

Current situation

Node – Besides the station itself, where trains, metro, taxis and car parking is available, there are other locations in the area where the transport modes converge. The square in front of the old station, and the two avenues that join it, have a concentration of busses, trams, taxis as well as a metro station underneath. At the other end of the new station, on Corso Ciacomo Matteotti and Corso Vittorio Emanuelle II, concentrate other bus lines. Busses are also available at Corso Bolzano, at the ‘Spina’ (Figure 4.66) (named Corso Inghilterra in the studied area at this scale), and Corso Vinzaglio. At the latter two axes, there are also bicycle paths, and on the last trams pass. There is a generous offer of car and bicycle sharing in the area.

Place – The construction works of the *“Passante”,* the ‘Spina’ and the station, have dominated and still dominate the area. The bus station at Corso Bolzano will also be another change to the location. Currently, the area is still predominantly residential, but there are also other uses like commercial, administrative and social facilities. The station itself will receive commercial areas and aims to be an urban space in continuity with its surroundings.

“La città entra in stazione [...] e la stazione diviene essa stessa città.” (D’Ascia, 2010, p.77).

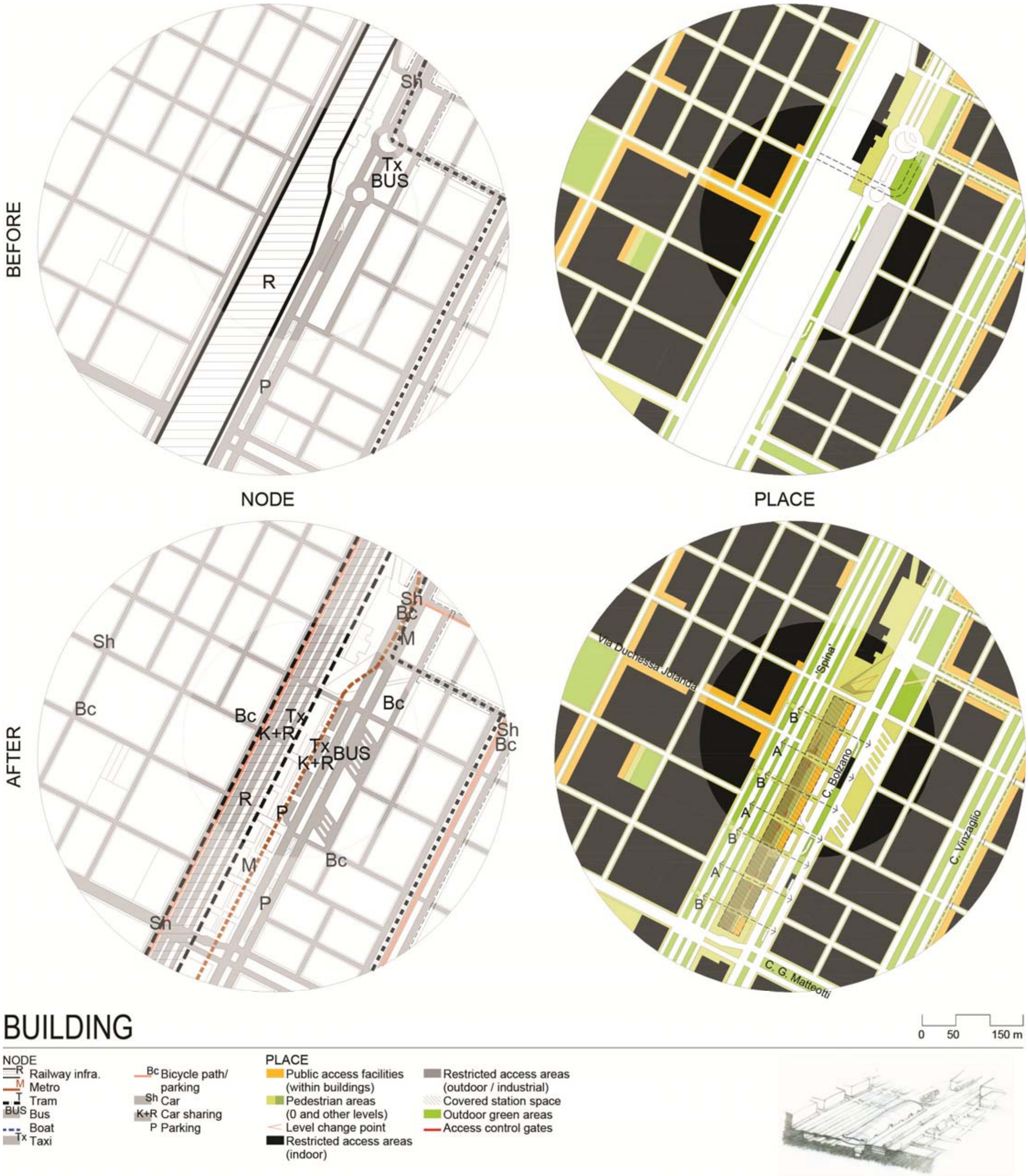
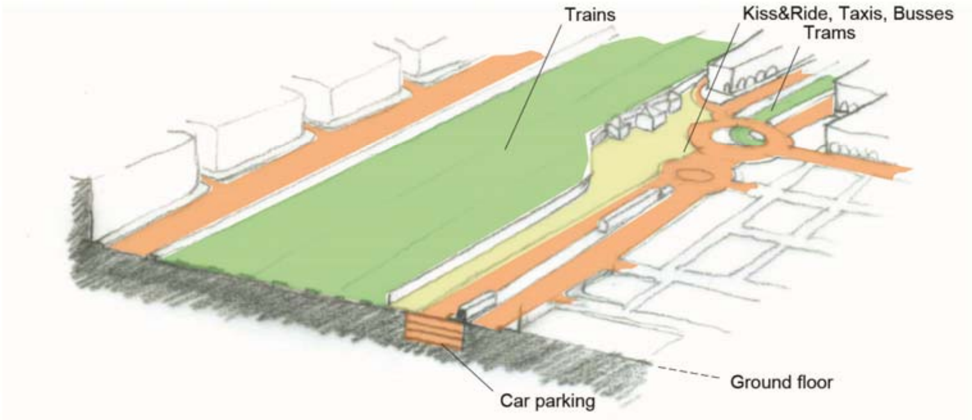


Figure 4.62 - 'Building' Set 1 of Turin case study



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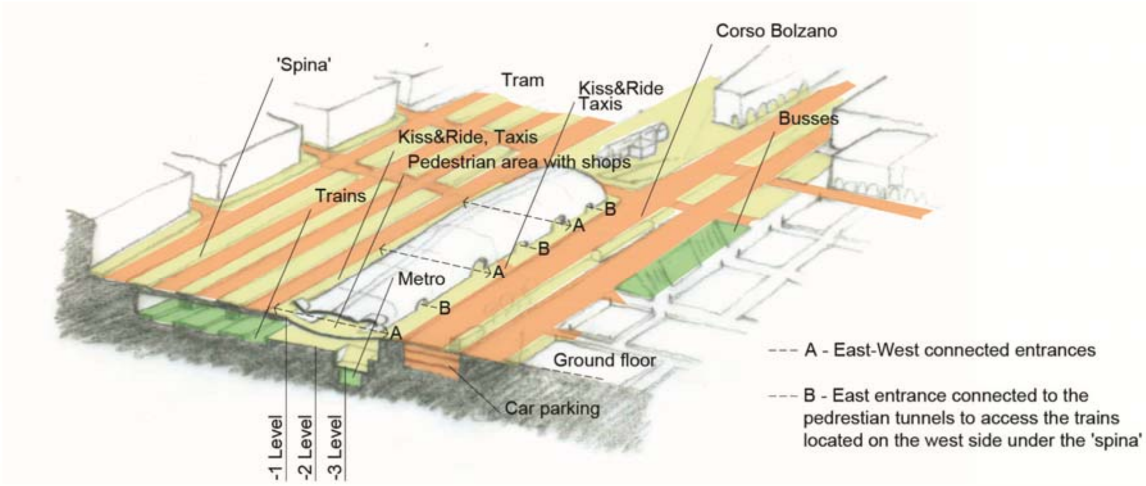

AFTER

0 10 50 m

Pedestrian / public space
Public transport
Private transport
Water

'Building' analyses (Figure 4.62)

Before the redevelopment project

Node – The railway line was a big barrier in the city and in the station area. The old station and the square in front of it housed the stops of the transport modes that crossed the area, forming a small 'node'. Trains, trams, busses and taxis converged in these spaces. To cross the railway barrier, there was a bridge for cars right next to the station building.

Place – The signs of the station buildings' old age were visible. Successive additions throughout time further degraded the station's architectonic ensemble. The station (Figure 4.65) related only with the square and avenues on its *front side*, as the barrier of the railway lines did not allow relationships with its *back side*.

After the redevelopment project

Node – The underground train (Figure 4.69) and metro platforms, as well as incoming taxis, kiss and ride and car parking are organized inside the new station. The outgoing taxis will stand at the 'Spina'. Trams and most of the busses will be organized at Corso Bolzano. Additionally, there will be car and bicycle sharing in the close vicinity.

Pedestrian flows are organized inside the station in two main directions, crossing several levels (Figure 4.64). One (longitudinal) direction is parallel to the railway lines, the 'Spina' and Corso Bolzano. The other direction follows the alignments of the neighbouring streets perpendicular to the 'Spina'.

Longitudinally, the building is generally divided in two main areas (Figure 4.67). One is dedicated to the station facilities and non-transport related functions, and the other to the circulation of pedestrians. The pedestrian area is divided into two spaces, both along the whole length of the building. One is a ramp which starts in front of the old station building, goes down to the level (-2) of the train tracks and access to the metro, and will end at the ground level of the planned station's (twin) tower. This ramp is designed to serve as a *street* inside the building, connecting its several levels. The other space is the station hall at -1 level (Figure 4.67 and Figure 4.68), which the project considers as reference level (D'Ascia, 2010) for access to the exterior of the building, internal circulation and location of several transport and non-transport related facilities.

On the east side façade, at regular distances, are seven entrances. Three of them connect to the three entrances at the west façade through transversal passages which link to the hall at -1 level. The remaining east entrances are canalized to the train access tunnels. The tunnels are placed above the railway tracks and under the 'Spina', connecting the station to the other side of this boulevard. These tunnels connect to the train platforms and to the ground level by means of stairs and elevators.

Place – It was the project's objective that the transversal passages would connect the city from east to west at street level in continuity with pre-existing street axes. In this way, the aim of the *"Spina Centrale"* to reconnect the two parts of the city until now separated by the railway infrastructure, would be reinforced.

> *"[...] the city comes inside the station and the station becomes a real part of the city, permeable to pedestrian flows crossed in all directions and at different levels."*

"The project of the new station of Torino Porta Susa is the project of a huge urban public space, where the station, conceived as an urban gallery, becomes a real street, a "passage", a new kind of urbanity shape for the future city. The railway station's transparent volume - a 385 m (the length of the TGV) long steel and glass tunnel, 30 m. width, with a variable height compared to the outdoor street level [...] - is proposed as a modern reinterpretation of the nineteenth century's urban galleries and the great historical station's halles, as well as a kind of symbolic building." (D'Ascia, 2010, p.71).

Inside the station, commercial spaces like shops restaurants, bars, terraces are expected to occupy the spaces that border the internal *streets*, which also have travel related facilities, like ticket sales, information, etc.. The Station Tower, which was thought of as a vertical city (D'Ascia, 2010), also in connection with the existing urban fabric, is planned to house semipublic functions such as a library, meeting and conference rooms, restaurants, fitness center and spa, terraces, panoramic views areas, etc.

Figure 4.63 - The arcade galleries bordering the streets and squares of Turin (2012)

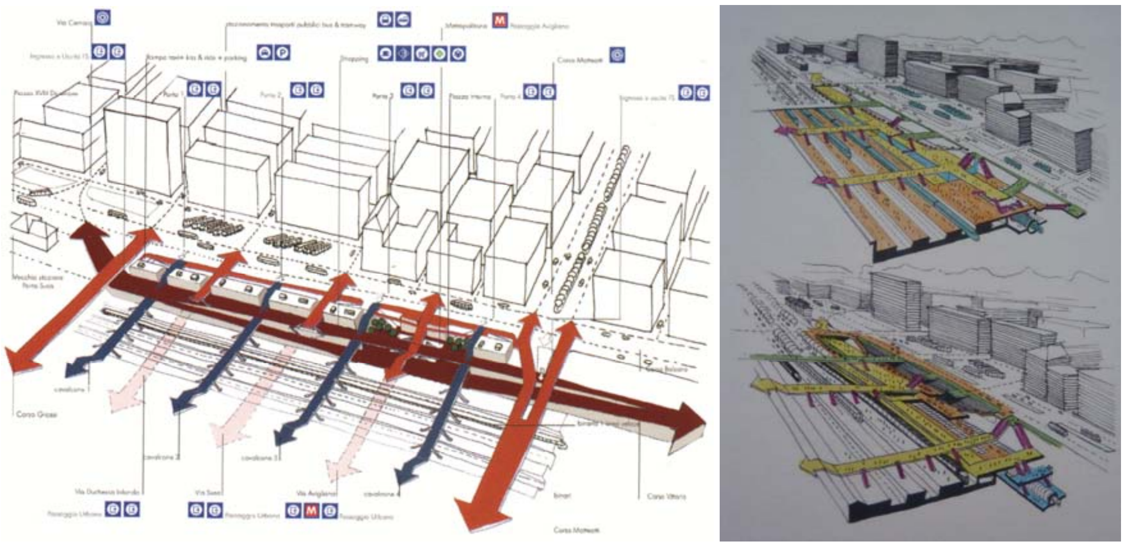

Figure 4.64 – Project's schemes of the urban connections of the station and its surroundings (AREP & Silvio D'Ascia)

Figure 4.65 – The connection axis between the old station and the historic centre (2012)

Figure 4.66 – The station, the 'Spina' (Corso Inghilterra) and the west neighbourhood (2012)

Figure 4.67 – The interior of the new station, along the longitudinal hall and ramp, overseeing levels - 2, -1, and 0 (street level), and one of the transversal passages (2012)

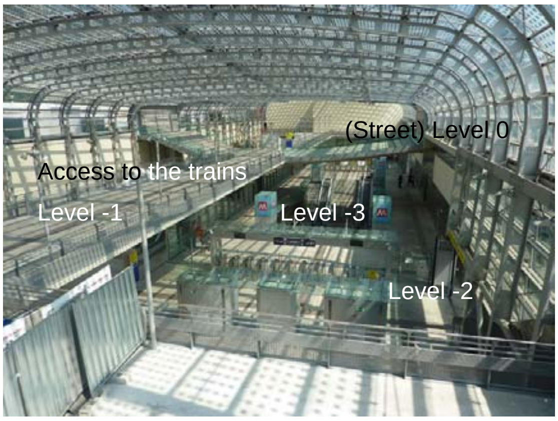

Figure 4.68 – The interior of the new station overseeing level -1 (the general reference level, and access to the trains under the 'Spina'), and level –2 (train tracks' level, and access to the metro which runs on level -3) (2012)

Figure 4.69 – Train platforms' level (-2) (2012)

Synthesis

The new station project brings spatial performance improvements to the station area of Turin. A new pleasant ‘urban gallery’ was added to its urban fabric. A variety of uses (inside the building) is brought to the station area, which until now was rather monofunctional. The railway fracturing barrier has disappeared. However, the expectations the project rose of being an urban connective element are defrauded to a certain degree. To a certain extent the ‘Spina’ replaced the former barrier. Along the whole extension of the station, it is only possible to cross the ‘Spina’ at ground level at three crosswalks. Two crosswalks are located at both ends of the station’s gallery, and the other is related to the station’s entrance aligned with the Via Duchessa Jolanda (Figure 4.62). Thus, two of the three transversal passages do not really provide the continuity with the contiguous streets, as stated by the project. Further, they are not exactly aligned with the mentioned streets. The crossing of the ‘Spina’ is made instead under it, through the tunnel accesses to the trains.

As a result of the extension of the building, there are large distances to be covered by travellers in some of the mode changes. The location of trams and busses closer to one end of station, which are almost opposite to the metro entrance location, contribute to this.

4.5. Results / Comparison

The results obtained in the analysis of the cases are compared in this section, following a structure similar to that of the subsections dedicated to each case. The cases were compared at city, urban area, and building levels. The groupings per category, ‘bridge’, ‘viaduct’ and ‘tunnel’, as well as ‘adapted’ and ‘new’ were also kept, especially in the organization of the second Set of drawings at ‘building’ level, in order to make the observations easily relatable with the analyses of the case studies described in the preceding sections.

Some common features are observable among the case studies in this sample. However, it is important to note that, given the small dimension of the sample, only six cases, it is not wise to generalize the observations to the whole category each case represents. Indeed, the similarities and differences among the cases of the several categories here analysed might not be dependent only on their category. A larger sample would be necessary to determine if a direct correlation exists. Nevertheless, the made observations are relevant for the objectives of this research and can provide clues for further research.

Closing this section, several summary charts are presented, illustrating the results and comparison of the analyses of all case studies: Table 4.3 outlines some key ‘node’ and ‘place’ characteristics of each case; Figure 4.73 gathers the main graphical analyses, at several scales, for all cases; and Table 4.4 displays an overview of the case studies’ analyses’ results.

4.5.1. City level

To a certain extent, the conclusions of the analysis at the city scale level are inherently limited (overview on a large scale), especially those regarding the possible impacts of the station’s redevelopment project in the agglomeration. Even though verification, based on other types of data and a wider sample of cases, might be necessary to validate some of them, there are important observations that can be made.

It is visible in all cases that the development of the built-up areas has a close relationship with the railway lines, as well as with other transport infrastructure such as main roads, metro or tram lines, displayed in the schemes. If the railway tracks, built in the early days, mostly became a separation between the historic centre and the 19th and 20th century urban expansions, they also became axes of urban developments. The planned integration of transport and urban developments is noticeable along the recently (re)built railway lines and stations, fitting into the *"global emergence of Transit Oriented Development"* (Bertolini, Curtis & Renne, 2012, p.41) policies[121].

While in its beginnings the railway was regarded as a progress factor facilitating (economic) exchanges with other territories, but to be kept preferably outside the city, time showed that it could be an ally to the agglomerations' urban development. To a certain extent this is visible in the schemes, nevertheless, it is hard to make further statements on the degree of mutual influence between the city and railway development based solely on these drawings. Associating the information extractable from the schemes with the data collected in Table 4.3, it is possible to distinguish other clusters.

Some of the cities' characteristics seem to be influential on the amount of users per day of their stations. Basel and Utrecht are two cities that are important traffic crossings at international and national levels. Their 'bridge' stations are among those that have more users per day. The 'viaduct' stations located in Amsterdam and Lisbon, which are capital cities, also boast many users per day. Antwerp and Turin are cities *"in transition"*, as defined by Pol (2002), which want to move away from their image of an industrial pole towards "*international service cities"*, putting a lot of effort and resources into fuelling that change. Their 'tunnel' stations have considerably much less daily users than the other four cases.

The amount of car and bicycle parking offered at the station area reflects the transport policies adopted by each city. It is clear that in Lisbon the car has a considerable role, as it has the biggest amount of car parking spaces and virtually no bicycle parking. Utrecht, Antwerp and Turin follow with a similar average of car parking, while Basel and Amsterdam offer the lowest number of spaces. Regarding bicycle parking, the Dutch cases score far higher than the other cases. Antwerp follows with bicycle parking and bicycle sharing, and Basel with bicycle parking. In Turin bicycle sharing is also available. In all of these cases there is an effort to promote the use of public transport.

It is also observable that the geographic position of the cities are relevant to the number of destinations available form their stations. The Dutch, Belgium and Swiss cities' stations offer many more international destinations than those more peripheral stations like Lisbon and Turin.

Node – In most of the case studies, the main structure of their railway network has been established in the first periods of analysis. Amsterdam's case is quite unique for the extension of the railway infrastructure established in the 'renaissance' period. The completion of a railway ring around the city and connecting to the airport was done between the 1970's and 2000.

Because all the studied stations are (becoming) the main station of their cities, they obviously have an important position within the agglomeration's transport network. All the different transport networks in the city cross at these stations. The cities with densely developed tram and or metro networks are mainly those with 'adapted' station buildings. Those are Basel, Amsterdam and Antwerp. Nevertheless, Turin also has a big tram network and the metro network of Lisbon is the most developed of all the studied cases.

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[121] The general principles of *"Transit Oriented Development"* (TOD), a concept born in the United States of America, have been adopted by the (re)development of railway station areas in other parts of the world. *"The basic philosophy appears to be the same in all contexts: concentrating urban development around stations in order to support transit use, and developing transit systems to connect existing and planned concentrations of urban developments."* (Bertolini, Curtis & Renne, 2012, p.41)

Place – All studied stations, except Gare do Oriente in Lisbon, have a central position in the agglomeration. The almost suburban location of Gare do Oriente contrasts with the closeness to the historic centre of the other cases. Within this sample of six case studies, the 'bridge' stations lie in cities with the smaller built-up extension, considering the areas analysed at city level. Both 'viaduct' stations are located close to the water. Both the 'tunnel' stations are located in cities that considered the railway tracks as unhandleable at surface. In Antwerp, it would mean building a viaduct through the existing urban fabric towards the north. While in Turin, the option was to keep a (railway) barrier dividing the city in two parts.

4.5.2. Urban area level

The way the station and its surrounding urban environment interact at 'node' and 'place' dimensions is more evident in the analysis schemes at the urban scale. Some clusters can be found among the case studies, even though the surroundings of each of the cases are different, topographically, in terms of transport and non-transport related layout, uses and development degree throughout time.

It is noticeable that the redevelopment projects of cases in the 'new' category cover extensive areas[122]; while projects of 'adapted' buildings have more limited interventions. Gare do Oriente is part of one of the biggest redevelopment project in terms of dimensions in the analysed sample of case studies. In this case, more than half of the area analysed corresponds to the converted brownfield that gave way to the Expo98. The characteristics of its location, among other factors, contributed to such an extensive operation to be possible. Utrecht is also quite an extensive intervention. Turin follows, but it is considerably smaller than Lisbon and Utrecht within the circular area analysed, even though its framing projects (the *"Passante"* and the *"Spina Centrale"*) cover much more area than is visible in the schemes.

The 'bridge' stations are located in areas that took more time to be fully developed. Different parts of these areas are clearly assigned to different historical periods. It is perhaps this *time patchwork* pattern that contributes to the need to reorganize an extensive part of the station area, in order to make it more coherent.

The 'tunnel' stations, on the other hand, are located in areas that were largely developed in the 'expansion' period (from 1850 to 1900), even if other parts were (re)constructed on other phases. These projects present more contained limits, corresponding mostly with the railway infrastructure areas.

The cases of 'viaduct' stations are atypical regarding size patterns. While the case of Lisbon has a large redevelopment area, Amsterdam is mostly bounded within the station islands. Common to both is the fact that the largest part of their territories was redeveloped within one specific period of time. In the case of Amsterdam it's the period until 1850, corresponding to the historic centre part of the station area. In Lisbon, it is the period between 1970 and 2000, corresponding to the Expo98 site development.

Node – It is perceptible that cases with 'adapted' stations have, also at this scale, the densest tram (and or metro, when existent) networks. The offer of car parking is spread over the area in most of the cases, with a clear concentration in/around the close vicinity of the station. In Amsterdam and Utrecht there is also a great offer of car sharing and bicycle parking. Turin and Antwerp also offer some car sharing, as well as bicycle sharing.

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[122] The (re)development projects of 'new' buildings are often related with real-estate development projects of the areas in the vicinity of the station building. Thus, the total amount of areas under (re)development can become considerably large.

Place – In all the cases there is a great variety of uses in the area surrounding the station. Within this sample of six case studies, the 'bridge' and 'tunnel' cases are those who have the most extensive areas dedicated exclusively to residential use. In Utrecht and Basel these areas are mostly located on one of the sides of the railway tracks, while in Antwerp and Turin there is a wider spreading over the whole area. In Lisbon there is also a considerable share of residential use, even though most of the area is devoted to public uses, of the commercial, social and administration clusters. In Amsterdam the residential use is associated with commercial, social facilities and administration uses, granting the area mixed features. The administrative uses concentrate largely around the station buildings in all cases.

4.5.3. Building level

At this scale it is possible to extract noteworthy lessons from the analysis schemes regarding the 'node' and 'place' characteristics of the station and its immediate surroundings. It becomes evident that all case studies improved their spatial performance, even though there are still issues to tackle. Adding to the schemes of the first Set of drawings at 'building' level (Figure 4.14, Figure 4.21, Figure 4.32, Figure 4.38, Figure 4.51, and Figure 4.62), in this subsection the second Set of drawings at 'building' level (Figure 4.70, Figure 4.71, and Figure 4.72) are presented. Both Sets of drawings sustain most of the reflections presented below.

Before the redevelopment project

Node – All the cases of 'bridge' and 'tunnel' stations, as well as the 'viaduct' case of Amsterdam, had transport layout issues to solve requiring a deep restructuring.

The cases of Basel, Utrecht, Antwerp and Turin clearly had a larger concentration of transport modes at one of the sides of the railway tracks. In the case of Antwerp, this grouping was in front of the main entrance of the 'terminal'. Lisbon's case is again atypical, as a 'node' did not exist at that location.

This concentration however was not synonymous of the variety of transport modes, nor did it grant compact distances between them. There were thus limitations on the interchange capacity of these stations. In Amsterdam and Utrecht, there were a great variety of transport modes, but it could be necessary to overcome considerable distances to commute between some of them. In the other cases the variety of modes was more limited, but so were the distances to walk between them.

Place – The exceptionality of the case of Lisbon is obviously also reflected at 'place' level. The existent station and its closest vicinity were *non-places* as described previously in this chapter. In all of the other case studies, the 'place' dimension was less developed than the 'node' one. Even if there were some non-transport related uses in the building, the station was mainly regarded as a transport interchange.

All of the stations were the embodiment of the railway tracks barrier in their cities. Some of the case studies had pedestrian passages that allowed the crossing of the railway tracks. However, the link provided by these passages was not sufficient to generate a real connection between the two separated parts of the city.

After the redevelopment project

Node – In Lisbon a 'node' was created essentially from scratch. The railway was enlarged, a metro line was added (firstly ending at the station and later on extended until the airport), local and long distance busses were relocated to the station, and taxis and car parking were added. All the

Figure 4.70 - 'Building' Set 2 of ‘bridge’ case studies

modes are placed within a compact layout allowing for easy commuting among them. Bicycles are the notable absentees in this case. These are however to be included in the new plan by Joan Busquets for the area.
The other 'viaduct' case, Amsterdam, also has a more compact and clear transport layout. This is achieved with apparent few changes. However, there are important alterations. One is the relocation of busses to dedicated platforms over new land clamed to the IJ. Underneath this new land, a tunnel organizes the car traffic on the IJ side. The assignment of several streets to pedestrians further restricts the car traffic in the area.

In Utrecht, the transport layout also became more compact and clear with apparent small changes. Busses, trams, taxis and cars were reorganized on new platforms parallel to those of the trains. These platforms are all at ground floor level, freeing the upper level for pedestrians. Additionally, an unprecedented number of covered bicycle parking places are being created in the area.
The transport layout of the other 'bridge' case, Basel, was also improved. The former concentration of transport modes in front of the main entrance was replaced by their compact reorganization on both sides of the railway tracks. The restrictions to the car traffic on the Centralbahnplatz also brought benefits for the continuity of the pedestrian space in the area. Additionally, bicycle parking has been created at both sides of the railway tracks.

The most notable changes at 'node' level of the two 'tunnel' cases are the distribution of modes over the area. In both cases there are more transport modes offered, and they no longer concentrated at one side of the tracks. In Antwerp, this meant the dismantling of the former *back side* with the creation of a new station entrance, which also offers transport interchange. In Turin, the railway track barrier at surface completely disappeared, allowing for a freer redistribution of transport modes. The extension of both stations, however, created layouts where big distances between the different transport modes can occur. This is in contrast with the 'bridge' and 'viaduct' cases, which reorganized their transport layout along both sides of the railway tracks, in a very compact manner.

Place – It is clear that all the projects invested in creating extra space for pedestrian movements inside the buildings, as well as in connection with the pedestrian spaces around them, which were also enlarged. These efforts embody the intention to quell the barrier effect of the railway infrastructure in the station area. There are however differences among the cases, as it is harder to create indoor public space in the 'adapted' buildings than in the 'new' buildings. The category of the station also influences these differences. This is thoroughly shown on the 'place' schemes and becomes particularly evident on the second Set of drawings.

'Bridge' stations always imply pedestrian spaces with (at least) two changes of level, one at one side and another at the other side of the railway tracks. The passage above the railway infrastructure serves both the transport access purposes and the urban fabric mending. Thus, its dimensions are important to avoid saturation and consequent inoperability for both functions. Basel and Utrecht (Figure 4.70) analyses illustrate very well this lesson. In Basel, the passage is not wide enough for the pedestrian traffic in the station, requiring additional solutions like the currently proposed tunnel. While in Utrecht, besides the existence of tunnels, the elevated passage has two distinct areas dedicated to pedestrians. One indoor and another covered outdoor, both bordered by shopping opportunities. This duplication allows for a

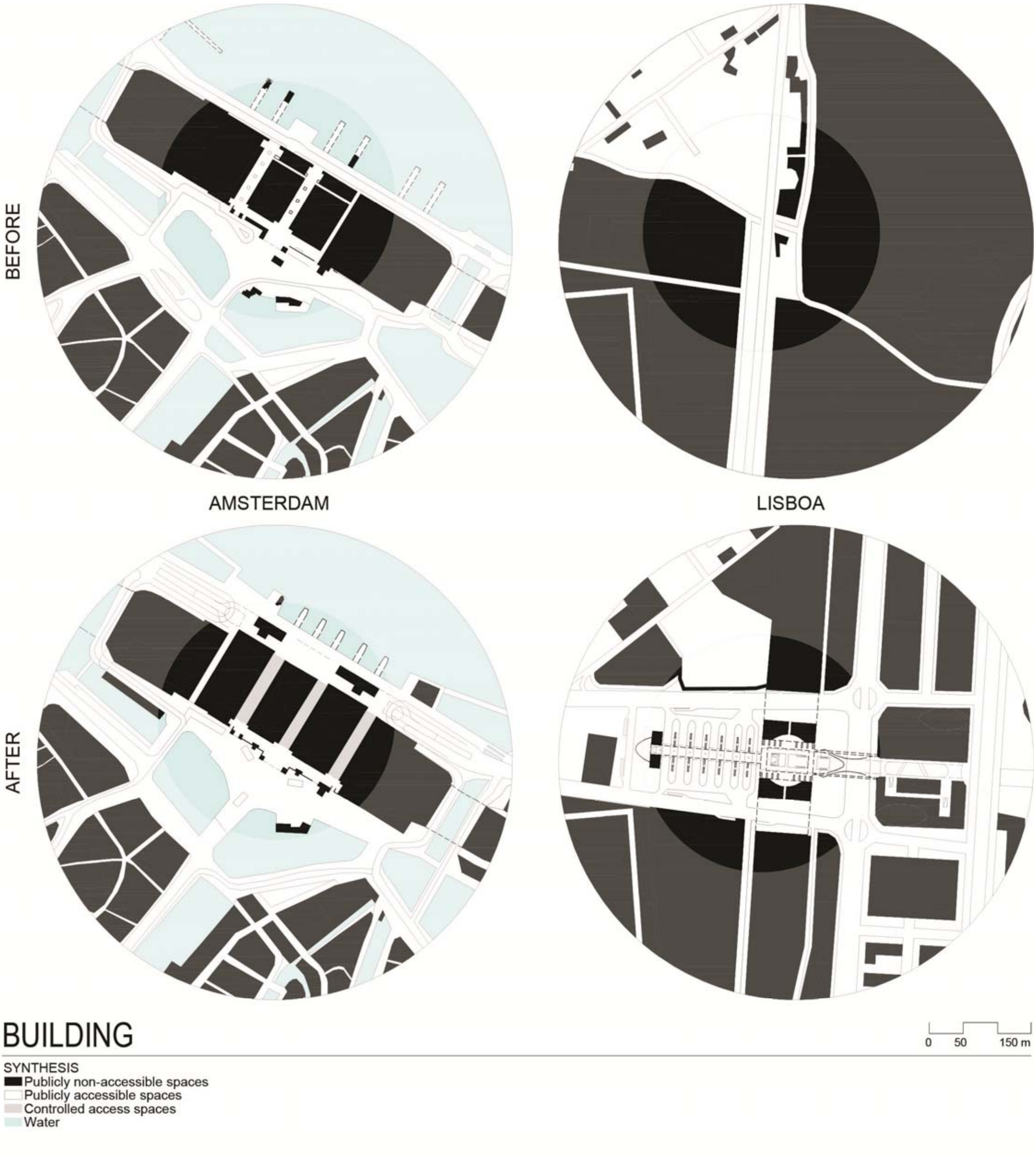

Figure 4.71 – 'Building' Set 2 of ‘viaduct’ case studies

natural distribution of users in the building according to their interests, generating less conflict among them.

The continuity of pedestrian flows crossing 'viaduct' stations is facilitated, as changes from one level to the other are not necessary. Also in this type of stations the dimensions of the areas destined to pedestrians are relevant. In the case of Amsterdam, not only the dimensions are crucial. The lack of alternatives to the tunnel passages and the plan to restrict the access to people in possession of a valid transport ticket jeopardizes the effectiveness of the link between both sides of the station. In Lisbon, on the other hand, there are tunnel and bridge alternatives to the pedestrian zones at ground level, connecting the station building with its urban surroundings and providing transport mode interchange space. Additionally, these spaces have generous dimensions, and have incorporated features of outdoor public spaces. In fact, the inexistence of doors marking the entrance of the station building accentuates the continuity of the public spaces in and outside the building.

The continuity of indoor and outdoor public space in the 'tunnel' cases is also facilitated by the inexistence of railway tracks at surface level. Therefore, it is possible to connect interior with exterior spaces at ground level. This is visible in the analysis of both cases. The project of Turin clearly states the intention of creating such urban interactivity between the building and its urban surroundings. This intention is achieved to a considerable extent, but the new barrier created by the car traffic at 'Spina' hinders it. Further, there is a high concentration of shops inside the station building, contrasting with their scarcity and dispersion in the surrounding area. Consequently, Turin station has the risk of becoming an (shopping) island in the area.
In the case of Antwerp, the layout allows for an indoor and outdoor physical and functional continuity of the pedestrian spaces, as well as of the commercial uses bordering them. The negative effect of car traffic to the spatial continuities has been diminished. Nevertheless, the Zoo continues to hider these continuities, as it creates a barrier in the area. Further, when the shops are closed the place dimension of the station is greatly diminished.

Regarding the uses at this scale, all the cases present a generous offer of shopping opportunities. As the 'place' schemes show, most of them propose layouts of pedestrian spaces which allow for physical and (commercial and services) uses continuity in and around the building. In this way, the barrier and the *back front* effects are diminished, and the stations anchor better in their territories.
The data gathering to build the schemes, foremost the direct observation of the case studies revealed that the uniformity of shops and services offered in all stations can, however, have an undesirable outcome. The many franchise shopping present in most of the stations tend to provide an unreferenced character to these spaces. They tend to look the same. Connecting a station building to, or even bring into it, the features of the surrounding urban area and its city, seems to be important in distinguishing it. This approach of differentiation can be observable in some of the cases. In Amsterdam and Utrecht, by the rearrangement or recreation of the water surfaces, for example. Especially in the 'new' cases, the use of architectural features can also provide such distinctive character. The *trees* train shed in Lisbon, the glass arcade gallery in Turin, the wavy roof of Utrecht Centraal, but also the resemblance of Basel Passerelle's roof profile with that of the mountains that surround the city, exemplify this.

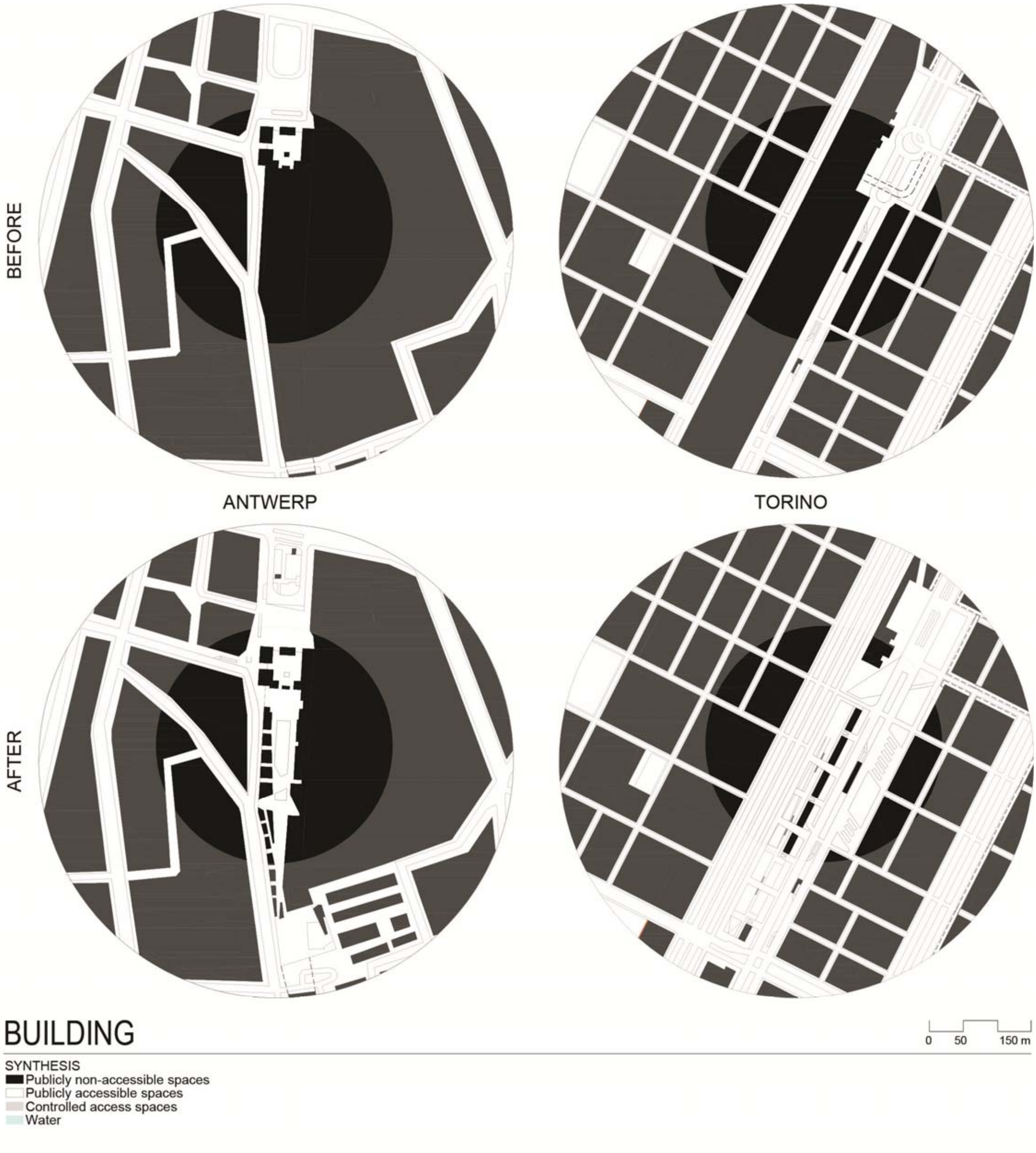

Figure 4.72 - 'Building' Set 2 of ‘tunnel’ case studies

4.5.4. Synthesis

Spatial accessibility and integration, at 'node' and 'place' dimensions, seem to be features sought after in all cases. Some cases achieve this better than others. Further, the cities' different contexts, necessarily produce distinct solutions. The approaches of each city, as well as those of railway (and other) stakeholders, to the redevelopment projects are bonded with their characteristics, such as size, (international / national / regional) importance, complexity and development level of their infrastructure, built-up densities, or specific topography, making each case unique. On the other hand, there is a certain degree of standardization of (commercial) uses offered at station areas, introduced by their redevelopment projects, that standardizes their spaces and detaches them from their (city and or urban surrounding area) spatial context.

At 'city' level the tendency to promote the use of public transport is noticeable, interconnecting the different modes and associating their interchanges with significant urban centres in the agglomeration. This projects a renovated image of the cities as 'nodes' and 'places', while it actually facilitates their users' daily lives.

At 'urban area' level, the analysis shows that the areas around the stations still reflect the effects of the railway infrastructure inflicted barriers. The *front and back side syndrome* is patent in the distribution of sorts of uses in the area, with more mixed and or *noble* uses at the *front side* and less *noble* and or monofunctional (residential) uses at the *back side*. This is something that will possibly only change with time, and after more than only punctual connections between the two sides have been established along the railway infrastructure, and at the stations themselves. Then, both sides can *contaminate* each other, at least to a certain degree.

At 'building' level, the big investment of the redevelopment projects is in establishing the connections between the transport modes and the urban surrounding (divided) areas. In this attempt, the layout of the public spaces inside the buildings tends to be designed incorporating outdoor characteristics and functions, namely those of streets and squares. Shops and other uses were added in an unprecedented way to the interior of European stations. Passages under and above the railway tracks are becoming *streets* and *squares* in continuity with those of the city. At the same time, the layouts that support modal interchange have become more compact under the *same roof*, facilitating travellers' journeys and diminishing spatial barriers.
Some features, however, can hinder the spatial performance of the stations' layouts, such as dimensions, relative positions of elements, etc..

Even if designed with the abovementioned intentions, the resulting spaces can, instead of promoting the connection of the building with its surroundings, potentiate their *divorce*. There is the risk that the station *drains* the life of its surroundings (and elsewhere) when transformed into a *little city* (mostly by the introduction of a shopping centre on the transport 'node'). The risk of the station becoming an island is aggravated when there are large monofunctional areas around the station. The case of Turin can be considered paradigmatic in these respects.
When there is a functional and physical continuity between the station's and its surroundings' spaces, there are more chances for the station to become an integrated part of the city, and more chances for the improvement of the spatial performance of the station area.

The results show that the redevelopment of the analysed case studies improved their spatial performance. However, the analysed stations are still not sufficiently integrated with their surrounding urban areas. Their spatial performance can and should be further improved.

Table 4.3 – Comparative of 'node' and 'place' characteristics of the studied stations ('building' scale - current state).

Case	Node									Place	
	Station users'/day	Train lines	Train platf.	International destinations	Metro lines	Tram lines	Bus lines	Car park	Bicycle park.	Functions types	qty
Basel (a)	135000	37	17+4	France, Germany Italy, Netherlands Praha, Moscow	-	7	4	518	1650 +	Restaurants/ snacks/cafés, book shops, telecommunication shops, flower shops, hairdressers, conference spaces, clinic, services*	37
Utrecht (b)	284000 (in 2025: 360000)	31	11+3	Basel, Zurich, Frankfurt , Munich, Copenhagen Warsaw, Praha	-	1	35	1535	16700 +	Restaurants/ snacks/cafés, book shops, flower shops, supermarket, offices, services*	34
A'dam (c)	250000	26	10+2	Basel, Berlin, Warsaw, Copenhagen Prague, Brussels, Antwerp, Paris, London	3+1	10	30	434	10000	Restaurants/ snacks/cafés, book shops, flower shops, natural products, conference spaces, hotel, offices, supermarket, services*	50 +-
Lisbon (d)	150000 (capacity: 200000)	14	8(+4)	Spain, France	1	-	37	2750	-	Restaurants/ snacks/cafés, pharmacy, clinic, hairdressers printing, cloth/ shoe shops, rent a car, temporary work space, supermarket, services*	48 +-
Antwerp (e)	33.641	25	6+4+4	Netherlands, Paris	5	3	8	1600	2900	Restaurants/ snacks/cafés, telecommunication shops, flower shops, cosmetics, diamonds, conference spaces, rent a car, supermarket, services*	71
Turin (f)	15000 (expansible to: 35000 / 70000)	8	6	Paris, Lyon	1	2	8	1047	-	Restaurants/ snacks/cafés, services*, unknown	28

(a) – (Parkhäuser Basel-Stadt, 2013; SBB/CFF/FFS, 2011, 2013c; Tarifbund nordwestschweiz, 2011; Veloparking, n.d.)
(b) – (Gemeente Utrecht, n.d.; Gemeente Utrecht, Corio, ProRail, NS, & Jaarbeurs, 2012; GVU, 2012; Parkeren in de Stad, 2013)
(c) – (Amsterdam Centraal, 2011; Gemeente Amsterdam, n.d; GVB, 2012; ProRail, n.d.)
(d) – (Carris, 2012; emel.pt; Mourato, 2013; Parkopedia, 2013; Parque das Nações, 2013; REFER, 2010;
(e) - (Belga, 2013; De Lijn, 2012;. Gemeentelijk Autonoom Parkeerbedrijf Antwerp, n.d.; Sclep, 2011; Velo, n.d.).
(f) - (Bestinparking, n.d.; Ciocchetti et al. 2011, pp 136; Ferrovie dello Stato Italiane (2008); Gruppo Torinese Trasporti S.p.A., 2012a, 2012b; n.d.)
* - Services, such as: toilets, ticket office, lockers, tourist information, police station, etc..

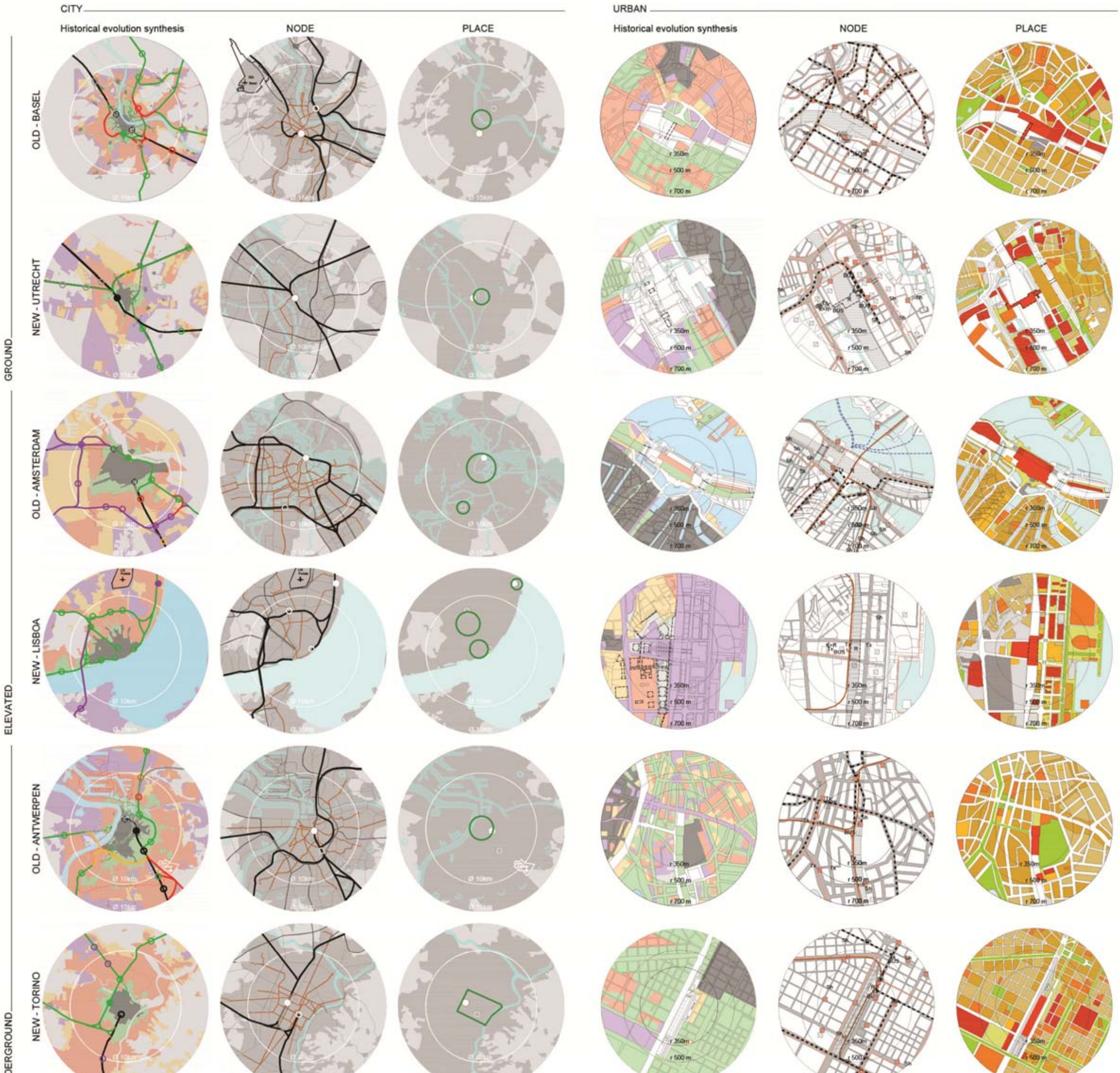

Figure 4.73 - Comparative of the graphical analyses of the case studies


BUILDING - BEFORE
NODE
PLACE
Synthesis
BUILDING - AFTER
NODE
PLACE
Synthesis

Table 4.4 - Overview of the results of the analysis of the case studies

Railway Station	Level	Cases	Ground BRIDGE: Node	Ground BRIDGE: Place	Cases	Elevated VIADUCT: Node	Elevated VIADUCT: Place
			> strong impact on urban surroundings > relatively easy to redevelop the railway tracks > passers-by must change level to cross the tracks			> soft impact on urban surroundings > hard to redevelop the railway tracks > no level change for passers-by to cross the tracks	
			Node	Place		Node	Place
OLD	City	Basel	- station area located at the crossing of a variety of (important) transport networks - promotion of public transport use (policies) - (inter)national + local destinations	- close link to city historic centre - city renovation / marketing	Amsterdam	- station area located at the crossing of a variety of (important) transport networks - promotion of public transport use (policies) - (inter)national + local destinations	- close link to city historic centre - city renovation / marketing
OLD	Urban	Basel	- (dense) transport networks conforming urban physical barriers	- attempt to enhance the functional and physical coherence of the urban area - redevelopment plan of considerable extent, but fragmented, intervention	Amsterdam	- (dense) transport networks conforming urban physical barriers	- attempt to enhance the functional and physical coherence of the urban area - redevelopment plan of limited area of intervention
OLD	Building: Virtues	Basel	- compact layout (small distances between transport modes) - creation of bicycle parking	- introduction of a prominent *back entrance* (contributing to diminish the *front back syndrome*) - several car free pedestrian routes across the area	Amsterdam	- compact layout (small distances between transport modes) - clear layout (clear-cut organized, e.g. relocation of bus lines on new platforms at railway tracks' level) - creation of extra bicycle parking	- creation of space to stay at the *front* and at the *back* of the station - several car free pedestrian routes in the area / tunnelling of some routes - hardly any undeveloped areas in the surroundings
OLD	Building: Shortcomings	Basel	- layout not readily clear - coincidence of the areas dedicated to access transport and non-transport uses (under dimensioned for all the pedestrian flows, e.g. 'Passerelle' not wide enough)	- many undeveloped areas in the surroundings - pedestrian routes across the area (and its barriers) limited by physical and functional characteristics (e.g. use of the underground bicycle parking and tunnels to overcome major traffic barrier; discontinuity of non-transport uses in the area) - non-transport uses are mainly commercial	Amsterdam	- coincidence of the areas dedicated to access transport and non-transport uses (under dimensioned for all the pedestrian flows)	- limitation of access to the pedestrian tunnels destroys the intended connection of the *front* and *back* of the station - non-transport uses are mainly commercial
NEW	City	Utrecht	- station area located at the crossing of a variety of (important) transport networks - Promotion of public transport use (policies) - (inter)national + local destinations	- close link to city historic centre - city renovation / marketing	Lisbon	- station area located at the crossing of a variety of (important) transport networks - Weaker promotion of public transport use (policies) - mainly national + local destinations	- distant link to city historic centre - city renovation / marketing
NEW	Urban	Utrecht	- (dense) transport networks conforming urban physical barriers	- attempt to enhance the functional and physical coherence of the urban area - redevelopment plan of considerable extent intervention	Lisbon	- (dense) transport networks conforming urban physical barriers	- attempt to enhance the functional and physical coherence of the urban area - redevelopment plan of considerable extent intervention
NEW	Building: Virtues	Utrecht	- compact layout (small distances between transport modes) - clear layout - diversity of options to access transport uses (tunnels + bridge)	- pedestrian routes across the area (and its barriers) enhanced by physical and functional characteristics (e.g. clear separation of the station and adjacent buildings; rehabilitation of the Catharijnesingel; link between the cultural uses at both sides of the railway tracks; generosity of dimensions) - hardly any undeveloped areas in the surroundings - several car free pedestrian routes in the area - varied non-transport uses in the area	Lisbon	- compact layout (small distances between transport modes) -clear layout - diversity of options to access transport uses (tunnels + bridge)	- multilevel, generously dimensioned, physically and visually linked spaces, providing room (and flexibility) for events (variety of possibilities to perform *"optional"* and *"social"* activities) - openness of the building, emphasizing its (physical and functional) continuity with its urban surroundings
NEW	Building: Shortcomings	Utrecht	- new bicycle parking under the east square hard to maintain socially safe	- spaces under the west square (and adjacent areas) hard to maintain socially safe	Lisbon	- no bicycle parking	- undeveloped *back side* of the station - priority given to cars

Underground
TUNNEL

> very soft impact on urban surroundings
> hard to redevelop the railway tracks
> no level change for passers-by

	Node	Place
Antwerp	- station area located at the crossing of a variety of (important) transport networks - promotion of public transport use (policies) - (inter)national + local destinations	- close link to city historic centre - city renovation / marketing
	- (dense) transport networks conforming urban physical barriers	- attempt to enhance the functional and physical coherence of the urban area - redevelopment plan of limited area of intervention
	- creation of bicycle parking and placement of bicycle sharing - clarity of layout (creation of multilevel extra train platforms, physically and visually linked to existing ones) - improved access to transport (dedicated spaces + addition of new entrances)	- new entrance of the station is a space for events - the station's redevelopment was a motor for further urban redevelopment -several car free pedestrian routes in the area
	- big distance between the two main entrances, and thus between transport modes	- consolidation of urban surroundings still necessary - railway tunnel didn't bring radical improvement of the barrier. (railway continues to affect the territory largely in the same way it did before the redevelopment)
Turin	- station area located at the crossing of a variety of (important) transport networks - Promotion of public transport use (policies) - mainly national + local destinations	- close link to city historic centre - city renovation / marketing
	- (dense) transport networks conforming urban physical barriers	- attempt to enhance the functional and physical coherence of the urban area - redevelopment plan of considerable extent intervention
	- placement of bicycle sharing - dedicated spaces for transport access	- creates streets with non-transport (shopping) uses inside the building - few undeveloped areas in the surroundings
	-big distances between transport modes - layout not readily clear	- does not entirely succeed to provide connections of the streets inside the building with those outside, as intended - priority given to cars

PART TWO - DESIGN

5. IMPROVING SPATIAL PERFORMANCE

This chapter presents the ‘design recommendations’ proposed by this research for the improvement of the spatial performance of HST station areas. Before presenting the ‘design recommendations’, the contribution of the use of *“research by design”* towards their definition is discussed. The *“research by design”* approach to address the spatial performance of European station areas, within the context of their current reconceptualization, was utilized by this research in two occasions. Firstly, in an initial preparatory exercise on the reconceptualization of station areas, which helped to explore the field of research and clarify its focus and method. Secondly, in a final propositional reflection, in which solutions were sought by designing for the spatial problems identified in the analyses of case studies presented in the preceding chapter.

The first section in this chapter reports on the preparatory exercise and on the redesign of the analysed case studies done in this research. The second section presents the ‘design recommendations’, which are based on the learning done from the synthesis of the available knowledge and the analyses of case studies, together with their redesign presented in the first section of this chapter.

5.1. Rethinking the railway station area

The explorative exercise on the reconceptualization of station areas, reported in the first subsection, was done with graduate students. The exercise was done in parallel with the early surveys of this research, preceding the analyses of the six case studies. It aimed to contribute to the rethinking of the railway station area in an urban scenario, through the research of new design approaches. By doing so, the exercise intended to set provisory ‘design recommendations’. These were to be tested and confirmed with the analysis of the research’s six case studies, leading then to a final set of ‘design recommendations’.

Although the results of the exercise were insufficient in establishing provisory ‘design recommendations’ to improve HST European station areas’ spatial performance, the exercise was a fruitful experience that is worth mentioning in this thesis. It contributed to the final definition of the ‘design recommendations’ by helping to identify focal issues for the overall research to address and stressing the need for a systematized graphical method to do it. This led to the development of the graphical analyses method adopted by the overall research.

The redesign of the analysed case studies is reported in the second subsection. After the analyses of the case studies, presented in the preceding chapter, each case was subject to a redesign proposal. These designs aimed to test the possibilities to diminish the shortcomings and enhance the virtues of the case studies’ spatial solutions. The redesigns have proven to be a valuable method to demonstrate the relevance of architecture in the improvement of the station areas’ spatial performance.

5.1.1. Preliminary exercise with students

It was proposed to students to explore how architectural design can improve the performance of the spaces of station areas in different cultural and physical contexts. For this, two cities in Europe, Amsterdam and Lisbon, were chosen as case studies. Students tried to find innovative spatial design solutions to improve the spaces of these station areas.

The exercise was carried out within the graduation studio MSc3 of 'Hybrid buildings' at the Architecture Faculty of Delft University of Technology, in the academic year of 2009-2010.
Students were invited to address the problem using two research approaches, sequentially in two stages: *"design research"* and *"research by design"*, as described below.

Design Research – Analysis

In the first stage of the exercise, several HST European projects were studied in order to learn from them. Students were divided into five groups, each assigned to one case. Their problems, opportunities and proposed solutions, from urban level to building level, were analysed. The chosen cases were the stations of: Breda Centraal in Breda, the Netherlands; Gare do Oriente in Lisbon, Portugal; Torino Porta-Susa in Turin, Italy; and Stuttgart Hbf and Berlin Hbf in Germany (Figure 5.1). These projects were selected because they present several innovative design solutions for the integration of the building with its urban surroundings[123]. They are all 'through' stations, which is the type of the majority of European HST stations within an urban context, to which this exercise was limited.

To complete the learning from the design solutions of the above mentioned projects and prepare the next stage of the research, other actions were carried out. Meetings and lectures with (academic) experts and authorities were organized. Data about the two locations proposed for the second stage of the work, was gathered and analysed. The two sites were visited and subjected to morphological, infrastructural, social and economic analysis. The results from these analyses, together with inputs from experts and authorities, provided the knowledge for the development of the second stage of the exercise.

Research by Design – Design

In the second stage of the exercise, having systematized the results obtained in the first research stage, students proceeded individually on the *"research by design".* In this stage each student developed a design proposal for one of the two studied locations: Entrecampos in Lisbon, and Zuidas in Amsterdam (Figure 5.2). Both sites do not have projects for a HST station building, even if in the case of Amsterdam this is the chosen location for it. This absence of projects was considered beneficial for the exercise, as their existence could limit the students design options. Also, this choice introduced different cultural and physical contexts to the design task, in order to explore if and how they influence it. Through the design of a Masterplan and later, of a station building, students further investigated innovative spatial solutions for station areas.

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[123] The criteria for the choice of this sample of cases differ from that used to choose the final group of six case studies to be analysed in this research. However, both samples include the cases of Lisbon and Turin. In the exercise with students there were no restrictions to the development stage of the project, nor to categories of station areas, which hadn't been defined at that moment. The research's six case studies were chosen among built cases, or in advanced stage of completion, thus, Breda and Stuttgart couldn't possibly be selected. Berlin and Turin cases were both classified as 'tunnel' stations, thus only one could be part of the final sample.

Breda (Koen van Velsen)

Berlin (Marcus Bredt)

Lisboa (2012)

Turin (Arep & Silvio D'Ascia)

Stuttgart (IngenhovenArchitekten)

Figure 5.1 – The five reference cases of the exercise

Zuidas (www.zuidas.nl)

Entrecampos (www.skyscrapercity.com)

Figure 5.2 – Aerial photographs of the locations for the exercise's design stage.

The conducted research led to the results and conclusions described below, per stage.

Analysis – Reference Cases

In the analysis of the projects of Breda Centraal, Gare do Oriente, Torino Porta-Susa, Stuttgart Hbf and Berlin Hbf, two issues emerged as being relevant for the success of the station building and its surroundings. There is a great focus of these projects in solving the **barrier effect**, created by the transport infrastructures onto the urban space; and in offering a **functional mix layout** able to support a lively environment in the building spaces.

Spatial solutions to respond to these aims vary among cases, but some tendencies are observable. Regarding the barrier effect, these projects either bury the rail infrastructure or elevate it to a level higher than that of the streets. Regarding the functional mix layout, many different uses are added to the transport offer, and their spatial organization presents urban characteristics. The classical uses are the shopping areas, but there are also offices, services and even housing within the station building as in Breda. Further, the way the planning processes of the case studies were conducted differs, seemingly depending on their specific cultural and physical contexts.

Design – Lisbon / Amsterdam

The following phase of the exercise, the *"research by design",* focused on the search for spatial proposals that could provide solutions for the barrier effect and the functional mix layout issues.

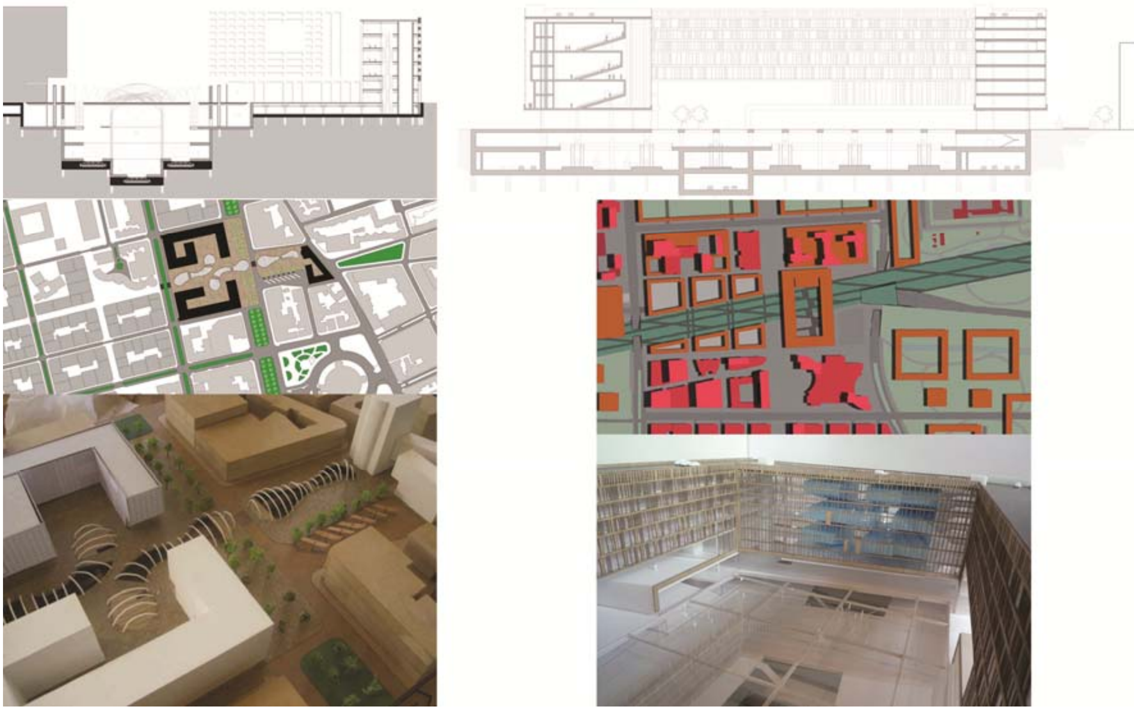


Figure 5.3 – Lisbon station area by Macedo Juca (2010) and Amsterdam station area by Buurman (2010)

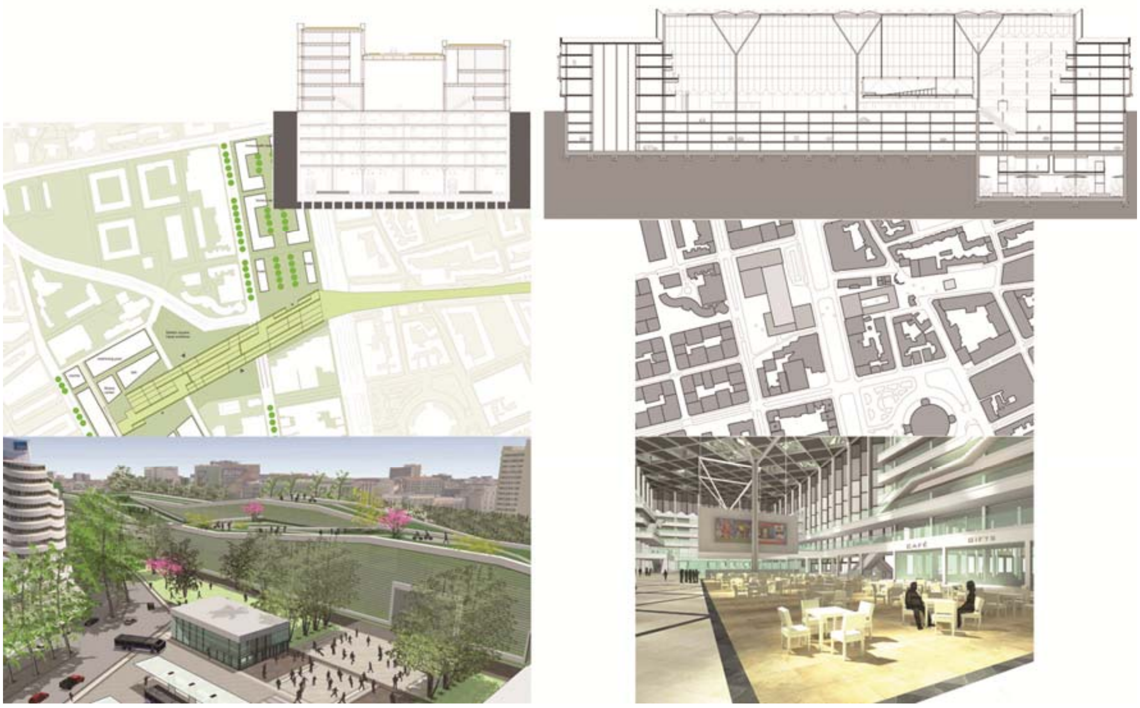


Figure 5.4 - Lisbon station area by Plugge (2010) and by Cheung (2010)

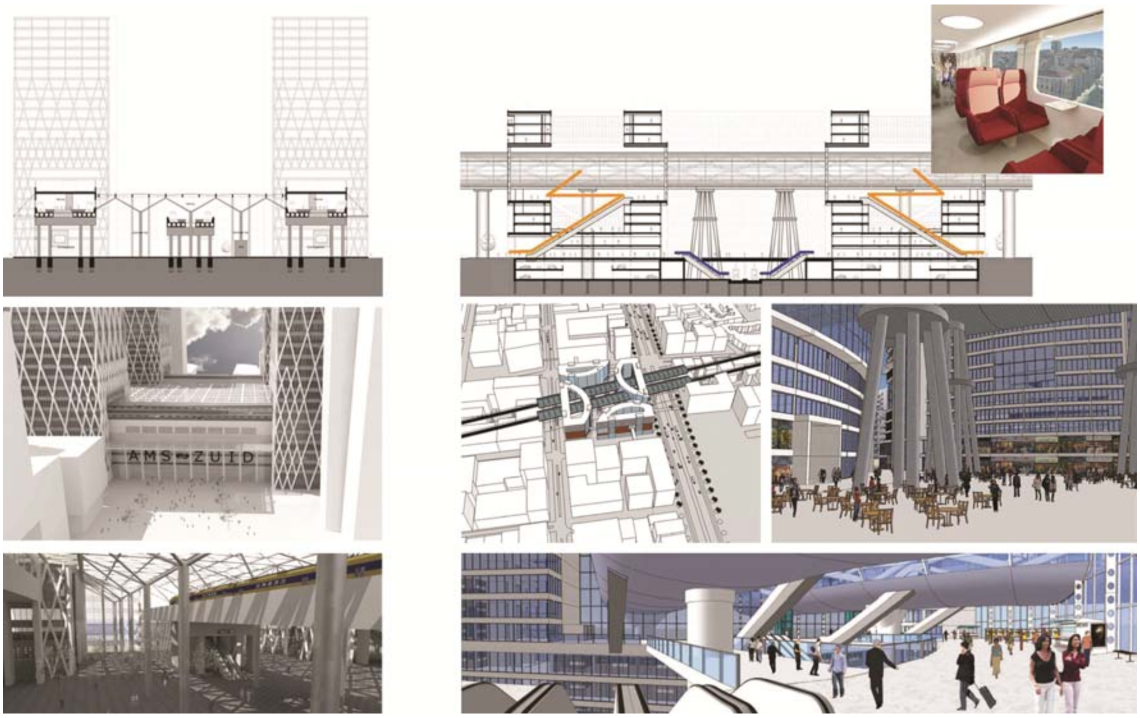


Figure 5.5 - Amsterdam station area by Vugrinec (2011) and Lisbon station area by Bouma (2011)

Again, the burying of rail infrastructure was the most chosen for option. It is argued that in this way it is easier to integrate the station building in the city. This solution was advocated for both sites. Even if in some cases (Figure 5.3) there is an attempt to maintain a strong (visual) connection to the railway tracks (Buurman, 2010; Macedo Juca, 2010), and in others (Figure 5.4) the railway tracks are completely secluded from any relation with the city (Cheung, 2010; Plugge, 2010). In contrast, is the choice to position the rail tracks higher above street level (Bouma, 2011, Vugrinec, 2011). This option (Figure 5.5) arguably promotes the relation of passengers with the city, contrary to the solution of burying the railway tracks. However, it increases the problems of access between street and platform, as the train tracks are positioned very high in relation to the ground level.

Regarding the 'functional mix layout' the proposals offered varied solutions from shopping, office, services and housing to entertainment facilities such as theatres and cinemas, University facilities, conference centres, green corridors, etc. Urban like layouts, within the station building, organized these uses in space.

Conclusions

The different cultural and physical contexts of the projects' locations do seem to play a role in the way planning processes are conducted. However, their influence seems to be more limited in the found spatial solutions. The latter tend to have common features among the cases, independently of their contexts. Both the analysed cases and the students' designs, follow a general tendency to integrate the station building with the urban area that surrounds it.

The degrees of success of this intent vary, but it is observable that a hybrid space of the station building with the urban space of the city is forming. Formerly, station buildings and city were clearly separated entities. The frontier between the two is not so obvious anymore when projects aim at integration between them. The station is no longer a conventional building, but it is also not transformed into a conventional urban space. Both the elimination of the barrier effect, and the variety and layout of the functional mix contribute to this *fusion* and to the creation of a new hybrid space. But this can also generate new problems. By gaining urban features, the station building is in some cases becoming a little city within the city, which can drain out the latter instead of creating bonds with it.

The methodology followed by the exercise, however, did not clarify how exactly the features of the analysed station areas contributed to the success of their spatial integration. Studying the characteristics of the station areas' design options without mapping their spaces, did not allow for the extracting of detailed information such as their spatial relations and implications to the quality of the station area's spaces. Thus, the students' designs build on limited information, and consequently the learning done from this experience wasn't as detailed as expected.

Nevertheless, the clarification of the direction that the reconceptualization of station areas is taking towards a hybrid space, was an important contribution of the explorative exercise to the overall research presented in this thesis. By highlighting the search for the definition of such hybrid space by the manipulation of their physical and functional layouts, the exercise made evident the scope of the overall research, as well as the need to approach it using graphical instruments of analysis.

5.1.2. Re-designing the case studies

The results of the analysis of the redevelopment projects' cases, described in chapter four, whose overview is presented in Table 4.4, showed the virtues and shortcomings of their spatial solutions. Some of the identified problems have been addressed in redesign proposals, either by the projects' promoters themselves or by other stakeholders. This research has also used redesign to assess the projects' virtues and shortcomings and investigate their possible spatial improvement. The redesign process of the research was thus developed at building level, and took into account the redesign proposals made by promoters and or stakeholders of the case studies, incorporating some of them into the research's redesign proposals.

The redesigns of the case studies proposed by this research were developed at the 'building' level. They are presented in a Set of drawings (Figure 5.6) which comprises 'node', 'place' and 'synthesis' schemes similar to those presented in chapter four. While the schemes in chapter four (Sets 1 and 2 at building level - Figure 4.7) regarded the analyses of the layouts of station areas 'before' and 'after' the redevelopment projects, the schemes presented in this chapter can be seen as a proposed 'future' layout. In the 'future' layout, the shortcomings and virtues found in the analyses of the cases have been addressed. Therefore, it can (potentially) improve the spatial performance of the station area. Each Set of drawings proposing 'future' layouts groups the 'node', 'place' and 'synthesis' schemes of the case studies belonging to the 'bridge', 'viaduct' and 'tunnel' categories. The 'future' schemes can be read in conjugation with the 'before' and 'after' ones, for a better understanding of the proposed changes. For a quick comparison, Figure 5.10 presented at the end of the first section of this chapter, which gathers the redesign schemes for all case studies, can be read in combination with the summary of analyses schemes for the 'before' and 'after' layouts, gathered in Figure 4.73. Additionally, Table 5.1 displays an overview of the redesign proposals for a 'future' layout.

Despite the fact that the cases of 'adapted' station buildings offer more limitations to spatial transformation than cases built 'new', and that 'new' cases can be expected to respond better to current demands, the fact is that both categories of cases presented spatial shortcomings as well as virtues. Neither of them have optimal spatial performance. When analysing the cases according to their type, common types of solutions are identifiable.

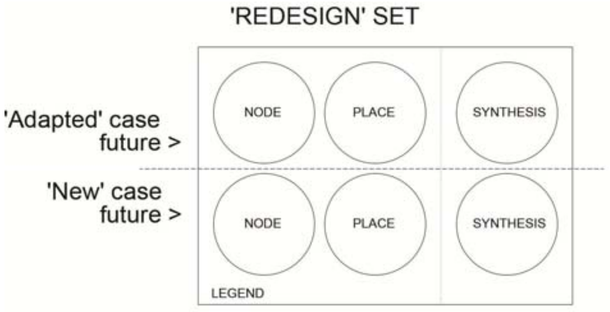


Figure 5.6 - Structure of the Sets of drawings for the redesign proposals

'Bridge' stations (Figure 5.7)

The railway infrastructure on ground level obviously implies a change of level from the street one if one wants to cross the bundle of tracks. Bridges and tunnels are used to do that. While the tunnels are an efficient way to cross the tracks and to access them, they are also spaces hard to be made pleasant. The difficulty into bringing a reasonable amount of natural light into such spaces is one reason why they are not regarded as places to stay. On the contrary, the bridge solution conforms better to such needs, but it is slightly less efficient for the transport transfer function than the tunnel under the railway tracks. The distances to overcome become greater as to go over the trains requires considerable height differences.
The analysis of cases shows that the combination of both solutions works better than reducing the possibilities of crossing the railway tracks to just a bridge or a tunnel. The dimensions of these spaces must be sufficient to accommodate the amount of 'node' and place' flows that need to use them, otherwise conflicts occur. The points where level changes occur, for example (mechanical) stairs, ramps, and elevators, are particularly important, as they can strangulate these flows. Further, these points are sensitive ones, as they can generate residual spaces, which might become unsafe parts of the station and or its immediate surroundings.

In Basel, the Passerelle, being the exclusive crossing of the tracks within the station, has proven to be insufficient for this purpose. Its dimensions do not facilitate the harmonious coexistence of the travel and non-travel related pedestrian flows (Figure 4.14 and Figure 4.70). The redesign of this case (Figure 5.7) shows that the Passerelle could have been designed (at least) as wide as the old station hall. The stairs that connect it to the hall could also be wider and the ramp placed on a side position. The lack of space does not allow placement of the ramp that would follow the natural pedestrian flow, similar to what happens at the south entrance.

In Utrecht the project offers several options to cross the railway tracks at the station area. It does not force people to go inside the station to cross the area. On the other hand, the creation of large elevated pedestrian areas covering spaces at ground level with uncontrolled access by people (contrary to the inaccessible train tracks), generate locations which can become dangerous in the station area.

The railway infrastructure barrier is not the only barrier to the pedestrian flows in these station areas. Heavy traffic roads, unclear routings towards the centers of the cities, etc., can also create barriers. In Utrecht that was acknowledged, and the proposal seems to solve it to a great extent. The proposal includes the suppression of the car highway and tunnels, the consequent reconstruction of the Catharijnesingel, and the pedestrainization of its margins (Figure 4.21 and Figure 4.70). There is also improvement planned for the route between the historical center, the station and the Jaarbeurs side. The station is now wider, and inside it the routing connecting both sides of the railway tracks is more direct and clear than previously. The Hoog Catharijne shopping center is now also less labyrinth like for those choosing to go through it to cross the area. Nevertheless, this connection could be even more direct. To this end, the redesign of this case study (Figure 5.7) proposes the widening and alignment of one corridor inside the shopping center, as well as of the new covered outdoor *street* of the station.

In Basel the barrier formed by the Nauenstrasse and the viaduct that separate the station complex and the older part of the city is quite relevant (Figure 4.14 and Figure 4.70). On the viaduct, there is a sidewalk allowing pedestrians to go from the city historical center towards the station complex, and vice-versa. However, this pedestrian continuity is subjugated to the car traffic. This pedestrian connection should be reinforced, especially considering the recently proposed tunnel under the railway tracks. The planned tunnel will link the south square, in which starts the Passerelle over the tracks, with the area of the Markthall and the viaduct, on the north side (Figure 4.11 and Figure 5.7).
The referred axis was the focus of attention in the *"Central Park"* project (Figure 4.10). This project proposed the construction of a garden over the railway tracks between the Passerelle and the Margarethenstrasse Bridge. The garden would become an extension of the Passerelle, in which shops would be opened to the new green area. However, there was no proposal to spatially solve the barrier posed by the Nauenstrasse's viaduct to the continuity of this pedestrian axis towards the city center. This is indeed a very delicate problem which requires a restrictive car traffic policy for the area, and interdisciplinary design work to put it into practice. The available space and the existence of a car tunnel under the Nauenstrasse make such an operation a very complex one.

Both the *"Central Park"* project proposed by a group of citizens, and the new tunnel under the railway tracks proposed by the railway company, could be fitted into the research redesign proposal. However, considering that the *"Central Park"* project was recently rejected in a referendum held by the city, only the tunnel project was adopted in the redesign proposed by the research. The redesign exercise (Figure 5.7) led to the proposal of the widening of the car tunnel under the Nauenstrasse to absorb more traffic, and the reduction or even suppression of car lanes at surface level, allowing for the use of the viaduct mainly as a pedestrian and cycle-able connection.

'Viaduct' stations (Figure 5.8)

When the railway infrastructure is placed on a higher level than that of the ground level, it is possible to use the street level to overcome the tracks, making it unnecessary to use bridges and tunnels for that purpose. The continuity between the urban fabrics of the two sides of the city can thus be considerable, as it sustains the natural pedestrian flows at street level. Despite that, elements such as tunnels and bridges are often used to complement the street level connections, especially when car traffic is present. The access to the railway tracks requires people to use stairs, elevators, or ramps to reach their elevated level from the ground floor.

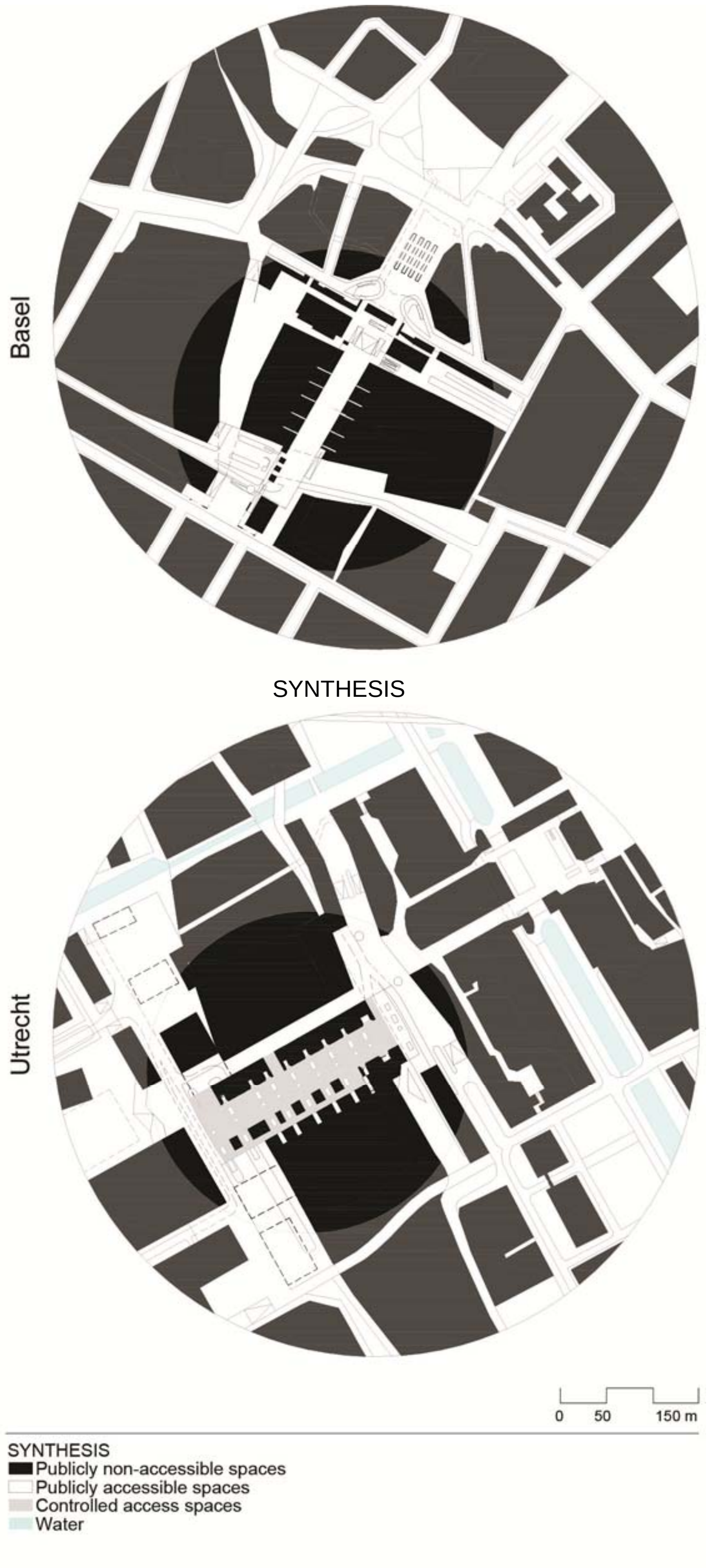
In the case of Amsterdam, both the railway and road barriers are not located at ground level in the redevelopment project (Figure 4.32 and Figure 4.71). The pedestrian passages at ground floor level, similar to tunnels, are used to cross and access the train tracks. These passages will all have shops and equivalent wide dimensions. However, in case the access control gates are kept, the passages won't be supporting the non-traveller pedestrian flows. In this way the barrier formed by the station complex is not fully going to disappear, and the shops located in the passages will only serve those in possession of traveller cards.

In order to improve the building spatial performance, the research has developed a few proposals using redesign (Figure 5.8). At least the central passage should not be gated at its ends. Instead, the gates should be placed at each stair accessing the platforms. This passage is wide enough to do that, won't have elevators, and the eventual strangulation of travellers' flows created by the gates new position could be alleviated by the following initiative. The creation of extra pedestrian passages, in between the middle and the edge ones, exclusively dedicated to travellers, without shops and gated at both ends, would provide an escape route for commuters acquainted with the space and in a hurry. The middle tunnel would then be regarded as a slower area, and thus more appropriate to feed the 'place' dimension of the station. The 'place' dimension would also be facilitated by such a passage, which would smoothen the connection between the city centre and the waterfront.

In Lisbon the connection problem is put in different terms. The station building does not create a barrier. The open character and generosity of dimensions of its public spaces, as well as their multiple levels, deconstruct the barrier effect the station complex could produce in the urban area. The problem here is the fact that there is actually no real (urban) *back side* of the station (Figure 4.38 and Figure 4.71). The undeveloped land in the station's urban surroundings introduces the discontinuity in the area. Thus, it is important to develop the vacant lots. The layout of the Urbanization Plan of Joan Busquets (Câmara Municipal de Lisboa, 2010) deals with this question very efficiently. Therefore it was adopted, with slight changes, in the research's redesign proposal (Figure 5.8). The symmetry axis of the station, which corresponds with its main pedestrian circulation streets, is elongated through the block proposed by Busquets on the west side of the station.

Further, the comfort level of travellers is still an issue in this case study, despite the addition of waiting rooms and toilets done in 2006 (Cerejo, 2006). Wind screens at the train and busses platforms would enhance the travellers' experience.

Figure 5.7 – 'BRIDGE' case studies' redesign Set


Basel
SYNTHESIS
Utrecht
0
50
150 m
SYNTHESIS
Publicly non-accessible spaces
Publicly accessible spaces
Controlled access spaces
Water

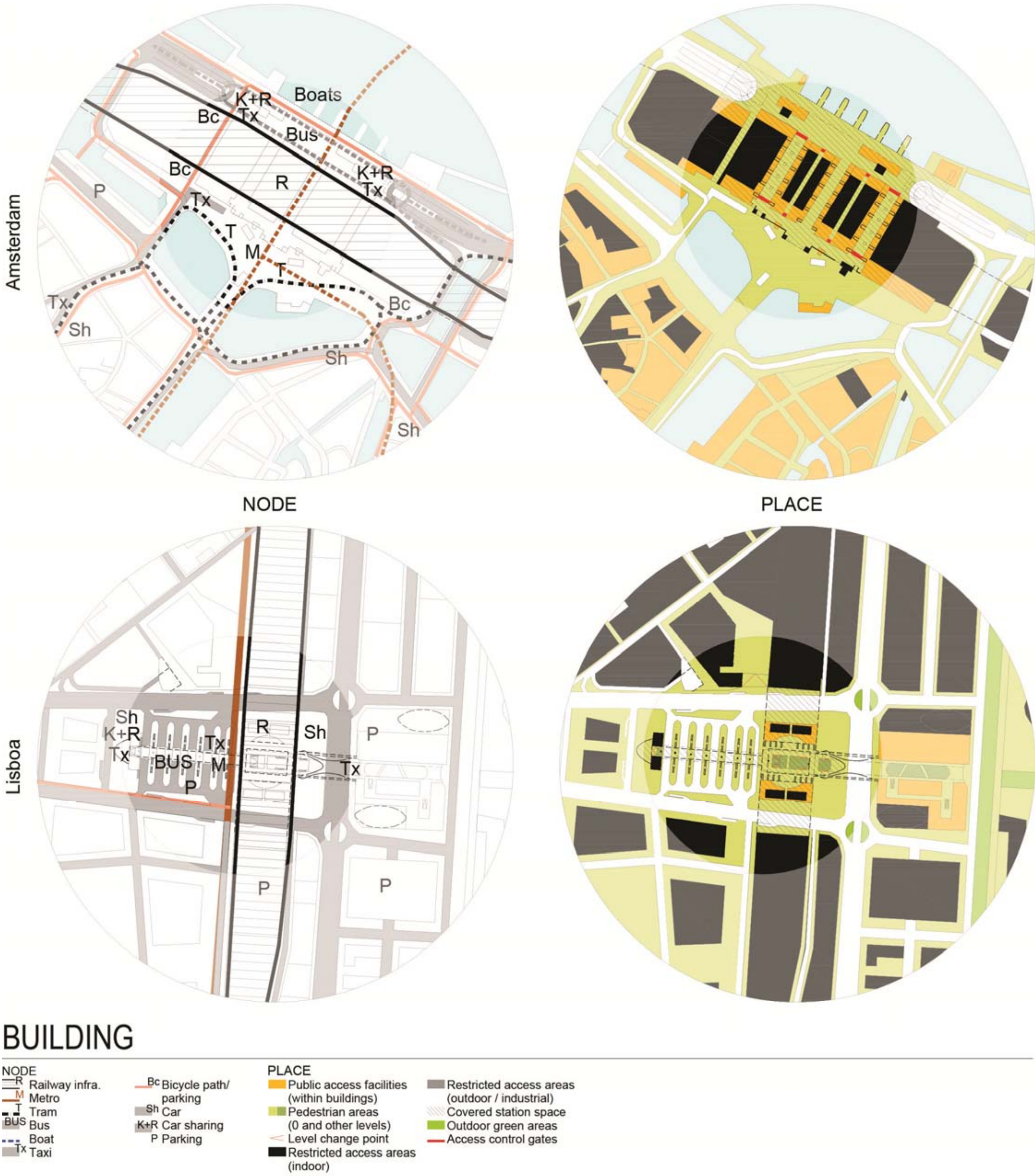
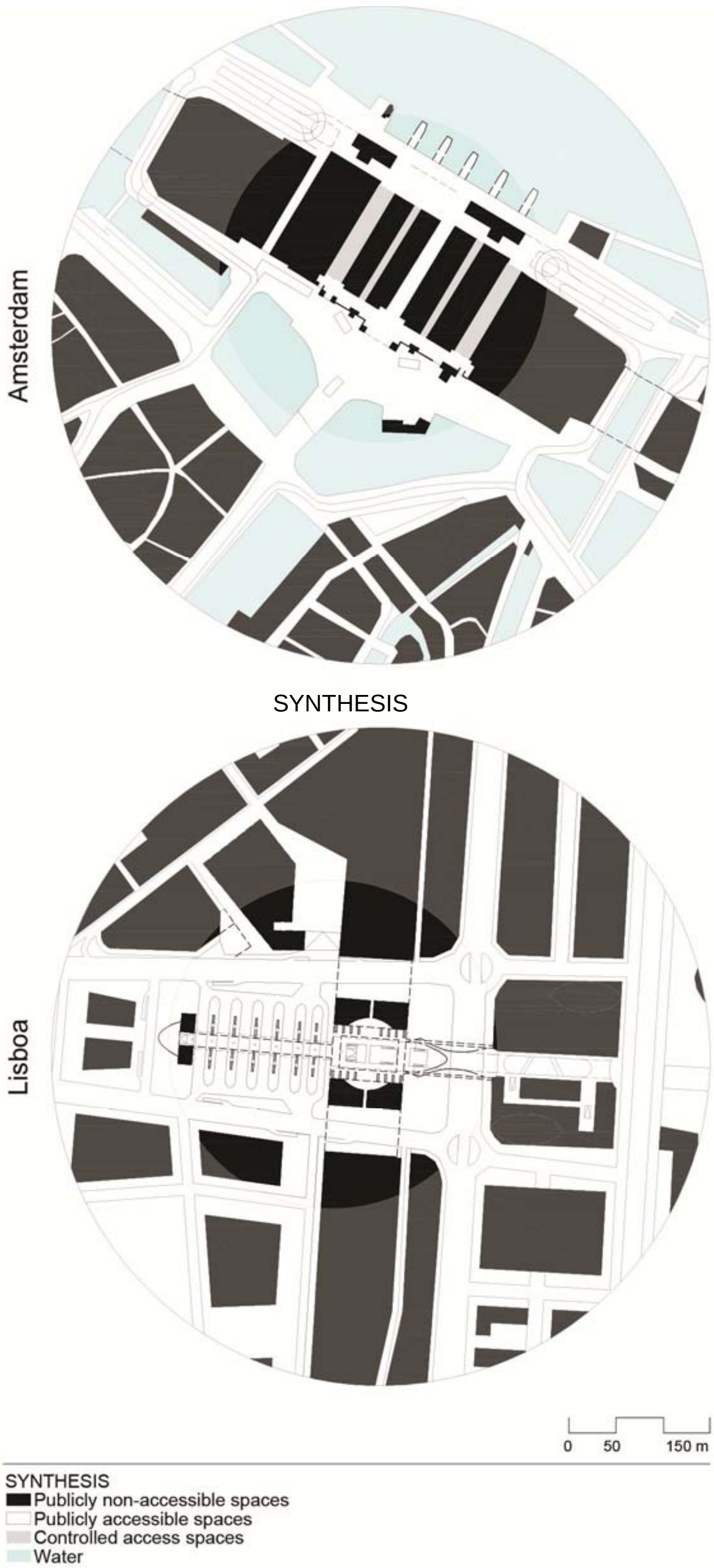


Figure 5.8 – 'VIADUCT' case studies' redesign Set


Amsterdam
SYNTHESIS
Lisboa
0
50
150 m
SYNTHESIS
Publicly non-accessible spaces
Publicly accessible spaces
Controlled access spaces
Water

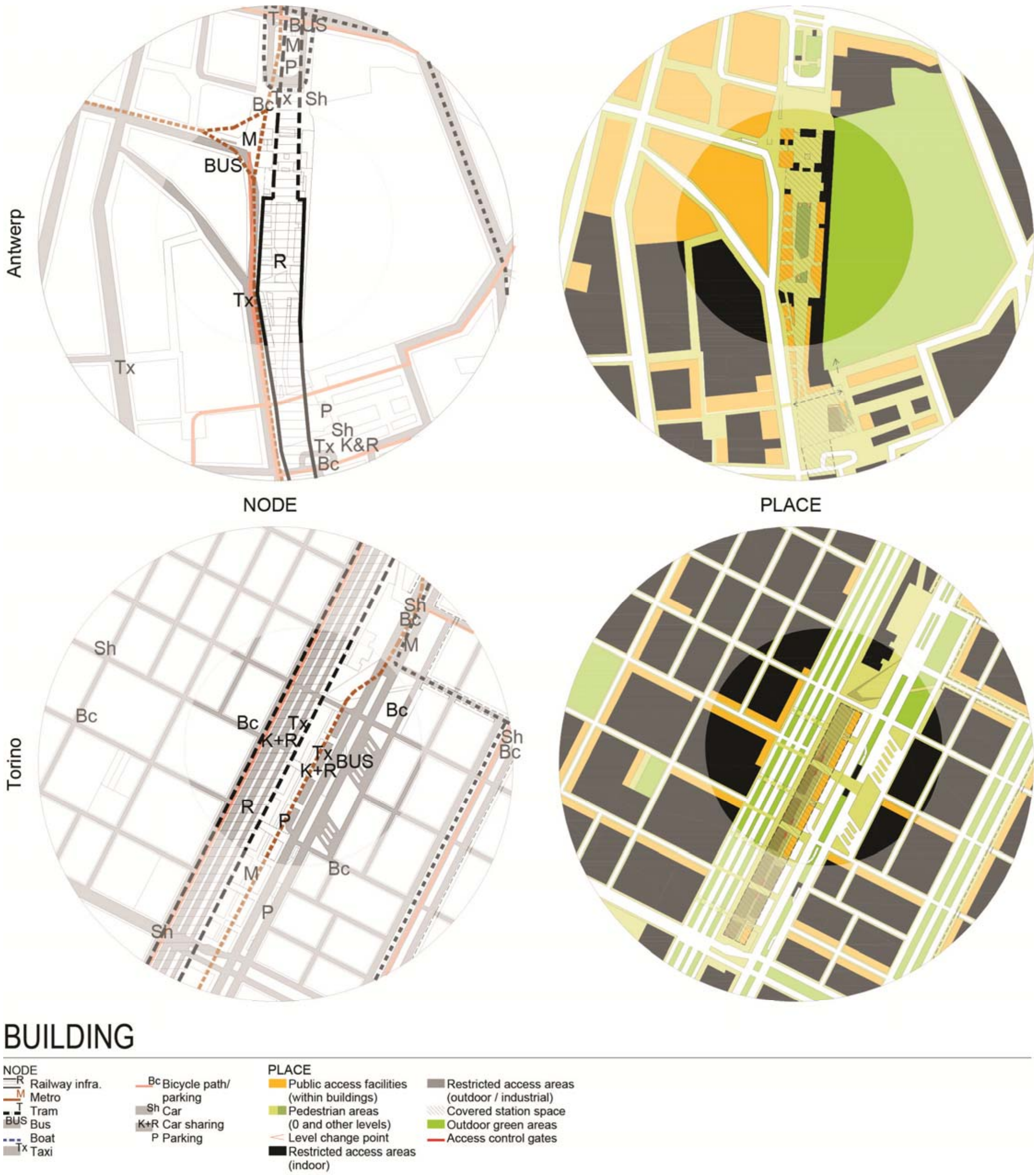
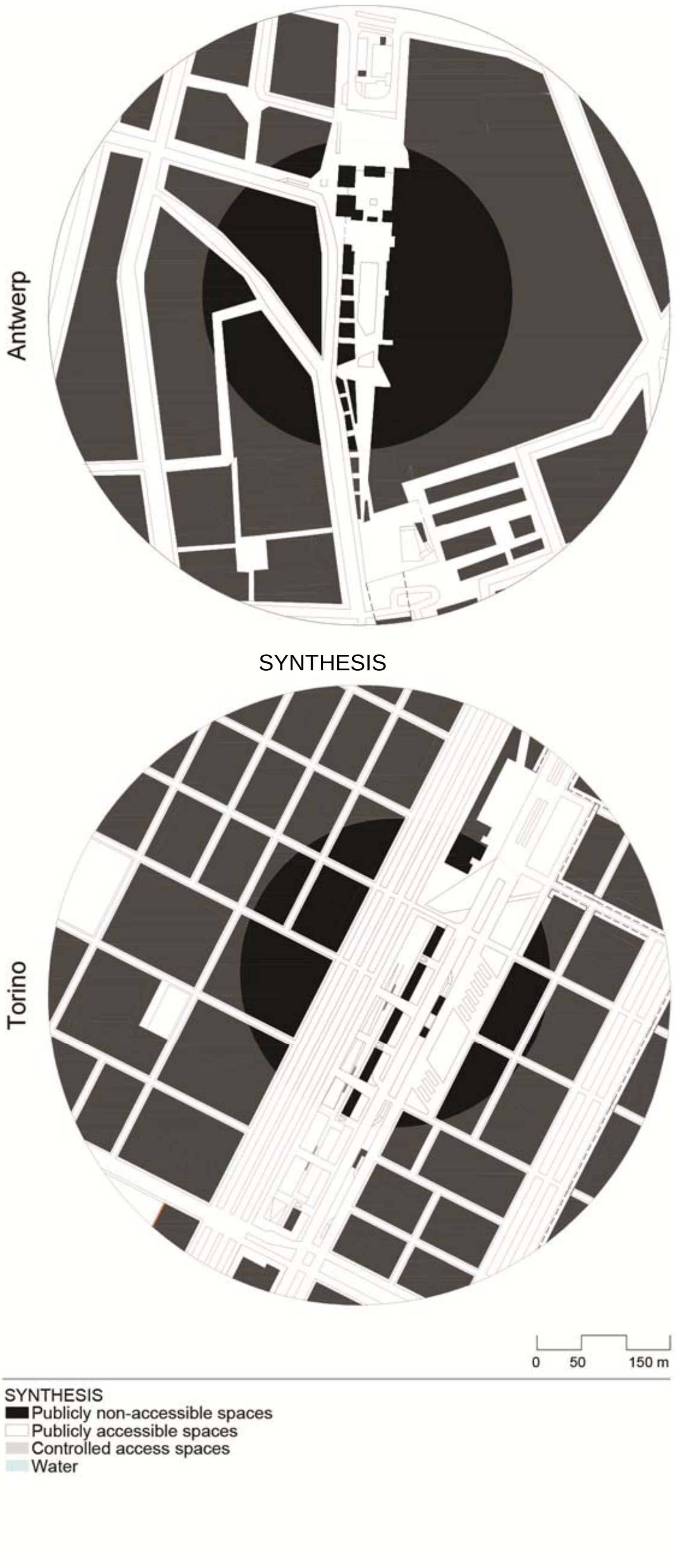


Figure 5.9 – 'TUNNEL' case studies' redesign Set


Antwerp
SYNTHESIS
Torino
0 50 150 m
SYNTHESIS
Publicly non-accessible spaces
Publicly accessible spaces
Controlled access spaces
Water

'Tunnel' stations (Figure 5.9)

A tunnelled railway infrastructure also allows using the street level to cross the station complex in continuity with the surrounding urban fabric. The use of bridges and tunnels is, in these cases, even more redundant. However, the attention to the barrier effects in the proximity of the station complex is not dispensable. As both cases show, to tunnel the railway infrastructure does not solve all the problems its former position(s) raised. Firstly, because the tunnelled infrastructure might not be the only one in the station complex, as in Antwerp where a set of (terminal) tracks is kept at its original position above ground level. Secondly, other barriers can be (created) in the station area, preventing the effective healing of the *front and back syndrome*, as in Turin because of the 'Spina' design.

Tunneling the railway infrastructure raises other problems, like the habitability of such spaces by humans. Safety and orientation issues become more pressing. While in the case of Antwerp this was addressed by bring natural light all the way down to the tunnel (Figure 4.56), in Turin the darkness and ungenerous dimensions of the train platforms (Figure 4.69) is one of the spatial shortcomings of the project. Observable in both cases is the length of the station complex and the consequent considerable distance between their main entrances, almost creating two different stations within one station.

In Antwerp, the redevelopment project's choice to maintain the pre-existent railway viaduct meant that, along it, there is not a substantial change in the relationship between it and its urban surroundings (Figure 4.51 and Figure 4.72). The redesign exercise (Figure 5.9) led to the proposal of an increased openness of the old infrastructure viaduct towards the surroundings to further dismantle its barrier effect. Especially near the new entrance side, where the extensive *"diamond gallery"* is developed, there are a few spaces with a somehow residual character. The darkness and consequent feeling of unsafety of these spaces should be counteracted. This is accentuated by the fact that there is no real continuity between the layouts of the interior of the station's new entrance, the new urban development at the Kievit area, and the vacant lots on the opposite side. The city's plan for the redevelopment of the vacant lots, which is included in the research's redesign proposal, stimulates such continuity between the two sides of the railway infrastructure, with the creation of interior pedestrian and cyclable streets and square. In order to enhance such continuity, the layout and uses of the development at the Kievit area are fundamental. Therefore, the redesign exercise proposes a rearrangement of the new entrance's interior space, making it more permeable, and thus allowing for better connections with its urban surroundings. A second entrance to the Zoo in this area could also be beneficial, as the zoo forms a barrier to the connection between the both sides of the urban fabric.

In Turin it seems essential to create surface passages at the 'Spina' (Figure 5.9) to materialize the aim of the redevelopment project of mending the urban fabric, which was very much emphasized but not totally accomplished (Figure 4.62 and Figure 4.72). The desired continuity, especially on the three main pedestrian transversal crossings of the station complex could be freed of all obstacles, such as the parking entrance at Corso Bolzano, which could make the access to the new bus station more effective.

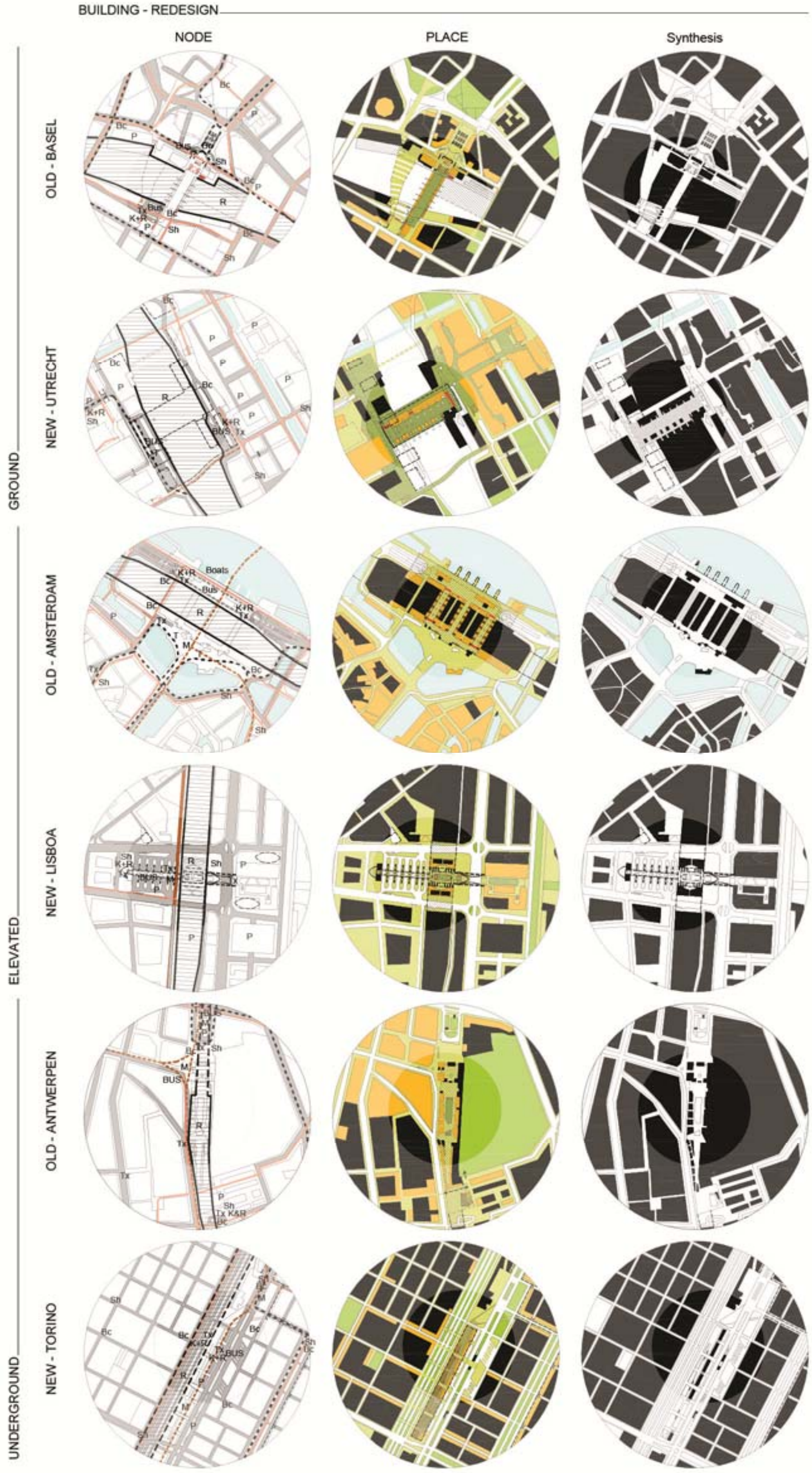


Figure 5.10 – Comparative of the redesign proposals of the case studies

Table 5.1 – Overview of the redesign proposals for the case studies

Railway Station	Level	Cases	Ground BRIDGE Node	Ground BRIDGE Place	Cases	Elevated VIADUCT Node	Elevated VIADUCT Place
OLD	City						
	Urban						
	Building	**Basel**	-extra and well dimensioned areas for access transport uses (pedestrian tunnel under the railway tracks)	- developed areas in the surroundings - improvement of pedestrian routes across the area (widening the 'Passerelle' and add extra south entrance; further limit the access of private cars to the area; widening car tunnel under the Nauenstrasse) - promote linked spaces to accommodate varied non-transport uses in the area (commercial, public facilities, etc.)	**Amsterdam**	- creation of segregated accesses to transport modes, adding to existing mixed ones	- promote the connection of the *front* and *back* of the station, by relocation of access control gates at the middle passage under the railway tracks
NEW	City						
	Urban						
	Building	**Utrecht**	-extra natural light in the underground bicycle parking	- emphasize the pedestrian link across the station area, by widening and aligning it	**Lisbon**	- promote bicycle routes and parking	- develop *back side* of the station

Underground
TUNNEL

	Node	Place
Antwerp	- shorten distances between transport modes	- consolidation of urban surroundings - rearrange the south entrance to enhance connections with the surroundings
Turin	- shorten distances between transport modes	- creation of extra passages at 'spina' to provide connections of the streets inside the building with those outside

5.2. Design recommendations

The recommendations presented here are based on the review of existing knowledge, a systematic series of graphical analyses, and *"research by design"*. Ultimately, their definition is grounded on internal and external factors that can influence the spatial performance of public space of station areas, clarified by this research. They are thus, based on methodically built knowledge.

Nevertheless, they are the result of the analysis of a limited amount of cases, and they are not verified in a full design process. Therefore, they are to be considered as informed orientations for design, but cannot be regarded as *irrefutable recipes* to accomplish good spatial performance. Every project should necessarily have a unique solution, resulting from an approach to its specific context and its specific issues.

Even if the number of analysed case studies might not be sufficient for generalizations, the recommendations are believed to be a first contribution to the improvement of station area's architectural interventions and consequently to their spatial performance.

The 'design recommendations' were organized into two clusters, and are grouped in the following subsections. Closing the section, a summary of the 'design recommendations' (Table 3.1) is presented.

The **first cluster** is focused on the **'spatial design' perspective**. It reflects on the internal factors of the public spaces of station areas that can influence their spatial performance. Detailed indications on the localization of elements, diversity of uses, as well as the overall perception of spatial quality, are given. The recommended actions are directly related with the results of the spatial inquiries of the case studies. They pinpoint the characteristics of the layout of the station area spaces that enhance their ability to offer adequate support for the activities to be developed in them.

Within this first cluster, the 'design recommendations' are presented per scale level and are also organized regarding 'node' or 'place' content. At each station redevelopment project (some) 'node' and or 'place' features will present different degrees of positive contribution to a good spatial performance. Thus, in order to attain optimal balance between the 'node' and 'place' at station areas, or in other words to achieve good spatial performance, it might be necessary to devote more attention to one aspect than to the other. Therefore, it was considered relevant to present recommendations focused on each of the two dimensions. In this way it is possible to invest more or less efforts in each to optimize the balance between the two.

The **second cluster** is focused on the **'planning process' perspective**, offering a more general and wider reflection on the overall results of the research. The reflection is widened to the external factors to the public spaces of station areas that can influence their spatial performance. The recommended actions are based both on the results of the spatial inquiries of the case studies, and the knowledge review presented in the first chapters. These recommendations are believed to have a positive impact on the laying out of spaces of station areas, contributing to their ability to offer adequate support for the activities to be developed in them. The implementation of the recommendations defined in the first subsection is facilitated by the recommendations presented in the second subsection.

5.2.1. 'Spatial design' perspective - Recommendations detailed by scale level

At 'city' and 'urban area' levels the recommendations of the first cluster are more generic, while at 'building' level they are more detailed and specific. The specificity of the several categories[124] the cases were grouped into, do not seem to have a significant influence on how they perform spatially at 'city' and 'urban area' level. On the other hand, at 'building' level, this is different.

Although it could be expected that projects with 'adapted' buildings would present more spatial solutions with shortcomings than projects with 'new' buildings, the difference isn't that significant within the analysed sample. Thus, it is sensible to say that despite the potential for better spatial performance of projects associated with 'new' station buildings, there is not a direct relation between the redevelopment type and the attainment of an optimized 'node and place balance'. It is also not possible to clearly associate a determined position of the railway tracks in relation with the ground floor level, with the achievement of a better spatial performance. These positions are bounded with the context of each case and depend largely on the pre-existing infrastructure position and urban development type. In truth, all of them have advantages and disadvantages, and all of them can be worked out spatially to offer similar levels of spatial performance.

What seems to be very important to obtain improved spatial performance, is to ensure a spatial continuity of the station with its urban surroundings at 'place' level. Such physical integration, advocated by Paksukcharern (2003) and Kusumo (2007), should allow for easy and pleasant pedestrian (and cycle-able) routes in and out of the station. But this alone is not sufficient. Besides physical, this 'place' continuity should also be functional, and work symbiotically with the transport interchange, allowing for seamless commuting. As the research shows, all the analysed cases, built 'new' or 'adapted', attempt to materialize such continuity. Most importantly, the research made clear how the projects are trying to accomplish this goal. They use *streets* and *squares* inside the station building, preferably in close relation with the streets and squares of their urban surroundings. These urban scale elements are being brought into the building and into its design vocabulary.
If the 'viaduct' stations have a great potential to ensure such continuity, as their pedestrian spaces are at ground floor like those of their urban surroundings, their 'node' dimension expansion might be limited because of the elevated position of the railway tracks. A 'tunnel' position of railway tracks allows for similar spatial continuity, and presents analogous 'node' problems. On the other hand, the greater flexibility at 'node' level of 'bridge' stations contrasts with their 'place' potential.

The 'design recommendations' at each level of scale are listed (and thoroughly explained when relevant) below.

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[124] As detailed before in this chapter, the cases were grouped according to different categories in order to understand if these have an influential role on their spatial performance. These categories were the case's redevelopment type, 'adapted' or 'new' building, and its position of the railway tracks in relation with the ground floor level, defining the 'bridge', 'viaduct' and 'tunnel' station categories.

CITY LEVEL

Node - The station should be located at a point in the city where the most important international, national and local transport networks cross (or can be brought close to) each other.

Place - The station should be located at a dynamic city centre, preferably near the historic centre.

A location in which there is a coincidence of transport networks crossings with (potential) liveable spaces of the city, grants a station area redevelopment project better chances for good spatial performance. Locations with such synergy increase the probabilities for diversity (of transport and non-transport related uses) and the city's overall spatial quality perception. The combination of accessibility to transport, services as well as cultural and natural landmarks (normally significantly concentrated at historical centres) contributes to the (re)creation of a reference place in the city. All of the six analysed cases have such locations. Most of them relate to the historic centres of their cities, as is visible in their mapping at this scale.

URBAN LEVEL

Node – The different transport networks' stops in the station area should be within a walkable distance from each other. Further, the transport related barriers in the station urban area should be dismantled, or at least diminished.

Place - Enhance (the quantity and quality of) the mix of uses in the station area, providing spatial continuity among them.

Also at the urban level, the location and diversity of transport and non-transport related uses are crucial to attain a good 'node and place balance'. For an optimal quality perception of the station area it is essential that the space provides good accessibility to all uses. Thus, providing spatial continuity for pedestrians in the area is very important. Facilitating the movement of people in the station area spaces enhances their liveability and performance.

BUILDING LEVEL

Node

- Improve the access to (public) transport modes and seamless commuting among them. Preferably, all transport modes should be *under one roof*, at a short distance of each other to allow for easy transfers - compact clear layout. The case of Amsterdam is a good example of this.

- Pedestrian, bicycle and public transport routes should be favoured over those of private car traffic. All the routings should be such that the pedestrian ones are not hindered by the (public) transport ones. Nevertheless, and as noted above, it is crucial that the locations of the transport modes (including private cars, kiss and ride, or parking areas) favour a seamless transfer among them.

- The commuting clarity between transport modes, can be facilitated by the location of busses and trams (or other transport modes) at analogous platforms to those of the trains, preferably on the same level, as in Utrecht and in Amsterdam.

- For the orientation of the users of the station, a clear sight of the station spaces, allowing an understanding of how they are organized is important. For that, besides the configuration of the layout, the use of natural light can contribute greatly. It is thus important to devote great attention to these issues in all cases. It is especially the case in ‘tunnel’ stations, in which it is desirable to have natural light at underground platforms levels. This allows for better orientation, clarity of the layout, and the enhancement of the perception of spatial quality. The case of Antwerp presents a way to deal with this issue by allowing the natural light filtered by the old train shed to reach the underground levels. The case of Turin does not succeed in this matter, despite the project’s intention to let the natural light penetrate to the railway track level.

- ‘Bridge’ stations perform better if a diversity of platform access is provided, in the form of tunnels and bridges under and over the railway tracks. Utrecht is a good example of this.

- It is important to efficiently accommodate transport and non-transport related pedestrian flows. If, at ‘bridge’ and ‘viaduct’ stations, universal access and generous dimensioning of the joint pedestrian passages to access transport and non-transport uses is not possible, then it is important to offer segregated spaces for different types of pedestrian flows. At ‘tunnel’ stations, such segregation is generally a norm, as a consequence of the railway tracks position.

Place

- The pedestrian space in and around the station should be physically and functionally linked. This enables a continuously (enjoyable) routes in the area through the station, helping to diminish its eventual barrier or island characteristics. To grant this continuity, it is particularly important that the spaces inside the station are accessible as much as possible during the whole day. The use of the station’s spaces by different types of users, and thus their ‘place’ dimension, would be facilitated in this way. Therefore, the different intensities of transport use along the day, and the control over the travellers’ access and choices, should not condition the access to the station’s public space.
When the access control set by railway companies to trains, as for example in the case of Amsterdam, completely restricts the use of the pedestrian spaces crossing the station, they cannot be considered as public spaces. Their restricted access blocks their desirable continuity with the urban surrounding public spaces.

- To favour an access as unrestricted as possible, the public space in and around the station should preferably have a similar scale. The pedestrian scale should be met in and around the station. Ultimately, the openness of Gare do Oriente is the most effective way to grant such continuity, to be found in the analysed case studies. Also, the adjustment of scale of the interior spaces of Utrecht’s station illustrates this very well. The redevelopment project has replaced small and low corridors by large and high spaces, which fit better with the surrounding area’s scale.

- To enhance the continuity, it is important to consolidate the surrounding neighbourhoods. If the (immediate) surrounding areas of the station are (partly) undeveloped or brownfields, like in Lisbon or in Basel, these act as barriers, hindering the desired urban continuities. The (planned) reorganization of undeveloped or degraded spaces around the station, as in the cases of Utrecht or Antwerp, for example, illustrates how this problem can be addressed.

- To further reinforce the continuity, the redevelopment of equivalent *front* and *back* entrances is fundamental. In this way, the *front and back side syndrome* - barrier effect - is easier to dismantle.

'New' cases like Turin and Utrecht actually do not have one main entrance anymore. On the other hand, the (normally) prominent architecture and cultural weight of an 'adapted' pre-existing building, can hinder similar architectonic (and consequently financial) investment efforts, resulting in a second entrance becoming a more modest one. Despite these difficulties, it is possible and desirable to reach an acceptable counterbalance at the 'adapted' station's entrances, as the analyses of cases demonstrate.

- The public space around the station should be preferably private car free, to enhance the abovementioned continuity.

- Spaces for non-transport uses and users shouldn't be limited to commercial purposes. A variety of functions and configurations is desirable, as it facilitates the use of the space at different times and for different purposes, by different types of people. In this way, a lively and varied environment is promoted. Temporary events like the exhibitions and the fairs that take place in Gare do Oriente, or the office spaces inside this station, are some examples that illustrate this very well.

- In order to provide adequate support to the uses that take place in them, spaces should ideally be flexible. Flexibility of spaces allows them to be appropriate for a wide variety of uses, allowing permanent and temporary events.

The uses that come into the station's spaces are not controllable within the scope of architectural design. On the other hand, architecture has control over the layout of station's spaces. Squares inside the building, like in Lisbon, or interior *streets* in the other cases, or even, more radically, spaces that grow or shrink according to the use degree, can provide the adequate support for the changing character of the activities that can occur at station locations.

- Take advantage of the topicality of the station area and its city to reinforce its distinctive spatial character (fighting against a uniformity, standardization, and mischaracterization brought into the station by (railway) *business packages*[125]. The emphasis of some of the (physical) features of the station surroundings can help to achieve this end. The case of Amsterdam, for example, takes advantage of the surrounding water. The roof of the 'Paserelle' in Basel's case suggests the profile of the mountains that surround the city.

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[125] The expression (railway) *business packages* is used to refer to the functions that station management companies, normally railway related, promote inside the building. The need for financial revenues has led to a focus on the development of commercial functions. Franchise shopping and transport corporate images contribute to an undifferentiated interior environment of stations.

5.2.2. ‘Planning process’ perspective - Common recommendations

The recommendations of the second cluster, presented in this subsection, are common to all categories of cases analysed in this research. They cover all the approached scales, even if they focus more onto the building level, as the recommendations of the first cluster also do. Most importantly, these recommendations frame the contribution of architecture to the improvement of the spatial performance of station areas within an interdisciplinary setting, acknowledging its limitations to accomplish it alone.

As highlighted in this research and endorsed in the previous cluster of recommendations, spatial (physical and functional) integration of the station (area) is central to the improvement of its performances. To provide such integration, flexibility, diversity, synergy and a *holistic* [126] approach to design is necessary.

Flexibility

The station (area) is in constant change. Almost as a living being, it requires constant dynamic balance to stay alive. Spaces of station areas should be able to respond efficiently and promptly to the changing ‘node’ and ‘place’ related demands. Station areas’ spaces should be able to accommodate changes, avoiding their periodical deep redesign.

The changes that occur at station areas can have both large and short time spans. They develop in the course of decades, as illustrated in the ‘historic evolution’ maps of the case studies, following seasonal changes, or in the course of a day. If in the peak morning and evening moments, when most commuters arrive or depart to work, the station is full of ‘node’ users, in the other moments other types of users will prevail in the area. Sometimes, it can even be the case that the station (area) spaces become quite empty. All this calls for the design of spaces that are able to accommodate change, spaces that are flexible.

The resilience of the spaces of some of the ‘adapted’ stations is an example of the necessary flexibility of space. Their spaces, originally planned for significantly different demands than the contemporary ones, are still able to be (reasonably well) adjusted. The urban like public spaces currently being designed within the (new and adapted) station buildings are another example. These are programmatically open spaces, allowing thus for flexibility in the accommodation of activities. Such spaces favour the physical and functional integration between the public spaces of the station and its surroundings, without implying their amalgamation. The case of Utrecht illustrates this very well. In the past, the station building and the Hoog Catharijne shopping centre were so intimately linked, that their spaces were not responding efficiently to the uses they supported. In the new project, the physical and functional integration is kept, but greatly improved by clearly separating the domains of the two buildings. The new Stationsplein Oost divides the former (station and shopping centre) complex, while connecting them at the same time.
Further, it is also imaginable that spaces themselves can transform accompanying the changing demands over a day, a week, or longer time spans. The provided space should be able to accommodate these dynamics, welcoming the inflow and outflow of (‘node’ and) ‘place’ functions (e.g. shops, restaurants,

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[126] The term *holistic*, is used here to emphasize the importance of a vision of the whole and the interdependence of its parts in a station (building) area (re)development (design) project, as well its desirability. It does not intend to imply an omniscience process. The research is aware that to incorporate all the possible variables in a (design) project is not feasible, but a good degree of multifactorial awareness is desirable and delivers better results than does narrow visions.

services, etc.). The building should be able to *grow* and *shrink*, without losing architectonical quality. It shouldn't become a pile of annexes. However, attention must be given to the fact that transport infrastructure is not as flexible as the 'place' functions, which can *appear* and *disappear*[127] much easier.

To accommodate change at station areas, flexibility at 'planning level' must also be adopted. Stakeholders' interests and resources must be flexibly allocated along the planning process and life span of the station (area). Considering that the timespan of redevelopment projects of station areas can be significant, it is quite likely that conditions change in time, during the implementation of the design, or even during the design phase itself. For example, the current crisis, consequent budget cuts and redefinitions of projects, focuses the efforts on the 'node'. The concern with 'place', which was initially high on the agenda of the redevelopment projects, seems to have become somewhat secondary for many stakeholders. Therefore, it is necessary that the station area's plans be drawn in such a way that they can accommodate change, cuts, etc., but are still able to be balanced. To do so, even when conditions become more adverse, a flexible approach to the design of the space of station areas seems to be the sensible way to deal with (financial and other) setbacks.

Diversity

There are no uniform or standardized design formulas to enhance the spatial performance of station areas. The specificities of the location of each station, the city, its culture, topographic characteristics, etc., in short, the topicality associated to each case should be incorporated into the station (area) design. This assures for the uniqueness of each station area 'place' dimension. It provides an identity for the station connected to its surroundings and the specific characteristics of its city. Therefore, different spatial configurations and uses are required at each station (area). Such diversity of spatial configurations and uses is likely to offer support to a wider range of ('node' and 'place') activities different types of station (area) users may wish to engage in. In this way, a wider spectrum of users can be attracted to the public spaces of station (areas), increasing their chances of becoming lively ones, of becoming spaces for *"cultural exchange"* and actual *"public domain",* as defined by Hajer & Reijndorp (2001).

Diversity is also a positive feature at the 'planning level', as it can enrich visions and approaches to problem solving by the incorporation of several perspectives. The recent design proposals for the case of Basel illustrate this point. The *"Central Park"* proposed by station area users generated a wider discussion with other stakeholders, namely the city and the railway company, on how to solve a spatial discontinuity in the station area. However, this debate didn't establish cooperation among the several stakeholders. The current design proposal, likely to be implemented, is an initiative of the railway company, which does not take advantage of the virtues of the *"Central Park"* proposal.

Synergy

As shown along this research, the physical spaces of the station (area) must support 'node' and 'place' activities, which should be synergetic. By feeding and supporting each other, these activities can develop

[127] Making again the parallel of the station (area) with a living body, the railway tracks can be regarded as its backbone. Other parts of the station (area), like the shops or even facades, can be seen as organs, thus they are somehow more or less flexible and replaceable. On the other hand, the blood and oxygen, the user flows, must flow well through the veins of the body otherwise it dies.

together in a balanced way. Consequently, it is only natural that the spaces that support them should also be designed to be synergetic. The spaces of the station (area) should complement each other in order to offer adequate support to their 'node' and 'place activities, instead of hindering their actions. Such synergy enhances the needed physical and functional integration of station area spaces.
If there are impediments to the implementation of the spatial options endorsed by the first cluster of recommendations ('spatial design' perspective), the physical and functional integration of station area spaces might not be realizable. This is especially true with regards to the functional integration, because, as mentioned before, architecture has hardly any control over the uses that will occupy the spaces it creates. However, by providing spatial quality and physical integration, architecture can facilitate the attainment of the functional integration. If spatial designers and other stakeholders involved in a station area redevelopment project are aware of this, (spatial) synergies can be easier to attain.

In fact, the synergy of interests and intervention strategies of all stakeholders involved in these projects, which is advocated by Pol (2002) and Peek (2006), should also be extended to the spatial level. Without a shared spatial awareness from the projects' outset, the risk of creating underperforming spaces is greater. The clear understanding of the context and the clear vision of aims agreed among all stakeholders, steered by a clever leadership and underpinned by spatial goals, are necessary. Such interdisciplinary synergy is crucial in the redevelopment projects to achieve optimal (spatial) 'node and place balance'. If the stakeholders involved in the redevelopment projects understand that a good performing space will offer a better support for the development of the activities they aspire to implement in the station area, it is likely that they will join their resources with those of the architecture to achieve such purposes.
The case of Basel illustrates very well how a plan, despite being derived from a set of shared interests, fragmented into separate spatial projects tends to generate fragmented spaces. Common spatial objectives were not assumed and kept (or jointly adjusted) along the whole process by all stakeholders. On the other hand, the case of Utrecht seems to have been more successful in conjugating the (spatial) interests of the stakeholders. The great amount of projects being developed in the station area is firmly attached into its common (spatial) vision conveyed in its Masterplan.

Holistic **approach to design**

Designing and implementing a station area redevelopment project are quite complex endeavours as they involve many variables. The long time spans of the projects and all the changes they can bring into them, the variety of involved stakeholders and of their interests, resources and strategies, the interdisciplinarity of these processes, or their multiscalar reach and impacts, can all have positive and negative effects on the definition of the station area's spaces.
Design proposals with partial approaches to these variables, necessarily overlooking some of their effects, often lead to spatial fragmentation, as well as to the inadequacy of the spaces of station areas to respond to the contemporary demands. These outcomes can be credited to the inadequate 'spatial design' solutions, but also to the 'planning process'. The 'planning process', can generate impediments to the implementation of good design solutions. These impediments mainly derive from the difficulties of stakeholders to find and pursue common (spatial) goals.

To achieve good spatial performance, it is essential that the projects are able to steer the abovementioned variables, profiting from their advantages and depleting their disadvantages. To do so, it is necessary that all intervening in the projects have the widest knowledge on these variables as possible. Thus, not only should the architecture be aware of the overall context involved in its design task, and work with it and not against it, the 'planning process' should also be aware of the added value of equating as many variables as possible while developing and or implementing design solutions. If this awareness exists, and all stakeholders reach an engagement on common (spatial) aims, then both 'spatial design' and 'planning process' can work together and create better performing designs.

As pointed out, physical and functional integration of the public spaces of the station (area) leads to improved (spatial) performances. To achieve such spatial integration, a design process which incorporates flexibility, diversity, synergy, and a *holistic* approach, at both 'spatial design' and 'planning process' levels is necessary. Within this framework, the roles of all stakeholders and disciplines involved in a station area redevelopment project should be readjusted. The role architecture (as the art and science of designing spaces) should have in the spatial definition of station areas will be further discussed in the following chapter.

Table 5.2 – Summary of the 'design recommendations'

DESIGN RECOMMENDATIONS

First Cluster	Level	Node	Place
	City	- station area located at the crossing of a variety of (important) transport networks ((inter)national + local destinations) - promotion of public transport use (policies)	- station area located at (potentially) dynamic urban centre
	Urban	- dismantle transport related barriers - walkable distance between different transport networks	- enhance the mix of uses in the area - spatial continuity among uses
	Building	- improve access to (public) transport modes and seamless commuting among them – clear compact layout - pedestrian, bicycle and public transport routes favoured over private car - commuting clarity (similar platforms for transport modes) - clear sight – use of natural light - diversity of access to platforms (bridge) - accommodate efficiently transport and non-transport pedestrian flows – generous dimensioning of spaces or segregation.	- functionally and physically linked pedestrian space, in and out of the station (no access control to grant access to all type of users in the public space of the building) - similar scale in and around the station building - consolidate the surrounding neighbourhoods - (re)develop equivalent front / back entrances - (private) car free surrounding spaces - a variety of functions and configurations is desirable (not limited to commercial uses) - promote flexible spaces to support diversity of use(r)s - take advantage of the topicality of the station area

Second Cluster		Flexibility	Diversity	Synergy	Holistic Approach
	Spatial design	- spaces should be able to accommodate changing functions . resilience of space . urban like spaces inside the building . "real-time" transformation of spaces	- diversity of spatial configurations and uses is likely to offer support to a wider range of ('node' and 'place') activities different types of station (area) users may wish to engage in - incorporate topicality into the station (area) design - uniqueness, identity	- the spaces of the station (area) should complement each other in order to offer adequate support to their 'node' and 'place' activities	- awareness of all involved variables, steering them profiting from their advantages and depleting their disadvantages
	Planning process	- stakeholders' interests and resources must be flexibly allocated along the planning process and life span of the station (area)	- the incorporation of several perspectives (of different stakeholders) can enrich visions and approaches to problem solving	- synergy of interests and intervention strategies of all stakeholders towards common spatial goals	- awareness of all involved variables, steering them profiting from their advantages and depleting their disadvantages

6. CONCLUSIONS

Closing the thesis, this chapter presents the contributions for knowledge of this research, final considerations on its results, as well as proposals for further research.

The need for a renovated approach to the redevelopment of station areas emerged from this research's exploration of the spatial performance of European case studies. The required changes and the crucial role that architecture can have in operationalizing such an approach are explained in the first section, by answering the research sub questions and the overarching question. Two supplementary general reflections on the research's results are made, describing the development of a 'station city' in Europe in search of better performing spaces of station areas, and stressing the role architecture ought to have in their definition.

Following this account of the contributions and limitations of the present study, further research paths are proposed in the second section.

6.1. Knowledge contribution of the thesis

This research contributes to the awareness of all stakeholders of the importance of design driven solutions to improve a station area's (spatial) performance. It highlights the decisive role architecture can have in this task, while acknowledging the importance of the interdisciplinary context of these projects in its development.

The (shaping and) use of systematic graphical analyses and redesign in the comparative study of HST European station areas, allowed this research to put forward 'design recommendations' to improve spatial performance at different scales. Applying this method, the research presents a unique overview of the past, present and future of the studied station areas' 'node' and 'place' characteristics. With this study, the research clarified that the spatial performance of the station and its urban surroundings improves when their (public) space is envisioned, designed and implemented as a whole and not as a collection of separate objects.

A new design approach, able to effectively balance the 'node' and 'place' of station areas, which requires an integrated method of intervention at the intermediate scale between the building and its urban surroundings, and for which architecture has the necessary skills, is therefore on demand. The (graphical) method used in this research has the potential to support such a novel design approach.

RQ - **How can architecture contribute to the improvement of the spatial performance of European HST station areas?**

In general terms, the research confirms that a different understanding of European HST station areas' spaces and their design task is a necessary condition for improving their spatial performance. To contribute to this improvement, architecture must position itself differently in the station area's design process.

The research learned, from existing knowledge, that the spaces of the station and of its surroundings should become physically and functionally integrated. This ensures better accessibility to both 'node' and 'place' activities in the station area, and improves the spatial performance of the station area. Therefore, as the studies of this research suggest[128], the station and its surroundings should be envisioned as an ensemble and not as isolated entities, and as such, their design tasks should not continue to be tackled as separate projects. This requires a (re)definition of the spaces of station areas, which encompasses an interdisciplinary method of intervention at the intermediate scale between the building and its urban surroundings. Accordingly, the traditional domains of each discipline involved in the design of station areas need to be adjusted. Such structural change to the station area's design task should be organized around spatial goals commonly subscribed by all stakeholders, which are adjustable along the timespan of the project's design, implementation and use. In this necessary design driven solution, architecture should have a central role and must work in two domains: in its own specific domain, the 'spatial design', and in close relation with the 'planning process'.

A detailed discussion on the fundaments of these outcomes is provided below with the answers to the research sub questions and two general reflections.

RsQ1 - **What types of factors can influence the spatial performance of station areas?**

Based on literature review, this research identified two types of factors that are influential to the spatial performance of station areas, answering the first sub question.

The **external factors** to public space of station areas are the constraints and facilitators to the laying out of public space of station areas. These factors can hinder or enhance the capability of station areas' public spaces to offer adequate support for the activities to be developed in them. The external factors were here named 'context' and 'experience', and belong to the domain of the redevelopment project's 'planning process'. They correspond to the station areas' physical, social and economic context framework, and the interaction and strategies of involved actors according to their resources and backgrounds.

The **internal factors** of public space of station areas are the shortcomings and virtues of the public space of station areas. These factors can hinder or enhance the capability of station areas' public spaces to offer adequate support for the activities to be developed in them. The internal factors were here named 'localization' (of elements), 'diversity of uses' and 'quality perception', and belong to the domain of the redevelopment project's 'spatial design'. They correspond to the characteristics of station areas spaces.

Both types of factors influence the manner in which station area's spaces are (re)defined, and consequently how they support the balance between their 'node' and 'place' dimensions. As the domain of architecture is the 'spatial design', its control over the external factors is limited. On the other hand, it has relevant skills to manage the spatial characteristics of station areas, and thus it can have a higher degree of control over the internal factors. Both types of factors were taken into account in this research. However, the inquiry on the internal factors was deeper. Not only because until now these factors were less explored, but also because they are within the domain of architecture and thus are more relevant while addressing the research problem.

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[128] This research's (graphical) analyses have confirmed that despite the attempts of the case studies to create integrated spaces of station areas, this objective wasn't completely achieved. The design of the spaces of stations and of its surroundings, even if departing from a common vision, mainly corresponds to different projects. These projects are mostly developed independently, leading to fragmented spatial solutions for the station area.

RsQ2 - **How did the spatial performance of station areas evolve?**

With the aim of gaining knowledge on how the abovementioned factors can affect the spatial performance of station areas, two surveys on the characteristics of their spaces were done. Both surveys were developed to answer the research's second sub question.

The first survey, which was based on literature review, investigated the evolution of these spaces through history. It allowed this research to identify and characterize distinct periods[129] along the existence of station areas, corresponding to stretches of time in which their spaces offered similar levels of support to 'node and place balance' (Figure 3.1). Such categorization made clear that the spatial performance of station areas has improved progressively in time, despite some setbacks.

In the 'origins' period only the 'node' dimension was supported by the spaces of the station, which was mainly an isolated building outside the city. In the subsequent periods, both the station and its surroundings also became a 'place', as the cities grew to embrace the station area. Even though the station area had become part of the city, in the 'decline' period its spaces were not supporting 'node and place balance'. This scenario is however reverting for some time now. The spaces of both the station and its surroundings are becoming more integrated and offering better support to 'node and place balance'.

Nevertheless, as stated in this research's problem definition and confirmed by its studies[130], the support which spaces of station areas give to 'node and place' activities can still be optimized. Station area's spatial characteristics, such as the railway barrier or the patchy urban fabrics developed around the station[131], were and still are influential to their current underperformance. Such features, and the identified distinctive forms of spatial relation between the station and its surroundings of each period, are correlated with the manner in which their spaces were approached and planned by railway companies and cities at those moments.

Besides also corroborating the abovementioned inferences, the second survey's categorization of different characteristics of European HST station areas showed which of these features are more predominant. The identified clusters, namely the 'new' and 'adapted' stations, and the several types of stations[132], helped to set the criteria choice of case studies and to the structure of their analyses.

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[129] It is important to remember that these periods proposed by this research cannot be regarded as self-contained, as different types of cases might overlap in time. Nevertheless, there is an acceptable degree of convergence among the station areas characteristics within the proposed periods.

[130] The explorative studies based on the literature review and survey of the European HST network station areas, the graphical analyses of case studies, as well as their redesign, sustain this.

[131] These problems of station areas are highlighted by this research's graphical analyses. Refer to these schemes in chapter four, and namely to the sets at building level.

[132] As explained in chapter 4, the choice fell onto the cases of 'through' stations in an urban context. The majority of European HST station areas are of this type, as they represent a more complex design task then that of a 'terminal', and their integration had been less studied until now. Such choice is thus relevant because it addresses a wide universe of cases for which spatial features were not previously sufficiently studied.

RsQ3 - **How are European HST station areas performing spatially?**

As previously stated, the surveys on the spatial characteristics of (European HST) station areas, and the graphical analyses to deeper inquire on how these features are influencing their current performance, allowed this research to confirm the present need to improve it. Foremost, the graphical analysis method developed and used to answer the third research sub question, made visible the attempts of all the analysed cases to materialize physical and functional integration of their spaces.

Indeed, such spatial continuity, by ensuring better accessibility to both 'node' and 'place' activities in the station area to all types of users, contributes to the improvement of its spatial performance. Searching for these spatial integrations, the case studies used *streets* and *squares* inside the station building, preferably in close relation with the streets and squares of their urban surroundings. In this way these projects tried to mitigate 'node' and 'place' accessibility barriers in the station area, such as the railway tracks, heavy traffic roads, degraded and or monofucntional zones. Additionally, they brought into the building, and into its design vocabulary, these urban scale elements.

The research could not establish direct causality between the categories in which the case studies were grouped in, and their spatial performance. In fact, even though it could be expected that projects with 'adapted' buildings would have more difficulties to find solutions to improve their performance than projects with 'new' buildings, it wasn't possible to identify a significant difference among the analysed sample of cases. The research found that the position of the railway tracks in relation with the ground floor level, which defined the 'bridge', 'viaduct' and 'tunnel' station categories, also does not have clear consequences on the achievement of a better spatial performance. This is especially true at city and urban levels of scale. At building level though, some nuances were found. As the pedestrian spaces of 'viaduct' stations, as well as those of their urban surroundings, are at the same (ground floor) level, they have a good potential to ensure physical and functional integration of their station areas. However, rearrangements of their railway tracks might be limited because of their elevated position, which makes improvements of their 'node' dimension more difficult. The position of railway tracks of the 'tunnel' cases allows for similar spatial continuity, and also presents analogous 'node' problems. In contrast, the 'bridge' stations have greater flexibility at 'node' level while inflexibility at 'place' level.

In short, the results of the graphical analyses show that examined case studies have improved their spatial performance with their proposed spatial solutions. However, these attempts to integrate the spaces of the station and of its surroundings still present some shortcomings in all categories of case studies.

RsQ4 - **How can the spatial performance of HST station areas be improved by architecture?**

Finding out how to solve the shortcomings of station areas' spaces was essential in answering the fourth sub question. To do so, the research set out to define 'design recommendations' intended to improve station areas' spatial performance.

The mapping of the case studies, which revealed the shortcomings and virtues of their spatial solutions (see their comparative summary in Figure 4.73 and Table 4.4), and their redesign (see comparative summary of the proposals in Figure 5.10 and Table 5.1), were major contributions to this definition. The mapping allowed an understanding of what features needed to be changed in order to achieve the physical and functional integration of the station areas' spaces, central for the improvement of their spatial performance. The redesign demonstrated that it is possible to find architectural solutions to improve the

spatial performance of each of the studied cases. It highlighted the aptitude of architecture to solve the spatial problems of station areas.
On the other hand, the knowledge on the (internal and external) factors that can influence station areas' spatial performance, gained through the previously mentioned reviews of existing knowledge, indicated that to control 'spatial design' related factors is not enough to provide spatial integration. Thus, the contribution of architecture to the improvement of the spatial performance of station areas must be framed within an interdisciplinary setting, acknowledging its limitations to accomplish it alone. Indeed, as the 'analysis matrix' (Figure 2.5) proposes, it is desirable that 'spatial design' and 'planning process' work together towards the improvement of station areas' spatial performance.

Specific 'design recommendations' (see summary Table 5.2), at both 'spatial design' and 'planning process' levels, were thus defined providing indications for the creation of (physically and functionally) integrated spaces at station areas. In general, the desirable variety and concentration of transport and non-transport functions must be clearly organized in space, dismantling barriers to their accessibility. Further, the specific (spatial) characteristics of the city in which the station area is located, should be considered in its design. To operate these changes, both 'spatial design' and 'planning process' should incorporate flexibility, diversity, synergy, and a 'holistic' approach in the design process.
The 'design recommendations' on the 'spatial design' perspective were however more detailed. This was possible because the analysis of the 'spatial design' related factors was deeper, a consequence of the research's' interest to understand how the performance of HST station areas can be improved by architecture. The analysis made clear that it might be necessary to develop more the 'node' or the 'place' features of a station area in order to balance them[133]. Therefore, it was considered necessary to provide recommendations focusing separately on these aspects. In this way it is possible to invest more or less efforts on each, to optimize the balance between the two.

'Node and place' balanced station areas are supported by spaces that provide access to transport and non-transport activities to all types of users, that dismantle barriers, and that promote spatial continuity and integration of their *front* and *back sides*. Thus, to provide good spatial accessibility[134] at station areas is central to improving their (spatial) performances. All projects analysed in this research sought for such spatial integration, but had difficulties in achieving it independently of using adapted or newly built buildings.
To attain spatial integration, station areas cannot continue to be designed as an ensemble of isolated buildings. The design task of the station building, in particular, should not be an introverted process. The design assignment for station buildings can no longer be circumscribed within its walls. At the 'spatial design' (physical) level, the intervention scale must be extended to incorporate the immediate surroundings of the building. This implies that, at the 'planning process' level, all the involved stakeholders

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[133] This is the case, for example, at *"unsustained nodes"* and *"unsustained places"*, as defined in the *"node-place model"* (Figure 2.3).

[134] Station areas should become an integrated space for accessibility, with increasing interaction and dismantling of frontiers among buildings and their surrounding urban area. They should be an area for accessibility to transport and non-transport activities, enabled by spatial accessibility; specifically spatial continuity and clarity of spaces. The *fusion* between station buildings and its urban surrounding areas should be done by continuous public spaces (in and out of the building) and not by their spatial amalgamation, as the case of Utrecht clearly demonstrates. Refer to accessibility as discussed in chapter two and summarized in Figure 2.4.

must really compromise around a common spatial goal from the outset of the project, and adapt it together when (and if) necessary. By doing so, the spatial (physical and functional) integration of the whole area is enhanced and so is its spatial performance.

It is however, not enough that all stakeholders involved in a redevelopment project are simply aware of need for cooperation, it is necessary that they effectively find ways to make it operational in cooperation with each other, dismantling their shared part of constraints to such a vision of the station area. This requires a coordination role, to which architecture is naturally well suited. Architecture has the knowledge to deal with the specificities of the intermediate scale between the station building and its urban surroundings, as well as to link them with the building itself. Further, as a synthesis discipline, which uses a (universal) graphical language-drawing, it has the skills to congregate different strategies into a common project.

By disclosing this way to bridge the abstract level of planological intentions with their actual translation into operative spatial physical terms, this research has thus, introduced a change to the understanding on station area space. Therefore, besides the graphical analysis method itself, the research contributes to knowledge by enhancing the awareness of all stakeholders on the decisive role of the spatial performance of a station area, and in turn, of the role architecture should have on their redevelopment projects.

Architectural interventions should go beyond their traditional scope regarding scale and methodology. They should focus on the intermediate scale between the station and its surroundings, reflecting the topicality of the station area, and result from a cooperation between the 'planning process' and 'spatial design'.

6.1.1. 'Station city' spaces (typology)

The search for an ideal concept for the XXI century station (area) transformed its spaces into an experimental laboratory once again. The heralded renaissance of station areas is grounded on the balance of their 'node' and 'place' dimensions, for its potential for improved economic, social and environmental performances. However, optimized spatial translations of such concepts are still not fully achieved in the (built) projects, i.e. the spaces of station areas are not fully supporting these objectives. Indeed, the spatial performance of station areas is currently reflecting some of the fragilities of their recent redevelopment projects, among which are the constraints imposed by their 'planning process' to their 'spatial design'.

The spaces of station areas are deeply marked by successive transformations, which increased their barrier character along their existence. If in the early days the station was mostly an isolated building, serving as a transition between the railway infrastructure and the city's urban fabric, that is no longer the case. The station is currently located within the city's urban fabric. Its primary transport function has blended progressively with non-transport related functions in the course of time, sometimes hindering each other's development.

These spatial relations of the station with its surroundings reflect directly the manner in which they were both approached and planned by railway companies and cities. The initial isolation was the resulting solution of the railway companies' preference for spaces freed of operational constraints, together with the fears of the cities and their inhabitants associated with the unfamiliarity of the then new technology. But as cities grew to embrace station areas, so did their (spatial) demands and problems. The station areas became a confluence point of all classes of people and (social) activities, but with clear (spatial) segregation. The fancy first class restaurants, hotels or waiting rooms, contrasted with the neighbourhoods for disadvantaged communities and all their problematic social activities and consequences. The railway tracks obstacle, a considerable degree of monofunctionality in the area dedicated to industrial premises, and low quality housing, are some examples of all sorts of (spatial) barriers that converged in the station area. The level of degradation increased when the car took preference as a mode of transport over the train. The issues faced by the redevelopment projects from the ‘renaissance’ period has thus been built up from the early days and not only during the ‘decline’ period. To those existing issues, add the difficulties of converging the interests of all stakeholders into common goals and agendas, as well as their great abstraction level. Together, they hinder the design of well performing station area spaces.

The ‘origins’ and the ‘renaissance’ periods are comparable regarding their experimental enthusiasm and length in time. The main differences are the obvious stages of development of the railway infrastructure technologies, and the way the design of the station building has been approached. While in the first period, the station design was the domain of a railway company[135], in the last period the design task is spread among a wide variety of stakeholders. In the early days, the station buildings were clearly a distinct design task separated from that of its surroundings, and even from those of the transport infrastructure related areas (platforms, sheds, etc.). While now, the station’s design task is a joint planning effort of railway companies, cities and other stakeholders, and is usually framed within masterplans[136] which embrace its surrounding urban areas. This is a considerable (ongoing) shift to the (spatial) understanding of station areas. However, this approach to the spatial definition of station areas hasn’t yet produced fully integrated spaces.

This seems to result from an insufficient integration of the projects’ strategies. In fact, the vision of each stakeholder on how to reach optimal ‘node and place balance’ can be as differing as their interests are. Transport companies are focused on the yields from the number of handled costumers and the real-estate value of their property, now centrally located. The city wishes to mesh the area with the rest of the urban fabric and make it work as a desirable place to live, recreate, travel to, and work in. Further, the station (area) redevelopment can be an opportunity to restructure the city’s (public) transport network, updating it to the contemporary (sustainability) needs and policies. This desire to combine the station (area) ‘node’ dimension with a ‘place’ dimension is also embraced by other property owners in the area, who see it as an opportunity to benefit from such arrangement, accentuating the commercial nature of these operations.

The users, who should be the natural beneficiaries of all the transformations of station areas, and are heralded as such by the redevelopment projects marketers, are tendentiously narrowly regarded as consumers of transport and non-transport related activities. That approach cannot be sustained much longer. However, and despite common statements of stakeholders in this direction, the fact is that the designed spaces do not often reflect a well-designed user oriented space. Furthermore, some (design)

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[135] In those days, it was even the case that several companies would build station ‘terminals’ right next to each other instead of joining efforts into the construction of a common building.

[136] Time and scarcity of resources increasingly brought more common sense into the development of stations, and the need for consensus is now widely recognized. However, the joint planning of station (areas) is a delicate process. The degree of complexity of the (re)development projects of station areas makes this evident.

options (such as access control gates, lack of free sitting opportunities, etc.) lead to the implicit exclusion of certain groups of people from the spaces of stations.

There is somehow an aspiration to replicate the (financial) successes of the ‘airport city’ model (Güller & Güller, 2001). This cannot however be achieved by the ‘station city’ by replicating the spatial structure of the ‘airport city’. Firstly, because the surroundings of airports and of stations are (generally) diametrically opposed. While airports are normally located on isolated sites away from the cities, stations are mostly located in the middle of their urban fabrics. Secondly, because the transport operation is quite different. Airport hubs do combine other transport modes with the airplane, however, they are subsidiary to it. At stations, the relationship between different modes of transport is much more complementary among them. Further, there are also differences in scale and the type of users.

The ‘station city’ in Europe also should not try to emulate the ‘station city’ in Asia. The *“hyperpole”* type (Tiry, 2008), common in Asia, has a completely different physical, social and economic context than the European cases. Consequently, Asian stations developed interior public spaces, like the atria of Hong Kong station complexes (Xue et al., 2012), which have tenuous connections to other (outdoor) public spaces of the city. In fact, according to Xue et al. (2012), they have even become *The* city's public spaces, as there are hardly any other. However, this does not correspond with the European reality. Thus, such type of stations would rather than revitalize the station areas, drain them and their city's life.
In Europe the ‘station city’ is much more regarded as an *“urban connector”* and is developing into an *“extended hub”* as categorized by Tiry (2008). As the results of the analyses of this research indicate, the ‘station city’ in the European context should be a station (area) working symbiotically with the city where it is located[137]. It should respect the (physical and societal) specificities of the city, leading to different spatial materializations in each city.

The tendency to integrate (physical and functional features of) public spaces of the station with those of its urban surroundings is transversal to the analysed case studies. This trend is independent of the station being an ‘adapted’ or a ‘new’ building, and of each city's different cultural and physical contexts. Even if the cultural and physical contexts of each city do play a role on the way planning processes are conducted, their influence is more limited on the found spatial solutions, which tend to have common features among the cases. The public spaces of the station building are merging with the urban public spaces of its surrounding areas. Covered squares and streets are some of the spatial solutions. New

[137] Ultimately, the concept can be extrapolated to other contexts, even the Asian one, as the correspondence with its specific context necessarily implies a different space from the ones in Europe or elsewhere.
It is also worthwhile to mention other projects to illustrate this statement. The design by Koen van Velsen for the station of Breda in the Netherlands, currently being built, proposes a continuity of the urban blocks and streets across (over and under) the railway tracks. A similar principle is used in the *“Floating City - Citta Sospesa”*, a competition entry project of Performa A+U and MVRDV for the new Bologna Centrale Station, in Italy, which proposes *“[…] a floating part of the city, connecting the heart of Bologna above the tracks.”* (Performa A+U, 2008).
The wining proposal of the competition for the design of Flinders Street Station, in Melbourne, Australia, by HASSELL and Herzog & de Meuron, is another illustrative example. This proposal integrates the existing station building with its urban surroundings. An addition to the pre-existing building (re)establishes urban connections and creates a ‘place’ in balance with the ‘node’. An open air amphitheatre facing the river, covered streets and squares establish the public space continuity with the surrounding areas, allowing for city live to flourish inside and outside the station complex (Furuto, 2013).

buildings have fewer limitations to integrate (becoming really open and hybrid) with the urban surrounding public space. The 'adapted' buildings, even if in a more constrained way, also seek ways to integrate their spaces with those of their urban surroundings.

Formerly, the station and the city were clearly separated entities, and so were their design tasks, which had different scales of approach. Even though the methods and scales of approach of their design tasks haven't changed so much, the frontier between the building and its surroundings is not so obvious anymore. By the progressive elimination of the 'barrier effect' and the addition of a varied 'functional mix', a new hybrid space is being created. The station is no longer a conventional building, but transforming it into an enclosed urban space can also generate new problems. Some stations, by adopting interior spaces with urban features (configurations, functions, etc.), are becoming a little city within the city, which can drain out the latter instead of creating bonds with it.

This risk of *destroying* cities is not exclusive of those stations. Indeed, attempts of creating buildings that function like cities are not circumscribed to such new station building typology. Research, discussions, designs, and even built examples of 'vertical cities' (often funded on the shortage of land to support the world's population growth and on sustainability issues) proliferate (for examples see: Cardno, 2009; Davison, 2014; Future Cities Laboratory, 2013; Harada, Hirakawa, Sakaguchi, & Yonezu, 2012; Robinson, 2014; verticalcity.org; verticalcitiesasia.com; Wong, 2004), as well as questions on their effects on urban areas. Furthermore, the focus on the creation of multifunctional buildings, also fuelled by economic interest, can thus easily become a marketing slogan devoid of meaning.

Despite all considerations, the station in the city is becoming a 'station city'. However, as pointed out above it should not follow the model of an 'airport city'. Its inner city location, contrary to that of airports outside the city, sets the main difference. The station's links to its urban surroundings connect it to all the public spaces and activities these have to offer. In this way a station supports a wider and more varied range of users and activities, than an airport does. Therefore, the station (complex) shouldn't be a self-enclosed and standardized entity like the 'airport city', with no connection to the urban fabric and identity of the city where it is placed. It shouldn't function as an island that concentrates 'node' and 'place' functions inside, and consequently drains the city from its life. Its functional program should complement that of its surroundings. In this way the station does not become a little city in the city, an island draining the life of the city where it is located. Instead, the 'station city' can be an extended space, incorporating the station and its surroundings, conforming a pole to irradiate life back into the city.

To achieve these objectives, it is essential that the design task of station area's redevelopment projects focus on the intermediate scale between the station and its urban surroundings.

The search for such a 'station city' continues into the future within the current 'consolidation' period. This period is similar to the preceding 'expansion' and 'modernization' ones, a time to evaluate and improve explored (spatial) solutions of the 'renaissance' period, to which this research is a contribution.

6.1.2. Spatial Performance by design

To explore the spatial performance of station areas, this research has shaped and applied a method using drawings to analyse it and to search for solutions for its improvement. By this graphical method, this research has made possible the spatial comparison of (the approaches to) 'node and place balance' among several case studies, at several scales and historical periods, as well as the development of proposals to enhance it. This exploration brought the analysis of the station area redevelopment projects' to a (concrete) spatial design level, which until now was kept to a (somehow abstract) planological level.

The schemes translate the 'node' and 'place' contents and their balance into spatial terms, offering an overview of (the evolution of) these characteristics in each case, as well as clarifying emerging clusters among them. The data that the schemes synthetize, which had not been systematized and compared in this way before, displays the spatial virtues and shortcomings of the analysed designs. This enabled a prompt assessment of the necessary adjustments to improve the case studies' spatial performance, leading to the definition of the 'design recommendations' presented in this thesis.

These studies focused mainly on the exploration of the scale in between the station and its urban surroundings. This investment of this research on the 'building level', suggested that architectural design ought to have a decisive role on the station area redevelopment project process. The study of this scale, not explored deeply enough before, made clear the need to bridge the gap between the abstract objectives for a station area redevelopment, with their actual translation into operative spatial terms. Thus, the need to restructure the (design) brief of a station area redevelopment project became clear.

These projects require a special attention to this intermediate scale level, in order to integrate the station with its infrastructure and the city. To (re)think these areas as abstract urban plans, or focusing on the details (of the appearance) of individual buildings, is simply not good enough. Architecture on the middle scale, with attention to the (outdoor and indoor) public spaces and infrastructure, can find a more efficient way to design these areas. A design is needed that does not depart from agendas or dogmas, but gradually responds to the characteristics of an area in the city and its programmatic needs.

Such 'middle scale design assignment' for station areas' spaces must entail a holistic approach, flexibility, diversity, and synergy (of interests and spaces), as discussed in detail in chapter five. Overall, it requires the combination of aims and efforts of 'spatial design' and 'planning process' around a common (spatial) strategy. Such arrangement of the (internal and external) factors identified in chapter two, can quell impediments to the implementation of good design solutions, avoiding the spatial fragmentation of station areas and their inadequacy to contemporary demands.

In the (re)definition of such non-optimized spaces, the traditional dominions of action of each stakeholder, as well as of each type of project[138], play a relevant role. These impose a compartmented way to face the design task, which obstructs the approach envisaged in this thesis. Thus, the agreement of all

[138] The different (professional) backgrounds of stakeholders influence their approaches to the (spatial) challenges of station area redevelopment projects, and the cooperation among them.

Each planning instrument or project level (zoning plans, masterplans, building projects, detail designs, etc) has a conventional field of action and should respond to specific demands as defined in legislation.

stakeholders on a (materializeable[139]) spatial strategy for their project on the middle scale level, supporting their (immaterial[140]) needs for economic, social and environmental improved performances, is crucial.

The graphical method used by this research to analyse the cases, can help to mediate the abovementioned agreement of ‘spatial design’ and ‘planning process’. It can become the common lexicon for all those involved in this new design approach.

The background disciplines of all the actors involved in a redevelopment process have their own specific lexicons. Therefore, on an interdisciplinary project like that of a station area, the same term[141] can be understood differently by several actors, while they might believe to have all understood the same. Drawings, as a universal language, can contribute to mitigate such misunderstandings. The graphical schemes created by this research served its purpose. However, to become a common lexicon, eventual improvements might be required. For instance, other graphic notations can be more appropriate in translating the concepts on which actors must reach understandings. Further, it is likely that it is necessary to add information into the schemes to enhance their utility on the design process, such as three-dimensional data (eventually unfolding the schemes in several ones by floor level) or data on the characteristics of the users, uses, etc. The use a more detailed scale for the ‘building’ level schemes is likely to better support the addition of such information and further enhance the utility of the schemes on the new design approach.

The method (in its current state) is also suited to approach the definition of the spatial configuration proposals of a redevelopment project. It does not provide a quantitative assessment on the proposals’ performances, but it offers an overview on its main characteristics, allowing for a qualitative evaluation at any point of the process. In fact, spatial performance is hard or even impossible to measure quantitatively, as such attempts imply accounting for an innumerable amount of subjective variables.

6.2. Proposals for further research

The results of this research widened the understanding of the contribution architecture can give towards the improvement of (European HST) station areas spatial performance. However, the work has also found limitations, and raised other questions, which open now new paths for further research. Some possibilities for further research are closely in continuity with this research itself, and other represent a wider supplementary step in the field. Below, some suggestions on further work to explore the theme are given.

6.2.1. Deepening the results

The categories in which the cases were grouped can have implications on their spatial performances. However, the limited number of case studies has hampered possible generalizations in this regard. The investigation of a larger number of cases can eventually unveil such implications.

[139] Here, the term materializeable connotes realizable or buildable.

[140] Here, the term immaterial connotes incorporeal or non-physical.

[141] The term accessibility, for example, as many others, can have different connotations for several actors.

Nevertheless, despite limitations deriving from the number of case studies, (new) (re)development projects of station areas can use the 'design recommendations' resulting from this research as basis for their spatial design. In fact, testing the proposed 'design recommendations' on a project environment can lead to their validation or eventual improvement. To do so, two paths could be taken.

One path is to simulate a project, within the academic environment, and involve external interested parties in the evaluation of the results. The present research used *"research by design"* to look into the problem through a design exercise with students and redesigning the analysed case studies, as described in chapter five. The results this approach achieved encourage using it further to test, validate and refine the outcome of this research. Students could be called to use the 'design recommendations' in a design for a station area. The results of the projects would be presented to stakeholders[142], who would assess them. The inputs provided by the stakeholders, would contribute to validate or eventually to improve of the 'design recommendations'.

Another way is to apply the recommendations on a real project, monitored by academic research. This is a more complex endeavour, as it implies the commitment of a project design team with the application of the 'design recommendations', and the acceptance of the academic motorization. The researchers should be able to accompany the design at all stages to be able to draw conclusions on the applicability of the 'design recommendations'.

Another point worth expanding on is the exploration of the scales above the 'building' level. The present research focused on the intermediate scale level between the building and the urban area when looking at the spatial results of redevelopment projects and their performance. However, it also pointed out that the implications of station area redevelopment projects are to be recognized at a wide range of scales. Further, it was noted that to understand the effects at one scale, those at other scales should also be comprehended, as there are interrelations between them. This research did not survey deeply such spatial effects at other levels of scale beyond the 'building' one. Such a study would be an important contribution in understanding the spatial effects of these projects at the city and other levels of scale, and to enhance the knowledge produced by the present research.

Further developing the graphic method used in this research at 'urban level' and especially at 'city level' would be advisable when used to support such a study. The method allows for secure lessons at 'building level', because the focus of this research was on this intermediate scale and thus the schemes were better fine-tuned. Still, even at this level of scale, the method might require eventual improvements. As pointed out before, this is the case if the method is used in the mediation between the 'spatial design' and 'planning process', within the context of the new design task proposed by this research.

[142] Stakeholders such as station management companies, transport (infrastructure) companies, city representatives (public space / economy / social), (planning) authorities, representatives of companies / services present in station areas (commerce, offices, culture, etc.), (transport) users, residents of the area, and architects / planners involved in station area's design.

6.2.2. New paths

The research made clear the need to congregate the stakeholders around common spatial aims. However, it did not explore systematically how to do so. It did not give concrete indications on how to remedy the constraints imposed by stakeholders' interests and approaches to (the brief of) the station (area) design task.

Finding ways to consistently restructure the station building design assignment, extending it to its urban surroundings, and in order to support it, ways to reorganize the relationships among stakeholders, are themes for another future research. Utilizing an improved graphical method, as described above, can be part of this effort to facilitate a close cooperation of the researchers and the practitioners.

REFERENCES

ADIF (n.d.). *Descubre la Alta Velocidad*. Retrieved November 25, 2008, from ADIF website: http://www.descubrelaaltavelocidad.net/default_es.aspx

Aken, J. E. van (2004). Management Research Based on the Paradigm of the Design Sciences: The Quest for Field-Tested and Grounded Technological Rules. *Journal of Management Studies, 41*, pp.219-246.

Alsop Architects, & Projectbureau Rotterdam Centraal (2001). *Rotterdam Ontwerp Masterplan.* Rotterdam, London.

Augé, M. (1995). *Non-Places: introduction to an anthropology of supermodernity.* London: verso.

Aviation Environment Federation (2000). *From planes to trains: Realising the potential from shifting short-haul flights to rail,* London: Friends of the Earth. Retrieved April 21, 2010, from www.foe.co.uk/sites/default/files/downloads/planes_trains.pdf.

Bahnprojekt Stuttgart-Ulm (2011) Connecting people: the new transport concept for Stuttgart and the surrounding region [leaflet]. Bahnprojekt Stuttgart-Ulm: Stuttgart

Bahnprojekt stuttgart–ulm (n.d.). *Hauptbahnhof Stuttgart*, Retrieved September 10, 2012, from: http://www.bahnprojekt-stuttgart-ulm.de/details/neue-bahnhoefe/hauptbahnhof-stuttgart/.

Bajard, M. (2011). Gares Centrales avec leurs quartiers: Méthodologie et comparaison. in Terrin, J.-J., Marie, J.-B. & Leheis, S. (eds.). *Gares et dynamiques urbaines: Les enjeux de la grande vitesse* (pp. 144-159). Marseille: Parenthèses.

Bajard, M., Betoux, C. & Lamarre, F. (2007). *De la gare à la ville : AREP, une démarche de projet*, Bruxelles: Editions AAM - Archives d'Architecture Moderne.

Berg, L. van den, & Pol, P. (1998). *The European high-speed train and urban development: experiences in fourteen European urban regions*. European Institute for Corporative Urban Research – Euricur Series. Aldershot: Ashgate.

Bertolini, L. (1996). Nodes and places: Complexities of railway station redevelopment. *European Planning Studies, 4*(3), pp. 331-346.

Bertolini, L. (1998). Station area redevelopment in five European countries: An international perspective on a complex planning challenge. *International Planning Studies, 3*(2), pp. 163-184.

Bertolini, L. (1999). Spatial development patterns and public transport: the applications of an analytical model in the Netherlands. *Planning Practise and Research, 14*(2), pp.199-210.

Bertolini, L. (2000). Planning in the borderless city: A conceptualisation and an application to the case of station area redevelopment. *Town Planning Review, 71*(4), pp. 455-475.

Bertolini, L., & Spit, T. (1998). *Cities on Rails: The Redevelopment of Railway Stations Areas.* London: E & FN Spon.

Bertolini, L., Curtis, C., & Renne, J. (2012). Station Area projects in europe and Beyond: Towards Transit Oriented Development? *Built Environment, 38*(1), pp. 31-50.

Bijl, R. van der (ed.) (2010). *Station Centraal: over samenbinden van station en stad*. Rotterdam: Uitgeverij 010.

Binney, M. (1995). *Architecture of rail: The way ahead.* London: Academy Editions.

Boarnet, M., & Crane, R. (2001). Travel by Design: The Influence of Urban Form on Travel. *Journal of Planning Literature, 15*(1), pp.3-23.

Bouma, S. (2011). *Lifted Train Station*. Master Thesis. Delft University of Technology, Delft. Available from http://repository.tudelft.nl/view/ir/uuid%3Af7da07de-1021-493d-a65e-aa7cb8d6a6f6/

Bourdin, A., (2011). Vers la Ville-Gare. in Terrin, J.-J., Marie, J.-B. & Leheis, S. (eds.). *Gares et dynamiques urbaines: Les enjeux de la grande vitesse* (pp. 160-173). Marseille: Parenthèses.

Brouwer, I. (2010). *Fixing the link: Creating a strong, vital and attractive link between the Dutch central railway station and city centre*. Master Thesis. Delft University of Technology, Delft. Available from http://repository.tudelft.nl/view/ir/uuid:6bbfcc6f-9908-421b-b665-89df1dba9efc/

Browne, B.(2008). Jean-Marie Duthilleul and Etienne Tricaud: AREP. Victoria: images publishing.

Bruton, P., & Brindle, R. (1999). Relationship between urban form and travel behaviour. *Research Report AAR*, *335*, pp.1-50.

Buurman, H. (2010). *Urban Lobby: design for High Speed Station at Zuidas Amsterdam*, Master Thesis. Delft University of Technology, Delft. Available from http://repository.tudelft.nl/view/ir/uuid%3Aeb05f02d-7b62-4337-9e07-93f90edebf2d/

Cardno, C. A. (2009). Stacked towers create vertical city in Rotterdam, *Civil Engineering, 79* (12), pp. 16-17.

Casseres, J. M. de (1937). Principles of Planology: A Contribution to the Scientific Foundation of Town and Country Planning, *The Town Planning Review, 17*(2), pp. 103-114.

Castells, M. (1989) The Informational City: Information Technology, Economic Restructuring and the Urban-Regional Process. Oxford: Blackwell.

Cavallo, R. (2008). *Railway in the urban context: an architectural discourse*. Doctoral Thesis. Delft University of Technology, Delft. Available from http://repository.tudelft.nl/view/ir/uuid:e3772d7f-2847-4d2f-bb63-65b2184d9fb3/

Cervero R. (2001). Integration of urban transport and urban planning, in Freire, M., Stren, R., (eds.). *The Challenge of Urban Government: Policies and Practices*, pp. 407-427. Washington, D.C.: World Bank Institute

Cheung, L. Y. (2010). *Highspeed Train Station and Masterplan Entrecampos International*, Master Thesis. Delft University of Technology, Delft. Available from http://repository.tudelft.nl/view/ir/uuid%3Aa0b16342-c87a-4c7b-8e4e-4b2c3f465bf2/

Chou, J.-S., & Kim, C. (2009). A structural equation analysis of the QSL relationship with passenger riding experience on high speed rail: An empirical study of Taiwan and Korea, *Expert Systems with Applications, 36*, pp. 6945-6955. doi:10.1016/j.eswa.2008.08.056

Conceição, A. (2007). *Spatial impacts of multimodal stations on the urban layout: clues for new solutions within a sustainable perspective*, Master Thesis. Instituto Superior Técnico, Universidade Técnica de Lisboa, Lisbon.

Conceição, A. (2009). Multimodal stations and its surroundings: a sustainable perspective. *Conference Proceedings of the 3rd CIB International Conference on Smart and Sustainable Built Environments – SaSBE 15-19 June 2009,* Delft.

Conceição, A. (2011). Rethinking the railway station area: research by design in architecture and urban space, *Conference Proceedings of the 6th International Congress of Design Research: An agenda for Design – CIPED*, Lisbon.

Conticelli, E. (2012). *La stazione ferroviaria nella città che cambia.* Milano - Torino: Bruno Mondadori.

Conticelli, E., & Tondelli, S. (2011). Railway Station Role in Composing Urban Conflicts. *TeMA*, *4*(4), pp. 47-58.

Davison, N. (2014, October 30) China's obsession with vertical cities. *The guardian*. Retrieved October 31, 2014, from http://www.theguardian.com/cities/2014/oct/30/china-obsession-vertical-cities-skyscrapers-urbanisation-megacity

Deutcsche Bahn (2008) *ICENetz 2008* [ICE network map].Retrieved November 10, 2008, from: www.bahn.de

Deutcsche Bahn (2011) *ICENetz 2011* [ICE network map]. Retrieved November 14, 2012, from: www.bahn.de

Deutsch-Bahn. (n.d.). *ÖBB railjet: Munich - Vienna every 2 hours*. Retrieved November 14, 2012, from Deutsch-Bahn website: http://www.bahn.com/i/view/GBR/en/trains/overview/railjet.shtml

Dieleman F.M., Dijst M., & Burghouwt G. (2002). Urban form and travel behaviour: Micro-level household attributes and residential context, *Urban Studies, 39*(3), pp. 507-527.

Dobbelsteen, A. van den, & Wilde, S. de, (2004). Space use optimization and sustainability: Environmental assessment of space use concepts, *Journal of Environmental Management, 73*, pp. 81-89.

Duin, L. van (2008). Research by design into the Dutch city. in Duin, L. van, & Claessens, F. (red./ eds.). *Over Holland7: 5x5 Projects for the Dutch city* (pp. 3-7). Amsterdam: SUN.

Edwards, B. (1997). *The Modern Station: new approaches to railway architecture*. London: E & FN Spon.

Edwards, B. (2011). *Sustainability and the design of transport interchanges*. London: Routledge.

European Commission - Directorate General for Mobility and Transport (2010). *High Speed Europe: a sustainable link between citizens.* Luxembourg: Publications Office of the European Union. doi: 10.2768/17821.

European Commission - Directorate General for Regional Policy (2011). *Cities of tomorrow: Challenges, visions, ways forward*. Luxembourg: Publications Office of the European Union. doi:10.2776/41803.

European Commission - Eurostat. (2013, June 24). *History of NUTS.* Retrieved November 21, 2013, from Eurostat website: http://epp.eurostat.ec.europa.eu/portal/page/portal/nuts_nomenclature/history_nuts

Ewing, R., & Cervero, R. (2001). Travel and the built environment: a synthesis. *Transportation Research Record, 1780*, pp.87-114.

Ferrarini, A. (2005). *Railway Stations: From the gare de l'est to Penn station*. London: Phaidon Press

Ferrarini, A. (2009). *La stazione del XXI secolo*. Milano: Mondadori Electa.

Florida, R. (2005). *Cities and the creative class*. New York / London: Routledge.

Frearson, A. (2011, June 22). Moving Platforms by Priestmangoode. *Dezeen Magazine.* Retrieved September 22, 2011, from Dezeen Magazine website: http://www.dezeen.com/2011/06/22/moving-platforms-by-priestmangoode/.

Frey, H. (1999). *Designing the city: Towards a more sustainable urban form*. London: E & FN Spon.

Future Cities Laboratory (2013) *The Vertical City*. Retrieved October 10, 2014 from ETH Zurich website: http://www.futurecities.ethz.ch/event/the-vertical-city/

Furuto, A. (2013, August 8) The Flinders Street Station Winning Proposal: HASSELL + Herzog & de Meuron. Retrieved October 10, 2013, from ArchDaily website: http://www.archdaily.com/413042/the-flinders-street-station-shortlisted-proposal-hassell-herzog-and-de-meuron/

Gehl, J. (2001). *Life in Between buildings: Using Public Space* (5th ed.). Copenhagen: The Danish Architectural Press

Gemeente Amsterdam - Dienst Zuidas (n.d.). *Over Zuidas.* Retrieved December 10, 2013, from Gemeente Amsterdam website: http://www.amsterdam.nl/zuidas/menu/zuidas/

Gemeente Breda (n.d.) *Via Breda.* Retrieved November 12, 2008, from www.viabreda.nl.

Gerkan, von M., Bund Deutscher Architekten, Deutcsche Bahn, & Förderverein Deutsches Architekturzentrum. (eds.) (1996). *Renaissance of Railway Stations: The City in the 21st Century*. Exhibition catalogue. Stuttgart.

Globalization and World Cities Research Network. (2011). *The World According to GaWC: 2010.* Retrieved November 25, 2011, from GaWC website: http://www.lboro.ac.uk/gawc/gawcworlds.html

Gospodini, A. (2005). Urban development, redevelopment and regeneration encouraged by transport infrastructure projects: The case study of 12 European cities. *European Planning Studies, 13*(7), pp. 1083-1111.

Griffin, K. W. (2004). *Building type basic for transit facilities.* Hoboken: Wiley

Güller, M., & Güller, M. (2001). *From airport to airport city*. Barcelona: Editorial Gustavo Gili

Hajer, M. & Reijndorp, A. (2001) *In search of new public domain: Analysis and strategy*. Rotterdam: NAI Publishers

Hall, P., & Banister, D. (1993). The second railway age. *Built Environment, 19*(2-3), pp. 156-284.

Handy, S. (1996). Methodologies for exploring the link between urban form and travel behaviour, *Transport Research - D, 1*(2), pp.151-165.

Handy, S. (2005). Smart growth and the transportation - land use connection: What does the research tell us?. *International Regional Science Review, 28*(2), pp.146-167.

Harada, T. , Hirakawa, K. , Sakaguchi, Y. , Yonezu, M. (2012) *Abeno Harukas: Vertical city toward natural symbiosis and sustainability* [Conference Paper]. Asia Ascending: Age of the Sustainable Skyscraper City - A Collection of State-of-the-Art, Multi-Disciplinary Papers on Tall Buildings and Sustainable Cities, Proceedings of the CTBUH 9th World Congress, pp 738-743.

Hermans, W. & Spek, S. (2001). *De Overstapmachine: Compositie van het Railstation.* Delft: Delft University Press.

ISIS, Ingénierie du trafic et des Systèmes d'exploration, Ernst&Young, & ADIELOR. (2004). *Analyse de l'impact du TGV-Est sur les agglomérations de Metz, Nancy, Epinal et Thionville : Rapport de phase 2*

Japan Echo Inc. (2011, January). *Japan's Platform-Side Shopping Malls: Making Japanese Stations More Than Just A Place to Catch a Train*. Retrieved July 30, 2011, from Trends in Japan website: http://web-japan.org/trends/09_lifestyle/lif110120.html.

Jong, T.M. de, Voordt, D.J.M. van der (eds.) (2002). *Ways to research and study urban, architectural and technological design.* Delft: Delft University Press.

Kennedy, C., Miller, E., Shalaby, A., MacLean, H., & Coleman, J. (2005). The four pillars of sustainable urban transportation, *Transport Reviews, 25* (4), pp. 393-414.

Kleinman, C.S. (ed.) (2008) Grote stationsprojecten in Nederland, *cement, 1*

Kooijman, D. & Wigmans, G. (2003). Managing the city: flows and places at Rotterdam Central Station. *City, 7* (3), pp. 301-326

Krizek K.J. (2003). Residential relocation and changes in urban travel: Does neighbourhood-scale urban form matter?. *Journal of the American Planning Association, 69*(3), pp. 265-281

Kusumo, C. (2007). *Railway station, centres and markets: change and stability in patterns of urban centrality*, Doctoral Thesis. Delft University of Technology, Delft. Available from http://repository.tudelft.nl/view/ir/uuid:4cf6afeb-fa72-4971-a0b3-61ed01b4260a/

Leboeuf, M. (2011) *High Speed & the City*. Presentation at 'Next Station' Conference, 17-18 March. UIC, Brussels.

Leemans, A., & Ivokovic, M. (2011). *Stations for High Speed Systems: Toolbox for the design and/or renovation of major interchanges.* Bruxelles: UIC.

Lourenço, M. G. (2004). Acessibilidades revitalizar as estações. *Imobiliária*, Junho/Julho, pp. 60-63.

Lusa. (2007, November 13). Estação do TGV em Lisboa vai ser na Gare do Oriente. *Público*. Retrieved April 21, 2008, from http://www.publico.pt/economia/noticia/estacao-do-tgv-em-lisboa-vai-ser-na-gare-do-oriente-1310527

Lusa. (2013, September 18). Um comboio de levitação magnética para andar a 600 quilómetros por hora. *Público*. Retrieved November 21, 2013, from http://p3.publico.pt/vicios/hightech/9332/um-comboio-de-levitacao-magnetica-para-andar-600-quilometros-por-hora.

Lynch, K. (1960). *The image of the city*. Cambridge, Mass.: MIT Press.

Macedo Juca, L. (2010). *High Speed Graduation Lab: Hybrid Buildings.* Master Thesis. Delft University of Technology, Delft. Available from http://repository.tudelft.nl/view/ir/uuid%3A126716f0-4484-4f11-bc3d-32457dbac980/

Mateus, R., Ferreira, J. A., Carreira, J. (2008). Multicriteria decision analysis (MCDA): Central Porto. *European Journal of Operational Research, 187,* pp. 1–18

Meeks, C.L.V. (1975). *The railroad station: an architectural history*. New Haven: Yale University Press

Moreira, P., & Guimarães, C. M. (2013). A quimera do tgv, *Jornal dos Arquitectos, 248* (Set-Dez), pp. 188-199.

Mulder, R. (2008). *The high-speed railway station of the future – How to achieve it?*. Presentation to the sixth UIC High-Speed Rail Congress, 17- 19 March. UIC, Amsterdam.

Networkrail (2011). *Guide to station planning and design*. Retrieved November 10, 2012, from www.networkrail.co.uk/aspx/6368.aspx.

Newman, P. W. G., & Kenworthy J. R. (1989). Gasoline consumption and cities: a comparison of United-States cities with a global survey. *Journal of the American Planning Association, 55*(1), pp. 24-37.

Niedenthal, C. (2008). *Banhöfe in Deutschland: Moderne städtische Zentren*. Berlin: Jovis Verlag.

NMBS (n.d.) *Het Station.* Retrieved January 14, 2011, from: http://www.b-holding.be/over-ons-bedrijf/activiteiten/het-station.

ÖBB-Infrastruktur AG. (n.d.). *Vom Bahnhof zur BahnhofCity.* Retrieved November 15, 2012, from Hauptbahnhof Wien website: http://hauptbahnhof-wien.at/de/Projekte/BahnhofCity/index.jsp.

OECD (2001). *Glossary of Statistical Terms: Producer services.* Retrieved April 10, 2010, from http://stats.oecd.org/glossary/detail.asp?ID=2440.

Paksukcharern, K. (2003). *Node and Place: a study on the spatial process of railway terminus area redevelopment in central London*. Doctoral Thesis. University of London, London.

Pané, I. & Diesfeldt, O. (2008) Five cities: Ten maps. in Duin, L. van, & Claessens, F. (red./ eds.). *Over Holland7: 5x5 Projects for the Dutch city* (pp. 9-19). Amsterdam: SUN

Parissien, S. (1997). *Station to Station.* New York, London, Hong Kong: Phaidon Press.

Paultre, D., Mialet, F., Duthilleul, J.-M., Tricaud, E. (1998). *Agence des Gares AREP: Pacours 1988-1998.* Roma: Diagonale.

Peek, G.-J. & Hagen, M. van (2002). Creating synergy in and around stations: Three strategies for adding value, *Transportation Research Record, 1793*, pp. 1-6.

Peek, G-J. (2006). *Locatiesynergie: Een participatieve start van de herontwikkeling van binnenstedelijke stationslocaties.* Doctoral Thesis. Delft University of Technology, Delft. Available from http://repository.tudelft.nl/view/ir/uuid:fe2c8782-f31e-4183-b1a7-66d7e177e24e/

Peek, G-J., Bertolini, L. & Jonge, H. de (2006). Gaining Insight in the Development Potential of Station Areas: A Decade of Node-Place Modelling in The Netherlands. *Planning, Practice & Research, 21*(4), pp. 443 – 462

Performa A+U (2008, July 16). *Floating City: New Bologna Centrale Station*. Retrieved November 25, 2010, from Europaconcorsi website: http://europaconcorsi.com/projects/68503-Floating-City-Citta-Sospesa.

Peters, D. & Novy, J. (eds.) (2012a). Railway Station Mega-Projects and the Re-Making of Inner Cities in Europe, *Built Environment, 38*(1).

Peters, D. & Novy, J. (2012b). Railway station mega-projects as public controversies: the case of Stuttgart 21. *Built Environment, 38*(1), pp. 128-145

Peters, D. & Novy, J. (2012c). Train station area development mega-projects in Europe: towards a typology. *Built Environment, 38*(1), pp. 12-30.

Pickering, A. (ed.) (2010) 2010 Showcase. *Railway Terminal World, 1*.

Pieters, D. (2004). Publiekprivate samenwerkingen: Stations in Leuven, Antwerpen en Luik, *de Architect, 35*(9), pp. 46-55.

Plugge, R. (2010). *Project Greenwalk*. Master Thesis. Delft University of Technology, Delft. Available from http://repository.tudelft.nl/view/ir/uuid%3Aa4520ee4-b631-4b4e-8524-51148a0a94d0/

Pol, P. (2002) *A renaissance of stations railways and cities: economic effects development strategies and organisational issues of European high-speed-train stations*, Doctoral Thesis. Erasmus Universiteit Rotterdam, Rotterdam.

Priemus, H. (2006) *HST-Railway Stations as Dynamic Nodes in Urban Networks*, Paper presented at the conference 'Land Use and Transportation Planning in Urban China', Ministry of Construction & China Planning Society, Beijing.

Priemus, H., Nijkamp, P., & Banister, D. (2001). Mobility and spatial dynamics: an uneasy relationship. *Journal of Transport Geography 9*(3), pp.167-171.

Priestmangoode. (n.d.). *The Future of Rail Travel.* Retrieved September 22, 2011, from Priestmangoode website: http://www.priestmangoode.com/transport/

ProRail (2010) *Mijn Proef Station.* Retrieved January 14, 2011, from: http://www.mijnproefstation.nl

Railway Technology. (n.d.). *Lisbon-Porto High-Speed Line: Portugal*. Retrieved November 14, 2008, from Railway Technology website: http://www.railway-technology.com/projects/alfa/

Richards, J., & MacKenzie, J.M. (1988) *The railway station: a social history.* Oxford: Oxford University Press

Ritsema van Eck, J., Burghouwt, G., & Dijst, M., (2005). Lifestyles, spatial configurations and quality of life in daily travel: an explorative simulation study, *Journal of Transport Geography, 13*(2), pp.123-134.

Robinson, J. (27 August 2014) *The city in the sky: Ambitious blueprint for London tower block that could house thousands of people - as well as schools, offices, shops and even parks*. Retrieved September 30, 2014, from MailOnline website: http://www.dailymail.co.uk/news/article-2735522/City-sky-Ambitious-tower-block-house-thousands-people-schools-offices-shops-parks.html#ixzz3IZN3fsiv

Ross, J. (2000) *Railway stations: planning, design and management.* Oxford: Architectural Press

Rossi, A. (1982). *The Architecture of the City.* Cambridge, Massachusetts: MIT Press

Roth, R., & Polino, M-N. (2003). *The city and the railway in Europe*. Aldershot: Ashgate.

Sassen, Saskia (1991). *The Global City*. New York: Princeton University Press.

SBB/CFF/FFS (2013a) *Rahmenplan Basel: Schlussbericht 31 March 2013*. Retrieved May 10, 2013, from www.sbb.ch/content/dam/sbb/de/pdf/sbb-konzern/ueber-die-sbb/projekte/ausbau-schienennetz/rahmenplan_basel_2013_de.pdf.

SBB/CFF/FFS. (n.d.a). *Rail City.* Retrieved November 20, 2008, from: www.railcity.ch.

SBB/CFF/FFS. (n.d.b). *RailCity: A name with pulling power.* Retrieved November 20, 2008, from SBB website: http://mct.sbb.ch/mct/en/im-railcity-broschuere.pdf.

SBB/CFF/FFS. (n.d.c). *Welcome to our stations*. Retrieved January 14, 2011, from Sbb website: http://www.sbb.ch/en/station-services/am-bahnhof/railway-stations.html

Schaap, P.-M., Verhave, B., & Verdonk, N. (2003) *Zes nieuwe Stations geven hart aan de stad*. The Hague: VROM.

Segratin, P. (2011). Comment ouvrir sur la ville um système de transport à grande vitesse?. in Terrin, J.-J., Marie, J.-B. & Leheis, S. (eds.). *Gares et dynamiques urbaines: Les enjeux de la grande vitesse* (pp. 174-185). Marseille: Parenthèses.

SNCB-Holding. (2010). *Het Station*. Retrieved January 10, 2011, from: http://www.go-mobile.be/nl/sites/het-station/over-het-station/crèches.

SNCF (2007) *2007, le réseau TGV s'élargit: plus de 30 nouvelles destinations*. Retrieved November 12, 2008, from: http://www.tgv-europe.com/en/Train/All_our_trains/TGV/?&_LANG=EN#.

SNCF (n.d.a) *Le réseau TGV* [Map]. Retrieved November 14, 2012, from: http://www.raileurope.eu/agencies/products/trains/tgv.

SNCF (n.d.b) *General overview of major train connections* [Map]. Retrieved November 14, 2012, from: http://www.tgv-europe.com/en/train-europe?rfrr=reserver%20un%20billet%20accueil_body_ournetwork.

Speck, G. (2012). History and Failure of the Mega-Project 'Frankfurt 21'. *Built Environment, 38*(1), pp. 103-112

Spek, S. van der (2003). Van station naar connector, *Nova Terra, 3*(3), pp.2-6

Spi+ Agence de développement économique pour la Province de Liège. (2005). *A New Ultramodern Station and District in Full Expansion*. Liège: Author. Retrieved November 11, 2008, from Spi+ website: http://www.liegeonline.be/en/medias/pdf/gareguilleminsEN.pdf.

Stead, D. & Marshall, S. (2001). The Relationships between urban form and travel patterns: an international review and evaluation, *European Journal of Transport and Infrastructure Research, 1*(2), pp.113-141.

Stein, J. (ed.) (1983). *The Random House Dictionary of the English Language*. New York: Random House.

Swissinfo (2003, January 15). *Railway stations undergo transformation.* Retrieved January 20, 2010, from Swissinfo, the international branch of the Swiss Broadcasting Corporation, website: http://www.swissinfo.ch/eng/archive/Railway_stations_undergo_transformation.html?cid=3111900.

Terrin, J.-J. (2011). Gares TGV: projects et stratégies urbaines, in Terrin, J.-J., Marie, J.-B. & Leheis, S. (eds.). *Gares et dynamiques urbaines: Les enjeux de la grande vitesse* (pp. 10-28). Marseille: Parenthèses.

Terrin, J.-J., Marie, J.-B. & Leheis, S. (eds.) (2011). *Gares et dynamiques urbaines: Les enjeux de la grande vitesse*. Marseille: Parenthèses.

Thorne, M. & Art Institute of Chicago (2001). *Modern trains and splendid stations: architecture, design, and rail travel for the twenty-first century*. London: Merrell

Tice, J. (2005). The Nolli Map and Urban Theory. in The interactive Nolli Map Website of the Department of Architecture of the University of Oregon. Retrieved March 20, 2013, from http://nolli.uoregon.edu/urbanTheory.html.

Tilman, H., (2004). Architectuur van stations: Stationsgebieden in Utrecht, Breda e Arnhem, *de Architect, 35*(9), pp. 34-45

Timmermans, H., Warden, P. van der, Alves, M., Polak, J., Ellis, S., Harvey, A.S., Kurose, S., & Zandee, R. (2003). Spatial context and complexity of daily travel patterns: an international comparison, *Journal of Transport Geography, 11*(1), pp.37-46.

Tiry, C. (2011). Métropoles régionales et grande vitesse: des projects de centralités multiscalaires. in Terrin, J.-J., Marie, J.-B. & Leheis, S. (eds.). *Gares et dynamiques urbaines: Les enjeux de la grande vitesse* (pp. 186-202). Marseille: Parenthèses.

Tiry, C., (2008). *Les mégastructures du transport, typologie architecturale et urbaine des grands équipements de la mobilité*. Lyon: Éditions du Certu.

Trip, J. J. (2007). *What makes a city? Planning for 'quality of place': The case of high-speed train station area redevelopment*, Doctoral Thesis. Delft University of Technology, Delft. Available from http://repository.tudelft.nl/view/ir/uuid:a0ee18b2-8cf3-45f7-8e2b-45141ab28ef4/

UIC & BB&J Consult (2010). *High Speed and the City*. Retrieved February 20, 2011, from www.uic.org/etf/publication/publication-detail.php?code_pub=518

United Nations (1992) *Earth Summit Agenda 21: the United Nations Programme of action from Rio.* United Nations.

United Nations Statistics Division. (2013, October 31). *Composition of macro geographical (continental) regions, geographical sub-regions, and selected economic and other groupings.* Retrieved November 20, 2013, from United Nations Statistics Division website: http://unstats.un.org/unsd/methods/m49/m49regin.htm#europe.

Verkersclub Deutschland (n.d.). *Kopfbahnhof 21: Die Alternative zu Stuttgart 21 mit Flughafenanbindung.* Retrieved September 20, 2012, from http://www.vcd-bw.de/themen/s21/kopfbahnhof21/index.html.

VROM (2004). *New Key Projects: the station as a gateway to the city*. Information leaflet. The Hague: VROM.

Vugrinec, S. (2011). Architecture - Hybrid Buildings - High Speed Train Stations, Master Thesis. Delft University of Technology, Delft. Available from http://repository.tudelft.nl/view/ir/uuid%3A9ad6e88c-4c37-45e7-a166-f3f7aaf4dd99/

Wegener, M., & F. Fürst (1999). *Land-Use Transport Interaction: State of the Art*. Deliverable 2a of the project TRANSLAND. Universität Dortmund. Retrieved March 9, 2010, from http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1434678.

Wilde, Sebastiaan de (2002). *Underground spaces at new heights*. Proceedings for ACUUS 2002 International Conference, Urban Underground Space: a resource for cities. 14-16 November, Torino.

Wilde, Sebastiaan de (2006). *Rail Estate: Multiple Use of Space and Railway Infrastructure*. Doctoral Thesis. Delft University of Technology, Delft. Available from http://repository.tudelft.nl/view/ir/uuid:a76b3465-bb54-4138-96cb-135a6af6b293/

Williams, K., Burton, E., & Jenks, M. (2000). *Achieving Sustainable Urban Form*. London: E & FN Spon.

Wong, K.M.G. (2004). Vertical cities as a solution for land scarcity: The tallest public housing development in Singapore, *Urban Design International, 9* (1), pp. 17-30.

World Commission on Environment and Development (1987). *Our Common Future*. Oxford: Oxford University Press.

Xue, C. Q. L., Ma, L., & Chuen Hui, K. (2012). Indoor 'Public' Space: A study of atria in mass transit railway (MTR) complexes of Hong Kong, *Urban Design International, 17*, pp. 87–105. doi:10.1057/udi.2012.6

Zemp, S., Stauffacher, M., Lang, D.J., Scholz, R.W. (2007). *Systemic perspectives on railway stations for sustainable transport and land use*. Conference paper STRC 2007, 7th Swiss Transport Research Conference. 12 - 14 September. Monte Verità / Ascona.

CASES

Baus, U., & Schlaich, M. (2008). *Footbridges: Structure Design History.* Basel: Brikhäuser.

Centraal Bureau voor de Statistiek (2012a). *Population dynamics; birth, death and migration per region - 2012*. Retrieved December 21, 2013, from Centraal Bureau voor de Statistiek website: http://statline.cbs.nl/StatWeb/publication/?VW=T&DM=SLEN&PA=37259eng&LA=EN

Centraal Bureau voor de Statistiek (2012b). *Demografische kerncijfers per gemeente 2012*. Retrieved December 21, 2013, from Centraal Bureau voor de Statistiek website: http://www.cbs.nl/NR/rdonlyres/61FD6C62-4103-4635-9FE8-B6F7DE8306EC/0/2012b55pub.pdf

Conceição, A., &. Nieuwenhuizen, J. van (2008). Knooppunt met hybride kap, *Sedebouw & Architectuur*, *25*(4), pp. 32-35.

Day, J. R., & Reed, J. (2010). *The Story of London's Underground*. London: Capital Transport Publishing.

Eurostat (2011a). *Population density: NUTS 3 regions.* Retrieved December 21, 2013, from Eurostat website: http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=demo_r_d3dens&lang=en.

Eurostat (2011b). *Area: NUTS 3 regions.* Retrieved December 21, 2013, from Eurostat website: http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=demo_r_d3area&lang=en.

Amsterdam

Amsterdam Centraal (2011). Fietsenstallingen. Retrieved November 10, 2013 from Amsterdam Centraal website http://www.amsterdamcentraal.nu/projecten/fietsprojecten/fietsenstallingen

Coördinatie Stationseiland (2004). *A new Station Island* [Information leaflet]. Amsterdam: Coördinatie Stationseiland.

Gemeente Amsterdam - Dienst Infrastructuur Verkeer en Vervoer (2003, September) *Meerjarenplan Fiets 2012 – 2016*. Retrieved October 15, 2013, from Gemeente Amsterdam website: http://www.amsterdam.nl/parkeren-verkeer/fiets/meerjarenplan-fiets.

Gemeente Amsterdam - Projectbureau Zuidelijke IJ-oever (n.d.) *Zuidelijke IJ-oever.* Retrieved December 10, 2013, from Gemeente Amsterdam website: http://www.amsterdam.nl/wonen-leefomgeving/bouwprojecten/zuidelijke-ij-oever/

Gemeente Amsterdam (1998) *Masterplan Amsterdam Zuidas.* Amsterdam: Dienst Ruimtleijke Ordening.

Gemeente Amsterdam (n.d.) *Noord/Zuidlijn*. Retrieved October 15, 2013, from Gemeente Amsterdam website: www.amsterdam.nl/noordzuidlijn

Gemeente Amsterdam, Nederlandse Spoorwegen, ProRail. (2005). *Masterplan Stationseiland Amsterdam*. Amsterdam: Gemeente Amsterdam.

NS, ProRail & Gemeente Amsterdam (n.d.) *Historie Amsterdam Centraal*. Retrieved October 15, 2013, from Amsterdam Centraal website: http://www.amsterdamcentraal.nu/achtergrond/geschiedenis/historie

ProRail (n.d.) *Station Amsterdam Centraal.* Retrieved October 15, 2013, from ProRail website: www.prorail.nl/projecten/station-amsterdam-centraal

Antwerp

Autonoom Gemeentebedrijf Stadsplanning Antwerpen, stad Antwerpen, AG VESPA, KMDA, & NMBS Holding. (2011). *De Stationsomgeving: De motor van de stad.* Retrieved December 21, 2010, from www.antwerpen.be/docs/Stad/Stadsvernieuwing/Stationsomgeving/20110923_Stationsomgeving_motor%20van%20de%20stad_web.pdf.

Direction générale Statistique (2013). *Population par lieu de résidence, nationalité, état civil, âge et sexe depuis 2001: 2013*. Retrieved December 21, 2013, from Direction générale Statistique website: http://bestat.economie.fgov.be/BeStat/BeStatMultidimensionalAnalysis?loadDefaultId=441

Sclep, E. (ed.) (2011). *Welcome to Antwerp central: the railway cathederal of the 20th and 21th century.* [information brochure]. SNCB holding, Brussels. Retrieved January 20, 2012, from http://www.plantlocationeurope.eu/pdf/brochure-antwerpen-en.pdf.

Stad Antwerpen (2012). *Urban development in Antwerp: Designing* Antwerp. Retrieved December 30, 2012, from Stad Antwerpen website: http://www.antwerpen.be/docs/Stad/Stadsvernieuwing/9746949_urbandevelopment_English.pdf

Vink, T., Vandenbroecke, H., & Somers, A. (eds.) (2010). *Omgeving Centraal Station: analyse en kader voor het te voeren ruimtelijk beleid*. Work document. Antwerp: A G Stadsplanning Antwerpen.

Voncke, J. (2003). Nieuw leven op en onder Koningin Astridplein: van obstakel tot bindende factor. *Cement, 55*(3), p.9-11.

Stad Antwerpen (2007, March 3) *BPA Pelikaanstraat*. Retrieved October 10, 2012, from Stad Antwerpen website: http://www.antwerpen.be/eCache/ABE/8027459.Y29udGV4dD04MDMzODk2.html

Belga. (2013, November 20). Brussel-Zuid telt de meeste reizigers. *De Standaard*. Retrieved December 21, 2013, from http://www.standaard.be/cnt/dmf20131120_00847881

Provincie Antwerpen (n.d.). *Mobiliteit*. Retrieved December 30, 2012, from Stad Antwerpen website: http://www.provant.be/mobiliteit/

Basel

Ambühl, I. (2012, April 22). Massive Kritik am Basler Bahnhofsprojekt. *Basel Die Nordwestschweiz*. Retrieved March 20, 2013, from http://www.bzbasel.ch/basel/basel-stadt/massive-kritik-am-basler-bahnhofsprojekt-124149460.

Basel-Stadt Statistisches Amt (2013). *Bevölkerungsstand nach Geschlecht, Heimat und Gemeinde - 2012.* Retrieved December 21, 2013, from Basel-Stadt website: http://www.statistik-bs.ch/tabellen/t01/1

Jacob Planung (2009) *CentralParkBasel: eine städtebauliche Studie*. Retrieved November 10, 2012, from http://www.spenden.centralparkbasel.ch/download/Content_attachments/FileBaseDoc/CPB-Buch.pdf

Kanton Basel-Stadt. (2013). *Tri-national cooperation.* Retrieved November 20, 2013, from Kanton Basel-Stadt website: http://www.basel.ch/en/Portrait/Aussenbeziehung/Trinationale-Zusammenarbeit.html

Office fédéral de la statistique (2013a). *Switzerland's population 2012*. Retrieved December 21, 2013, from Office fédéral de la statistique website: http://www.bfs.admin.ch/bfs/portal/en/index/news/publikationen.html?publicationID=5381

Office fédéral de la statistique (2013b). *Statistique de la superficie 2004/09*. Retrieved December 21, 2013, from Office fédéral de la statistique website: http://www.bfs.admin.ch/bfs/portal/de/index/themen/02/03/blank/data/gemeindedaten.html

Parkhäuser Basel-Stadt (2013) *Permanentes Parkleitsystem Basel.* Retrieved November 14, 2013 from Parkhäuser Basel-Stadt website: http://www.parkleitsystem-basel.ch/parkhaus/centralbahnparking.php

SBB/CFF/FFS (2011). *Basel sbb Abfahrtszeiten: Gültig vom 11.12.2011 bis 8.12.2012.* [train timetable] SBB/CFF/FFS: Basel

SBB/CFF/FFS (2013c). *SBB Facts and Figures 2013.* Retrieved January 10, 2013, from SBB/CFF/FFS website: http://www.sbb.ch/en/group/the-company/facts-and-figures/railway-stations.html

Veloparking (n.d.). *Veloparking Centralbahnplatz*. Retrieved November 15, 2013 from Veloparking website: http://www.veloparking.ch/

Weber, D. (2011, March 10). Outdoor-Spezialist erobert Markthalle. *Basler Zeitung*, Retrieved April 5, 2013, from http://bazonline.ch/basel/stadt/OutdoorSpezialist-erobert-Markthalle/story/25332564.

Wüest, M. (2013, November 16). Es braucht hier einen Extraeinsatz. *Basler Zeitung*. Retrieved December 20, 2013, from http://bazonline.ch/basel/Es-braucht-hier-einen-Extraeinsatz/story/26755799.

Lisbon

Carvalho, F. (2012). Santa Maria dos Olivais: uma freguesia património de Lisboa, *Ubimuseum,1*, pp. 75-88. Retrieved February 20, 2013, from www.ubimuseum.ubi.pt/n01/about.html.

Figueira de Sousa, J., & Fernandes, A. (2012). Metamorfoses da cidade portuária: transformações da relação entre o porto e a cidade de Lisboa. *Confins, 15*. doi:10.4000/confins.7702

França, J.-A. (1989). Preface. in Henriques da Silva, R., *Lisboa de Frederico Ressano Garcia: 1874-1909*. Lisboa: Câmara Municipal de Lisboa.

Gomes, R. M., & Gomes, G. (2006). *Os Caminhos-de-Ferro Portugueses 1856 – 2006*, Lisboa: CP – Comboios de Portugal.

Henriques da Silva, R. (1989). *Lisboa de Frederico Ressano Garcia: 1874-1909*. Lisboa: Câmara Municipal de Lisboa.

Instituto Nacional de Estatística (2012). *Censos 2011: Resultados Definitivos*. Retrieved December 21, 2013, from Instituto Nacional de Estatística website: http://www.ine.pt/scripts/flex_definitivos/Main.html

Mendes Pinto, P. (2003). *Aeroporto Marítimo de Cabo Ruivo: A Aviação em Lisboa antes do Aeroporto da Portela*. Lisboa: NAV-Portugal E.P.E..

Pinheiro, M. (2008) *Cidade e caminhos de ferro.* Lisboa: Livraria editora figueirinhas.

Parkopedia (2013). *Gare do Oriente Sul: Parque de Estacionamento*. Retrieved November 10, 2013, from Parkopedia website: http://www.parkopedia.pt/estacionamento/parque-de-estacionamento/gare_do_oriente_sul/1990/lisbon/

Silva Dias, F. da, & Silva Dias, T. da (1993). *Lisboa: freguesia de Santa Maria dos Olivais*, Lisboa: Contexto.

Turismo de Lisboa (2013) *Nations Park Fairs at the Estação do Oriente: Level -2*. Retrieved December 10, 2013, from Turismo de Lisboa website: http://www.visitlisboa.com/Conteudos/Eventos/2013anual/01/Nations-Park-Fairs-at-the-Estacao-do-Oriente---Lev.aspx

Velez, J.P. (2008) *Expo'98: História de um território reinventado*. Lisboa: Parque Expo 98 S.A..

Cerejo, J. A. (2006, March 30). Gare do Oriente vai ter salas de espera oito anos depois. *Público.* Retrieved April 11, 2013, from http://www.publico.pt/local-lisboa/jornal/gare-do-oriente--vai-ter-salas-de-espera-oito-anos-depois-70927.

Boaventura, I. (2009, March 20). Querem fazer uma cidade por nichos: Lisboa oriente. *Público*. Retrieved April 10, 2013, from www.publico.pt/temas/jornal/querem-fazer--uma-cidade-por-nichoslisboa-oriente-18438658.

Câmara Municipal de Lisboa (2010, July) Plano de Urbanização da Área Envolvente à Estação do Oriente: Proposta Preliminar. Retrieved December 10, 2013, from the CML website: http://www.cm-lisboa.pt/viver/urbanismo/planeamento-urbano/planos-com-termos-de-referencia-aprovados/plano-de-urbanizacao-da-area-envolvente-a-estacao-do-oriente

REFER (2010) *Lisboa Oriente*. Retrieved December 15, 2012, from Refer website: http://www.refer.pt/MenuPrincipal/REFER/Estacoes/Estacao.aspx?stationid=9431039

Mourato, P. (2013, May 20). Gare do Oriente recebe hoje 150 mil pessoas por dia. *Diário de Notícias.* Retrieved March 20, 2013, from www.dn.pt/inicio/portugal/interior.aspx?content_id=3229021&seccao=Sul. Accessed 10 September 2013.

Parque das Nações (2013) Transportes. Retrieved November 15, 2013, from Portal das Nações website: http://www.portaldasnacoes.pt/category/transportes1/

Turin

Cavicchioli, S. (2009) Vie e mezzi di trasporto: da Carlo Alberto all'Unità. in Sereno, P. (ed.). *Torino Reti e Trasporti: Strade, veicoli e uomini dall'Antico regime all'Età contemporanea*. (pp. 59-103). Torino: Archivio Storico della Città di Torino.

Ciocchetti, A., Corsico, F., Rosso, E., & Bocconcino, M. (2011). Torino Porta Susa et la Spina Centrale. in Terrin, J.-J., Marie, J.-B. & Leheis, S. (eds.). *Gares et dynamiques urbaines: Les enjeux de la grande vitesse* (pp. 124-141). Marseille: Parenthèses.

Comune di Torino (2012, July 5) *Passante Ferroviario: Il Potenziamento Del Nodo Ferroviario Di Torino E Il Viale Della Spina.* Retrieved October 25, 2013, from Servizio Telematico Pubblico, Trasporti e Viabilità website: http://www.comune.torino.it/trasporti/bm~doc/passantescheda-3.pdf

D'Ascia, S. (2010). Torino Porta Susa, PEC SPINA2: Stazione Ferroviaria e Torre Servizi, *TeMA , 3*(4), pp71-82.

Ferrovie dello Stato Italiane (2008). Torino Porta Susa: La nuova stazione AV in cifre. Retrieved November 12, 2012, from Ferrovie dello Stato Italiane website: http://www.fsnews.it/cms/v/index.jsp?vgnextoid=76275d6ac472c310VgnVCM1000008916f90aRCRD#2

Istituto nazionale di statistica (2012). *Popolazione e famiglie*. Retrieved December 21, 2013, from Istituto nazionale di statistica website: http://www.istat.it/it/popolazione

Pieri, F. De (2009) La ferrovia nella città: progetti, cantieri, dibattiti. in Sereno, P. (ed.). *Torino Reti e Trasporti: Strade, veicoli e uomini dall'Antico regime all'Età contemporanea*. (pp. 191-227). Torino: Archivio Storico della Città di Torino.

Urban Center (2012) *Stazione porta susa*. Retrieved November 20, 2012, from Urban Center website: http://www.urbancenter.to.it/indexScheda.php?id_prog=173

Utrecht

Bestuur Regio Utrecht (n.d.) Geschiedenis. Retrieved December 15, 2013, from Regiotram Utrecht website: http://www.regiotramutrecht.nl/homepage/copy_of_geschiedenis

Ector Hoogstad Architecten (2011) *Stationsplein Oost Utrecht*. Retrieved November 25, 2011, from Ector Hoogstad Architecten website: http://www.ectorhoogstad.com/en/projects/stationsplein-oost-utrecht

Gemeente Utrecht, Corio, ProRail, NS, & Jaarbeurs.(2012, July 2) *OV-terminal Utrecht Centraal*. Retrieved October 23, 2013, from CU2030 website: http://cu2030.nl/page/ovterminal

Parkeren in de Stad (2013). *Parkeergarages Utrecht*. Retrieved November 15, 2013, from Parkeren in de Stad website: http://www.parkerenindestad.nl/utrecht/parkeergarages

Projectorganisatie Uithoflijn (n.d.) *Uithoflijn*. Retrieved December 15, 2013, from Uithoflijn website: http://www.uithoflijn.nl/home/

Spoorwegmuseum (n.d.) *Van station naar museum tot station*. Retrieved November 10, 2013, from Spoorwegmuseum website: http://www.spoorwegmuseum.nl/het_museum/maliebaanstation/geschiedenis_van_het_maliebaanstation.html

SOURCES FOR THE SETS OF DRAWINGS

Amsterdam

Background maps

Topografische Dienst (1854). *Topografische en Militaire Kaart van het Koninkrijk der Nederlanden: Kaartblad Amsterdam TMK25.* [map] (1:50.000). TU Delft Library Kaartenkamer, Delft.

Provincie Noord-Holland (1866). *Gemeente Amsterdam: nº2 de Stad.* [map]. (1:21500). Leeuwarden: uitgave van Hugo Suringar. TU Delft Library Kaartenkamer, Delft.

Topografische Dienst (1908-1909). *Amsterdam Chromo-Topografische Kaart in Bonneprojektie: b347 en b348*. [map] (1:25.000). TU Delft Library Kaartenkamer, Delft.

Topografische Dienst (1950). *Topografische Kaart van Nederland: Zaandam 25B*. [map] (1:25.000). TU Delft Library Kaartenkamer, Delft.

Topografische Dienst (1952). *Topografische Kaart van Nederland: Amstelveen 25D*. [map] (1:25.000). TU Delft Library Kaartenkamer, Delft.

Topografische Dienst (1950). *Topografische Kaart van Nederland: Ilpendam 25E*. [map] (1:25.000). TU Delft Library Kaartenkamer, Delft.

Topografische Dienst (1949). *Topografische Kaart van Nederland: Amsterdam 25G*. [map] (1:25.000). TU Delft Library Kaartenkamer, Delft.

Topografische Dienst (1981). *Topografische Kaart van Nederland: Zaandam 25B*. [map] (1:25.000). TU Delft Library Kaartenkamer, Delft.

Topografische Dienst (1969). *Topografische Kaart van Nederland: Amstelveen 25D*. [map] (1:25.000). TU Delft Library Kaartenkamer, Delft.

Topografische Dienst (1981). *Topografische Kaart van Nederland: Ilpendam 25E*. [map] (1:25.000). TU Delft Library Kaartenkamer, Delft.

Topografische Dienst (1969). *Topografische Kaart van Nederland: Amsterdam 25G*. [map] (1:25.000). TU Delft Library Kaartenkamer, Delft.

Topografische Dienst Kadaster (2004). *Topografische Kaart van Nederland: Zaandam 25B*. [map] (1:25.000). TU Delft Library Kaartenkamer, Delft.

Topografische Dienst Kadaster (2004). *Topografische Kaart van Nederland: Amstelveen 25D*. [map] (1:25.000). TU Delft Library Kaartenkamer, Delft.

Topografische Dienst (1994). *Topografische Kaart van Nederland: Ilpendam 25E*. [map] (1:25.000). TU Delft Library Kaartenkamer, Delft.

Topografische Dienst (2000). *Topografische Kaart van Nederland: Amsterdam 25G*. [map] (1:25.000). TU Delft Library Kaartenkamer, Delft.

Transport networks

Gemeente Amsterdam - Dienst Infrastructuur Verkeer en Vervoer (2003).

Gemeente Amsterdam (n.d.). *Parkeergarages.* [Interactive map of car parking of Amsterdam]. Retrieved November 10, 2012, from http://www.amsterdam.nl/parkeren-verkeer/parkeren-amsterdam/parkeergarages/

Green Wheels (n.d.). *Waar vind ik een Greenwheels?.* [interactive map of carsharing parking in the Netherlands]. Retrieved October 12, 2012, from https://www.greenwheels.com/book/search/nl/location/.

GVB (2012). *Lijnennetkaart.* [Public Transport Network map of Amsterdam]. (scale not given). Retrieved November 5, 2012, from http://en.gvb.nl/reisinformatie/plattegronden/Pages/Lijnennetkaart.aspx.

Station plans

Gemeente Amsterdam, Nederlandse Spoorwegen, ProRail. (2005).

Antwerp

Background maps

Valerius-Jouan, C.T.(ca. 1854). *Plan de la ville d'Anvers et des environs.* [map]. (1:10000). Stadsarchief Antwerpen (12#4192). Retrieved from http://zoeken.felixarchief.be/zHome/Home.aspx?id_isad=46065.

Kymeulen, A.J. (1904). *Compagnie Générale des Tramways d'Anvers: Plan du réseau mars 1904.* [Antwerp Tram Network map]. (1:20000). Stadsarchief Antwerpen (12#4219). Retrieved from http://zoeken.felixarchief.be/zHome/Home.aspx?id_isad=46065.

De Rouck, R. (ca. 1950-1955). *Antwerpen en randgemeenten: wegenkaart.* [map]. (1:15000). Stadsarchief Antwerpen (12#8870). Retrieved from http://zoeken.felixarchief.be/zHome/Home.aspx?id_isad=46065

Wegenwerken rond Antwerpen [map]. (ca. 1970). (1:1500). Stadsarchief Antwerpen (12#4294). Retrieved from http://zoeken.felixarchief.be/zHome/Home.aspx?id_isad=46065

Geocart (2001). *Stedelijk onderwijs Antwerpen.* [map]. (1:17500). Stadsarchief Antwerpen (12#12515). Retrieved from http://zoeken.felixarchief.be/zHome/Home.aspx?id_isad=46065

Transport networks

Cambio Autodelen (n.d.). *Standplaatsen in België.* [interactive map of carsharing parking in Belgium]. Retrieved November 12, 2012, from https://www.greenwheels.com/book/search/nl/location/.

De Lijn (2012). *Netplan Antwerpen Mortsel Edegem*. [Public Transport Network map of Antwerp]. (scale not given). Retrieved November 5, 2012, from www.delijn.be.

Gemeentelijk Autonoom Parkeerbedrijf Antwerp (n.d.). *Parkeermogelijkheden.* [Interactive map of car parking of Antwerp]. Retrieved November 10, 2012, from http://www.parkereninantwerpen.be/parkeermogelijkheden

Velo (n.d.). *Handige fiets van 't stad: kaart fietsstations.* [bycicle stations map of Antwerp]. (scale not given). Retrieved September 10, 2012, from http://www.velo-antwerpen.be/

Station plans

Buyten, P. van (1992). Antwerpen Centraal Station TGV: mobiliteit en patrimonium verzoenen. *Aplus: Belgisch tijdschrift voor architectuur, 115* (2), pp.26-35.

Pieters, D. (2004).

SNCB-Holding (2011). *Anvers-Central: Plan de la gare et des alentours.* [information plans of the station]. (scale not given). Bruxelles: SNCB-Holding.

Voncke, J. (2003).

Basel

Background maps

Vermessungsamt Basel-Stadt (ca. 1958). *Basel und Umgebung: 1850.* [map]. (1:12500). Planarchiv (W 3,361). Staatsarchiv Basel-Stadt, Basel.

Vermessungsamt Basel-Stadt (ca. 1958). *Basel und Umgebung: 1900.* [map]. (1:12500). Planarchiv (W 3,362). Staatsarchiv Basel-Stadt, Basel.

Vermessungsamt Basel-Stadt (ca. 1958). *Basel und Umgebung: 1958.* [map]. (1:12500). Planarchiv (W 3,363). Staatsarchiv Basel-Stadt, Basel.

Vermessungsamt Basel-Stadt (ca. 1967). *Basel und Umgebung, mit Strassenverzeichnis*. [map]. (1:12500). Planarchiv (Z 1,52). Staatsarchiv Basel-Stadt, Basel.

Transport networks

Tarifbund nordwestschweiz (2011) *Liniennetz Basel und Umgebung 2011 TNW* [Public Transport Network map of Basel]. Retrieved from BLT Baselland Transport AG website:

http://www.blt.ch/FahrplanundLiniennetz/BLTTram/BLTTram.aspx

Mobility carsharing (n.d.). *Standorte.* [interactive map of carsharing parking in Switzerland]. Retrieved November 12, 2012, from https://www.mobility.ch/de/privatkunden/standorte/.

Basel-Stadt (n.d.). *Stadtplan: Informationen.* [Interactive map of Basel]. Retrieved from Basel-stadt GeoPortal website: http://www.stadtplan.bs.ch/geoviewer/.

Station plans

SBB/CFF/FFS (2013b) *Innenplan Bahnhof Basel SBB und Umgebungsplan*. [plan of the SBB station in Basel and its urban surroundings]. Retrieved from http://www.sbb.ch/content/dam/infrastruktur/trafimage/bahnhofplaene/plan-basel-sbb-a4.pdf

Mazzoni, C. (2006).

Lisbon

Background maps

Neves, J. M. C. (ca.1860). *Planta da cidade de Lisboa*. [map]. (ca. 1:12000). Cartografia (cc-757-v). Biblioteca Nacional de Portugal, Lisboa. Retrieved from http://purl.pt/3405.

Gabinete de Estudos Olisiponenses (1993) Atlas de Lisboa: a cidade no espaço e no tempo, Contexto, 1993 - 142 pagina's (Lisbon, Portugal)

Plano Hydrográfico do Porto de Lisboa (detalhe), 1847

Costa, A. (1909). *Carta de Lisboa e seus arredores* [map]. (ca. 1:50000). Cartografia (cc-1082-r). Biblioteca Nacional de Portugal, Lisboa. Retrieved from http://purl.pt/22524.

Ressano Gracia, F. (1903). *Planta Geral da Cidade com todos os estudos que dizem respeito a este anteprojecto: Plano Geral de Melhoramentos da Capital.* [map]. (1:25000). (PT/AMLSB/CMLSB/UROB-PU/11/393; Página 1). Arquivo Municipal de Lisboa, Lisboa.

Groer, E. de (1948) *Plano Ditector de Urbanização de Lisboa: PGUEL*. [map]. Retrieved from Câmara Municipal de Lisboa website: http://www.cm-lisboa.pt/viver/urbanismo/planeamento-urbano/plano-diretor-municipal/enquadramento-do-pdm.

Abrantes, A. E. (1938) *Elementos para o Estudo do Plano de Urbanização da Cidade de Lisboa: Planta da Cidade de Lisboa, planta nº1 Desenvolviemnto superficial da cidade*. [map]. (1:25000). (Ref PT-AMLSB-AL-CMLSB-UROB-PU-12-01-01 - Folha 1). Arquivo Municipal de Lisboa, Lisboa.

Zona de protecção das Instalações da Marinha no Alfeite [map]. (1944). in *Diário da República, I Série, n° 138*, 28 de Junho de 1944, p. 584.

Meyer-Heine, G.(1967) *Plano Director: Grandes propriedades do estado e municipais.* [map]. (1:40000). (Ref PT-AMLSB-CMLSB-UROB-PU-12-03-03 - Folha 10). Arquivo Municipal de Lisboa, Lisboa.

Transport networks

Carris (2012) *Mapa de rede: Transportes de Lisboa.* [Public Transport Network map of Lisbonl]. Retrieved November 10, 2012, from http://www.carris.pt/pt/mapas-carris/a703_all.

Mobcarsharing (n.d.). *Parques: mob acessível.* [interactive map of carsharing parking in Lisbon]. Retrieved October 12, 2012, from http://mobcarsharing.pt/pt/estacoes.aspx.

http://www.emel.pt/

http://www.emel.pt/pt/mobilidade/bicicletas.html

Station plans

Trigueiros, L., & Sat, C. (1998) Expo'98 Exposição Mundial de Lisboa: Arquitectura. Lisboa: Editorial Blau.

Jodidio, P. (ed.) (1998). *Estação do Oriente*. Lisboa: Livros e Livros.

EPAL (2010, Junho). Campus EPAL. *Águas Livres, 194,* p.9. Retrieved November 21, 2012, from www.epal.pt.

Câmara Municipal de Lisboa (2010, July)

Turin

Background maps

Rabbini, A. (1867). *Carta topografica dei contorni di Torino*. [map]. (ca. 1:25000). Tipi e disegni (64.8.5). Archivio Storico della Città di Torino, Torino.

Pianta della Città di Torino coll'indicazione del piano unico regolatore e di ampliamento: Progetto I variante b e Progetto III con linea esterna del Progetto variante b. [map]. (1906). (1:15000). Affari Lavori pubblici (cart. 394 bis, tavv. 3 e 4). Archivio Storico della Città di Torino, Torino.

Pianta della Città di Torino. [map]. (ca. 1960). (1:15000). Tipi e disegni (64.6.20). Archivio Storico della Città di Torino, Torino.

Città di Torino (1977). *Planimetria sintetica del Piano Regolatore Generale della Città di Torino*. [map]. (1:25000). (Serie 1K28BI). Archivio Storico della Città di Torino, Torino.

Transport networks

Gruppo Torinese Trasporti S.p.A. (2012a). *Mappa della rete urbana e suburbana feriale*. [Public Transport Network map of Torino]. (scale not given). Retrieved October 12, 2012, from http://www.gtt.to.it/urbana/mappa/mapparete.pdf.

Gruppo Torinese Trasporti S.p.A. (2012b). *Mappa di dettaglio della rete del centro Città.* [Public Transport Network map of Torino city centre]. (scale not given). Retrieved October 12, 2012, from http://www.gtt.to.it/urbana/mappa/zona_centro.pdf

Gruppo Torinese Trasporti S.p.A. (2012c). *iO guido car sharing Torino: parcheggi.* [interactive map of carsharing parking in Torino]. Retrieved October 12, 2012, from http://www.carcityclub.it/mappa-parcheggi

Bestinparking (n.d.). *Elenco Parcheggi.* [interactive map of car parking in Torino]. Retrieved October 12, 2012, from http://www.bestinparking.it/it/garage-siti.

Gruppo Torinese Trasporti S.p.A. (n.d.). *Parcheggi.* [interactive map of car parking in Torino]. Retrieved October 12, 2012, from http://gttweb.5t.torino.it/gtt/trasporto/parcheggi.jsp

Citta' di Torino (n.d.). Stazoni. [interactive map of bycicle sharing parking in Torino]. Retrieved October 12, 2012, from http://www.tobike.it/frmLeStazioni.aspx.

Citta' di Torino (2012) *Mappa delle Piste Ciclabili: to bike sharing Torino*. [map of bycicle paths in Torino]. (1:28000). Retrieved October 12, 2012, from http://www.comune.torino.it/ambiente/bici/

Citta' di Torino (1995) *Nuovo Piano Regolatore Generale: Azzonamento, Tavola n.1, Foglio n.8B e Foglio 9A.* [zoning map]. (1:10000). Retrieved October 12, 2012, from http://www.comune.torino.it/geoportale/prg/cms/tavole-di-piano.html

Station plans

Browne, B.(2008).

Bajard, M., Betoux, C. & Lamarre, F. (2007).

D'Ascia, S. (2010).

D'Ascia, S. (n.d.). *Porta Susa*. Retrieved October 12, 2013, from http://www.dascia.com/porta-susa.

AREP (2013). *Porta Susa*. Retrieved October 12, 2013, from http://www.arep.fr/en/#/projects/new-railway-stations/turin-porta-susa-station.

Utrecht

Background maps

Provincie Utrecht (1865). *Gemeente Utrecht.* [map]. (1:50000). Leeuwarden: uitgave van Hugo Suringar. TU Delft Library Kaartenkamer, Delft.

Topografische Dienst (1902). *Utrecht Chromo-Topografische Kaart in Bonneprojektie: b445*. [map] (1:25.000). TU Delft Library Kaartenkamer, Delft.

Topografische Dienst (1959). *Topografische Kaart van Nederland: Vinkeveen 31E*. [map] (1:25.000). TU Delft Library Kaartenkamer, Delft.

Topografische Dienst (1950). *Topografische Kaart van Nederland: Oud-Loosdrecht 31F*. [map] (1:25.000). TU Delft Library Kaartenkamer, Delft.

Topografische Dienst (1959). *Topografische Kaart van Nederland: Woerden 31G*. [map] (1:25.000). TU Delft Library Kaartenkamer, Delft.

Topografische Dienst (1959). *Topografische Kaart van Nederland: Utrecht 31H*. [map] (1:25.000). TU Delft Library Kaartenkamer, Delft.

Topografische Dienst (1952). *Topografische Kaart van Nederland: Soestdijk 32A*. [map] (1:25.000). TU Delft Library Kaartenkamer, Delft.

Topografische Dienst (1953). *Topografische Kaart van Nederland: Zeist 32C*. [map] (1:25.000). TU Delft Library Kaartenkamer, Delft.

Topografische Dienst (1958). *Topografische Kaart van Nederland: Benschop 38E*. [map] (1:25.000). TU Delft Library Kaartenkamer, Delft.

Topografische Dienst (1959). *Topografische Kaart van Nederland: Vianen 38F*. [map] (1:25.000). TU Delft Library Kaartenkamer, Delft.

Topografische Dienst (1957). *Topografische Kaart van Nederland: Culemborg 39A*. [map] (1:25.000). TU Delft Library Kaartenkamer, Delft.

Topografische Dienst (1969). *Topografische Kaart van Nederland: Vinkeveen 31E*. [map] (1:25.000). TU Delft Library Kaartenkamer, Delft.

Topografische Dienst (1970). *Topografische Kaart van Nederland: Oud-Loosdrecht 31F*. [map] (1:25.000). TU Delft Library Kaartenkamer, Delft.

Topografische Dienst (1969). *Topografische Kaart van Nederland: Woerden 31G*. [map] (1:25.000). TU Delft Library Kaartenkamer, Delft.

Topografische Dienst (1970). *Topografische Kaart van Nederland: Utrecht 31H*. [map] (1:25.000). TU Delft Library Kaartenkamer, Delft.

Topografische Dienst (1974). *Topografische Kaart van Nederland: Soestdijk 32A*. [map] (1:25.000). TU Delft Library Kaartenkamer, Delft.

Topografische Dienst (1973). *Topografische Kaart van Nederland: Zeist 32C*. [map] (1:25.000). TU Delft Library Kaartenkamer, Delft.

Topografische Dienst (1969). *Topografische Kaart van Nederland: Benschop 38E*. [map] (1:25.000). TU Delft Library Kaartenkamer, Delft.

Topografische Dienst (1969). *Topografische Kaart van Nederland: Vianen 38F*. [map] (1:25.000). TU Delft Library Kaartenkamer, Delft.

Topografische Dienst (1977). *Topografische Kaart van Nederland: Culemborg 39A*. [map] (1:25.000). TU Delft Library Kaartenkamer, Delft.

Topografische Dienst Kadaster (2004). *Topografische Kaart van Nederland: Vinkeveen 31E*. [map] (1:25.000). TU Delft Library Kaartenkamer, Delft.

Topografische Dienst Kadaster (2004). *Topografische Kaart van Nederland: Oud-Loosdrecht 31F*. [map] (1:25.000). TU Delft Library Kaartenkamer, Delft.

Topografische Dienst Kadaster (2004). *Topografische Kaart van Nederland: Woerden 31G*. [map] (1:25.000). TU Delft Library Kaartenkamer, Delft.

Topografische Dienst Kadaster (2004). *Topografische Kaart van Nederland: Utrecht 31H*. [map] (1:25.000). TU Delft Library Kaartenkamer, Delft.

Topografische Dienst Kadaster (2004). *Topografische Kaart van Nederland: Soestdijk 32A*. [map] (1:25.000). TU Delft Library Kaartenkamer, Delft.

Topografische Dienst Kadaster (2004). *Topografische Kaart van Nederland: Zeist 32C*. [map] (1:25.000). TU Delft Library Kaartenkamer, Delft.

Topografische Dienst Kadaster (2004). *Topografische Kaart van Nederland: Benschop 38E*. [map] (1:25.000). TU Delft Library Kaartenkamer, Delft.

Topografische Dienst Kadaster (2004). *Topografische Kaart van Nederland: Vianen 38F*. [map] (1:25.000). TU Delft Library Kaartenkamer, Delft.

Topografische Dienst Kadaster (2004). *Topografische Kaart van Nederland: Culemborg 39A*. [map] (1:25.000). TU Delft Library Kaartenkamer, Delft.

Transport networks

GVU (2012). *Lijnennetkaart.* [Public Transport Network map of Utrecht]. (scale not given). Retrieved November 5, 2012, from www.gvu.nl.

Green Wheels (n.d.).

Gemeente Utrecht (n.d.). *Parkeerplattegrond Utrecht.* [Interactive map of car parking of Utrecht]. Retrieved November 10, 2012, from http://objectdesk.gemgids.nl/Publication/Site/180#

Station plans

ProRail (2009, June 24). *Stationsgebouw: Plattegrond bestaande situatie, V1 niveau.* [building plan]. (1:500).

ProRail (2009, June 24). *Stationsgebouw: Plattegrond nieuwe situatie, V1 niveau.* [building plan]. (1:500).

ProRail (2009, June 18). *Stationsgebouw: Bestaande situatie en sloopwerk, Langsdoorsneden straminen C en F.* [building section]. (1:200).

ProRail (2009, June 18). *Stationsgebouw: Bestaande situatie en sloopwerk, Doorsneden straminen 0 en 6.* [building section]. (1:200).

ProRail (2009, August 28). *Stationsgebouw: Bestaande situatie en sloopwerk, Doorsneden straminen 13 en 17.* [building section]. (1:200).

ProRail (2009, June 18). *Stationsgebouw: Bestaande situatie en nieuwbouw, Doorsneden straminen C en F.* [building section]. (1:200).

ProRail (2009, June 18). *Stationsgebouw: Bestaande situatie en nieuwbouw, Doorsneden straminen 0 en 6.* [building section]. (1:200).

ProRail (2009, April 20). *Stationsgebouw: Bestaande situatie en nieuwbouw, Doorsneden straminen 13 en 17.* [building section]. (1:200).

ProRail (2009, April 20). *Stationsgebouw: Bestaande situatie en nieuwbouw, V1 oostzijde.* [building section]. (1:200).

ProRail (2009, September 23). *Stationsgebouw: Bestaande situatie en nieuwbouw, V1 westzijde.* [building section]. (1:200).

SUMMARY

Since its origin, the railway station has had a complicated relationship with the city, demanding periodical updates, particularly regarding spatial issues. With the aim of improving the liveability of station areas, current redevelopment projects are reconceptualising them as balanced transport 'nodes' and 'places' in the city. However, the proposed spatial solutions do not fully support the sought after economic, social and environmental performances. These intentions continue to be predominantly bounded with the (abstract) planological level, not finding appropriate translation at the (concrete) spatial design level. Further, the interdisciplinary nature of the highly complex planning and design processes of station areas, which should contribute to enhance the performance of their spaces, reinforces constraints and relegates architecture to a marginal role in this quest. It is thus necessary to understand how architecture can contribute to the improvement of the spatial performance of contemporary stations areas, supporting their current reconceptualization.

To gain this understanding, the research explored the factors which influence the spatial definition and performance of European High Speed Train station areas, using *"design research"* and *"research by design"*. Via a theoretical integrative framework, synthesized from knowledge developed by architecture and other sciences, case studies of 'through' stations were analysed and compared. Six cases, encapsulating the most recurrent relative positions of the railway (infrastructure and the station building) towards the(ir) direct built environment, were chosen out of a large sample. For each category (cases with railway tracks at (a) ground level, (b) elevated level and (c) underground level), two cases, featuring an adapted station building and a newly built one, were studied. Their physical and functional characteristics were mapped at several scales and moments (in history), as well as redesigned. A variety of positive and negative approaches and solutions to the problem were identified.

The research is rounded up with a set of 'design recommendations' meant to improve the performance of station area spaces, based on the results of the (graphical) analyses and the redesign exercises. In general, to attain such performance the (physical and functional) integration of the public spaces of the station and of its surroundings, along with the specific (spatial) characteristics of the city they are located in, are crucial. The desirable concentration of transport and non-transport functions must be clearly organized in space, dismantling barriers to their accessibility. To operationalize such integration in all categories of cases, architecture must go beyond its traditional scope regarding intervention scale and methodology. This requires a structural change to the station area's design task, which should be organized around spatial goals commonly subscribed by all stakeholders, and in which architecture should have a central role. Such renovated awareness on the approach to the redevelopment of station areas is necessary for the improvement of their spatial performance. In this way the 'city's station' can become a 'station city' which enhances the city's liveability, instead of draining it out.

NEDERLANSE SAMENVATTING

Sinds het ontstaan van treinstations heeft dit gebouwtype een gecompliceerde relatie met de stad waardoor periodieke aanpassingen vereist zijn, vooral ten aanzien van ruimtelijke vraagstukken. Met als doelstelling om de leefbaarheid van stationsgebieden te verbeteren worden huidige projecten conceptueel herontwikkeld als gebalanceerd *knooppunt* en tegelijk als *verblijfplaats* in de stad[143]. De voorgestelde ruimtelijke oplossingen ondersteunen echter niet geheel de gewenste economische, sociale en ecologisch prestaties. De goede bedoelingen vinden vooral hun weerslag op het planologisch niveau, maar worden niet goed genoeg vertaald naar oplossingen op het niveau van het ruimtelijke ontwerp. Het interdisciplinaire karakter van het plan- en ontwerpproces, welke zou moeten bijdragen om de prestaties van de ruimte te versterken, blijkt vaak juist beperkingen op te werpen en architectuur te beperken tot een marginale rol. Het is daarom noodzaak om te begrijpen en duidelijk te maken hoe architectuur kan bijdragen aan de ruimtelijke prestaties van huidige stationsgebieden om hun herontwikkeling te ondersteunen.

Om dat begrijpen heeft dit onderzoek de factoren onderzocht die de ruimtelijke definitie en prestaties van Europese Hoge Snelheid Treinstation gebieden beïnvloeden, gebruik makend van ontwerpend onderzoek. Vanuit een theoretisch integraal raamwerk, ontwikkeld vanuit architectonische en andere kennisgebieden, zijn casestudies van 'doorgaande stations' geanalyseerd en vergeleken. Zes casestudies, uitdrukking gevend aan de meest voorkomende positie van de sporen en het stationsgebouw in relatie tot zijn directe gebouwde omgeving, werden uit een groot aantal cases gekozen. Voor iedere categorie, casestudies met (a) sporen op maaiveld niveau, (b) sporen op een verhoogd niveau en (c) sporen op ondergronds niveau zijn twee voorbeelden, waarvan 1 een herontwikkelings project en 1 een nieuwbouw project, bestudeerd. De fysieke en functionele karakteristieken zijn in kaart gebracht op verschillende schaalniveaus en op verschillende tijdstippen in de tijd, waarna voorstellen voor verbeteringen zijn geformuleerd. Verschillende positieve en negatieve mogelijkheden en oplossingen van de problemen zijn geïdentificeerd.

Het onderzoek wordt afgerond door een serie ontwerp aanbevelingen te presenteren, bedoeld om de prestaties van de ruimte van stationsgebieden te verbeteren, gebaseerd op de resultaten van de (grafische) analyses en herontwerp oefeningen. Om in het algemeen die prestaties tot stand te brengen is de fysieke en functionele integratie van de openbare ruimte in de stations zelf en die in zijn omgeving in samenhang gebracht met de specifieke ruimtelijke karakteristieken van de stad waarin het station zich bevindt cruciaal. De gewenste concentratie van aan transport en niet aan transport gelieerde functies moet helder ruimtelijk georganiseerd zijn om barrières ten aanzien van bereikbaarheid te voorkomen (ontmantelen). Om dergelijke integratie te operationaliseren in alle categorieën van casestudies moet architectuur wat betreft schaal en methode voorbij zijn traditionele reikwijdte gaan. Dit betekend een structurele verandering ten aanzien van de ontwerptaken voor stationsgebieden welke georganiseerd moeten worden rondom ruimtelijke doelen die door alle stakeholders worden ondersteund, waarbij architectuur een centrale rol vervult. Deze verandering van de manier om stationsgebieden te herontwikkelen is noodzakelijk om tot goede ruimtelijke prestaties te komen. Op deze manier kan het stedelijke station een 'stationstad' worden zodat de levendigheid van de stad wordt verbeterd.

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[143] Het concept van stations als knooppunt en verblijfplaats in de stad, oorspronkelijk gedefinieerd in het Engels als *Node and Place* door Bertolini (1996), en wijdverspreid tussen onderzoekers en praktijkmensen door het boek *"Cities on rails"* (Bertolini & Spit, 1998), wordt sindsdien algemeen gebruikt. Bertolini (1999) suggereert daarbij een balans tussen het knooppunt en de verblijfplaats.

CURRICULUM VITAE

Ana Luísa Martins da Conceição van Nieuwenhuizen was born on 3 October 1975 in Alhos Vedros, Portugal. After completing her pre-university education in 1993, she graduated with distinction from FAUTL, Faculty of Architecture of the Technical University of Lisbon in 1999. Until 2008, she worked as an architect independently and in collaboration with several architects, mostly with Prof. Dr. Arch. Gonçalo Byrne. She was involved in the design and construction of projects ranging from interior design to urban planning. This multiscalar experience led her to seek complementary knowledge with an MSc in Urbanism and Territory Management. In 2007 she completed this degree by Instituto Superior Técnico of the Technical University of Lisbon, with the dissertation “Spatial Impacts of Multimodal Stations on the Urban Layout: Clues for new solutions within a sustainable perspective”. Interested in contributing further to this field, in 2008 she started her PhD research on the spatial performance of European HST station areas. She became then guest researcher at the Building Typology Chair of the Department of Architecture of Delft University of Technology. In the academic year of 2009-2010, she has taught graduation design studio MSc3 of ‘Hybrid buildings’ at the Architecture Faculty of Delft University of Technology, within which she developed part of her PhD research. She has presented her research in international conferences, as well as in the Peer-review colloquium series and the Apertis Verbis research seminar of the Architecture Department of Delft University of Technology.