

CHAPTER ONE: INTRODUCTION

The objective of this research is to investigate, through a morphological study of eleven mainline railway terminus areas in central London, the spatial conditions in which they can be converted successfully from transportation nodes into urban places. In practical terms, the research seeks a model through which railway terminus areas can redevelop their physical and spatial structures, designed as regional-to-local transport nodes, to function also as local pedestrian nodes, thereby creating urban settings with a vibrant mix of pedestrian activity relating both to their immediate urban contexts as well as to their regional transport destinations. The research aims to benefit planners and designers, through the better understanding of how railway termini and their surroundings interact in order to ensure the success of railway terminus area redevelopment projects in cities.

1.1 STATEMENT OF THE PROBLEM

The major transformation of railway termini, including both system electrification in the early 20th century¹ and station modernisation² towards the end of that same century, has added much complexity and ambiguity to their internal spaces and related structures. Although railway termini are no longer venerated as '...volcanoes of life, ...the finest churches in the world, ...palaces of the modern industry or ...cathedrals of a new humankind'³ as they were in their early years, most continue to have important roles as major transport interchanges in cities.

The end of the 20th century was a turning point in the history of railways in Europe. Rail transport was rediscovered as an alternative to the congested road system and connected to other transport infrastructures to optimise people's choices of travel on

¹ The electrification of railways took place since the early 20th century until after World War II when steam engines were completely replaced by electric and diesel engines. Without soot, smoke and steam, the system allowed cleaner stations and lines that can be sited in tunnels. The positioning of tracks in a cutting between tunnels also allowed more complicated use of levels to simplify circulation (*Sheppard, 1996*).

² As few large stations have been built since the 1920 when the rail network was fully in place, railway termini have since required only redevelopment and renovation. The major modernisation occurred during the 1980s and aimed not only to restore the dilapidated railway stations but also to increase revenues for their operators by accommodating more commercial spaces. Cross circulation, raised level concourses and air rights above rail lines were the predominant approaches. Examples are *Liverpool Street, Charing Cross, and Euston Stations* in London (*Sheppard, 1996*).

³ These enthusiastic comparisons were made by writers such as *Malevich, Cendras, Gautier* in *All Station*, published by The Science Museum in London in 1979.

local, regional and intercontinental scales. Furthermore, this has occurred within the context of complex factors including the promotion of sustainable transport and land use, the stimulation of local economies, the progress on railway technologies especially the high speed train network (HST), the property market cycle and the impact of globalization that has encouraged major cities to compete among themselves to maintain their economic status as global cities⁴. Major railway termini have become hubs of the network due to their strategic locations in cities, and the quasi-urban spaces of their interiors, which increasingly serve various non-transport related functions such as retail shops, cafes, restaurants, supermarkets, clinics or even libraries and spas, packed within a multi-layered environment. Furthermore, station environs are also the focus of numerous urban restructuring initiatives as blighted station neighbourhoods and disused railway lands, associated with 'disurbanity' within such strategic sites in the heart of cities, offer unrealised profits for the railway operators.

Despite such great awareness of both problems and opportunities, planners often consider the station development process as a daunting task due to its complexity. Luca Bertolini and Tejo Spit, researchers at the Department of Applied Geography and Planning at the University of Utrecht, who have carried out a study on planning and management strategies of major railway station area redevelopment projects in Europe⁵, noted in their 1998 book, *Cities on Rails, The Redevelopment of Railway Station Areas*⁶, the difficulty of such projects. Due to the long development period, different locations in cities, various involved working parties (architects, urban designers, planners, property developers, local representatives, railway operators, etc.), and different functions required for each station location, they argued that the projects are often considered a challenge for planners, mostly resulting in conflicts of interests among parties, rather than creating the intended order from chaos. They suggested that the solution requires a multi-focal, long-term process viewed from several urban planning and management perspectives.

⁴ See Bertolini and Spit, 1998 for more details on the factors driving the return of the railway age.

⁵ The projects include *Euralille* in France, *Utrecht Centrum Project* and *the Zuidas* in the Netherlands, *Stockholm City West* in Sweden, *Basel Euro Ville* and *Zentrum Zurich Nord* in Switzerland and *King's Cross* railway lands in UK.

⁶ The book is so far the only textbook about the urban regeneration at railway station areas with a focus on European cases. However, the authors have previously done several studies based on other global cases. The publications include; Bertolini, L. (1996a). *Knots in the net, On the redevelopment of railway stations and their surroundings*. In *City*, 1, 1/2, 129-137, Bertolini, L. (1996b). *Nodes and Places: Complexities of Railway Station Redevelopment*. In *European Planning Studies*, 4, 3, 331-345, Bertolini, L. and Spit, T. (1997). *Realizing the Potential; European lessons for the Utrecht Centrum Plan and Amsterdam Zuid-WTC*, a research paper presented to the University of Utrecht.

However, their study touches upon the practical notion of the spatial-functional context of railway station locations only tangentially. Neither does it provide empirical verification of how the successful projects are defined in terms of urban spatial design, which may also be the crucial procedure in securing successful urban regeneration along with key management, financial and policy instruments.

So far there has been very little specific research about railway-related urban projects focusing on a tractable design process. Although planners have set up varied guiding principles to benefit the appointed design teams for the refurbishment of railway stations and the redevelopment of their surroundings, they have failed to introduce the quantitative linkage between the suggested guidelines and their effects on space use. Banister (1995) discussed, in general terms, transport-related urban development in terms of the regional scale economic impact that would occur at railway stations where the increased amount of movement could influence the development of land uses in the vicinity of stations, both at termini and with knock-on effects at stations down the line. Edward (1997) noted some design principles; for example that the stations and their surroundings should be well connected and designed with the efficiency and safety concerns as paramount. Stuyven (1998) suggested that the redevelopment process should aim to eliminate the urban incision caused by railway lines and that the entire urban fabric '...up to a minimum of 1 km around the station [should be] a favoured area for condensation of land uses' (Stuyven op.cit.:19). Other similar guidelines have been established and shared among the planners of Japan Railways, French National Railways, British Rail and Railtrack, Dutch Railways, Swiss Railways and other railway operators around the world⁷. However, it was Bertolini and Spit (1998) who best summarised the conceptual design framework for all railway station area redevelopment projects, stating that the process primarily aims to create a railway station as a node of the transportation network and a place in the city. Despite such clear objectives, it seems that the physical and spatial development process remain an ambiguous and vague procedure for all urban designers.

This ambiguity usually leads to the outcome that there is no clear spatial-design explanation of how successful projects such as the Broadgate Complex at Liverpool Street Station in London, and La Gare Montparnasse in Paris (Figure 1.1a-e) were transformed from blighted station areas to become both efficient transport nodes and vibrant urban places where people, not only rail travelers or commuters, but also urban dwellers, converge in the multi-use environment. These areas have become both

⁷ Stewart, 1995, *Agence des Gares*, 1998, *Bertolini and Spit*, 1998.

destinations and transitional spaces in their cities, a success similarly envisaged for an ambitious project like the Station Quarter; Frankfurt 21 (Figure 1.1f).

Similarly, there is no clear spatial-design perspective to explain why some high profile station development projects like Euralille at Lille Flandre-Europe Station in Lille or Waterloo Station in London (Figure 1.1g-i) fail to achieve the same degree of vitality benefiting their local surroundings as was expected. For both projects, although high speed rail networks (the Eurostar service) has improved the accessibility at these station locations and turned them into important regional and international transport nodes in Europe, the stations and their environs are still segregated from their local surroundings. The redevelopment cannot overcome the urban incision caused by the entangled railway structures and are unable to revitalise the local surroundings and their blighted condition. In addition to these large scale unsuccessful developments, it also turns out that there has been no tractable process to explain why small termini like London's Cannon Street and Charing Cross Stations do not share the liveliness of their urban settings.

The principle vehicle to address this problem will be a series of studies of London's eleven mainline railway terminus areas: King's Cross/St.Pancras, Liverpool Street, Fenchurch Street, Cannon Street, London Bridge, Waterloo, Charing Cross, Victoria, Paddington, Marylebone, and Euston Stations. London is unique in both having such a large number of termini and in the variety of ways in which they are embedded in the dense urban fabric in different locations (Figure 1.2). All of the termini date from the last century and so also have a long history of affecting and being affected by their urban contexts. It is also the case that several have been subjected to recent redevelopment, often with a view to upgrading the quality of the terminus and its surroundings, and not always with equal success.

According to the survey of current urban conditions at these terminus areas, which includes a general overview of their land use and levels of pedestrian movement (see a series of notes and photographs in Appendix A ⁸), all of them seem to have several sub-areas attached to the terminus buildings, with distinctive urban conditions and unequal degrees of vitality and blight. They all have various combinations of vibrant areas, with high levels of pedestrian activity and mixed land use, quieter areas with single land use, and blighted areas with deserted pedestrian environments.

⁸ The survey has been carried out throughout the period of study and the results were finally checked in July 2001.

Liverpool Street Station is the most vibrant terminus, with a double-level internal space well-used by commuters, travellers, office workers, shoppers as well as urban dwellers. The terminus is well-connected to the bustling Broadgate Complex: the newly created office development with retail spaces and three well-used public squares built over its approach tracks. The redevelopment commenced in the 1980s with its current phase still ongoing. The terminus is also surrounded by areas with mixed land use of offices, retail, commercial, hotels and several newly developed spaces in the station's vicinity such as the Spitalfield's office / market complex, office and apartment buildings. Although the area further down the tracks is still left undeveloped, and is currently occupied by mixed old and new residences, it is home to a very lively Bangladeshi community, the well-known street market of Brick Lane and the new goods yard market being renovated under the railway viaduct spaces (Figure 1.3a-d).

Charing Cross is very much busier than Cannon Street Station. Both are elevated bridgehead railway termini located just beyond the river Thames' bank with rather enclosed internal spaces segregated from their vibrant surroundings by the level differences. Having a high level of pedestrian activity throughout the day, the area around Charing Cross Station is occupied by a mixed land use of offices, hotels, entertainment places, retail, commerce, residences, governmental institutions and public parks (Figure 1.4a-d). The area of Cannon Street Station is less vibrant by comparison, predominantly filled with large-scale office buildings. Some of them, especially those located at the front and sides of the terminus, have street-level retail spaces. Their rear aspects along the Thames are restricted to riverside offices and service facilities such as entrances, parking and storage, warehouses. Thus to a large degree the area is used only by office workers during the morning, lunch and evening hours and is almost vacant at other times of the day (Figure 1.5a-d). The offices with some retail development at these two termini - 25 Downgate Hill at Cannon Street Station and Embankment Place at Charing Cross Station, both implemented during the 1980s - do not have very much physical impact on their urban surroundings as they were constructed by using air-rights above the terminus structures.

The surroundings of Euston and Victoria Stations are a combination of busy front and side areas with mixed activity and rather quiet rear residential areas. Euston is a busy terminus with a mixed-use internal environment which recently included a temporary exhibition space. However, it is hidden away from the main road to the front behind a bus station, a park and an office complex developed during the 1970s. It has a busy area beyond this, filled with offices, retail, commercial buildings, a university campus (University College London) and a hospital (University Hospital), while its east

and west sides include retail, small businesses and residential uses for the local Asian communities. The areas at the back of Euston Station along both sides of the approaching rail lines are rather quiet but shows no sign of blight, being largely occupied by pleasant and well-kept residential properties, including terrace houses, council flats and apartments, (Figure 1.6a-d).

Victoria Station is another bustling terminus with a mixed use internal environment and a vibrant front area filled with retail, commercial buildings, offices, hotels, theatres and residential flats. The terminus has the new office and commercial complex, Victoria Place, built over a part of both it and its tracks. However, as the new development does not completely cross the railway embankment (as does the Broadgate Complex at Liverpool Street Station) it does not reconnect the neighbourhoods to either side of the tracks. Due to a higher level from the adjacent streets, the complex can only be entered through steps or ramps. The area at the back of Victoria Station is a combination of well-kept terrace houses and slightly blighted council flats, especially those adjacent to the existing train depots (Figure 1.7a-d).

The surroundings of London Bridge, Fenchurch Street, and Waterloo Stations are generally well-used with some small blighted and inaccessible pocket areas attached along their approach railway lines at the rear. All three of them are elevated terminus structures with enclosed and segregated internal spaces. London Bridge Station is a terminus with a branch line station hidden behind offices, retail uses and railway viaducts crossing over the Thames from Cannon Street Station. Its front area is densely built up with small offices, businesses, retail, warehouses and, at weekends and early mornings, Borough Market. The whole railway structure is elevated on viaducts; thus the station can only be entered by large ramps from the front, a pedestrian bridge from the side street, and escalators from one of its viaduct spaces. There are several routes crossing under the viaducts whose spaces are otherwise fully utilised as a museum space (The London Dungeon), retail, restaurants, cafés, warehouses, and garages, etc. The north side, between the railway viaducts and the Thames, which used to be an area occupied by old wharves and warehouses, has been largely redeveloped. Several warehouses have been refurbished as offices, commercial and apartment spaces. The area also includes the Great London Authority (GLA) headquarters building, recently completed. The south side is a combination of hospital buildings (Guy's Hospital), small businesses, art studios, and a quieter area of warehouses and residential flats. There are some undeveloped pieces of land fenced off for private parking garages or left vacant and blighted attached both to the north and south of the rear railway viaducts (Figure 1.8a-d).

Fenchurch Street Station is a small elevated terminus hidden among high and medium-rise office buildings. As it is located in the City of London, the terminus is surrounded by office buildings with ground floor retail units, cafés, and restaurants. Some are incorporated into its railway viaducts, thus making them fully utilised, and also helping to create a vibrant street level environment continuing to other buildings located next to them. However, the area further down the tracks, where some parts of the viaducts have been fenced off, is a combination of old and new housing estates and blighted warehouses and parking lots (Figure 1.9a-d).

Waterloo Station is bounded by heavily trafficked roads and junctions; thus its immediate environment is rather hostile to pedestrians. At its front, pedestrians can cross to the areas beyond only by a network of underground pathways. As an elevated terminus, its front and east sides are bounded by ramps and driveways, while its west side can be approached only through a pedestrian bridge or an underground tunnel. The station's front is also hidden behind the railway viaducts carrying the trains from Charing Cross towards London Bridge Station, with the intermediate stop of 'Little Waterloo' (or Waterloo East Station as it is now more commonly known), a branch line railway station connected to the Waterloo terminus by a pedestrian bridge. However, the mixed retail, office, and residential area further north is well used by pedestrians. The station's west frontage is hidden behind an office complex developed in the 1960s and its surrounding is occupied by large scale office buildings (for example The Shell Centre), the South Bank cultural centre, a hotel and an aquarium (formerly County Hall). The area is largely occupied by single use buildings with very few ground level urban activities. The vibrant parts associated with mixed-use activities are the newly redeveloped Forum Magnum Square and Jubilee Gardens leading to a major tourist attraction; the London Eye. The viaducts to Waterloo's rear are predominantly bordered with council flats, and the area is moderately used. Most viaduct spaces are blocked or turned into garages, parking, warehouses or small businesses which are all in a dilapidated condition. The railway viaducts allow several routes to connect between two sides of the railway tracks but some are fenced off from the streets and associated with small pockets of waste areas (Figure 1.10a-d).

Paddington, Marylebone, and King's Cross/St.Pancras are vibrant but rather enclosed termini which have busy front areas but are surrounded by very blighted areas on the other sides especially their rear. Being occupied by only some dilapidated building structures, the blighted parts are mostly vacant and inaccessible and often attached by blighted housing estates. Some areas are pedestrian deserted for most of the times.

All three station areas are also cut through by Grand Union Canal which reinforces the interruption of pedestrian network even more. Paddington Station has recently been refurbished and now its internal space accommodates the Heathrow Express, airport check-in facilities and more commercial units. The terminus is hidden behind the railway hotel, built as its front façade, and an office complex. Due to the terminus being built at a lower level than its adjacent streets, its internal space, although vibrant, is very little exposed to the outside. The front area of Paddington Station is characterised by a mixed use of offices, retail, a hospital complex (St. Mary's Hospital and School) and well-kept terraced houses. Paddington Basin, a large vacant railway area and goods yard with very few accessible routes from its surroundings, lies to the north of the terminus. The area is divided by Canal Basin with few crossing routes and is bounded to its west and north sides by the railway lines and the motorway (the Westway or A40). However, following the completion of the station's refurbishment, the Paddington Basin area is currently being redeveloped, having been left as vacant railway lands for a long period of time, with its first phase due for completion in 2002 (Figure 1.11a-d).

Marylebone Station is a small terminus, its set back location almost unnoticed from the busy Marylebone Road. Its vibrant interior is the result of a very recent refurbishment. It now accommodates more commercial and catering spaces, which makes it a popular destination for local people and office workers during lunchtime. Its urban setting is a combination of retail, offices, hotels, and terrace houses to its front side, and rather blighted housing estates and council flats at its back, which were redeveloped in the 1950s on the site of former goods yards. An office development was attached to the west side of the terminus in the 1980s' but did not utilise the air-right above the railway lines. There are several more apartment buildings currently under development in some vacant areas along both sides of the railway lines, but all turn their back against the railway embankment. The pedestrian movement level in the area is relatively moderate compared to the other bigger and busier termini, but is extremely low in the residential neighbourhoods to the rear (Figure 1.12a-d).

King's Cross Station has a more bustling internal environment than the high level St.Pancras Station situated next to it. Although King's Cross and St.Pancras Stations are located just off a main road, the front bustling area being occupied by offices, small businesses, hotels, retail and several old and new housing estates, a large blighted railway land area of approximately sixty acres that lies within the triangle of the railway junction to the north of both termini creates a very large urban hole in the city surrounded by blighted housing estates and council flats. This area, that is occupied

by an old rail depot, dilapidated warehouses, a workhouse hospital, gas-holding structures, a small park, and Grand Union Canal, is notorious for drug dealing and prostitution. The King's Cross area is dubbed one of the largest brownfield site in Europe because of this vast undeveloped railway wasteland located in the inner city area. Although some buildings are still in occasional use, the area is generally left vacant most of the time. Having only a few accessible routes from its surroundings, the area has a very low pedestrian movement level with a high level of illicit activities being recorded (Figure 1.13a-d).

After reviewing these distinctive urban conditions, characteristics and functional components of all eleven London's railway terminus areas, it seems that each needs to be addressed differently in order to fulfil their potential roles as idiosyncratic nodes and places in the city. Some, such as Liverpool Street and Charing Cross Station's surroundings are already vibrant areas, and should have their physical and spatial properties maintained and evaluated to ensure the success not only of their own further redevelopment phases but also other future projects. It is clear that individual redevelopment processes should address the spatial-functional characteristic of each station location, rather than relying upon a single overarching policy applied to all cases. Most importantly, before the redevelopment is planned, the locational characteristics of the railway terminus and its relationship to the city have to be well understood, including the physical urban pattern, land use and other spatial properties.

1.2 THE RESEARCH SCOPE

As described above, the thesis sets out to investigate the physical and spatial characteristics of the urban setting of significant transport nodes that could also function as vibrant urban places in the city. It also aims to provide an explanation, through an analytical process, of why some particular nodes are more or less successful as places than the others. 'Place' in this thesis is taken to mean an urban setting with a vibrant mixed use environment related in part to the influence of the urban grid configuration on movement (Hillier et al 1993, Hillier 1996a). This definition deliberately does not engage in a phenomenological discussion of the essence or meaning of place, nor does it touch on the distinction between place and space. Its objectives are more modest and practical, directed towards the pragmatic concerns of relating the level of pedestrian movement found in and around the terminus, both station or non-station related, to the creation of a significant pedestrian node, a 'place'

in the city. The understanding of 'place' is further refined by Hillier's concept of a 'live centre', where the urban grid is intensified and its effect on movement subsequently influences the intensification of activities (Hillier, 2000).

The investigation is particularly concerned with assessing what spatial factors promote good levels of 'natural movement' (Hillier et al, 1993) both in and around the terminus buildings. The assessment of pedestrian space uses is based on direct observation and the demographic data gathered by the station operators' own surveys. A series of chronological figure and ground study of the terminus areas along with a historical review of their urban evolution explain the long term interaction between the railway structures and their urban physical surroundings. Space syntax methods, a set of computer techniques developed at the Bartlett School of Architecture, University College London, are used for analysing how the terminus structures spatially affect their current urban settings, and how the terminus areas are spatially embedded in the larger scale structure of the urban grid. No attempt is made to examine the psychology and motivation of people who move to and through the terminus areas. The evidence used is the objective properties of space through patterns of movement and land use.

The scope of this research covers an investigation of all London's mainline railway termini and their urban surroundings except Blackfriars Station. This small bridgehead terminus on the bank of the Thames has been excluded because its approaching railway are almost unrelated to its urban setting, being immediately carried away on viaducts across the river. The research focuses only on London's railway termini, not 'through stations', as the first type are more important in terms of architectural, urban and social significance and have more critical effect on the urban grids than the latter. Located among the densely built up areas in the city centre, railway termini are the end-of-line stations where all trains terminate, bringing a great number of passengers, commuters and goods into and out of the city (Holland, 1971). The through railway stations, following Holland's definition, are where trains stop just temporarily for embarking and alighting passengers or goods. Their locations are also farther out of the inner urban areas in less densely built up sites compared with the termini. Hence these through stations tend to draw and attract significantly less movement and have a less complicated entanglement of transport infrastructures (see Appendix B for more descriptions and illustrations of all railway station types).

Steven Parissien, a writer who wrote about the history of railway stations, noted that railway termini always represent varied grand architectural styles, from the revivalism or eclecticism of the classical to the modern style, and show an excellent collaboration between architects and engineers in the design and construction of

exquisite long span train-sheds (Parissien, 1997). At their heyday, when railways were the only long haul means of travel, termini were the sole distributing points for all who lived far away, and were the gateways of cities. Great termini accommodated diverse public facilities such as retail and other commercial outlets, and became the centre of local communities and destinations in their own right.

Although at present they no longer act as the city's main gateways due to the rise of car and air travel, most now find themselves among the most pivotal sites in the city. Paradoxically, while they are served by important thoroughfares they are also entwined by that same transport infrastructure, a mesh of surface and underground trains, as well as roads and highways that can interrupt their approaching pedestrian routes. This spatial dilemma is more intensified at the railway termini than the other types of station. Finally, this research does not include London's underground train stations as their immediate rail networks do not have any physical impact on the surface urban grids, emerging from below ground rarely within the central zone.

In defining the area of study as the 'railway terminus area', the research uses the suggestion made by Bertolini and Spit (1998) that this area be within a walkable radius of five hundred metres around the terminus building or approximately a ten-minute walk. This boundary, however, may or may not include the area that has been affected by the terminus structures, as the termini may have an influence far beyond their surroundings. Conversely, it is also possible that the immediate surrounding may show no sign of any relationship to the terminus. One reason is that most terminus areas have been bisected by railway lines for a long period of time. As Alexander (1965) argues, cities are always influenced by the overlapping systematic forces of economics, politics, and culture. Therefore, these sub-areas, both around the terminus buildings and the areas evolving independently beside the tracks, could also have been influenced by other factors. Thus, in this research the area within ten-minute walking distance around each London's terminus will first be defined then further refined for specific cases by the topography of the urban street grid to include all that is significant and to prevent the exclusion of areas within the same urban block.

Since the aim of this research is to look at the relationship between urban grids and patterns of pedestrian movement in London terminus areas, architectural elements and proportions such as the relationship between floor area and the heights and functional elements of buildings will not be analysed. Likewise, this study will not involve aspects such as ownership, management or weather variables, although care was taken to ensure that movement was observed under reasonably good and comparable weather

conditions. Finally, no attempt will be made to understand or to explain the socio-economic or political context of the terminus areas under investigation.

1.3 THE STRUCTURE OF THE ARGUMENT AND THE THEORETICAL FRAMEWORK

The main argument this thesis proposes is that the successful process of converting a railway terminus area into a place is related to its spatial context and, therefore, that the process must take into account the spatial configuration of both internal and external spaces of the terminus building and how they are embedded in the city. This means that successful outcomes depend on how well the spaces of the terminus are integrated into the local system of pedestrian movement and the degree to which the surrounding urban grids satisfy the spatial conditions that enable this to happen.

In making this argument, the thesis draws on the theory and earlier empirical results of the Space Syntax research programme in studying the relation between the configuration of the urban grid and pedestrian movement in cities and the powerful relationship that has been established between both factors and the growth of local centres. The key aspects derive from Bill Hillier's theories of natural movement and movement economy and to a lesser extent, theory of centrality as a process.

Hillier's idea of the vibrant urban place depends on natural movement, which is how the configuration of the urban grid facilitates movement from all parts to all others in an urban area, where attractors and generators of movement are homogeneously diffused throughout the system, making some parts vibrant and some parts quiet (Hillier et al, 1993). The pattern of natural movement, thus determined by the urban grid, subsequently influences land use patterns by attracting movement-seeking uses, such as retail to locations of high natural movement while drawing non-movement seeking uses, such as residential uses, to locations with low natural movement.

Hillier called this the process of movement economy. The movement attractors then attract more movement to the high natural movement locations which in turn draws further movement-seeking uses, creating multiplier effects which result in an urban pattern with dense mixed use areas set against other more homogeneous, mainly residential zones in the low natural movement areas (Hillier, 1996a).

Therefore, to enable this process of natural movement and movement economy to develop in any local area critically depends on how well the local urban grid is integrated into a large scale urban context in order to make the system of local movement become a part of the global movement in the city.

In turn, this process can be magnified in the circumstance that the intensification of movement economy process also occurs in an area of a locally intensified grid structure creating 'local syntactic integration'. This occurs in areas having smaller and more regular urban blocks, a spatial condition that minimises 'metric integration' or real distance and mean trip lengths from all points to all others in the local area. In such a circumstance the area will become a 'configurational attractor' whereby pedestrian movement and activity are both concentrated and multiplied by these reinforcing effects occurring both within the area itself and its immediate surroundings. Hillier has argued that this intensified grid characteristic is always found in live centres of towns and cities and has called this the process of centrality (Hillier, 2000).

The thesis takes its starting point by making three propositions based on these ideas. The first proposition is that there are three characteristics of railway termini that distort and disrupt the process of natural movement in the urban settings in which they are embedded, thus make the areas become blighted. Firstly, while the urban place in Hillier's idea is a configurational attractor; attracting movement by the influence of the local grid and subsequently affecting the development of land use from the multiplier effect process, a railway terminus is, on the contrary, a point attractor; attracting and generating a large amount of movement toward its entrances regardless of the grid configuration. A high level of movement in the station's immediate surroundings might be noted only during the station's peak hours, reducing dramatically at other times of the day, without being sustained in the same way as areas where movement is influenced by the grid configuration.

Secondly, the movement inside the terminus is not from all parts to all others but much more deterministic, between the station's entrances and platforms. This type of movement belongs to passengers who use the station to board trains or interchange with other modes of transport. Being the centre of transport node, the terminus building whose internal space is enclosed and segregated from its surrounding grid network would also be cut off from or even obstruct the natural movement system itself. It means that the terminus can attract only transport passengers, mostly toward its front, but not other urban dwellers from its surroundings. The station might seem to be busy

with high levels of passenger during its peak periods, but its single-use internal environment could be left almost vacant at other times of the day.

Thirdly, a railway terminus can be a negative attractor. While an attractor is an urban entity that attracts movement so that its presence can usually be detected in increasing movement rates on certain alignments as the attractor is approached, a negative attractor deters movement away from it. It describes how railway lines and their related structures such as train sheds, goods depots, and railway lands disable the natural movement system by acting as an urban barrier to the rear of the terminus and preventing people from reaching their destinations at the other side of the tracks. Hence movement tends to decrease as the railway areas are approached and this disruption of natural movement subsequently undermines the movement economy process. As a result, the area to the rear of the terminus is unable to attract further land uses, while the existing ones are left blighted and vacant because there is no to-and-through movement in the area.

Here we find the paradox in Bertolini and Spit's node-place idea. The perspective outlined above means the concept of node and place in fact causes a spatial dilemma in the terminus area because, while to be an efficient transport node requires a good connection of transport infrastructures resulting in the entanglement of urban barriers that severely disconnect the pedestrian grid network, this disrupts the potential for natural movement, the primary factor in the process of forming vibrant urban places.

Furthermore, the node-place strategy is also a contradictory spatial process that leads to a predicament in the development of railway station areas. Bertolini and Spit (1998) noted that the critical mass of transport networks attract particular land uses to develop. However, in turn the increasing activities also necessitate increased accessibility and traffic support, while the dense cluster of land uses can make it difficult for the transport network to adjust and expand, and furthermore increasing traffic may also decrease the urbanity of the area. Importantly, this points to the effects that point and negative attractors, such as transport infrastructures at railway stations, impose upon their surroundings both in terms of land use development and the degree of vitality. However, it also crucially suggests that the solution to overcome these problems comes through a process of spatial organisation that balances all related pedestrian / transport networks and urban entities.

The second proposition of this thesis is that to transform the blighted transport nodes into vibrant urban places is thus to revive the natural movement system by integrating the terminus spaces into their local grid network so that they become a part of the local movement system. This means creating the 'urban grid-related movement' to complement the deterministic 'station-related movement' by promoting well spatially embedded terminus buildings that are able to also draw the movement of non-passengers, into their internal spaces. To allow this to happen, the stations' surrounding grids must also be well integrated into the larger urban network. This also means that the urban incision caused by the terminus structures and railway lands should be eliminated in order to get rid of the negative attractor effects in the areas. The well integrated pedestrian networks in the railway termini and their surroundings can then function as both destinations and transitional spaces and should attract both station users and urban dwellers to and from the areas as well as generating pedestrian movement passing through the areas to all other destinations in the city.

The well embedded railway termini can thus be seen as configurational attractors, in addition to their nature as point attractors whereby the deterministic movement can still be found in their concourse spaces. The transport nodes like railway termini that fulfil these spatial properties would also become pedestrian nodes, well linked with both to and through pedestrian movement networks. The well interconnecting urban grids that weave through and around the termini would also enhance their movement attractor effect, having a large number of pedestrians drawn and generated from all around the buildings, not only at their front. Through the movement economy process, the station areas altogether would potentially develop into configurational attractors in a larger scale with high levels of grid-related as well as station-related movement that would potentially draw more land uses, with subsequent multiplier effects leading to the development of further land uses within the stations' surroundings through the generation of increased amounts of movement. This would result in having the areas both in and around the termini clustered with mixed activities and altogether become vibrant urban places in their own right.

These spatial conditions lead to the final proposition of this thesis. The railway terminus areas, having been spatially re-engineered to revive the natural movement and subsequently stimulate the movement economy process, would potentially become live centres in the city, in the terminology of Hillier. This is because the increased amounts of movement, as being added up altogether by the natural movement and all other movement drawn by the railway termini as well as other attractors, could

subsequently lead to the intensification of urban grids, as suggested by Siksna (1997) in the recent studies of Australian and American cities, to allow greater ease of movement within the areas. However, this spatially led and dynamic process of centrality in any local urban area requires a long period of time to fully take shape, and so such an evaluation is not fully possible in this thesis. A forecast, based only on the spatial potentials of individual termini to become live centres will be offered at the end of the study.

1.4 THE THESIS OUTLINE

In order to investigate which spatial properties lead to a high natural movement level in and around London's railway termini, the thesis is organised as a comparative case study of all eleven railway terminus areas in London based on the three propositions of the research argument, and structured around seven chapters as follows:

This first Introduction Chapter states the problem and the theoretical framework that lead to the formulation of the main thesis question and arguments. It starts by introducing the subject and aims of the research before outlining why the node-place problem in railway terminus area redevelopment exists through an overview of the current urban conditions of all case studies. Important terminology related to the thesis question is defined to limit the scope of the research study area. The thesis arguments are then shaped on the basis of related theories. At the end of Chapter One, how the thesis is structured according to its objectives and the contents of the subsequent chapters are clarified.

Chapter Two clarifies and substantiates the problem definition. It begins with a historical review of the changing role of railway stations in cities, focusing on the redevelopment of nodes into places. This is followed by a review of some recent projects in Europe where an attempt has been made to urbanize the termini. The evolution of terminus areas and their development potential will then be summarised using a conceptual and diagrammatic framework derived from node-place theory. The objectives of this first part are to review what is necessary to turn a node into a place and to establish a common ground for the node-place development framework of railway terminus areas in urban practice design. In the second part, the work done by authors who focus on the theoretical analysis of how the morphological relation between local urban areas and the city relates to their successful performance as places will be critically reviewed. Space syntax is then presented as the main analytical tool that

purports the spatial analysis of railway terminus areas, both at the architectural and urban scales, and relevant works using the space syntax methodology are described.

The investigation of London's railway terminus areas begins with a study of their internal dynamics. In Chapter Three , two selective London termini are examined in terms of their internal spatial structures and patterns of use and movement. This study aims to ascertain how far the very different spatial configurations of both termini play a role in the deterministic movement patterns between their entrances and platforms, as well as in many other kinds of activity that are increasingly provided within termini at present. Different techniques of spatial analysis that have successfully been used for large open spaces (as opposed to linear street spaces) will be used experimentally along with empirical observations of static and moving behaviours of the station users.

The next three chapters present a series of studies gradually building up to the precision of urban morphological properties of eleven London's railway termini. Starting from figure and ground studies, the analysis moves on to spatial configurational analysis and the implications on space use patterns.

Chapter Four investigates how the terminus structures have affected and been affected by the urban physical pattern of their surroundings since their first arrival in the areas, up until the present time and how the evolving physical pattern relates to the urban condition of each terminus area introduced in Chapter One. The chapter begins by examining in detail the historical evolution of the terminus areas, both in terms of their embedding in different sites in the city dictated by the decisions of railway companies, and in terms of their different layouts necessitated by the existing urban conditions. Firstly, the development sequence of the termini will be reviewed, leading to the current situation in which they now exist as an ellipse bounding the inner London area. Secondly, the evolution of the urban physical pattern of all eleven terminus areas is examined through a series of figure-ground studies compared in three periods; first, the existing pattern before the construction of the terminus structures; second, toward the end of the 19th century after the period of urban consolidation when the areas started to decline and finally, the present time. In cases where the terminus area is currently being redeveloped, such as the Paddington Station area, the prospective figure-ground pattern after the redevelopment is also analysed.

Chapter Five examines the spatial configuration of London terminus areas as they are now at present using the space syntax computer modeling technique termed axial

analysis. The study in this chapter is structured in three main parts. Firstly, the study begins from the large spatial map of London and examines how each terminus is embedded within the global and local spatial cores of the city. Secondly, the spatial analysis focuses more on a local scale to investigate how the terminus structures, including internal and external spaces, are embedded and affect their local spatial grid network. These two types of axial representation are analysed graphically in order to establish an intuitive grasp of the spatial structure of the study areas in two different scales. Thirdly, the study turns to a numerical analysis, comparing the degrees to which the station buildings spatially embed within their urban context. All studies included in this chapter aim to identify the spatial relationship between London termini and their larger urban spatial structure and to establish spatial database of each terminus area to be examined in relation with the empirical data on its functional use in Chapter Six. Through a comparative study, the chapter examines to what extent London terminus areas share common morphological characteristics that are related to the vibrant place as well as blighted urban conditions set out in the introductory chapter. At the end of this chapter, the categorisation of all terminus areas is established as a result of the comparative analysis.

Chapter Six covers a further analysis of space use in the railway terminus areas focusing on the relationship between their spatial properties and pedestrian movement data. The chapter is divided into two main sections to separately examine the station-related and urban-grid related movement patterns within each station area. First, this section investigates the effects of the termini as point and negative attractors through a graphical presentation of day average movement levels, empirically observed on some key routes around the terminus buildings during both station's peak and non-peak periods. The second section analyses, through numerical data, the relationship between the spatial configuration and movement rates in order to trace out the natural movement level in all sub-areas around the terminus buildings. According to the preceding categorisation of London's terminus areas, the findings of both studies in this chapter add up in precise details in term of pedestrian space uses in the areas.

Chapter Seven brings together all the findings of the previous chapters in a general discussion. All eleven London's termini and their settings are reviewed in the light of node-place conceptual framework based on the outcome of the research. The key point of the review is the degree to which each London's terminus, a transport node, also functions as a vibrant urban place. This summarisation is done through a statistical analysis of the relationship between the station's spatial embedding values and their

internal space use data such as percentages of passengers and non-passengers, the amount of retail and catering spaces. In other words, the review focuses on the degree to which the terminus buildings attract other types of station user besides the transport passengers relates to how well they spatially embed within the city. This also enables an assessment of how the spatial embedding influences the development of non-transport related functions such as retail and food facilities inside their concourse spaces. The review will also further explore the spatial potential of the unsuccessful or undeveloped terminus areas and make a suggestion of how to turn them into places including the spatial potential of the already successful case to be further developed into a 'live centre'. At the end of discussion, the chapter concludes by assessing the physical and spatial characteristics that might relate to a series of criteria for the successful creation of railway terminus areas, as significant transport nodes and also vibrant urban places in the city.

Figure 1.1: Some examples of railway terminus area redevelopment projects

a-d: BROADGATE COMPLEX: this successful development at LONDON LIVERPOOL STREET STATION accommodates office and commercial spaces, as well as three new public squares.

(Source: <http://www.rudi.net>)

e: The decking over the railway platforms at PARIS GARE MONTPARNASSES includes office and commercial spaces and a three hectare public park.

(Source: Agence des Gares, 1998)

f: The reconstruction of FRANKFURT AM MAIN station is linked to an ambitious plan for a new mixed-use district built on reclaimed railway land. The project is called STATION QUARTER / FRANKFURT 21.

(Source: Powell, 2000)

g-h: The refurbishment - office development at LONDON WATERLOO STATION accommodates the intercontinental rail link to mainland Europe but fails to eliminate the detrimental effects of the urban incision caused by the railway structures itself, which leads to associated urban blight. (Source: An aerial view - Getmapping.com)

i: EURALILLE, a large scale mixed use development, was implemented during the construction of LILLE EUROPE, a major node of the Europe high speed train link. The new development is segregated and alienated from the existing neighbourhoods. (Source: Bertolini and Spi, 1998)



Figure 1.2: The locations of all mainline railway termini in London



MAINLINE RAILWAY TERMINI
and associated approach lines
from the Ordnance Survey Map, 1995

Figure 1.3: Liverpool Street Station area



- a: The double height concourse space inside Liverpool Street Station. The upper gallery is at the same level as the surrounding streets and is often used by pedestrians as a short cut between urban blocks.
- b: Exchange Square: the new public space was built above Liverpool Street Station's approach lines.
- c: Brick Lane: a busy commercial street at the heart of a large Bangladeshi community.
- d: The viaduct space is now intended to accommodate a 'Goods Yard Market' at weekends.

Figure 1.4: Charing Cross Station area



- a: A railway hotel forms Charing Cross Station's front facade.
- b: Villiers Street, a bustling retail strip at the east side of the terminus building, connects Strand Street at the station's front to Victoria Embankment at the back.
- c: The railway viaducts have been refurbished as retail spaces.
- d: The Embankment Place office development was built over the terminus by using the air rights above the railway tracks.

Figure 1.5: Cannon Street Station area



- a: The front facade of Cannon Street Station. The area is occupied by office, retail and small business uses.
- b: The office development at 25 Downgate Hill, was built above the terminus structure.
- c: One of the railway viaduct spaces was turned to a motorcycle showroom.
- d: Upper Thames Street at the back is mostly used by office workers during peak hours and is almost vacant at the other times of the day.

Figure 1.6: Euston Station area



- a: Euston Station is a large railway terminus which appears to be hidden behind an office complex, park, bus station and the station's own forecourt, all constructed during the 1970s.
- b: The station's forecourt between the terminus building and bus station.
- c: Private houses were built alongside the railway tracks to the rear side of Euston Station.
- d: The residential locates to the station's rear is a well kept and pleasant environment, mostly occupied by council and terraced houses.

Figure 1.7: Victoria Station area



- a: The area to the front of Victoria Station is bustling with travellers, tourists, office workers as well as local people.
- b: Victoria Place Shopping Galleria was built above a part of the approach tracks. Its level is slightly higher than the surrounding street level.
- c: The residential neighbourhood at the back of the station is a combination of terrace houses, council flats and apartment buildings.
- d: Many residential blocks adjacent to the railway lands typically face away from the railway track. Many are in poor condition, especially those adjacent to the old rail depot.

Figure 1.8: London Bridge Station area



- a: London Bridge Station is set back from Borough High Street behind retail and office buildings and the railway viaduct carrying trains from Cannon Street Station.
- b: The west (front) side of the terminus is occupied by new developments of office and residential uses, most have been refurbished from old riverside warehouses. There are also a prison ~~the Guild~~ and a wine cellar ~~the Guild~~ which attract tourists to the riverside during the week, as well as Borough Market, a local destination during weekday mornings and weekends.
- c: The south side of London Bridge Station's viaducts along St.Thomas Street is very much quieter than the north side. Some viaduct spaces have been utilised as small retail shops but the attached land is still vacant and used as a parking lot for local office workers.
- d: The north side of the railway viaducts along Tooley Street is bustling with tourists, office workers, travellers, shoppers. The viaduct spaces have been turned into a great tourist ~~landmark~~ ~~landmark~~ and several retail spaces. There are several commercial / office / residential developments newly constructed in the area between Tooley Street and the Thames. Some were refurbished from existing riverside warehouses.

Figure 1.12: Marylebone Station area



- a: Marylebone Station is set back from the busy Marylebone Road in a quiet neighbourhood behind a hotel and office buildings.
- b: The terminus' front facade on Melcombe Place was restored in the 1980s. The area is very busy during peak hours but rather quiet at the other times of the day.
- c: The development of office buildings in the 1980s was bounded by the station's west side.
- d: There are several new residential blocks that have recently been constructed in the railway land adjacent to the railway tracks.

Figure 1.13: King's Cross Station area



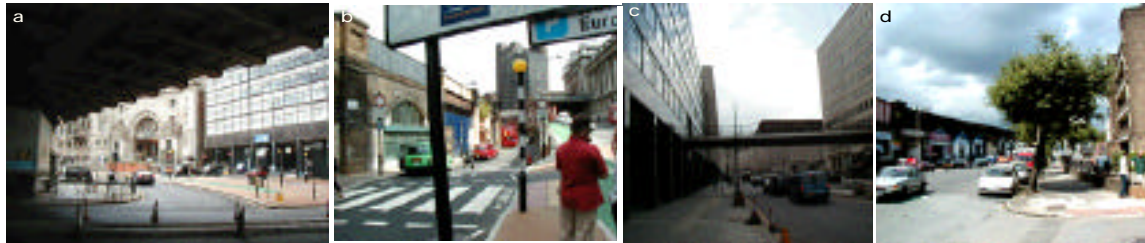
- a: An aerial view shows a large area of railway land of approximately 60 acres to the rear of King's Cross and St.Pancras Station.
(Source: Union Railways London & Continental / from Bertolini and Spit, 1998)
- b-c: Besides the railway structures, the railway land is occupied by old warehouses, factories, gas holding structures and has only a few accessible routes from the surroundings. The area is unpopulated for most of the time, both weekdays and weekend, and become the location for illicit activities: drug dealing, prostitution, etc.
- d: There is some new housing recently developed along the banks of Grand Union Canal at the edge of the railway land.

Figure 1.9: Fenchurch Street Station area



- a: Fenchurch Street Station is a small terminus hidden from Fenchurch Street behind large scale office buildings, some still under construction. The terminus itself is also topped by office space.
- b: Its railway viaduct spaces are fully utilised. Mostly have been refurbished as cafes, restaurants or small retail shops well used by local office workers.
- c: Some parts of the viaduct structure further out to the east have been fenced off and the area has been turned into parking lots or garages.
- d: There are several newly constructed residential developments adjacent to the railway lines.

Figure 1.10: Waterloo Station area



- a-b: Waterloo Station's front facade is bounded by a taxi ramp and the railway viaducts carrying trains from Charing Cross Station. Despite an improvement of pedestrian accessibility to the front of the station, the busy junction and the viaduct structure still make it difficult for people to approach the station at street level. Most people use the underground tunnels or pedestrian bridges to avoid crossing the busy roads.
- c: The office buildings along York Road at the west side of the terminus do not provide street-level urban facilities such as retail units, cafes, restaurants, etc. Thus, there is little urban interaction with passers by.
- d: The blighted viaduct structures at the back of the terminus are mostly blocked off and turned into storage spaces or garages. Their condition is dilapidated.

Figure 1.11: Paddington Station area



- a: The newly refurbished Great Western Railway Hotel forms Paddington Station's front facade.
- b: Its internal space has also recently been developed to accommodate more retail units, catering spaces and the new Heathrow Express service.
- c: The Canal Basin cuts right through the near vacant railway land adjacent to the north of Paddington Station.
- d: The railway land is also bounded to its north by the Westway which worsens the segregation between the Basin area and its surrounding neighbourhoods. The new mixed use development, Paddington Basin, is thus confined within the area located between the terminus structures and the Westway.