CHAPTER SEVEN

THE SPATIAL PROCESS OF CREATING PLACES OUT OF NODES IN RAILWAY TERMINUS AREAS

This thesis has investigated a fundamental issue for the design process of railway terminus areas; which spatial conditions lead to high levels of mixed-use and activity within railway termini. Conceptually it seeks a spatial model of railway terminus areas that allows the terminus buildings, as transport nodes, to work also as significant places in the city.

It has been suggested that planners and designers still perceive railway station area redevelopment as a daunting task that requires complex and long term management procedures and a fusion of disciplines. Despite Bertolini and Spit's (1998) clear conclusion that the key concept in most current projects was to develop railway stations as a node and place in the city, the missing link between spatial design and its effects on space uses has created an ambiguous and vague task for architects and urban designers. This thesis has employed a combination of configurational analyses of increasing precision, urban condition surveys, and detailed observations to examine London's eleven mainline railway terminus areas. So far, it has revealed that it is possible to analyze the relationship between morphological patterns and space uses within the areas.

At the end of each chapter, the main findings have been discussed in detail. This final chapter brings all these conclusions together into a single conceptual framework of the 'node-place'. It is structured into three parts. Beginning with the crucial examination of the effects of urban spatial configuration on space uses within all London's termini, the first part presents the regression analyses between the quantification of the stations' spatial embedding[1] and percentages of non-passenger spaces, including retail/catering functions, within the termini (differentiated from passenger and transport-related functions)[2]. With a set of precise spatial and space use data, this final analysis aims to justify the main hypothesis that the degree of mix-use space within the environment, a characteristic of a vibrant urban place, is critically related to how each station concourse is embedded within their urban

[1] The spatial embedding values of all London's railway termini are derived from the spatial analysis in Section 5.3.3 of Chapter Five.

[2] All demographic and space use data are provided by the station operators.

settings, each with distinctive spatial structures. In the second part of this chapter, each of London's railway termini will be reviewed in the light of their node and place characteristics, and further consideration will be given to their development potential based on the outcomes of the whole research. The final epilogue concludes by suggesting a theoretical model in which a railway terminus can be transformed from a node into a place.

7.1 REGRESSION ANALYSIS: The relationship between spatial embedding values and non-transport related space uses of the railway terminus buildings

It has been suggested in the preceding chapter that the integrated spatial grid networks of sub-areas around some of London's termini such as Liverpool Street, Fenchurch Street, Victoria, Charing Cross, and Cannon Street Stations, sustain high levels of natural movement because their external structures cause very little interruption to the spatial context. However, the spatial embedding analysis in chapter five (section 5.3.3) revealed that only Liverpool Street Station appears to have its internal space well embedded in the local and global spatial grid structures. The station outperforms the others by improving to a greater extent the local and global integration including the intelligibility values of its urban setting.

Based on Hillier's ideas of natural movement and the movement economy, the main proposition for successfully creating a place out of a transport node such as a railway terminus is to embed its internal space into the local grid network so that the node itself becomes an integrated part of the local pedestrian movement system. Practically, this means creating 'urban grid related movement' to complement the deterministic 'station related movement' inside the terminus building. This is similar to the principle of how the spatially integrated sub-areas around some terminus structures sustain good levels of natural movement to complement the deterministic movement attracted and generated by the station entrances (as discussed in chapter six). The conjecture is that the level of urban dwellers naturally drawn into any given railway terminus building is dependent on the degree to which its internal space is embedded within the urban spatial structure. These 'other station users', categorised as 'non-passengers' as opposed to 'passengers' entering the stations to board trains or other transport modes, belong to the local movement system of the terminus area and their levels are largely determined by the urban grid configuration, following the theory of natural movement.

Through the movement economy process, the successful development of movement-seeking functions such as retail and catering facilities is thus more likely to occur within station concourses that are used to a greater extent by the non-passengers whose numbers are not affected by the train timetable but remain constant throughout the day. The ratio of these urban facilities to all public accessible areas inside the termini can then also be examined in relation to the spatial embedding values of the termini, addressing the likely profit-making considerations faced by station operators. Transport nodes such as railway termini, whose internal spaces have a good degree of mix among not only station users - both passengers and non-passengers – but also mixed types of activity - both transport and non-transport related facilities - then become vibrant urban places in their own right. This conjecture will be justified by the strong relationship between the ratios of non-passenger and retail/catering spaces recorded within the terminus buildings and their spatial embedding values.

The final regression analyses are based on the spatial embedding variables derived from section 5.3.3 of chapter five and the space use data supplied by the station operators[3]. Table 7.1 illustrates all variables for all London's eleven termini in the form of a single data table. Columns A and B list global and local spatial embedding values respectively[4]. In order also to examine if the non-transport related internal space uses are influenced by the degree to which the terminus spaces enhance the intelligibility of their urban surroundings, column C (the ratio of the intelligibility value of the area with and without the terminus space[5]) is also included in the statistical analyses.

Columns D-L list the internal space use data of all London's termini including the related calculations. The two key dependent variables that will be examined separately in relation to the three independent spatial variables mentioned above (columns A-C) are shown in column E (percentage of non-passenger) and column L (percentage of retail and catering spaces inside the termini).

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3 The internal space use data for *Charing Cross, Liverpool Street, Victoria, Euston, Waterloo, London Bridge, Paddington,* and *King's Cross Stations* was provided by Railtrack (currently dissolved). The data for *Fenchurch Street* and *Marylebone Stations* was provided by C2C Railways and Chiltern Railways respectively. The data for *Cannon Street Station* is from London Bridge Station's operator who presently operates both stations.

4 Refer to section 5.3.3. The global spatial embedding value of the terminus space is the ratio between mean global integration value of the station's modeling area with the terminus space and that without (µ.intN.w.intl//wo.intl) while the local spatial embedding value of the terminus space, the ratio between mean local integration value of the station's modeling area with the terminus space and that without (µ.int3.w.intl//wo.intl)..

5 Refer to Section 5.3.3 for the ratio of the intelligibility value of the station's modeling area with the terminus space and that without (intllgblty.w.intl.//wo.intl.)

Table 7.1: Spatial embedding values and internal pedestrian space use data for London's railway termini

column	A	B	C
	µ.intN.w.int //wo.int	µ.int3.w.int //wo.int	intllgblty.w.int wo.in
Cannon Street	1.000	0.998	0.997
Charing Cross	1.000	1.000	0.999
Liverpool Street	1.030	1.012	1.076
Victoria	1.00	1.000	1.003
Fenchurch Street	0.981	0.988	0.986
Euston	1.001	0.999	1.001
Marylebone	1.000	0.99	1.002
Waterloo	1.000	0.998	1.000
London bridge	1.00	1.000	1.003
Paddington	1	0.998	1.002
King's Cross	1.001	0.999	0.98

column	D	E	F	G	H	I	J	K	L
	% o passenge	% o non-passenge	interna retail are (sq.m.	interna catering are (sq.m.	total F+ (sq.m.	total interna public are (sq.m.	% o interna retail are	% o interna catering are	% o J+K area
Cannon Street	9	1	38	25	64	189	20.	13.	3
Charing Cross	8	2	48	56	104	248	19.	22.	41.
Liverpool Street	6	4	231	210	441	900	25.	23.	4
Victoria	8	1	183	140	323	709	25.	19.	45.
Fenchurch Street	n/	n/	6	8	15	89	7.	9.	17.
Euston	8	1	60	121	181	531	11.	22.	34.
Marylebone	8	1	19	22	42	125	15.	1	33.
Waterloo	8	1	81	155	236	590	13.	26.	4
London bridge	8	1	73	54	127	320	23.	16.	39.
Paddington	9		41	105	146	450	9.	23.	32.
King's Cross	8	1	30	72	103	292	10.	2	35.

The stepwise regression analyses shown in Tables 7.2-7.3 reveal that the local spatial embedding values (column B in Table 7.1) generally outperform the other two spatial variables. This means the number of non-passengers and the amount of retail/catering spaces inside the termini are most influenced by how their internal spaces are embedded within their local grid configuration (integration 3). This is similar to pedestrian movement levels around the terminus structures which are also found to be most influenced by how the grids are structured to benefit local-scale movement in the areas, confirmed by the regression analyses in chapter six[6].

Table 7.2: Stepwise regression analysis: percentage of non-passengers inside London's railway termini and spatial embedding variables

PERCENTAGE OF NON-PASSENGER in London's termini vs.3 independent variables
- **µ.intN.w.intl//wo.intl**
- **µ.int3.w.intl//wo.intl**
- **intllgblty.w.intl//wo.intl**

F to Enter	4
F to Remove	3.996
Number of Steps	1
Variables Entered	1
Variables Forced	0...0

Variables in Equation

Parameter:	Value:	Std. Err.:	Std. Value:	F to Remove:
INTERCEPT	-3588.477			
µ.int3.w.intl//...	3604.199	1045.751	.793	11.878

(Last Step) STEP NO.1 VARIABLE ENTERED X1:µ.int3.w.intl//wo.int

R:	R-squared:	Adj. R-squared:	Std. Error:
.793	.629	.576	2.5

Analysis of Variance Table

Source	DF:	Sum Squares:	Mean Square:	F-test:
REGRESSION	1	74.247	74.247	11.878
RESIDUAL	7	43.753	6.25	
TOTAL	8	118		

Variables Not in Equation

Parameter:	Par. Corr:	F to Enter:
µ.intN.w.intl//...	.367	.935
intllgblty.w.int...	.027	.004

6 See **Table 6.4** and **Plate 6.2** in **Section 6.2.1:** *Methods of the statistical analysis.*

Table 7.3: Stepwise regression analysis: percentage of retail and catering spaces inside London's railway termini and spatial embedding variables

PERCENTAGE OF RETAIL AND CATERING AREAS in London's termini vs.3 independent variables
* **µ.intN.w.intl//wo.intl**
* **µ.int3.w.intl//wo.intl**
* **intllgblty.w.intl//wo.intl**

F to Enter	4
F to Remove	3.996
Number of Steps	1
Variables Entered	1
Variables Forced	0...0

Variables in Equation

Parameter:	Value:	Std. Err.:	Std. Value:	F to Remove:
INTERCEPT	-3588.477			
µ.int3.w.intl//...	3604.199	1045.751	.793	11.878

(Last Step) STEP NO.1 VARIABLE ENTERED X2:µ.int3.w.intl//wo.int

R:	R-squared:	Adj. R-squared:	Std. Error:
.793	.629	.576	2.5

Analysis of Variance Table

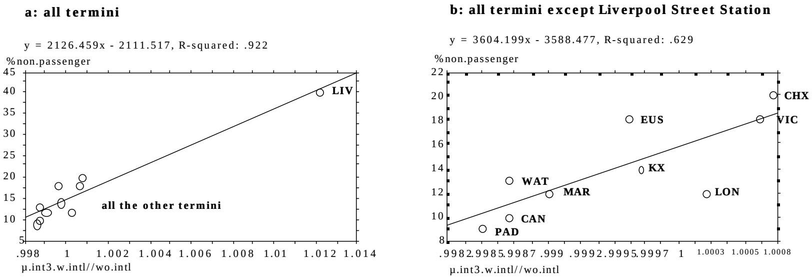
Source	DF:	Sum Squares:	Mean Square:	F-test:
REGRESSION	1	74.247	74.247	11.878
RESIDUAL	7	43.753	6.25	
TOTAL	8	118		

Variables Not in Equation

Parameter:	Par. Corr:	F to Enter:
µintN.w.intl//.	.367	.935
intllgblty.w.int...	.027	.004

Plate 7.1a shows the simple regression analysis between local spatial embedding values (column B in Table 7.1) and the percentage of non-passengers inside all London's termini excluding Fenchurch Street Station [7] (column E in Table 7.1). The scattergram reveals a strong correlation, with an R-squared value of 0.922. However, the scatters are not evenly distributed along the regression line due to a large margin between Liverpool Street Station, positioned at the top right corner, and the other termini, grouped in the bottom left. This is because Liverpool Street Station significantly outperforms the other termini in terms of its degree of spatial embedding as well as the percentage of non-passengers the terminus draws into its internal space. The simple regression analysis (Plate 7.1b) with Liverpool Street Station excluded in order to reveal a truer picture of the relationship between both variables in all other stations, still gives a striking result. The scattergram shows a strong correlation with an R-squared value of 0.629.

Plate 7.1: Regression analysis: percentage of non-passenger inside London's railway termini and their local spatial embedding values

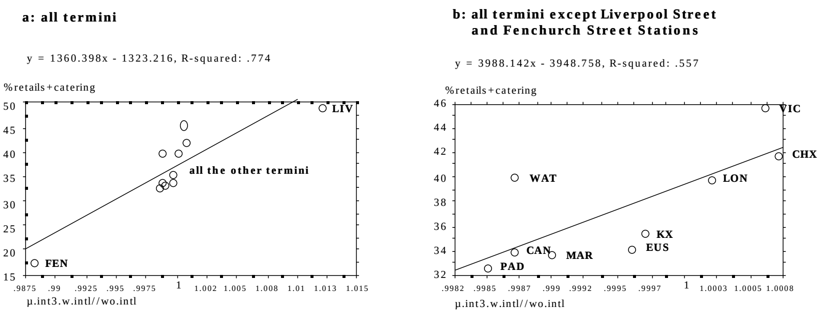


The simple regression analysis, depicted in Plate 7.2a-b, between local spatial embedding values (column B in Table 7.1) and percentage of retail/catering spaces

7 According to the interview with the station manager of C2C Railways, the operator of Fenchurch Street Station, C2C has no record of demographic data on percentages of passenger and non-passenger. It might be possible that the number of non-passenger is very low because this small and elevated station is rather segregated from the street level. According to the initial survey (see **Appendix-A**), the station is heavily used only during the morning and evening peak periods and left almost vacant for most times of the day.

within all eleven termini (column L in Table 7.1) shows a rather similar pattern. In the first scattergram, two large margins are caused by Fenchurch Street and Liverpool Street Stations which are apparently isolated from the rest of the group. While Liverpool Street Station, positioned at the top right corner, apparently greatly outperforms the others, Fenchurch Street Station is contrarily the worst in the group, located to the bottom left. However, the exclusion of these two exceptional cases in the next scattergram (Plate 7.2b) still reveals a strong correlation with an R-squared value of 0.557.

Plate 7.2: Regression analysis: percentage of retail and catering spaces inside the railway termini and local spatial embedding values



The results are striking. Both simple regression analyses confirm that the more the terminus building spatially embeds within its local grid structure, the more it attracts non-passenger users and influences the development of retail and catering spaces within its internal space.

The terminus building that makes its urban setting more locally integrated within the city, demonstrated by an increase in mean local integration values for the area after its internal space is included, makes the terminus area more accessible for local scale journeys. Its internal space, which becomes an integrated part of those journeys, is thus likely to be used by more urban dwellers and subsequently attract more retail and catering spaces that would take advantage of their through movement. The station where various types of people and activity, both transport and non-transport related, converge throughout different times of the day would never be left entirely vacant even during the station's off-peak periods due to the continuous flow of natural movement sustained by the urban grid configuration itself.

Through a set of precise spatial and space use data, the statistical analyses verify that the process of creating a place out of a transport node such as a railway terminus is critically related to spatial variables. It also establishes the crucial fact that the railway terminus that is most likely to function as a vibrant urban place, with good degrees of mixed station users and activities in its internal environment, has to act as a 'configurational attractor'.

Liverpool Street Station, the only successful case, reveals that to enable this to happen, the station's surrounding grids have to be well interconnected and integrated within the larger urban spatial network. Its annexed urban redevelopment not only eliminates the spatial incision caused by the railway lines but also utilises its spatial potential by drawing several important integrators into both the site and the newly refurbished terminus building. A major transport node and 'point attractor' such as Liverpool Street Station, whose urban spatial structure allows its internal space to become a 'configurational attractor', thus becomes a vibrant urban place in its own right.

7.2 LONDON'S MAINLINE RAILWAY TERMINUS AREAS: A review of their node and place characteristics and development potential

It appears that the outstanding success of Liverpool Street Station cannot be easily imitated elsewhere due to its unique spatial layout and relationship to the city. The distinctive urban spatial configurations of London's railway terminus areas, caused by the initial layouts of the terminus structures in different locations and a long process of the areas' evolution[8], make all the termini idiosyncratic nodes and places in the city. Not all of them appear to achieve, or have a development potential to achieve, the ideal node-place synergy in railway terminus areas, as discussed in chapter two (section 2.2). The diagrammatic framework, shown again here in Plate 7.3 , envisages the final stage of a successfully evolving railway terminus area. It depicts the ideal circumstance whereby the terminus, as a major node of the transport network, has been transformed into a place and the formerly blighted immediate surroundings have also been revitalised as a vibrant urban setting. The successful redevelopment outcome is thus projected as a node-place railway terminus well embedded within its urban place setting in which a cluster of mix-use activities is found in and around the station building. The whole complex acts as a catalyst for further urban development which might lead to the station area becoming a rejuvenated local centre.

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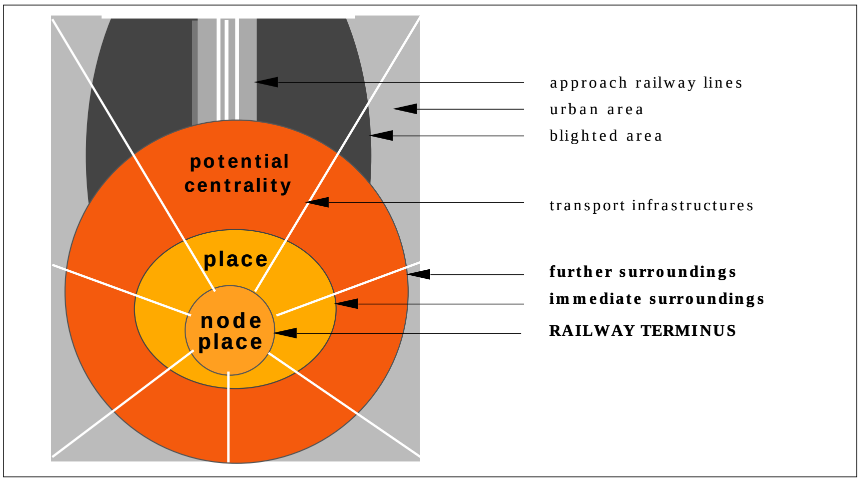
[8] Refer to **Section 4.1:** *Development of London's mainline railway termini* and **Section 4.2:** *The changing morphology of London's railway terminus areas* in chapter four.

Plate 7.3: The ideal model of node-place synergy in railway terminus area, further developed from the original Bertolini and Spit's model.



Based on the outcomes of the whole research, the following review will discuss the potential for each of London's terminus areas in the light of this conceptual framework, showing how and why some nodes are more successful as places and possess more potential than others to be further developed as live centres, as defined by Hillier (2000).

* **Liverpool Street Station** appears to be the only London terminus which is likely to achieve the ideal node-place synergistic model mentioned above. Having an important integrator extending all the way through its lower-level concourse hall from Eldon Street with another two integrators running across both of its upper-level promenades, its internal space becomes very well integrated in the spatial grid structure. The station has far better spatial embedding values, both locally and globally, than the other termini. It becomes, therefore, an important part of both local and global movement systems that pedestrians naturally use as a part of their journeys within the area. The station also improves the mean intelligibility value of its urban setting. This suggests that its existence enhances the navigational knowledge of pedestrians in the area, or expressed more formally, the quality off information about how the whole (global) area is structured that people derive when moving around locally.

High levels of non-transport related use and activity are found to be influenced by this well integrated internal space itself. The station attracts 40% of non-passenger users and records 49% of retail and catering spaces[9], almost half the number of all station users and half the amount of all public accessible spaces of the station concourse.

The dense and coherent grid-integration network of the station area greatly contributes to the success of the terminus as it provides the spatial potential for its concourse space to draw integration into itself. It thus seems that the station building and its surrounding spatial structures become unified as a single integrated grid network. This development potential of Liverpool Street Station provided by its spatial setting became tangible after the completion of the Broadgate Complex development which started prior to the refurbishment of the station itself. Using the air rights above the railway structures, the new development complex not only eliminates the urban incision formerly caused by the old Broad Street Station and the approach railway lines, but also draws integration into the site itself. In other words, the complex utilises the spatial potential of the larger urban network to integrate itself more fully within the city. The neighbourhoods on both sides of the railway tracks become reconnected by several integrators through the newly developed complex of mix business, retail and commercial land uses, including three new public squares. It also provides accessibility to the station's concourse space in all directions. High levels of movement, attracted by the station entrances and sustained by the integrated grid configuration, are evidenced in all sub-areas around the terminus. As a configurational attractor, the terminus which is knotted by transport networks has thus also become a node within the pedestrian network.

The initial development of the Broadgate Complex in the 1980s has been followed by several more phases, filling the building blocks and usable grounds into the vacant areas mostly located to its north along the railway lines. Other urban development projects of varied scales are also evident within the immediate surroundings of the complex especially to its east side around the Spitalfields area and its northwest around Shoreditch. The station area now accommodates both old and new land uses of mixed activity ranging from quiet residential, light industrial, warehouses and workshops to busy retail, commercial and business uses. Only the areas located alongside the railway tracks further down the lines are still left undeveloped and slightly blighted. However, it is clearly evident in the current figure and ground study of the station area that its figural block pattern becomes denser and more coherent as the urban grid network around the terminus structures becomes more intensified due to these fill-in developments.

9 Refer to Table 7.1, column E: percentage of non-passenger and column L: percentage of retail and catering spaces

From the morphological point of view, it thus seems that the Liverpool Street Station area has great potential to be further developed as a live centre, to use Hillier's terminology (2000). From the urban area severely scarred by the entangled railway structures of Broad Street, Liverpool Street and Bishopgate Stations, its spatial grid structure has been re-engineered to be more intensified and integrated with the city. The revival of natural movement into the area along with the add-on station related movement around the station due to its nature as a great movement attractor has subsequently influenced and even accelerated the movement economy process, resulting in a cluster of mixed uses and activity focusing in and around the terminus. This potential is strengthened by the fact that more and more urban development projects of mix land use are evident around the station's core complex which is constantly fluxed by both station-related and grid-related movements.

Plate 7.4 summarises the Liverpool Street Station area redevelopment strategy in a conceptual diagram. The terminus can be seen as a node and place well embedded within its urban place setting whereby a spatial potential to be further developed into a new local centre is also strongly evident.

Plate 7.4: Diagram of LIVERPOOL STREET STATION AREA redevelopment strategy

* **Victoria Station** is an enclosed node located within a mixed vibrant and quiet setting. Although its recently refurbished terminus building is located within a dense and integrated grid network and has several entrances situated in almost all directions, the internal space does not utilise the spatial potential provided by its urban setting to draw any significant integrator into itself. As a result, the terminus is not very well embedded spatially and even becomes a barrier to some of its surrounding grids. The concourse space attracts only 18% non-passengers, which is not proportionate with a rather high percentage of retail and catering spaces (45.6%). This high ratio of non-transport related facilities appears to be a result of the initial

refurbishment plan of the station operator. Its detailed internal study[10] revealed that the number of station users in Victoria Station would dramatically decrease during its off-peak periods such as the late morning and the late afternoon.

However, among all the other London's railway termini besides Liverpool Street Station, Victoria Station seems to be the next best terminus with a great potential to be further developed and achieve the ideal node-place synergy. This is because its surrounding grid network is already dense and well integrated. The approach railway lines are well embedded within the urban grid structure and the station area in general is not limited nor confined by any other natural or man-made barriers. Its grid network is densely constituted with coherent and regular figural building blocks, almost reflecting the fine mesh of its urban spatial pattern. Sub-areas at the station's front attract high levels of both grid-related and station-related movement while those at the rear which sustain only moderate levels of natural movement are still well fluxed with movement attracted and generated by the station entrances.

The negative attractor effects in the area are limited as the terminus structures allow most of the grids to cross over. Based on these morphological properties of the site alone, there are two major suggestions to enhance Victoria Station as a vibrant urban place. First, certain station entrances should be relocated in order to align with major integrators which would then pass through its internal space. This would eliminate its nature as a spatial barrier and instead re-integrate the terminus into the local movement system. Second, the station's annexed development complex (Victoria Shopping Arcade) should be expanded to cross all the way over the railway tracks so that it can reconnect both neighbourhoods alongside the railway embankment.

Apart from the ongoing commercial and office developments evidenced around the front and sides of the terminus building, Victoria Station also has a potential development area at its rear. The below-ground level railway lines make it technically easier and more cost effective for any usable space to be built over. If the existing terminus complex could be spatially reorganised by utilising more of its spatial potential and further urban development at the station's rear could create integrated links between both sides of the railway embankment, the station area would also have a potential to be further developed into a new local centre.
Plate 7.5 summarises the current development strategy of Victoria Station area. The diagram portrays the terminus and its annexed office and shopping complex as

10 Refer to Chapter Three.

enclosed and isolated entities. The ongoing development projects mostly located to the station's front and sides are not related in any way with the station's internal space. However, the site still accommodates a potential development area at the station's rear.

Plate 7.5: Diagram of VICTORIA STATION AREA redevelopment strategy

* **Euston Station** can be seen as a comparative case to Victoria Station. Similar to Victoria, Euston Station is also an enclosed node located within a mixed vibrant and quiet urban setting (Plate 7.6). Both share similarities in terms of the physical and spatial characteristics of their terminus as well as surrounding urban structures. The station buildings are about the same size, with similar ground-level station concourses, platforms and approach railway lines. Although Euston Station area is limited by Regent's Park and the King's Cross railway lands to the west and east respectively and its railway lines act as a more severe urban barrier than those of Victoria Station, both terminus spaces still share approximately the same value of global spatial embedding (1.0020 and 1.0019 for Victoria and Euston Stations respectively[11]) and attract the same percentage of non-passengers (18%[12]). These precise spatial and space use data suggest that both terminus areas are spatially related to the city in a similar way despite being scarred by two completely different station structure layouts[13].

Although Euston Station appears to fit well within the urban grid pattern[14], its internal space, similar to Victoria, is still rather enclosed and segregated from the

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11 Refer to Table 7.1, column A: the ratio of the mean integration values of the station's modeling area with and without the internal space.

12 Refer to Table 7.1, column E: percentage of non-passengers.

13 Refer to Section 3.7: Discussion and conclusion in Chapter Three: The internal dynamic of railway termini, a comparative study of Euston and Victoria Stations.

14 Refer to Section 4.4.2a: Euston Station area, the figure and ground study in Chapter Four.

urban surroundings. The terminus building is set back at the front from Euston Road. Although one major integrator is drawn into its internal space, it appears to pass through only the front colonnade not the main concourse hall. Its recently refurbished terminus space is well used mostly by transport passengers during the station's peak periods and left almost vacant at other times of the day[15].

Unlike Victoria, the spatial structure of Euston Station's rear area, especially to the west side of the railway embankment, does not have grid-integration but line-integration characteristic. Although the grid network is still quite densely distributed, its approach railway lines allow only a few routes to cross over. The spatial configuration of the areas along the railway lines thus appears to be less integrated than that of the front. This also reflects in different levels of movement and types of activity evidenced within the front and the rear areas. While to the station's front there is a vibrant urban environment of mixed business, commercial, retail, residential, hospital, and university land uses, the rear is mostly occupied by quiet and well-kept residential neighbourhoods. However, although low levels of natural movement are recorded, these residential areas are not in a state of blight. According to the detailed spatial analysis[16], it appears that all sub-areas around Euston Station are tied together by a major grid framework formed by three important integrators: Camden High Street, Hampstead Road, and Euston Road. Despite being less integrated, these rear areas are not segregated as lumps. The current figure and ground study also confirms that the overall urban physical pattern around the terminus structure is dense and coherent throughout.

The development potential of Euston Station area is not limited spatially but by the building height control area called 'the St.Paul's Height'. The regulation prevents any large scale vertical building development in the area that would block the view of St.Paul's Cathedral from Primrose Hill. The area is thus still largely undeveloped as large scale development projects built horizontally are considered less feasible by developers. The office complex in front of the station, including all other high-rise buildings in the area, were constructed before the commencement of this regulation. Although there are also some other small scale retail, business, and residential developments within the Asian communities located alongside the station building, they are not related in any way with the terminus space.

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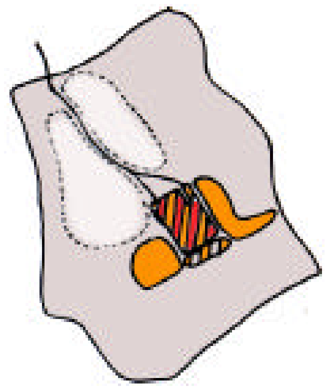
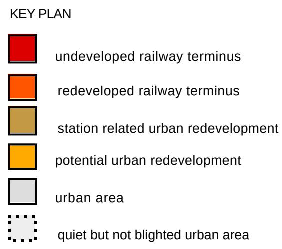
15 Refer to Chapter Three.

16 Refer to Section 5.3.2a: Axial analysis of Euston Station area.

Plate 7.6: Diagram of EUSTON STATION AREA redevelopment strategy





The suggestion to improve the vibrancy of Euston Station is to create more connections between the neighbourhoods alongside the railway tracks. This is simply to increase the spatial potential for the station's internal space to become well embedded within its urban setting. The station's front entrances should be more directly connected with Euston Road instead of being hidden behind the bus station and other blockades in Euston Square Garden and the station's forecourt. The station should also provide more direct entrances from its rear areas so that the integrators can be drawn in from all directions.

* **Charing Cross, Cannon Street** and **Fenchurch Street Stations** can all be seen as enclosed nodes on elevated viaduct structures located within vibrant place settings (Plate 7.6, 7.7, and 7.8 respectively). Although their urban grid structures are densely interconnected and well integrated, their internal spaces appear to 'float over' and be segregated from the surroundings. However, despite the topographical limit of the Thames, Charing Cross and Cannon Street Station areas still outperform Fenchurch Street Station area as their grid networks appear to be more coherent and densely intensified. In the latter case, the grids become more sparse in the areas further down the railway lines as a result of some waste pocket spaces attached to the railway viaducts themselves. The urban settings of Charing Cross and Cannon Street Stations thus provide a greater spatial potential for their internal spaces to be embedded. Additionally, both termini also have a direct access to their concourse halls from the street level at their front while Fenchurch Street Station is completely elevated above ground. The two termini are more spatially integrated and record relatively larger percentages of non-passengers and non-transport related uses than that of the Fenchurch Street.

In general, these three termini can be seen as being similarly surrounded by vibrant sub-areas that sustain good levels of natural movement. Their station entrances create fluxes of movement adding onto such grid-related movement in some of the sub-areas. Only Fenchurch Street Station area still has undeveloped sub-areas adjacent to the railway viaducts further down the lines where low levels of natural movement were recorded. This is simply because Cannon Street and Charing Cross Stations have a rather limited rear area where their terminus structures create very little effect upon the surroundings.

However, their topographical limitation means that Charing Cross and Cannon Street Station areas have less spatial potential for future urban development compared to Fenchurch Street Station area. Both terminus areas almost have no room for future grid intensification that could take advantage of both station-related and grid-related movements and be further developed into new local centres. Large scale building developments at Charing Cross and Cannon Street Stations were mostly constructed using the air-rights above and beneath the terminus structures or limited to some specific locations where some plots of lands were still available such as the riverfront area in the case of Cannon Street Station and the east side area of Charing Cross Station. For Fenchurch Street Station, the developments occurred both above and immediately around the terminus building with some ongoing projects also evident further along the railway lines.

The option to move the concourse halls down to the ground level in order to provide some direct spatial connections with their surrounding grids might be too costly and technically complicated as it would require reorganising the railway track and platform systems. Thus, it seems that these three elevated termini might not be able to completely transform into vibrant places to the same degree as the more successful Liverpool Street Station. However, their internal spaces could be re-engineered so that they would be more spatially embedded within their already vibrant urban place settings. In order to achieve this, Fenchurch Street Station needs a more complicated spatial rearrangement than the other two as its internal space is completely elevated above the ground level in all sides. This might be done by creating a 'transitional concourse space' which can be accessible from its surrounding sub-areas at the ground level of the terminus. This transitional space could function as the station's foyer which would provide some better links between the street grids and the elevated concourse hall. Charing Cross and Cannon Street Stations should provide more direct accesses and visual connection to their concourse halls especially from the sides and rear where the level differences are large. Their existing front entrances should be improved in a way that the station concourses become more open and directly accessible from the street grids.

However, Fenchurch Street Station area appears to have a better development potential than the other two termini as it has no topographical limit and still includes more undeveloped plots of lands at its rear, evident as gaps of varied sizes in its current figure and ground pattern. Some waste pocket spaces located further down the railway lines including their viaduct spaces provide 'rooms' for the urban grids to be more intensified around the terminus structures.

Plate 7.7: Diagram of CHARING CROSS STATION AREA redevelopment strategy

Plate 7.8: Diagram of CANNON STREET STATION AREA redevelopment strategy

Plate 7.9: Diagram of FENCHURCH STREET STATION AREA redevelopment strategy

* **London Bridge** and **Waterloo Stations** are both enclosed nodes elevated on viaduct structures which locate within slightly blighted urban settings (Plate 7.10 and 7.11 respectively). Their bold spatial characteristic is the sparsely grid network that accommodates several waste pocket spaces as well as other urban barriers besides the terminus structures themselves. Both terminus spaces, also recently refurbished, were completely elevated above ground level. The station concourses are connected to their surrounding streets only through a series of ramps, steps, and underground tunnels. Thus, they are not embedded well within their spatial settings. However, London Bridge Station appears to outperform Waterloo as its front ramp acts as a transition space. Two integrators connect Borough High Street to the front with the concourse hall through this ramp. On the contrary, no significant integrator can be directly drawn into Waterloo Station's internal space. However, both termini attract approximately the same percentage of non-passenger (12% for London Bridge and 13% for Waterloo) and record very close percentages of retail and catering spaces (39.9% for London Bridge and 40% for Waterloo). This suggests that their surrounding urban grids might be distinctively structured despite their general similarities.

Similar to the other three elevated termini (Charing Cross, Cannon Street and Fenchurch Street Stations), London Bridge and Waterloo Stations appear to 'float over' the urban grid networks rather than being a part of them. However, the surrounding grids of the first three termini are more densely interconnected while those of the latter two are more sparse and less coherent. This is because London Bridge and Waterloo Stations are entangled by the railway structures both at their front and rear. Most of their viaduct structures have also been blocked off to accommodate other uses. Some are attached with waste pocket spaces which consist of fenced parking lots, vacant fields, or deserted playgrounds. Both station areas are also limited by some enclosed and segregated properties such as Guy's Hospital (in case of the London Bridge) and the Southbank area, St.Thomas Hospital, and Lambeth Palace (in case of the Waterloo). The spatial grids around both terminus structures thus appear to be sparsely built up. Their figure and ground studies also reveal loose and less coherent figural blocks constituted around large gaps scarred by the railway lines.

As both termini appear to have their entrances rather hidden from the main front roads, movement recorded within their front areas are largely influenced by other major attractors. Their sub-areas record high to moderate levels of natural movement in general. In some sub-areas especially those along the rear side railway lines, low natural movement rates are recorded and the negative attractor's effects are evident. These are the areas whose urban grids are interrupted by blocked viaduct and waste pocket spaces or enclosed properties. They have a slightly blighted condition. Some locations include deserted building structures in a state of disrepair.

Despite several spatial similarities, London Bridge Station area still has a better development potential than Waterloo Station area. This is simply because the first area is less limited by enclosed properties than the latter. London Bridge Station area has more available spaces for future urban development. However, both areas accommodate several vacant plots of land which have been left deserted or fenced off as waste areas. These areas provide a great development potential to create a more intensified grid network around the terminus structures. However, the ongoing urban developments at London Bridge instead focus intensively along the riverside. Those at Waterloo Station area include a large scale urban redevelopment at the Southbank and some smaller projects located to the station's front beyond the railway lines as well as to the east side. These developments create a more intensified grid pattern around the terminus building. The Southbank's urban redevelopment at Waterloo Station area proposes to bring its elevated pedestrian network down to ground level to be able to make more sensible connections with the surrounding grids. However, all developments do not appear to create any spatial link with the terminus spaces.

Plate 7.10: Diagram of LONDON BRIDGE STATION AREA redevelopment strategy

Plate 7.11: Diagram of WATERLOO STATION AREA redevelopment strategy

However, the new development plans for both termini suggest that some large scale office, hotel, and commercial complexes are to be built on top of the station buildings and their platforms. They will include a plan to extensively re-engineer their internal spaces. The proposals are to move the concourse halls of both termini, now elevated above ground level, down to the street level in order to extend the length of the rail platforms all the way into the existing halls. If such proposals were realised, it seems likely that both London Bridge and Waterloo Stations would become more integrated within their surrounding grids. They could also be transformed into vibrant urban places if their spatial potential was fully utilised in the same way as at Liverpool Street Station.

* **Paddington Station** is an enclosed node located within a blighted urban setting (Plate 7.12). Although the station has been recently refurbished and now accommodates more retail and catering spaces including the new airport check-in facilities, only 9% of the station users are non-passengers. This means that most people come to use the station for transport purposes. The spatial embedding values reveal that the terminus space is not very well embedded in its spatial setting. This is due to the fact that the station is rather enclosed and hidden behind the railway hotel. As a lower level terminus, the significant level difference of four metres between the concourse hall and the surrounding streets also makes their spatial connections overly complicated.

The spatial segregation of the station's internal space is also a result of the disrupted urban grid structure. In other words, the station site does not provide the spatial potential for the terminus space to become fully embedded. The grid network of Paddington Station area is severely disrupted not only by the railway structures and railway lands but also the Canal Basin and the Westway, all located to the north of the terminus. Its physical and spatial patterns show a large gap representing the urban incision caused by these barriers. The negative attractor effects are clearly evident within their immediate surroundings. Although the station area in general still records moderate levels of natural movement, the railway lands site is totally deserted of pedestrian.

However, the ongoing Paddington Basin development does not utilise well the spatial potential of the site. The spatial analysis of its proposed development plan revealed that the new complex is segregated as a whole from its surroundings. It does not draw enough integration into the site to be able to establish itself as an embedded part of the existing grid network. Due to the level difference between the development complex and the terminus space, both entities have complicated spatial connections through ramps and steps. Its future figure and ground pattern also reveals that the new development complex appears to narrow down, but is unable to eliminate, the gap formerly caused by urban barriers. It also does not create a coherent figural pattern with the surrounding area.

Being a below ground level terminus like Liverpool Street Station, a multi-layered environment should be introduced in its internal spatial arrangement. The street level gallery crossing over the lower level station concourse space could be created as a direct link between the Paddington Basin development complex, to the north and east of the terminus, and the west side neighbourhood. This proposal would embed the terminus space into its setting as well as drawing integration to the station complex from the station side. As the Westway is a strong barrier and difficult to break through, the development complex should consider drawing more integration from its east and south neighbourhoods including creating more connections across the Canal Basin.

Plate 7.12: Diagram of PADDINGTON STATION AREA redevelopment strategy

* Similar to Paddington, **Marylebone Station** is a node located in a blighted urban setting (Plate 7.13). The station is set back from the busy Marylebone Road in a quiet neighbourhood of office, hotel, and residential areas. Its internal space has also been refurbished to accommodate more retail and catering spaces. However, it is not well embedded in its urban setting. The grid network of Marylebone Station area does not provide a good spatial potential for the terminus space as it is severely scarred by the railway lines and various enclosed residential properties. Its internal space draws only 12% of non-passenger which means that the station can become very quiet during off-peak periods.

The urban grid structure of the front area of Marylebone Station is clearly distinctive from that of its rear. While the front side has a grid-integration characteristic and is densely distributed, the rear has a line-integration system and is clearly disruptive. The figure and ground study also reflects different patterns between both sides. While dense and coherent figural block pattern is evident at the front, the rear has fragmented and loosely constituted blocks with a clear urban incision. The negative attractor effects are also evident within the immediate surroundings of these barriers while the front area records high levels of natural movement. Residential neighbourhoods alongside the approach railway lines are rather enclosed and extensively blighted.

The urban developments in Marylebone Station area are attached to the terminus structures but have no spatial relationship with the station's internal space. In order to embed the station into the grid network, first of all, the existing enclosed residential properties at the station's rear should be opened up more and draw integration into themselves. These integrators should be aligned to create east-west connections across the railway tracks, linking together the neighbourhoods on both sides. This is to create a more interconnected and integrated urban grid structure in order to improve the spatial potential for the terminus space to become fully embedded. The station building itself already has a potential to align some integrators to pass through its concourse. Marylebone Station area has a great potential for future development as it accommodates several undeveloped plots of land especially those alongside the terminus structures which have been left in a state of blight.

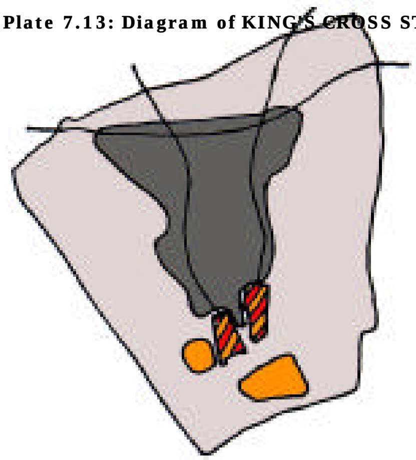
Plate 7.13: Diagram of MARYLEBONE STATION AREA redevelopment strategy

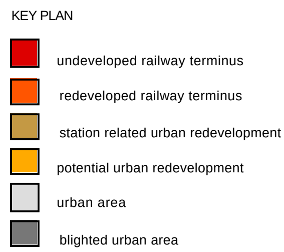
* **King's Cross Station** is a node located within a very blighted urban setting (Plate 7.14). Although the terminus building is located along the busy Euston Road and its internal space draws several integrators into itself, the severely disrupted urban grid network does not provide the spatial potential for the terminus space to be well embedded. The station draws only 14% non-passengers and records 35.5% of retail and catering spaces.

The urban grid network of King's Cross Station area is extensively disrupted by the entanglement of railway infrastructures and railway lands. This urban incision is clearly evident in both the spatial and physical urban patterns as a large 'void', taking up an area of approximately 160 acres, the largest brownfield site in Europe. This void is bordered with residential neighbourhoods whose spatial structure is segregated. These areas are seen as fragmented and loose figural blocks attached to the large void in the station area's figure and ground study. The railway land site, including these adjacent neighbourhoods, is certainly blighted. Some locations are occupied by dilapidated building structures and are almost devoid of pedestrians. The negative attractor effects are extensively evident to the rear with very low rates of natural movement being recorded. The station's front area is busy with both grid-related and station-related movement.

The early major development projects at King's Cross Station area include a large scale housing complex located to the south and the British Library to the east with some other residential projects along the Union Canal. With the recent approval of the Channel Tunnel Rail Link project the railway land site including both King's Cross and St.Pancras Station buildings are to be extensively spatially reorganised. St.Pancras Station will become the new terminus for the Eurostar train service. It appears that the node characteristic of both termini will become strengthened further. However, the success of this large scale redevelopment project that could potentially make the termini significant places within the city structure critically depends on its spatial configuration. If the stations' internal spaces and the new development complex are well integrated with the urban grid network and the urban void is eliminated or filled with a more intensified grid, King's Cross Station area still has the spatial potential to be further developed into a new local centre.

Plate 7.13: Diagram of KING'S CROSS STATION AREA redevelopment strategy





7.3 EPILOGUE

The review of London's mainline railway terminus areas and their development potential within a node-place conceptual framework suggests a theoretical model in which a transport node such as a railway terminus could be transformed into a vibrant place. The model is elaborated as follows;

- Railway termini must have internal spaces well embedded in their spatial settinga so that they becomes an integrated part of the local movement system. This is to attract a good level of natural movement to complement the deterministic movement within the concourse space, creating a mixed-use environment whereby the station users consist of not only passengers but also urban dwellers. Through a movement economy process, movement seeking functions such as retail and catering could then be successfully developed in proportion with levels of urban dwellers who pass through the station throughout the day, influence by the urban grid configuration not train timetables. A well embedded terminus space thus has a better potential than a segregated one to sustain a vibrant environment of mixed activity, both transport and non-transport related. To enable this to happen, first of all the station's surrounding grid structure has to be densely interconnected and integrated in its larger urban network. This is to establish a spatial potential for the terminus space to draw a number of significant integrators into itself such that the station, as a point attractor, could also become a configurational attractor.

- The well interconnected and integrated grid network of the terminus area means that the external station structures such as the approach railway lines and all other related structures have to be well embedded and avoid creating severe disruption to the urban grid structure. This is to eliminate the negative attractor effects which occur as a result of the interruption of the natural movement system, a major cause of urban blight.

- In the case that the urban grid structure is extensively disrupted or severely discontinued by the terminus structures, station area redevelopment proposals should create more spatial links by reconnecting the grids on both sides of the railway tracks. Using the air-rights above or beneath the railway lines, the new development complex should eliminate the urban incision by establishing itself as a linkage between the two formally separated neighbourhoods. Practically this is to create a pedestrian grid network that can overcome the transport infrastructure in the area in order to eliminate the negative attractor effects and to revive the natural movement within the system. Similar to the station's internal space, the new development complex should fully utilise its spatial potential by appropriately drawing integration into itself in order to encourage a good level of natural movement into the site. This is the only effective way to eliminate the negative attractor effects and at the same time to stimulate the movement economy process that can bring about the development of new land uses in the area.

- The potential of the newly developed station complex to become integrated in its larger urban network means that the location of the terminus area itself in the city is crucial. The strategic location where the terminus area has no topographical limit nor is confined by other barriers is necessary to guarantee the successful creation of a place from a transport node. An area that is well interconnected and integrated with the city's grid structure in all directions would have a greater spatial potential to draw integration into the site and be further developed.

- Since the spatial potential is provided by the urban grid structure, the terminus space can be successfully embedded within its spatial setting by drawing integrators into its concourse hall. The key is to find some spatially integrated line(s) to be extended into the station and make them connected or aligned with other integrators on the other side. If the station is elevated, the transitional space should be created at its ground level in order to establish more spatial connections between the high level terminus space and the surrounding streets. The best option would be to extensively reorganise the terminus space and bring the concourse hall down to the street level.

- The terminus space should be spatially reorganised in a way that its internal space influences a clear right-of-way for each important function. To become a vibrant and effective urban place, all activities, both static and moving, should co-exist without any severe interruption to one another. As the deterministic movement inside the station has been proven to be influenced by the internal spatial configuration, the location of all station functions can then be arranged in correspondence with the configuration itself. The urban grid configuration of the station setting must also be examined in order to identify the probable natural movement pattern inside the station. The location of key station functions that usually dominate the station concourse, such as ticket office, waiting area before the train timetable billboards, etc, could then be arranged in accordance with the natural movement pattern. The option of a multi-layered environment thus becomes more desirable as such spatial arrangements can cope with a large amount of static and moving activities that converge within the terminus space.

- The station complex should help create more direct accessibility to the station concourse in all directions. This is to create the attractor effects that would bring about additional station-related movement to complement the grid-related movement within the station's surrounding areas. This combination of movement types which occupy the street spaces in different ways and at different times of the day could accelerate the movement economy process, creating a cluster of mixed-use and activities focused in and around the terminus building.

- Lastly, the urban developments that occur within the immediate surroundings of the developed station complex should further utilise the spatial potential of the site. They should aim to create an intensified grid network constituted by regular sized building blocks in order to establish a highly integrated spatial structure that could well take advantage of the unusual flux of movement within the station area. This process of grid intensification would contribute to the dynamic process of centrality through which the terminus area could, as a whole, be further developed into a new live centre.