Impact of Multi-Station Aggregate Hub Redevelopment on Surrounding Urban Areas: A Case Study of London's King's Cross

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Abstract
Multi-station aggregation hubs – interconnected transport nodes in high-intensity urban areas – significantly influence metropolitan growth, yet systematic research on their regional development impacts remains limited. This study examines London's King's Cross–St Pancras hub redevelopment using spatiotemporal data (1996–2023). Three analytical zones (Core zone, Central Impact Zone and Wider Impact Zone) were established to assess transport networks, functional vitality, and development intensity via GIS and qualitative methods. Findings indicate a 25:11:8 ratio of renewed building areas across zones, with development intensity strongly correlated to hub proximity. The core zone saw significant growth in consumer/service-oriented POIs, evolving into a mixed-use creative hub. Insights are provided for redeveloping similar hubs in high-density cities, particularly China.

Keywords
Multi-Station Aggregation; Transportation Hubs; Urban Area; King's Cross; Spatiotemporal Evolution

1 Introduction

Rail transit is reshaping existing urban spatial configurations and travel patterns (Chu and Wei, 2017; Li et al., 2015), even accelerating the redefinition of architectural boundaries, pathways, and frequencies, thereby creating new spatial forms oriented toward speed (Chu and Su, 2024). Since the 21st century, the rapid development of urban rail transit systems, exemplified by metro networks in Chinese metropolises, has profoundly transformed spatiotemporal perceptions of urban spatial development. In Asia, large cities are planning and implementing massive investments in public transport networks, where the promotion of transit-oriented development (TOD) policies has become pivotal to building public transport-centric cities (Kidokoro, 2020). For instance, Tokyo's rail system enhanced transport capacity and efficiency through measures such as double-track expansions, metro development, new route creation, express services, and station upgrades, supporting the city's transition toward compact and low-carbon spatial structures (Cao, 2022). Rail transit development influences urban layout and intensity, offering sustainable frameworks for creating compact, mixed-use communities around transport hubs in city centers.

Existing studies on the integration of rail transit stations and surrounding land development primarily focus on single-station-centered approaches, categorizing research based on station functions or locational characteristics. However, as cities evolve, urban transport hubs increasingly interconnect with neighboring stations, while metro lines constructed in different periods form complex spatial structures (Li et al., 2024). In recent years, metropolises central areas have witnessed intensified rail station clustering and increasingly intricate network configurations (Yang, 2021). Due to factors such as the alignment of new lines, construction challenges, and infrastructure constraints, later-built stations may not align with existing ones but could emerge within walkable distances. These stations, through infrastructure upgrades, coalesce into multi-station aggregation hubs (Zhu and Wang, 2022). Such hubs, often located in urban cores or critical transport nodes, present significant opportunities for shaping surrounding areas (Li et al., 2024; Desjardins, Maulat and Sykes, 2014). Over the past three decades, these hubs have proliferated in global urban development, with their optimized layouts structurally enhancing spatial quality in central districts (Yang, 2021). Nevertheless, systematic research on multi-station hubs and their interconnected urban functional districts remains insufficient, and their spatiotemporal evolution mechanisms require further study.

The King's Cross area in London, a vital transport hub and urban core in the city's northeast, hosts two major rail stations (King's Cross and St Pancras) and six underground lines. Its closely linked stations exhibit rich spatial hierarchies and order, making it a representative multi-station aggregation hub. This study traces the redevelopment of King's Cross over the past two decades, employing multi-source archival surveys, GIS-based quantitative analyses of transport networks, functional shifts, and development intensity, and typological examinations of renewal modes. By combining quantitative and qualitative methods, it analyzes the impact of

multi-station hub redevelopment on regional development, aiming to uncover patterns of influence exerted by such transport complexes on urban growth. The findings are expected to provide insights for the planning and redevelopment of multi-station aggregation hubs in other emerging metropolises.

2 Research Methods

2.1 Case: King's Cross, London

The King's Cross area is located in the northeast of central London, at the junction of the Camden and Islington boroughs, serving as a critical transport hub where King's Cross Station and St Pancras Station converge. After World War II, containerized rail freight replaced traditional freight methods, leading to large areas of land and buildings within the region being repurposed for cargo storage. Due to poor management, the station environment became increasingly dirty and dim, while unemployment severely impacted local communities. By the 1980s, the area had become a region in urgent need of urban revitalization. However, redevelopment efforts in the 1980s and 1990s repeatedly failed due to challenges in coordinating land ownership, incomplete public facilities, and unclear industrial targets.

The real reconstruction of the area began in 2000 with the Channel Tunnel Rail Link project. A development consortium named King's Cross Central Development Partnership (KCCLP), composed of companies such as Argent, LCR, and Exel, was established as the sole landowner to lead the redevelopment of the King's Cross core zone. Building on comprehensive upgrades to King's Cross and St Pancras stations, the project capitalized on high transport connectivity to integrate multiple underground lines, transforming former industrial sites into a mixed-use urban district combining commerce, culture, creativity, and research. This revitalization became a new engine for urban development, driving growth in surrounding areas. The urban transformation also brought significant opportunities: between 2010 and 2022, the number of companies in the core zone nearly doubled to 800, office rents surged from 48% below to 19% above central London averages, and employment increased from 8,000 to 27,000 jobs (Regeneris Consulting, 2017). The King's Cross redevelopment project stands as one of the UK's largest and most notable urban regeneration initiatives of the past three decades.

As a representative multi-station aggregation hub with nearly two decades of redevelopment history and a stabilized built environment in recent years, King's Cross was selected as the focus of this study. Based on reports published by the King's Cross development authority (Regeneris Consulting, 2017) and the King's Cross Master Plan (Allies and Morrison Architects, 2007), the research scope was divided into three zones (hereafter referred to as the "Three Zones," Figure 1): Core zone, Central Impact Zone and Wider Impact Zone.

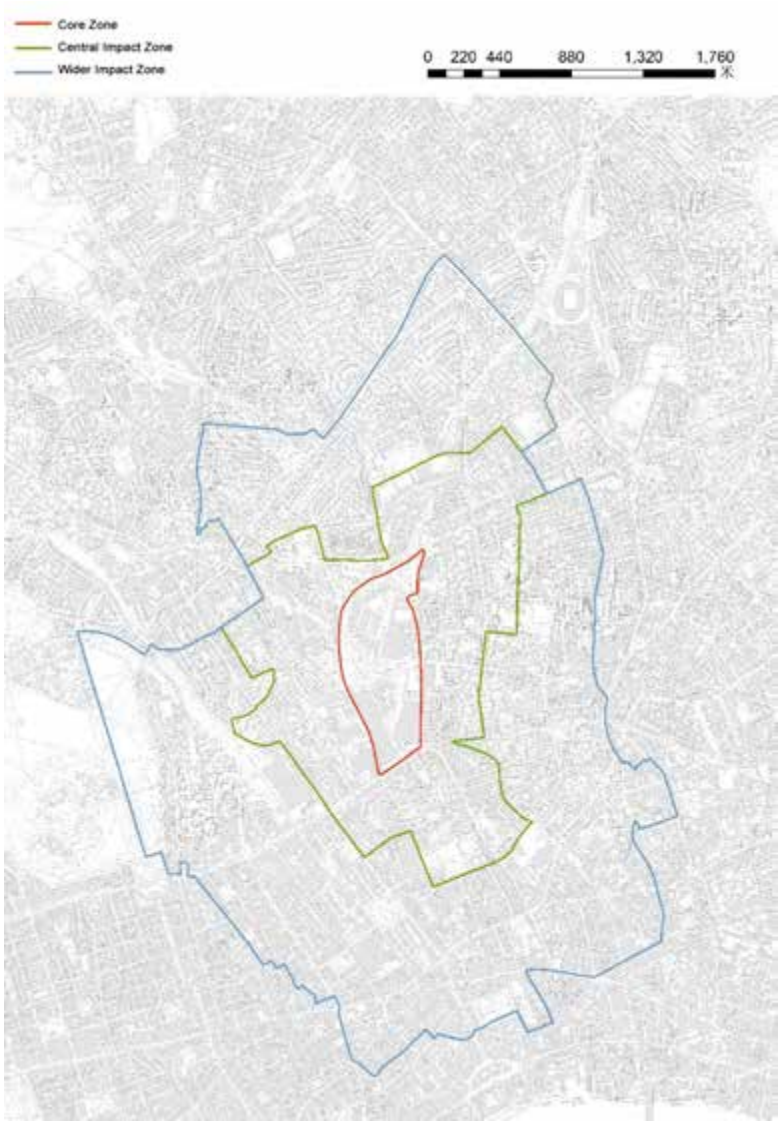


Figure 1: Three Analytical Zones of King's Cross

2.2 Data Sources: Documents and Spatial Data

This study collected and analyzed documents and spatial data related to the redevelopment of King's Cross from multiple sources. For documentary data, this included historical records of the area, planning and design proposals from developers and urban designers, relevant planning documents published on the official websites of the Camden and Islington local authorities, progress reports on the King's Cross core zone (2008–2024) published by KCCLP on its official website, and a 2017 construction evaluation report for the core and impact zones by Regeneris Consulting (Regeneris Consulting, 2017). For spatial and statistical data, the study acquired: Ordnance Survey datasets (2007–2023): Built-environment typology maps, building height data, and Points of Interest (POIs); Transport for London (https://tfl.gov.uk): Ridership statistics for stations (2007–2017); UK Office for National Statistics (www.ons.gov.uk): Census data (2001, 2011, 2021) at the Output Area (OA) level, with each OA typically covering 40–250 households.

2.3 Analytical Methods: Integration of Qualitative and Quantitative Approaches

The research first clarified the historical development trajectory of King's Cross through document analysis, with a particular focus on the evolution of the core zone's built environment and the historical integration of rail and underground lines. Historical changes were mapped visually. At the macro level, ridership variations across stations were visualized, while transport networks, functional vitality, and development intensity within the three zones were analyzed and visualized using ArcGIS to quantify the impact of multi-station transport

development on surrounding areas. Building on this spatial analysis, the study classified and examined spatial renewal patterns across the three zones. Typical buildings were categorized by renovation scale, from largest to smallest:1) Brownfield redevelopment, 2) Demolition and reconstruction, 3) Functional adaptation and renovation, 4) Vertical or horizontal expansion. The development of King's Cross was systematically analyzed through both renovation typologies and spatial layouts.

3 Multi-Station Aggregation Hub and Regional Impact in King's Cross

3.1 Aggregation Development of Transport Hubs

In the 1990s, the King's Cross–St Pancras underground station comprised three distinct stations: the Metropolitan/Circle Line (constructed 1864–1870), the Piccadilly/Northern Line (1906–1907), and the Victoria Line (1968). These stations were connected by narrow, temporary passageways, which became severely congested by the late 1990s due to escalating passenger volumes (Bessant, 2004). Following the 1987 King's Cross fire, the 1989 Fennell Report (Fennell, 1989) by the UK House of Commons recommended that London Underground investigate "riderships and overcrowding at stations and implement remedial measures." The London Underground (King's Cross Station) Act 1993 authorized infrastructure upgrades to alleviate congestion. The underground connectivity project, designed in 1999 and constructed from 2000, was implemented in two phases: Phase I (2006): Expanded the original ticket hall and constructed a new western ticket hall adjacent to St Pancras Station, directly linking to the Metropolitan/Circle Line platforms; Phase II (2009): Added a northern ticket hall with tunnel access to the Piccadilly Line and improved accessibility features (Figure 2).

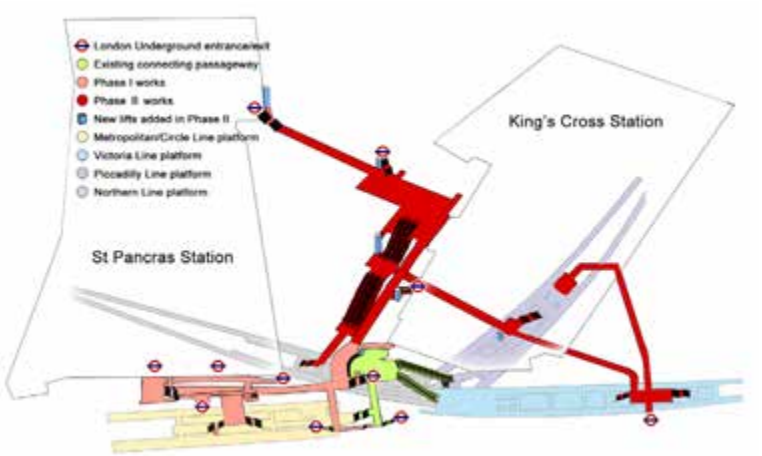


Figure 2: Schematic Diagram of the Multi-Station Aggregation Project at King's Cross

The redevelopment added six new access points in Phase I and two in Phase II, resulting in 11 underground entrances across three ticket halls. These upgrades integrated six underground lines and two national rail stations, resolving congestion and providing capacity for the 2012 London Olympics. The consolidation of previously fragmented stations into a multi-station aggregation hub significantly improved accessibility, enabling the hub to accommodate Eurostar's high-speed rail services and catalyzing large-scale urban renewal in the surrounding core zone (Allies and Morrison Architects, 2007).

Following the November 2007 opening of St Pancras International Station and further optimization of underground and above-ground facilities, rail and underground riderships exhibited steady growth. From 2008 to 2017, annual ridership at King's Cross–St Pancras underground station increased by 46%, King's Cross rail station by 40%, and St Pancras International nearly doubled. The growth rate at King's Cross–St Pancras far exceeded the London Underground average and ranked highest among surrounding stations (Figure 3), driving substantial ridership growth in the King's Cross area, particularly in the core zone.

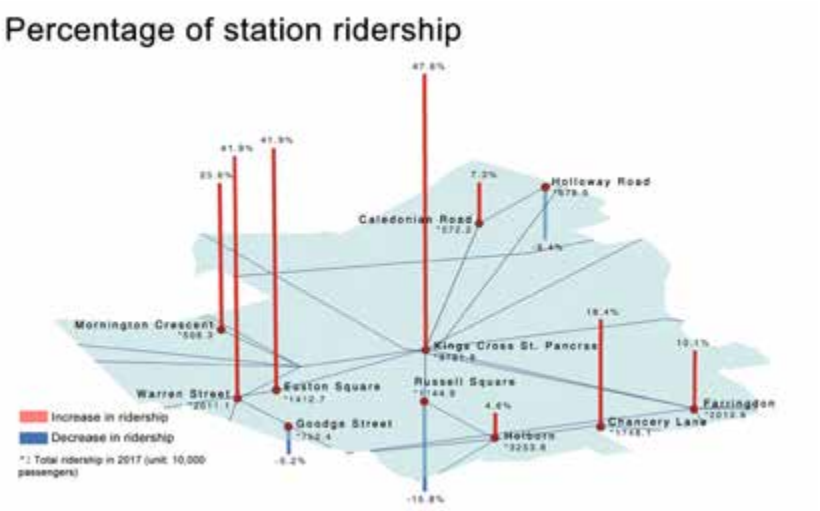


Figure 3: Annual Ridership Changes at King's Cross Stations (2007–2017)

3.2 Evolution of the Transport Network

The redevelopment of the King's Cross area has had an impact on the transport network mainly in terms of the reconfiguration of roads in the core zone, where the northern part of the site, which was previously divided by transport routes and freight depots, has been reconfigured in a phased manner, and the links with the surrounding area, in particular the aggregated sites, have been enhanced in the following ways (Figure 4): Early redevelopment focused on opening east-west freight routes and extending Camley Street and Pancras Road into the core zone. These newly connected arteries, alongside the existing York Way, redefined the primary transport network of King' s Cross. In the middle of the redevelopment, two narrow historic canal bridges were replaced with 18-meter-wide pedestrian bridges—dual-function structures designed for daily foot traffic and emergency access (e.g., firefighting). This phase also rationalized key north-south connections, establishing a cohesive axis from York Way through the canal to the station area and onward to A501 Road. In the concluding stage, vacant plots were systematically redeveloped to form a comprehensive pedestrian network. Newly constructed building clusters integrated well-defined public spaces and streetscapes, further enhancing the core zone's vibrancy. Post-redevelopment, the entire zone achieved a balanced yet diverse street layout, markedly improving traffic fluidity and urban functionality.

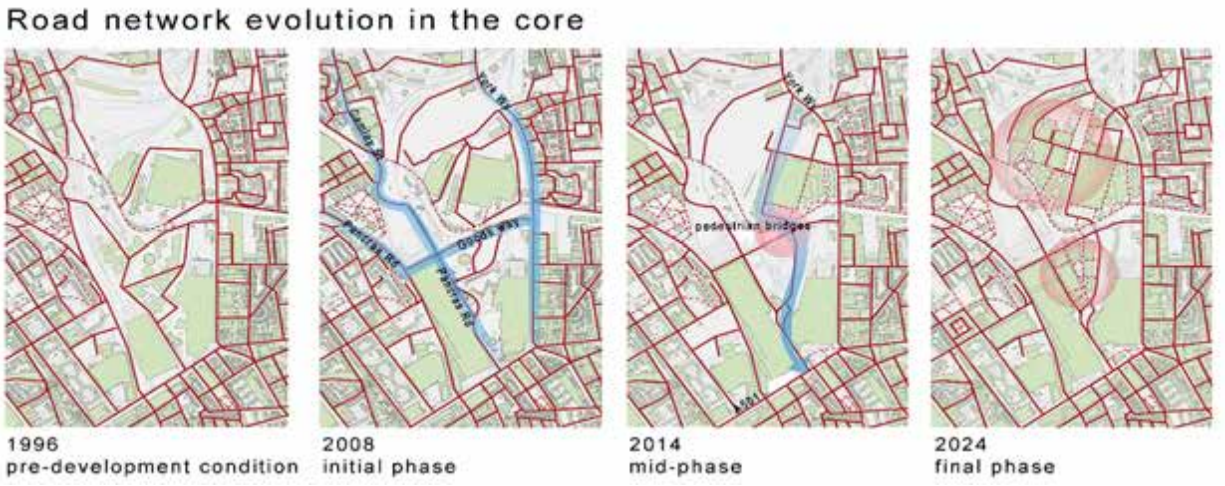


Figure 4: Road network evolution in the core zone (1996–2024)

3.3 Functional Vitality Transformation

The redevelopment of King's Cross spurred significant socio-economic agglomeration, with increased activity levels across surrounding areas. Points of Interest (POI) data, reflecting the diversity and density of urban functions, provide critical insights into the spatial evolution of economic and social activities driven by the hub's growth (Desjardins, 2014). Between 2014 and 2023, the total number of POIs across the entire King's Cross area remained relatively stable, with minor fluctuations. Notably, manufacturing-related POIs experienced a sharp decline of 19.5%, signaling the outward relocation of industrial activities and the reallocation of space for commercial and social uses (Regeneris Cunsulting, 2017).

A comparative analysis of the three zones reveals divergent trends. While the central and wider impact zones saw slight decreases in total POIs, the core zone experienced a 102.7% surge over the decade. Specifically, consumption and entertainment POIs in the core zone grew by 127.4%, and commercial services POIs surged by 200%, contrasting with marginal declines in the other two zones (Figure 5). This transformation underscores the core zone's emergence as a dynamic urban functional district. Its enhanced functional diversity and economic agglomeration capacity have revitalized the once transit-dominated hub into a vibrant, attractive destination.

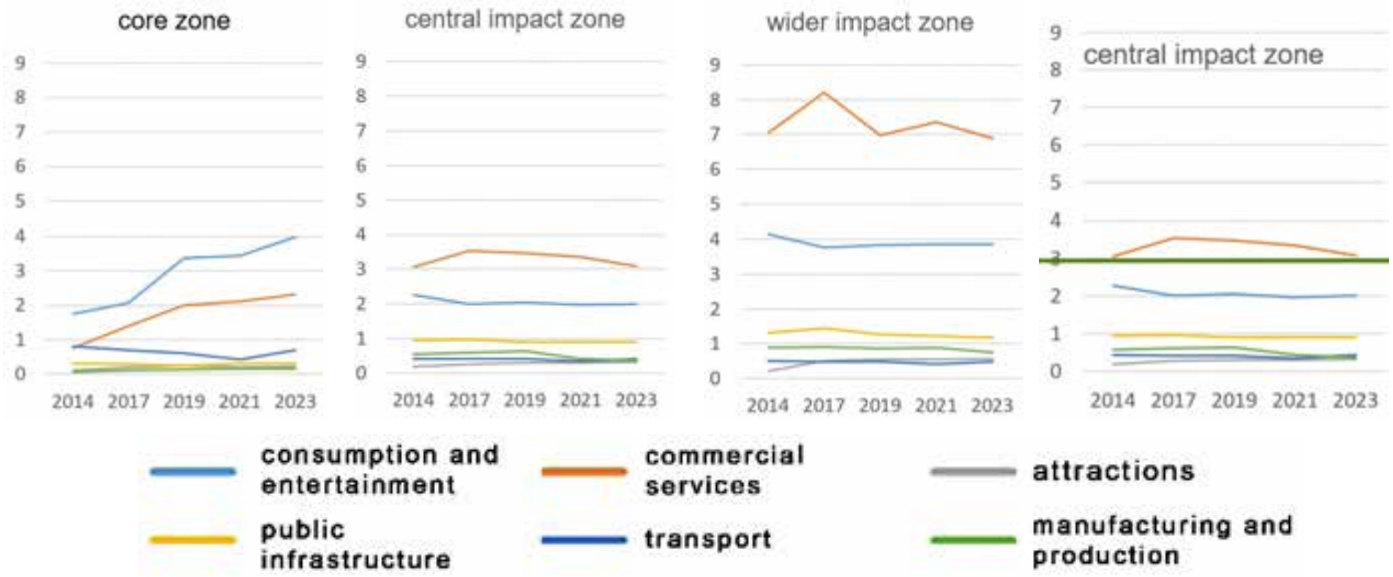


Figure 5: Changes in POI density per hectare across zones (2014–2023)

3.4 Intensity of Spatial Development

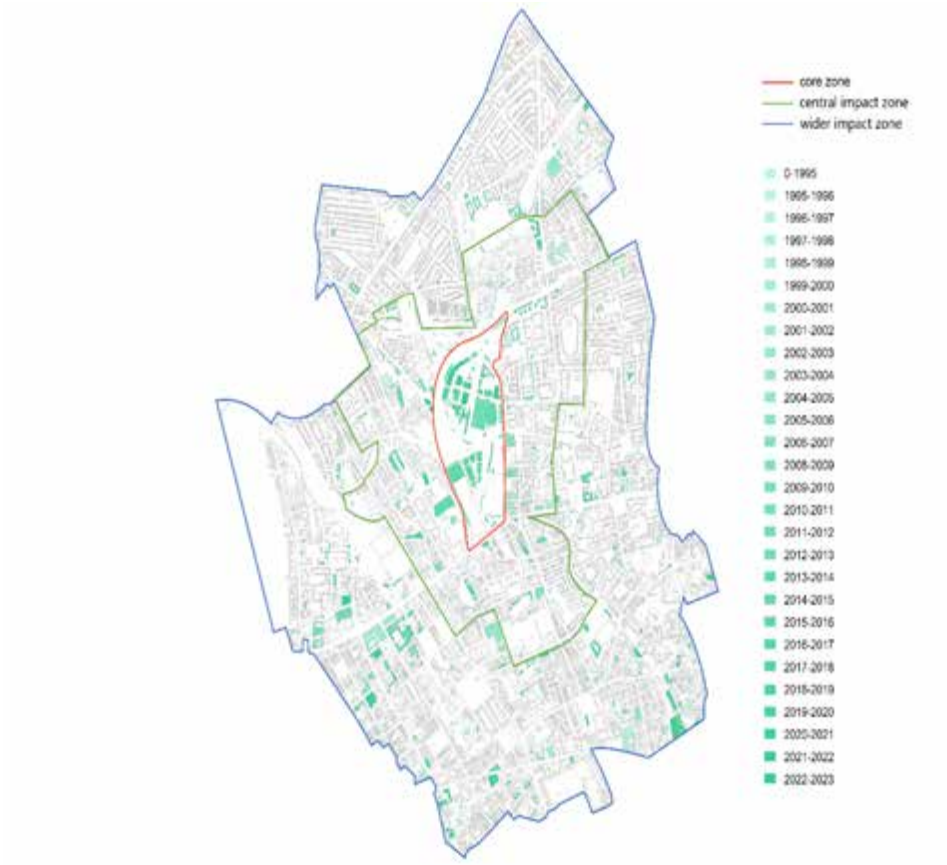
Analysis of building volume records since 1996 reveals stark disparities in development intensity across the three zones. core zone, central impact zone and wider impact zone exhibited a 25:11:8 ratio in newly added floor area per hectare. Driven by extensive brownfield regeneration opportunities, the core zone—despite occupying less than 5% of the total study area—accounted for over quarter of the total development volume, far outpacing the other zones. The central impact zone saw slower growth, with approximately 1% of buildings undergoing annual additions or major expansions, a renewal rate higher than that of the potential impact zone, which represents typical central London development patterns (Table 1).

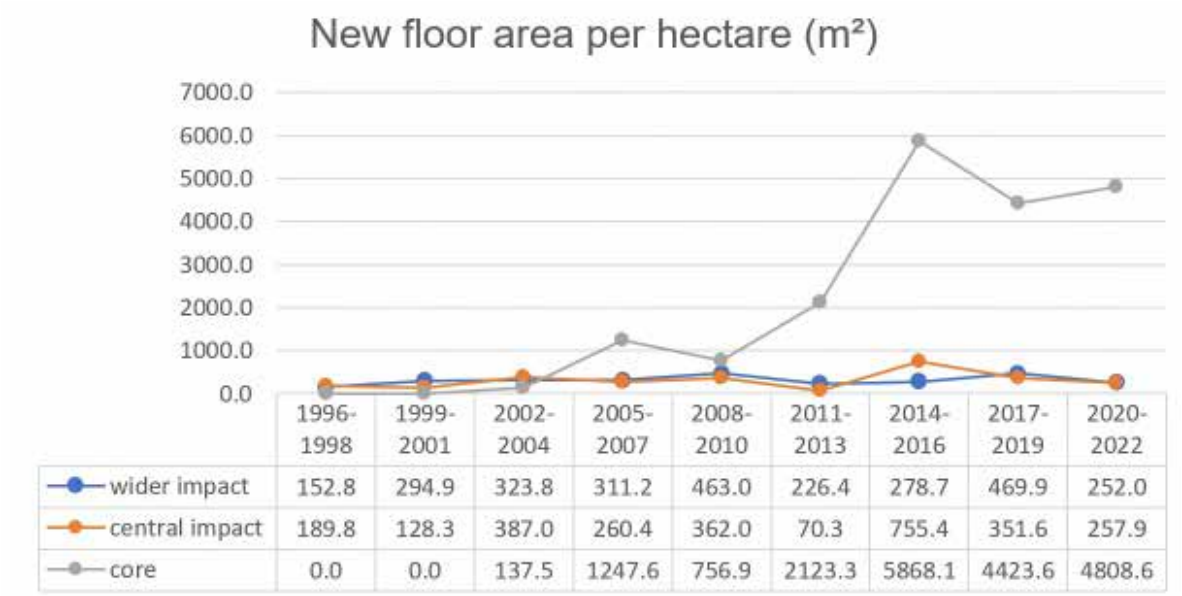
This pattern underscores the catalytic role of the King's Cross–St Pancras multi-station hub in amplifying spatial development momentum. Overall, the development rate exhibits a strong positive correlation with proximity to the hub: areas closer to the aggregated transport nodes demonstrate higher spatial value and greater redevelopment incentives.

Table 1: Spatial Development Metrics Across Zones (1996–2023)

Metric	core zone	central impact zone	wider impact zone
Newly added floor area (10,000 m²)	93.3	73.6	196.8
Total floor area (10,000 m²)	126.5	275.0	977.4
Land area (hectares)	48.0	266.6	709.6
New floor area per hectare (100 m²)	193.7	27.6	27.7
Proportion of building volume renewal	73.7%	26.8%	20.1%
*Floor area is estimated based on building morphology and height data, assuming an average floor height of 3.5m.			

The three zones exhibited distinct spatiotemporal development trajectories. Notably, the core zone did not immediately witness large-scale construction at the outset; in fact, no buildings were completed in the four years following the integration of St Pancras International Station, primarily due to delays in the development cycle. Significant construction commenced in 2007, spurred by the influx of passengers from Eurostar services and the aggregation of multi-station connectivity. This catalyzed the area's transformation into a hub for cultural, research, and corporate institutions, attracting multinational corporations, startups, and Central Saint Martins (University of the Arts London) to occupy office complexes built on regenerated brownfield sites. From 2011 onward, a wave of high-intensity development swept the core zone, with buildings progressively erected from south to north. By 2020, however, most core-area projects had been completed, leading to a decline in development rates. In contrast, the primary and potential impact zones experienced far lower construction volumes, characterized by fluctuating, modest growth. Yet, at every stage, the primary impact zone consistently outpaced the potential impact zone in development volume, reflecting the substantial momentum generated by the King's Cross hub aggregation. Spatially, most developments in the primary impact zone clustered around the core zone (Figure 6). Planned developments in adjacent areas further amplified this effect. For instance, Islington Council proposed high-density developments along York Way (adjacent to the core zone), including office, retail, leisure, and residential spaces. The plan identified four sites for high-rise buildings (30+ meters) and prioritized commercial floor space categories such as Grade-A offices, mixed-use spaces, and co-working facilities. (Islington Concil, 2023)





	1996-1998	1999-2001	2002-2004	2005-2007	2008-2010	2011-2013	2014-2016	2017-2019	2020-2022
wider impact	152.8	294.9	323.8	311.2	463.0	226.4	278.7	469.9	252.0
central impact	189.8	128.3	387.0	260.4	362.0	70.3	755.4	351.6	257.9
core	0.0	0.0	137.5	1247.6	756.9	2123.3	5868.1	4423.6	4808.6

Figure 6: Spatial distribution and comparative metrics of redeveloped buildings (1996–2022)

4 Spatial Renewal Methods in King's Cross Area

The King's Cross Opportunity Area, driven by the demand for foot traffic from transportation aggregation nodes, has spatially sought a variety of development patterns to promote economic agglomeration and diversification in and around the core zone. By tracing the spatial changes within the three King's Cross districts from 2007 to 2023, this study summarizes the development patterns into four types of patterns based on the underlying conditions

and spatial changes: overall demolition and redevelopment patterns, functional renewal and alteration, and expansion upwards and to the periphery (Figure 7). These types provide a large number of possibilities for spatial change and growth in multi-site agglomeration lots in already built-up urban high-density areas, progressively optimizing the relationship between transportation-space-function.

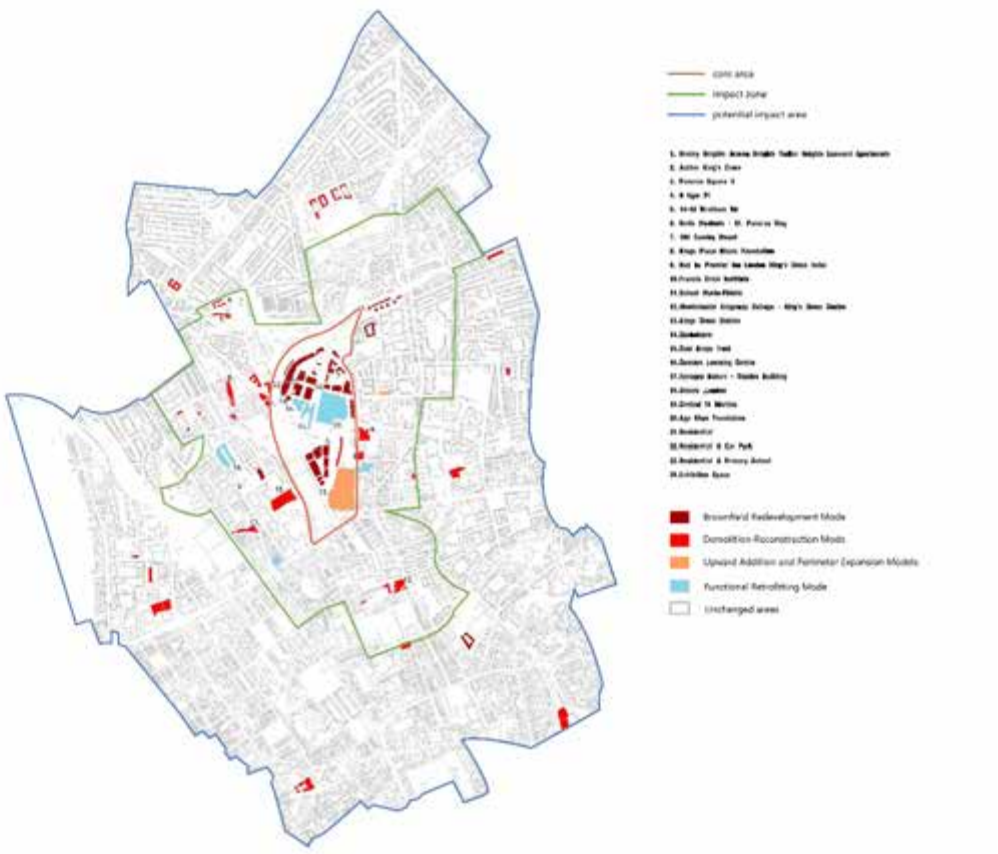


Figure 7: Distribution of the four development patterns in the King's Cross area

4.1 Brownfield Redevelopment Mode

The King's Cross and St Pancras stations, with their long histories, historically required extensive land for freight yards and rail operations. With advancements in transportation and logistics, many low-efficiency lands previously used for storage and rail operations were repurposed for redevelopment. This mode involves completely transforming the original land use to meet new spatial demands, significantly enhancing land value and utilization. Due to the abundance of brownfield sites in the northern part of the core zone, this became the most prevalent renewal mode in King's Cross (indicated by wine-red buildings in Figure 7).

A representative example is Pancras Square in the core zone. Located in the triangular area between King's Cross Station and St Pancras International Station, this prime urban site was previously occupied by rail yards and gas holders. After relocating the gas holders, redevelopment began in 2008, resulting in seven medium-height, high-density office blocks arranged in a street-like layout (Figure 9). Completed between 2013 and 2023, these buildings include Pancras Square 1 (designed by David Chipperfield Architects) and Pancras Square 4 (designed by Eric Parry Architects), which harmonize new structures with preserved historical buildings. The lower floors feature publicly accessible amenities such as retail, dining, a library, and leisure spaces, while the upper floors provide premium office space. The area's superior transport connectivity and livable environment have attracted global corporations like Universal Music, Google, and Meta.

Figure 8: Aerial view of Pancras Square (Source: Apple 3D Maps)

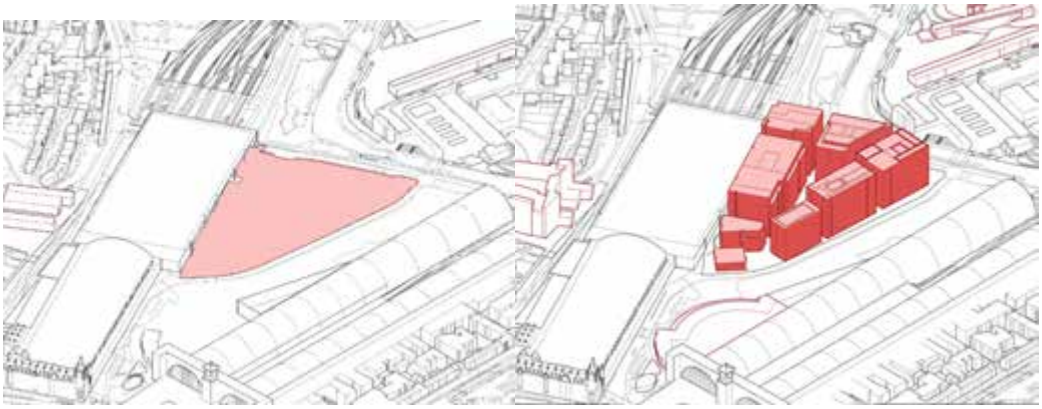


Figure 9: Before-and-after comparison of Pancras Square 1–7.

4.2 Demolition-Reconstruction Mode

Driven by the development momentum generated by multi-station aggregation, non-historic buildings with poor quality or low intensity near the hub were demolished and replaced with higher-density structures. This mode primarily occurred in the primary impact zone, where original buildings held limited historical value (marked by red buildings in Figure 7).

The Francis Crick Institute, a major biomedical research center west of St Pancras Station, exemplifies this approach (Figure 10). Construction began in 2007 with the demolition of fragmented, low-value buildings on the site. Completed in 2016, the 12-story, 100,000 m² complex integrates one-third of its structure below street level to minimize visual impact and creates public gardens. The institute now employs over 1,000 scientists, further energizing the area.

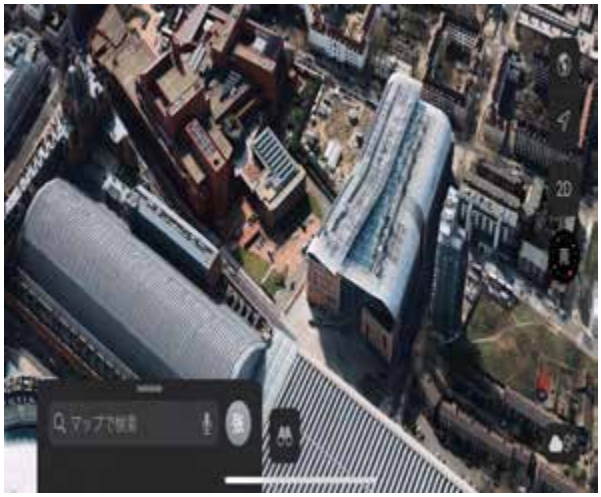


Figure 10: Aerial view of the Francis Crick Institute (Source: Apple 3D Maps).

Figure 11: Francis Crick Institute Before and After

4.3 Functional Retrofitting Mode

This mode involves partial renovations or expansions of existing buildings to adapt to new functions. It is categorized into three types:

1. Partial Retrofitting: Modifying specific sections of a building to enhance functionality or aesthetics while complying with regulations.
2. Functional Conversion: Repurposing structures while retaining their core framework (e.g., converting factories to residences or shops to offices).
3. Complete renovation with structural retention: Preserving the original structure but fully refurbishing it for new uses.

Heatherwick Studio undertook the restoration and adaptive reuse of two Victorian-era warehouses in the King's Cross core zone. These elongated brick warehouses, constructed in 1850 alongside railway viaducts, were interconnected via elevated walkways to create cohesive public spaces (Figures 12 and 14). The design introduced sloping glass extensions that extend upward from the original gabled roofs, forming interconnected upper-level spaces that serve as focal points for events and retail activities. The lower levels feature double-height volumes for hosting concerts, while the preserved cobblestone courtyards and historical façades maintain the site's industrial heritage. While creating new elements, the project's careful restoration of the surviving Victorian buildings and cobblestone courtyards to retain their historic character has created an unusual mix of retail spaces through the adaptation of internal spaces.

Figure 12: Coal Drop Plaza Elevation and Existing Conditions

The adaptive reuse of three historic gas holders exemplifies functional conversion combined with structural preservation. The original cast-iron gasometers—iconic symbols of the area's industrial past—were relocated and repurposed into residential complexes housing over 140 apartments (Figures 13 and 14). The design preserved the gasometers' industrial aesthetic and physical integrity while introducing a fourth "virtual drum" at their intersection to form shared courtyards for residents. The apartments range from studio to three-bedroom layouts, with the interstitial spaces between the gasometers transformed into landscaped gardens.

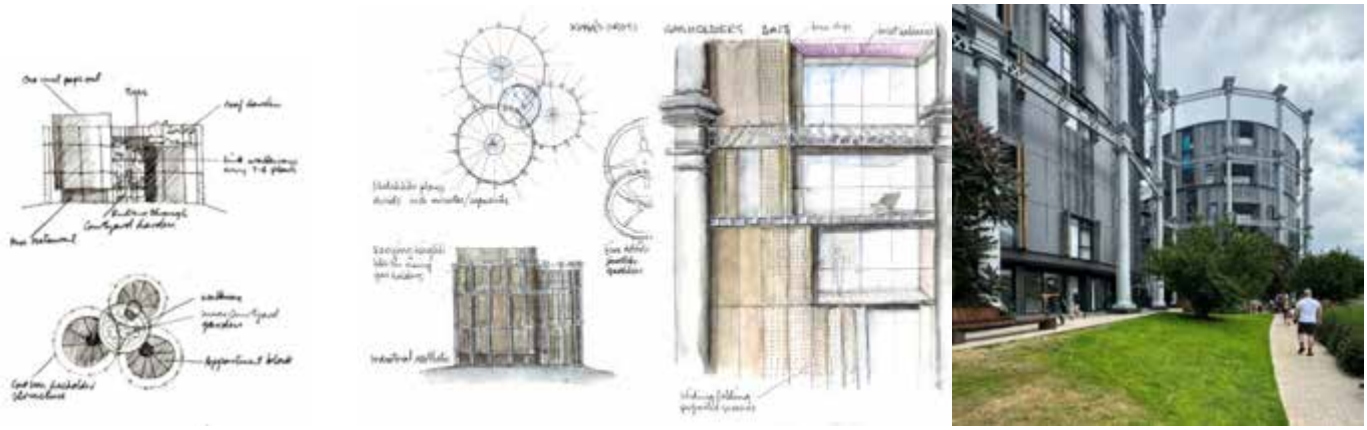


Figure 13: Triplex Gas Storage Tank Design Analysis Diagram and Current Status

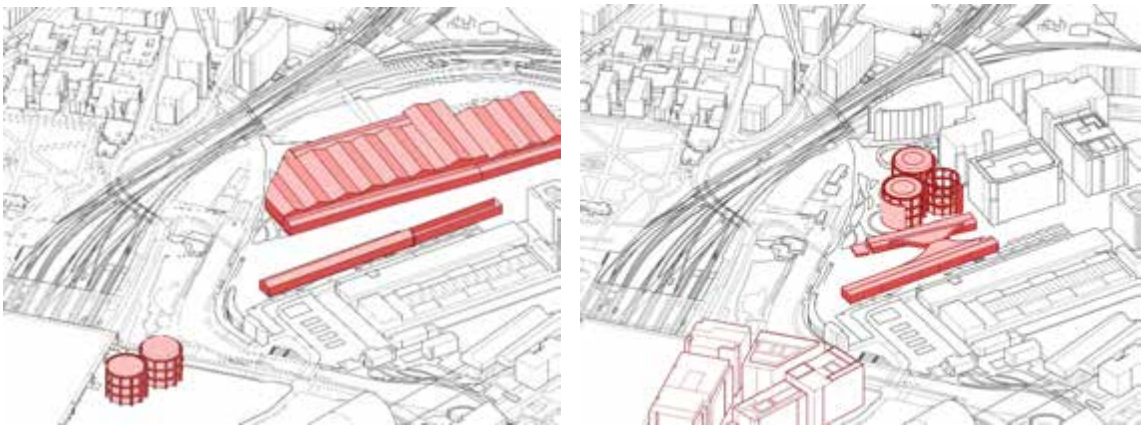


Figure 14: Comparison of Triplex Gas Storage Tank and Coal Drop Plaza before and after construction

4.4 Upward Addition and Perimeter Expansion Models

This mode expands buildings vertically (adding floors) or horizontally (extending laterally) to meet spatial demands.

The original height of buildings on some plots is lower than the upper limit of statutory requirements or urban design guidelines, or there are available plots in the vicinity, and reasonable expansion is carried out through optimization of design to meet the present new space requirements, which can be classified into two modes according to the two dimensions of expansion: 1) Horizontal Expansion - adding a Horizontal expansion - adding a new structure or building next to or around the original building to expand its scale or function and integrate with the original building; 2) Vertical expansion - adding a new floor or structure on top of the existing building to increase the available space.

The new west side ticket hall between King's Cross and St. Pancras International stations is a typical example of a horizontal expansion (Figures 15-16). The new West Side Ticket Hall extension designed by John McAslan + Partners (JMP) is an important extension to achieve multi-station interconnectivity as King's Cross and St. Pancras stations become increasingly important as transport hubs and St. Pancras becomes the starting point for access to the continent, and in anticipation of the London 2012 Olympic Games. The new West Side Ticket Hall Extension, designed by John McAslan + Partners (JMP), is an important extension that will enable the interconnection of multiple stations. Echoing the adjacent Great Northern Hotel, the hall is 20m high and dominated by a 150m span semi-circular arch that spans the west elevation of the existing Grade I listed King's Cross station, creating a new entrance to the station that leads from the southernmost point of the structure to the northernmost point of the station's west concourse. Considering the protection of the original station façade, the structural survey report concluded that only the central part of the original station façade could have a structural support base. Therefore, the project was cleverly designed as a semi-circular dome structure to fully utilize this structural support foundation. The dome was independently supported by 16 dendritic steel columns and was the largest single-span structure in Europe at the time. The transformation of the ticket hall was both visually striking and able to accommodate 50 million passengers a year, acting as a catalyst for the transformation of King's Cross into London's new transportation hub.

Figure 15: Aerial view of the new Western Ticket Hall and human eye viewpoints

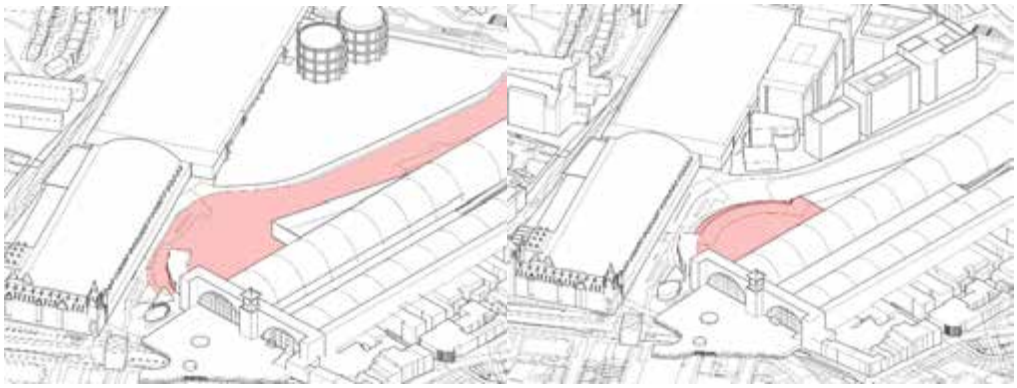


Figure 16: Comparison of the New Western Ticket Hall before and after its completion

5 Discussion and Conclusions

The redevelopment of King's Cross demonstrates that the aggregation of transport hubs—through the expansion of rail networks and integration of existing stations—creates efficient connectivity, driving increased passenger flows and stimulating demand for complementary functions and spatial provisions. The introduction of Eurostar services in 2007 and the completion of two multi-station ticket halls between 2006 and 2009 streamlined passenger transfers, amplifying the hub's aggregation effect. From 2008 to 2017, annual passenger growth at King's Cross rail station, St Pancras International, and the King's Cross–St Pancras Underground stations exceeded 40%, surpassing London-wide average growth. This passenger flow has generated a greater demand for more intensive spatial usage, as evidenced by the significant growth of consumption/entertainment and commercial services POIs in the core zone. Over the 1996–2023 period, the emergence of new economic and employment models transformed the transport-aggregated area into a creative industry cluster, fostering a live-work balance that established King's Cross as a desirable mixed-use district.

In recent years, reduced demand for freight storage and rail infrastructure—driven by containerization and rail-overbuild technologies—has freed up land for multi-station hub redevelopment (Chen and Zhuang, 2022; Chen, 2018). At King's Cross, the shift from a historic freight-passenger hub to a passenger-dominant transport node unlocked underutilized rail yards and storage sites. Post-2007, the core zone prioritized redeveloping the strategic corridor between St Pancras and King's Cross, creating Pancras Square—a high-density office and retail cluster. Subsequent phases regenerated northern brownfield sites, integrating cultural, educational, residential, and commercial functions into a cohesive urban district.

Proximity to the multi-station hub strongly correlates with development intensity. From 1996 to 2023, 25: 11: 8 of new floor area per hectare was added in the core, central impact, and wider impact zones, respectively. Spatiotemporal analysis reveals that most developments occurred post-2009, following the completion of St Pancras International's integration and underground connectivity upgrades. Market-driven dynamics prioritized sites closest to the hub, where spatial value and redevelopment incentives peaked. For instance, Islington Council's high-density plans along York Road—adjacent to the core—emphasized Grade-A offices and mixed-use spaces, reinforcing the hub's catalytic role.

Against the backdrop of global urbanization shifting from expansion-driven growth to stock optimization, how to strategically reshape urban structures and functions through spatial regeneration has become a shared challenge for cities worldwide. King's Cross exemplifies how rail-concentrated areas can lead urban renewal. Aggregating proximate existing and planned stations enhances foot traffic, driving spatial-functional optimization and broader regional revitalization. It is foreseeable that with continuous advancements in transportation technology, the reduced demand for ancillary transport infrastructure and increased functional integration will enable sophisticated mixed-use design to unlock greater development potential in urban multi-hub aggregation zones. Under the synergistic effects of various urban models, such approaches will significantly enhance district functionality and elevate spatial quality. This transportation-hub-driven regeneration model may well become an indispensable pathway for emerging cities to achieve low-carbon, efficient, and human-centered urban transformation.

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