A Design-led Research Project in Urban Regeneration: How Human Centred Emotional Design Can Help in Restructuring the Post-industrial Site

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List of Abbreviations

Abbreviation	Description
HCD	Human-Centred Design
ED	Emotional Design
KE	Kansei Engineering
HCED	Human-Centred Emotional Design
TICCIH	The International Committee for the Conservation of Industrial Heritage
UCD	User-Centred Design
PD	Participatory design
DT	Design Thinking
VR	Virtual Reality
GSR	Galvanic Skin Response
PSA	Power Station of Art
SMEs	Medium-Sized Enterprises
CIC	Community Interest Company

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Abstract

This thesis utilises a research framework based on a double diamond model to explore design challenges in revitalising post-industrial sites. Specifically, it investigates the potential of Human-Centred Emotional Design (HCED) theory to enhance the visitor experience and contribute to the regeneration sites.

To achieve the research objectives, this thesis conducts an extensive literature review encompassing existing research on urban regeneration, post-industrial transformation, and relevant theories regarding HCED and design approaches. This review aims to define the scope of HCED in this study, highlight current issues in post-industrial regeneration projects, emphasise complexities associated with converting former industrial sites, and identify potential future trends in urban regeneration efforts.

Based on insights from the literature review, this thesis proposes a hypothesis that HCED theory can facilitate the regeneration of post-industrial sites at the visceral, behavioural, and reflective design levels. To test this hypothesis, the study employs diverse research methods, including fieldwork-based case studies, to gain comprehensive insights into various types of regeneration projects across diverse cultural contexts. Additionally, participatory design methods, such as focus groups, questionnaires, interviews, and analysis of digital footprints, are used to gather insights and feedback from stakeholders representing different backgrounds.

The findings from the case studies and stakeholder engagement inform the development of a design framework rooted in HCED theory. This framework is further validated through the creation of a conceptual design and a comparative analysis with the existing design of Albert Dock. Both designs are recreated in virtual reality (VR) to facilitate participant comparison. Galvanic Skin Response (GSR) techniques and self-report questionnaires are employed to collect participants' emotional responses and assess their preferences.

The experimental results indicate that participants generally show a greater inclination towards the conceptual design based on HCED theory, finding it more engaging across all three design levels. Consequently, it can be concluded that the HCED-based design framework proposed in this study is effective and has the potential to significantly enhance the visitor experience in post-industrial regeneration projects.

This design-oriented research project addresses the emotional aspects of urban regeneration design, particularly in relation to the redevelopment of post-industrial sites.

It offers a standardised, principled, and interdisciplinary design solution for the field of urban regeneration. Furthermore, the theoretical contributions of this thesis promote a comprehensive understanding of how post-industrial sites can be transformed into vibrant, habitable urban spaces that cater to the emotional and psychological needs of visitors.

Declaration

No portion of the work referred to in this thesis has been submitted in support of an application for another degree or qualification of this or any other university or other institutes of learning.

Some sections of this work have been published in advance in:

- Zhan, X., Guo, F.B. and Roberts, E., 2023. Image-based research methods for mapping tourist behaviour: smart photos. *Tourism Recreation Research*, pp.1-7.
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- Zhan, X., Jiang, B. and Guo, F.B, Emotional Responses to Spatial Design in a Regeneration Project: A Study Using Virtual Reality and Galvanic Skin Response Methodology. *Art and design review* (In press).
- Zhan, X., Guo, F., Fairclough, S. and Lee, D., 2021, July. Psychological Impact on Design: Empirical Case Studies in City Regeneration of Post-industrial Sites. *In International Conference on Applied Human Factors and Ergonomics* (pp. 320-327). Springer, Cham. DOI org/10.1007/978-3-030-80285-1_38
- Zhan, X. and Guo, F., 2022. Experiencing the History and Cultural Heritage: A Tourist-Centred Map Design of Liverpool City. *AHFE International: Industrial Cognitive Ergonomics and Engineering Psychology*. 2022 Jul 21; 35:125-33. DOI org/10.54941/ahfe1001611
- Ge, X., Qu, J. and Zhan, X., 2020. A Review of the Indicators for Assessing the Sustainability of Urban Regeneration. *Annual Conference on Big Data. Engineering Management.*
- Guo, F.B., Roberts, E., Johnston, K. and Zhan, X., 2023. Industrial Regeneration in China: A Project Journey.

The list includes references to joint authorship of published materials which might have been included in a thesis submitted by another student to this university or another university or other institute of learning.

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Chapter 1: Introduction

Urban regeneration and industry restructuring are challenges faced by cities in both the East and the West, leading to the redevelopment of numerous abandoned industrial sites (Yin et al., 2015; Jucu and Voiculescu, 2020; Endo, 2022). The redesign of these spaces, acting as a new driver for urban regeneration, is expected to fuel local economic growth and enhance the quality of life of residents (He and Gebhardt, 2014; Gospodini and Manika, 2020). However, some attempts at redevelopment have failed to consider the distinctive context and character of the location, resulting in designs that do not meet the needs and desires of the community. Moreover, people nowadays expect more than mere functionality in their chosen environment; they also benefit from interaction, connection, and engagement of the senses. Therefore, this study proposes the use of Human-Centred Design (HCD) and Emotional Design (ED) in regenerating post-industrial sites.

HCD not only helps people articulate their needs and achieve their goals as efficiently as possible, but also values emotional responses. By combining HCD and ED, this study aims to develop a more effective and desirable approach to regenerating post-industrial sites. The research will explore how Human-Centred Emotional Design (HCED) can be applied to post-industrial sites to ensure that the redevelopment is more effective and provides a desirable experience for the community. The following section introduces the general issues addressed in this research, including the aim and objectives of the research, an overview of the thesis, and its contributions.

1.1 Background and Motivation of the Study

Most post-industrial sites are experiencing a recession due to rapid economic development and restructuring, which has led to the redevelopment or reutilisation of a mass of abandoned industrial sites. Despite losing their original functions, these industrial sites still hold certain economic, cultural, and social values (Mommaas, 2004; Della Spina, L, 2019). Consequently, transforming abandoned factories for various uses has become an ideal option for cities' development (Gerkan, 2004; Plevoets and Van Cleempoel, 2019). Thus far, many cities are redeveloping post-industrial sites as catalysts for regenerating urban areas. Examples such as Royal Albert Dock in Liverpool and the 798 Art Zone in Beijing are epitomes of this strategy, having turned to the creative cultures of these cities to provide platforms for economic development to flourish (Zeng and Wang, 2009; McCarthy and Wang, 2015). The success of these projects in driving the

development of a creative economy has created a blueprint for the format of industrial sites and cultural parks in cities around the world. However, they have led to a number of redevelopment projects which are merely imitative (Sepe, 2018).

In the era of HCD-driven industry, design is increasingly concerned with higher-level human needs, and architectural space is imbued with greater emotional significance (Zhang and Dong, 2009; Crippen, 2022). Satisfying people's demands has become an increasingly important focus of design research. As a result, more architects and designers are emphasising HCD, particularly its psychological and emotional dimensions. Simultaneously, the rapid development of technology has diversified people's lifestyles. People's requirements for architectural space are not only met by its function but are ideally expected to provide emotional satisfaction. The architectural space creates a functional place for people's daily work and life and is endowed with additional emotional connotations. As Patrick Geddes (1915) stated, 'a city is more than a place in space, it is a drama in time', indicating that a city is primarily an emotional experience. Thus, the contemporary design seeks to offer people an advanced experience where emotion is a pervasive quality that shapes the experience (Forlizzi, Disalvo and Hanington, 2003).

However, it is striking that psychology, the discipline most concerned with human behaviour and emotions, has yet to establish a presence in urban regeneration thinking, policy and practice (Murray and Landry, 2020). This has led to the phenomenon that many urban regeneration projects, while ambitious in seeking to foster economic growth, and doing well commercially by providing retail and entertainment facilities, often fail to consider people's emotional requirements. Furthermore, some regeneration projects fail to respond to the different contexts of each location within the design and planning due to a lack of consideration of local history and cultural heritage (Ujang and Zakariya, 2015).

Therefore, in order to fill this gap, this study explores how HCED theory can help in urban regeneration, particularly in post-industrial sites. The author developed a strong interest in urban regeneration during her master's studies and anticipates continuing her research during the doctoral period. Participating in an AHRC Newton Fund Project - *What aspects of participatory design can help urban revitalisation, in particular in the restructuring of former industrial zones in China?* - provides an opportunity to work within an international cross-disciplinary team and access a broader range of resources and a larger sample size for the survey.

1.2   Aim and Objectives

The research question is: How can post-industrial sites be effectively transformed into vibrant and liveable urban spaces, enhancing the overall visitor experience? This study aims to explore how HCED can be implemented in urban regeneration areas by drawing inspiration from different disciplines such as art, design, psychology, sociology and engineering. With the primary goal of the study is to develop a comprehensive design guideline for the transformation of post-industrial areas, which strives to focus on people's emotional and psychological needs.

The aim will be achieved through the following objectives:

- Articulate the nature of urban regeneration and the significance of the transformation of post-industrial sites.
- Understand the definition of HCED and other design-related concepts or approaches.
- Identify current issues in post-industrial site transformation and explore contemporary trends in architectural design and urban regeneration.
- Summarise the characteristics of post-industrial site transformation projects through case studies and gathering feedback and opinions from various stakeholders.
- Develop conceptual designs for post-industrial areas based on HCED theory and test and evaluate proposed conceptual designs.

This research combines applied and theoretical approaches to discover the design criteria and approaches taken in regeneration of post-industrial sites. With this study, the author hopes to inspire architects and designers of urban regeneration projects to reflect on human emotion, showing the longing for creating evocative projects that successfully reflect post-industrial sites as rich, meaning-filled places and spaces. This research will provide a valuable contribution to urban regeneration and architectural design by highlighting the importance of human emotion in post-industrial site design and providing a conceptual design solution that incorporates HCED theory.

1.3   Overview of the Thesis

This research adopts a knowledge-focused approach guided by the Double Diamond model—a design thinking framework that visually represents the design process. Widely employed for structuring problem-solving and fostering innovation in design, the model

features two diamond shapes symbolising divergent and convergent thinking. The process unfolds across four methodological stages: discover, define, develop, and deliver. The thesis is organised into seven key chapters, as illustrated in Figure 1.
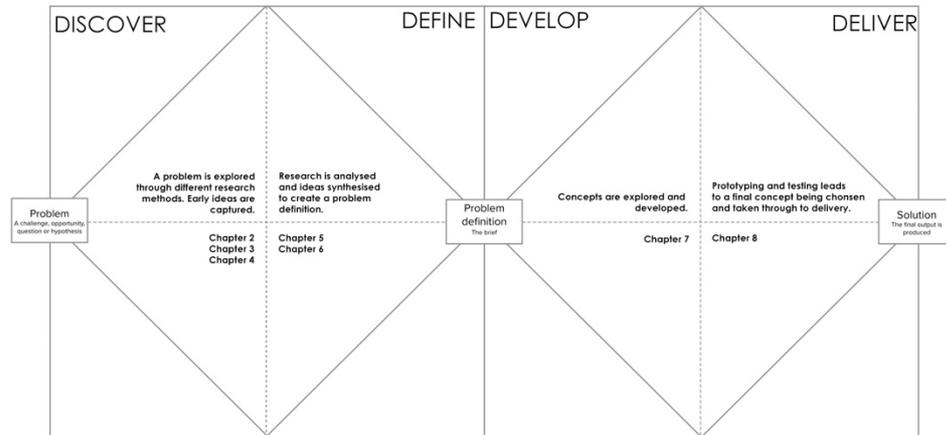
Figure 1. Double Diamond model (self-study).

Discover

Chapter 2 provides a comprehensive literature review regarding urban regeneration and post-industrial site transformation, examining the scope and definition of HCED theory and its applications. The chapter also reviews the impact of ethnographic and cultural contexts on urban regeneration, identifies current issues in post-industrial regeneration projects and construction issues in factory transformation, and suggests future trends for architectural design and urban planning.

Chapter 3 presents the hypothesis of the study based on the literature review findings that HCED can help regenerate post-industrial sites on three levels: visceral, behavioural, and reflective.

Chapter 4 clarifies the methodology of the study. It proposes a research framework based on the double-diamond model and introduces a range of qualitative and quantitative methods applied to this study, such as empirical fieldwork, focus groups, interviews, questionnaires, and digital footprint, to provide first-hand information and collect sufficient data.

Define

Chapter 5 investigates four well-known examples of post-industrial sites in different cultural contexts in the UK and China, summarises their characteristics, and draws out the reasons for their success.

Chapter 6 reveals the preliminary results and findings of the study. It presents and analyses the results of focus groups, interviews, questionnaires, and digital footprints, with a focus on the insight and feedback of diverse stakeholders. Combining the findings from stakeholder research with case studies, a design approach based on HCED theory is provided.

Develop

Chapter 7 develops a conceptual design based on the findings of the analysis phase, selecting Albert Dock as the subject of an experiment to apply the conceptual design to a real project and to document the whole design process. A series of objective evaluation methods were also developed to determine the effectiveness of the design approach.

Deliver

Chapter 8 discusses the results and draws conclusions, summarising the creative contributions, discussing the limitations of the study, and making recommendations for future academic investigation.

1.4   Summary of Chapter 1

This chapter elaborates on the research background and motivation of the research. It outlines the significance of regeneration projects for urban development and potential issues in these projects – particularly, the absence of consideration for human emotion. Correspondingly, the aims and objectives of the research are derived, and the structure of this thesis is clarified. Finally, the study's contribution to the existing body of knowledge is illustrated.

Chapter 2: Literature Review in the Field of Study

The literature review provides a comprehensive overview of the existing knowledge on urban regeneration and human-centred emotional design (HCED), which contributes to the formulation of a research question and the selection of appropriate research methodologies. The literature review consists of six sections: 1) Clarifying the nature of urban regeneration and the significance of post-industrial site transformation; 2) Introducing the scope and definition of HCED; 3) Presenting the theory of ethnography, with a focus on its cultural implications; 4) Identifying issues in current post-industrial regeneration projects; 5) Elucidating construction issues in factory transformation; 6) Summarising future trends in architectural design and urban planning.

2.1 Urban Regeneration and Post-Industrial Sites in Cities

Urban regeneration

Urban regeneration is a complex and multifaceted phenomenon that has long been a prevalent strategy for revitalising declining industrial cities (Barrou and Benbouaziz, 2017). The global transfer of industrial chains has led to the decline of many urban areas: in response, urban regeneration initiatives have emerged as a strategy to tackle this issue by stimulating economic growth, enhancing urban vitality, and improving urban competitiveness (Orueta, 2007; Hui et al., 2021). Urban regeneration is defined as a comprehensive and integrated vision and action that leads to the resolution of urban problems and seeks to bring about lasting improvements in urban areas' economic, social, and environmental conditions (Roberts, 2000). Urban regeneration emphasises the continuation of existing urban spaces and facilities, the maintenance of existing buildings and environments to satisfy the demands of urban advancement, and the upgrading of existing urban industrial structures (Cui, Broere and Lin, 2021).

Urban regeneration aims to revitalise the local economy by attracting new businesses and investment to the area (Grodach and Loukaito-Sideris, 2007). It also seeks to address environmental issues and promote sustainable development (Nesticò, Elia and Naddeo, 2020), encompassing efforts to improve air and water quality, minimise waste generation, and encourage the adoption of renewable energy sources. Furthermore, urban regeneration endeavours to create more green spaces and enhance access to nature within the urban site (Carpenter, 2013). Enhancing the overall quality of life for residents and

workers in the area represents a fundamental objective of urban regeneration. This includes improving housing conditions, creating new job opportunities, and increasing access to essential services, such as healthcare, education, and transportation (Sørensen, 2018). In order to achieve these goals, urban regeneration typically involves a wide range of interventions and stakeholders, including government agencies, private developers, community organisations, and local residents (Carter and Roberts, 2017). The achievement of success in urban regeneration necessitates a coordinated and cooperative approach to planning, design, and implementation.

Overall, urban regeneration is a crucial strategy for addressing the challenges facing declining industrial cities and promoting sustainable and equitable urban development. It aims to improve the lives of residents, revitalise the local economy, and create more liveable and sustainable urban environments.

Post-Industrial Sites in Cities

The post-industrial site is a crucial link between sustainability and urban regeneration (Walljes and Ball, 1997; Loures and Burley, 2012). As heavy industry collapsed in many countries, and social structure changed, post-industrial sites were gradually integrated into the urban fabric and eventually became urban centres (Swensen and Stenbro, 2013; Oevermann and Mieg, 2015), signifying that these cities have entered the middle to late stage of industrialisation. Meanwhile, they are also faced with strategic adjustment of economic and social structure during a period of comprehensive transformation, which has posed new requirements for the functions of industrial sites in these cities (Wang et al., 2011).

Although these aged factories have been decommissioned, many still exist today as cultural heritage (Oevermann et al., 2015). In 2003, the International Committee for the Conservation of Industrial Heritage (TICCIH) passed the Nizhny Tagil Charter for industrial heritage, proposing to include industrial heritage in the UNESCO World Heritage List. As claimed by the Charter, industrial heritage refers to the remains of an industrial culture that possess historical, technological, social, architectural, and scientific value (Ralser, 2019; Bazazzadeh et al., 2020). As society places a premium on post-industrial sites, awareness of the value of industrial buildings is increasing (Swensen and Skrede, 2018). The unique architectural style of industrial sites is considered to represent an aesthetic (Fragner, 2012; Berg, 2017). Furthermore, the transformation of industrial sites also provides usable space for new activities that support sustainable local

development and regeneration processes (Zavadskas and Antucheviciene, 2007; Ferretti and Degioanni, 2017).

Given the above, the regeneration of post-industrial sites constitutes a robust foundation for the principles of sustainable development. Moreover, by virtue of its multifaceted significance encompassing social, historical, cultural, and technological aspects, this process can be perceived as a catalyst for future urban regeneration (Martinović and Ifko, 2018). Thus, the regeneration of industrial sites assumes a key role in the metamorphosis of industrial cities into post-industrial cites and constitutes a vital domain within the realm of urban regeneration, which is also essential for enhancing the comprehensive competitiveness of cities and achieving sustainable development objectives (Galdini, 2019).

Regeneration of Post-Industrial Sites

The regeneration of post-industrial sites is a multifaceted process that involves repurposing abandoned or underutilised industrial sites to create sustainable and functional spaces (Gospodini, 2006; Ling, Handley and Rodwell, 2007). These sites can include a range of disused structures such as factories, warehouses, and industrial parks that are no longer in use due to obsolescence or abandonment. The regeneration process involves a range of activities, such as environmental remediation, site assessment, design and planning, infrastructure development, and community engagement (De Sousa, 2003). The primary objective of regeneration is to transform the post-industrial site into a new and productive site that meets the needs of the local community while also preserving and enhancing the natural environment.

In the context of regeneration, it is critical to identify and comprehend the distinctive features of the factory building. Stratton (2003) categorises structures in post-industrial sites into five groups: multi-storey mills and warehouses, daylight factories, great halls, single-storey sheds, and non-buildings.

Multi-storey mills and warehouses are the favoured types for industrial preservationists. They are praised for their creative use of iron devoted to the urban site (Richards, 1958). Cleared of machinery, they offer wide, well-lit spaces and sturdy floor loadings. Mills and warehouses can embrace a range of internal treatments, from the simplest use of existing internal space to more interventions (Stratton, 2003). Excellent examples include the Crespi d'Adda near Milan (Figure 2a), which was transformed into

an open-air museum of industrial archaeology, and the regeneration of Liverpool's Royal Albert Dock in the UK (Figure 2b).

Figure 2: Multi-storey mills and warehouses.
a. The Crespi d'Adda (Italia.it, 2023); b. Royal Albert Dock (Personal Photograph).

The daylight factory is a type of factory building that appeared in the 19th century, where the reinforced concrete frame supported the load so that the perimeter walls of the factory could be filled with glass to allow natural light to penetrate interior workspaces (Kahn, Ferry and Sanders, 1987). These buildings have open floor space and a decreasing number of support columns. The floor-to-ceiling window walls of the concrete framing system allowed these workspaces to be bright and airy. The M. Wile and Company Factory (Figure 3a) and the Ford assembly plant (Figure 3b) in New York are historic daylight factories and significant examples.

Figure 3: The daylight factory.
a. The M. Wile and Company Factory Building (M. Wile and Company Factory Building 2022); b. the Ford assembly plant (Daylight factory, 2023).

Great hall is where large machines are put together and adjusted, such as vast railway sheds and erecting shops created using iron and glass, where the open spaces of the halls provide further possibilities for renovation. Successful examples include St Pancras Station, the Tate Modern in London (Figure 4a), and the Power Station of Art in Shanghai (Figure 4b).
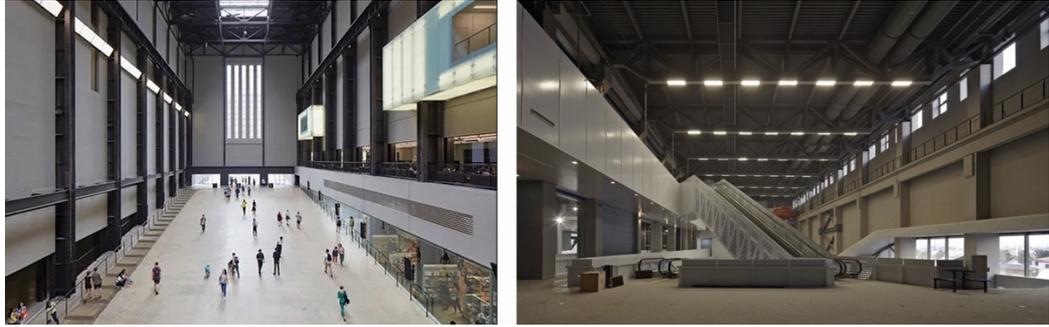
Figure 4: Great Hall.
a. Tate Modern (Larsen, 2017); b. Power Station of Art (Gaete, 2012).

Single-storey sheds appear to be the most successful of virtually all industrial building forms. Their structures have evolved from simple brick and timber to modern metal forms. Few sheds are protected by listing, although they are readily adaptable to almost any industrial use (Stratton, 2003). The former Blackburn Aircraft Factory (Figure 5a) in the UK and The Pace Gallery in Beijing 798 Art Zone (Figure 5b) serve as typical examples of Single-storey sheds.

Figure 5: Single-storey shed.
a. The former Blackburn Aircraft Factory (The former Blackburn Aircraft Factory, 2023); The Pace Gallery in Beijing 798 Art Zone (Tomarnstein, 2019).

Non-buildings are the objects that attracted industrial archaeologists to devote most of their efforts to process-specific industrial structures rather than conventional buildings. Examples include blast furnaces, bottle ovens and lime kilns. They are often preserved as monuments or to achieve an integrated relationship between these structures and warehouses with which they were operationally inter-dependent (Stratton, 2003). These non-buildings require systematic research and evaluation to examine their value. For example, the boiler and winch preserved at Liverpool's Royal Albert Dock constantly remind people of the dock's bustling past (Figure 6a). Likewise, the crisscrossing pipes, huge generator tanks and towering chimneys at Beijing 798 Art Zone (Figure 6b) were preserved as part of its industrial heritage.

Figure 6: non-buildings.
a. Royal Albert Dock (Personal Photograph); b. 798 Art Zone (Christian Mio Loclair 2023).

During the regeneration process, the above five types of buildings can be classified into two categories according to their transformed functions: single-use and mixed-use projects (Zhan and Guo, 2022). The single-use project targets a specific function or business, such as housing, office, commercial use, cultural use, or monument. In contrast, the mixed-use project demonstrates the incorporation of multiple forms of building to house the most appropriate functions, spreading financial risks across different markets, and attracting various funding sources. Its complementary functions are residential, office, retail, and cultural, which can support each other, making a scheme more attractive to all users and giving it long-term vitality (Stratton, 2003).

It is crucial to acknowledge that buildings are intricate systems, and their design, construction and function can produce diverse outcomes. Therefore, an understanding of the classification of industrial buildings and structures is a prerequisite for designing buildings before implementing their regeneration. With a comprehensive understanding of the basic condition of the building, the designer can take the next step towards regenerating the post-industrial site.

Urban regeneration planning policy in China and the UK

China and the UK have faced the challenges of urbanisation and have implemented distinct urban regeneration planning policies to address the complex issues associated with rapid urban growth.

China has experienced unprecedented urbanisation over the past few decades, leading to the proliferation of megacities and the redevelopment of existing urban areas. The Chinese government has embraced urban regeneration as a key strategy to address issues such as outdated infrastructure, environmental degradation, and social inequalities (Yi et al., 2017). One notable feature of China's approach to urban regeneration is the strong role played by the central government. The government has implemented top-

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down policies that prioritise economic development and infrastructure improvements (Liu, 2004; Yu et al., 2021). Massive urban renewal projects, such as the redevelopment of old industrial zones and the creation of new urban districts, are common. However, this approach has been criticised for its potential to displace local communities and neglect social and cultural considerations (Tian and Yao, 2018). Furthermore, China's emphasis on economic growth has sometimes resulted in the prioritisation of large-scale developments over the preservation of historical and cultural heritage (Wai-Yin and Shu-Yun, 2004). The balance between economic progress and cultural heritage preservation remains a significant challenge in China's urban regeneration planning.

In the UK, urban regeneration planning policies are characterised by a more decentralised approach, with a focus on community involvement and sustainable development (Bailey, 2012). The UK's approach has evolved over time, with an increasing recognition of the importance of mixed-use developments, brownfield regeneration, and the preservation of historical and cultural assets (Robbins, 2013). One key feature of the UK's urban regeneration policy is the emphasis on public-private partnerships (Kort and Klijn, 2011). Local governments often collaborate with private developers to fund and implement regeneration projects. This approach aims to leverage private investment while ensuring that the development aligns with the community's needs and values (Carter and Roberts, 2017). Community engagement is another critical aspect of the UK's urban regeneration strategy (Lawless and Pearson, 2012). Local residents and stakeholders are often involved in the planning process, fostering a sense of ownership and ensuring that the regeneration projects address the specific needs of the community. This participatory approach enhances the social sustainability of regeneration initiatives.

While both China and the UK share the goal of addressing urban challenges through regeneration, their approaches differ significantly. China's top-down, centrally controlled model emphasizes economic development and large-scale infrastructure projects. In contrast, the UK's decentralised approach prioritizes community involvement, sustainable development, and the preservation of cultural heritage.

Urban regeneration planning policies in China and the UK reflect the diverse challenges and priorities of each nation. China's approach has been successful in rapidly transforming urban landscapes and boosting economic growth. However, concerns about social equity, community displacement, and the preservation of cultural heritage persist. In the UK, the focus on community engagement and sustainable development has led to

more inclusive and socially sustainable regeneration projects. However, the pace of development may be slower compared to China.

In summary, urban regeneration is a vital strategy for addressing the challenges faced by declining industrial cities, with post-industrial sites serving as key components. The success of regeneration efforts depends on a comprehensive understanding of the unique features of industrial buildings, collaboration among stakeholders, and adaptation to the specific context of each region. The differences in the urban regeneration policies of China and the UK highlight the diverse challenges and priorities faced by each nation in their efforts to create sustainable, vibrant, and inclusive urban environments.

2.2 The Scope and Definitions of Human Centred Emotional Design

2.2.1 Human-Centred Design

In recent years, design has undergone a transition from a technology-driven approach to a human-centred design (HCD) approach, marking a new phase in the field (Nguyen Ngoc, Lasa and Iriarte, 2022). Designers are increasingly recognising that the failure of design solutions is not due to a lack of advanced technology, but rather to a failure to understand users' needs, as design serves human beings rather than objects. Consequently, HCD or user-centred design (UCD) has emerged as an important aspect of design theory, gaining prominence in various fields and disciplines related to design.

The distinction between HCD and UCD is subtle yet significant, particularly when one delves deeper into the distinction between the terms 'human' and 'user'. Rouse (1991), who acknowledged design as being centred around 'people', employed the term 'user' to refer to stakeholders, subsuming it under the concept of 'human-centred design', which implies that UCD is a subset of HCD. When considering human attributes in design, it is essential to contemplate all the psychological, physiological, social, and other qualities that influence any human when interacting with a design. This requires a consideration of the general innate characteristics of human psychology and perception. Whereas UCD necessitates further examination of the target audience. Furthermore, UCD could be viewed as a less emotionally empathetic approach (Campese, Amaral and Mascarenhas, 2020), which primarily focuses on the tangible, physiological ways users interact with a platform. In contrast, HCD incorporates emotional or psychological preferences as well. UCD and HCD are exemplified in the context of designing a Public Transportation System. UCD focuses on understanding commuter preferences through methods like

surveys, shaping design with features like mobile ticketing. HCD broadens the perspective to consider environmental, socio-economic, and cultural factors, collaborating with diverse professionals. The resulting design not only meets user needs but aligns with broader societal and environmental goals, incorporating features like green spaces at transportation hubs.

Although the terms "user" and "human" are often used independently when referring to design strategies, they are closely related and not mutually exclusive. In some scenarios, HCD and UCD are essentially the same, as they place people at the centre of design and focus on their perception and experience of design (Campese, Amaral and Mascarenhas, 2020). Therefore, for the purpose of this study, HCD will be used consistently.

The academic literature currently lacks consensus on the meaning and scope of HCD (Lallemand, Gronier and Koenig, 2015). Scholars have used the term to refer to a philosophy (Abras et al., 2004; Chamberlain, Sharp and Maiden, 2006), process (Gulliksen et al., 2003; Rouse, 2007; Vechakul, Shrimali and Sandhu, 2015), approach (Mao et al., 2005; Viitaniemi et al., 2010; Steen, 2011), or set of principles (Vredenburg et al., 2002; Rippon, 2006). For example, Rubin and Chisnell (1994) defined HCD as a process focused on user tasks, which helps users develop their tasks and not what they need to change in their behaviour to use something. Karat (1996), however, characterised it as an iterative process that involves potential users in designing usable systems. Similarly, Gulliksen et al. (2003) described HCD as a cyclical process that requires a series of activities performed with appropriate methods. In 2002, Vredenburg et al. proposed that HCD should be viewed as a set of principles that prioritise the needs and goals of real users over technological considerations. This idea was later supported by the development of the process standard ISO/PAS 18152 (2003), which considers HCD as a method. Despite these differing views, the underlying concept of user involvement in the design process remains a central tenet of HCD.

The HCD approach is a structured methodology that comprises five core stages necessary for its understanding and practical application, as per the International Organisation for Standardisation (ISO, 1999). The stages are as follows: planning the HCD process, comprehending and defining the context of use, specifying user and organisational requirements, producing designs and prototypes, and conducting user-based assessments. It is essential to note that HCD methodology should not impose the

designer's preferences on the project but rather facilitate, communicate, and translate the needs and desires of the users involved (Joseph, 2014).

To achieve this, various methods such as questionnaires, interviews, and focus groups are employed in the initial stage to elicit user needs. Subsequently, user needs are analysed, and personas are created to develop a clear picture of the target user. When entering the concrete design phase, from creating the information architecture to drawing the flow chart and then designing the prototype, which requires a certain number of users to test the usability of the design prototype (Campese, Amaral and Mascarenhas, 2020) (Figure 7). For instance, by inviting several typical users to manipulate the prototype design created by the designers and developers, issues and defects can be identified early on through observation, listening and problem identification, enabling shortcomings to be pinpointed for further improvements. This iterative process can save significant time and costs in later modifications (Campese, Amaral, and Mascarenhas, 2020).

Overall, HCD is an approach to interactive systems development and an iterative design process that aims to make systems usable and useful by focusing on the users, their needs, and requirements. The design team involves users throughout the process, employing various research and design techniques to ensure user-centricity in each phase. The HCD approach is also applicable to architecture design, as incorporating the user's perspective into the design process can lead to a better user experience (Maguire, 2001). Therefore, the use of HCD is deemed necessary as a tool for users to interact and communicate with the built environment in urban regeneration projects.
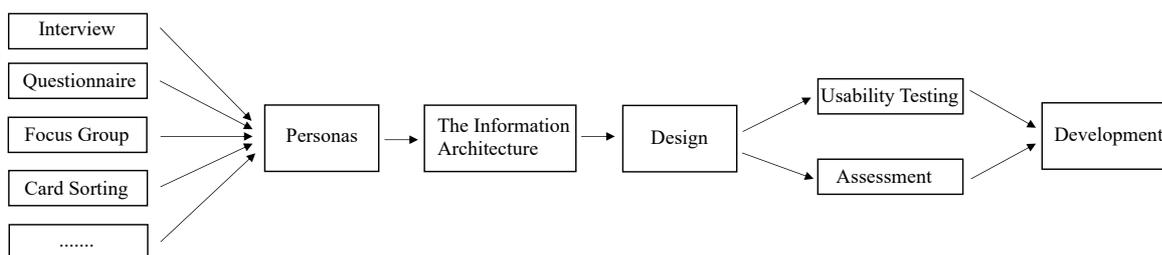
Figure 7: The process of HCD approach.
Source: Campese, Amaral and Mascarenhas, 2020.

Participatory Design

Participatory design (PD) is a method within the field of HCD that places a strong emphasis on involving users actively in the design process (Steen, 2011). It is rooted in the fundamental principle that those who are affected by a design should have a voice in its creation (Bjögvinsson, Ehn and Hillgren, 2012). PD aims to engage people in

improving, innovating, and influencing design by harnessing their collective experience to construct better services and outcomes (Burkett, 2012). In essence, PD is a social process that acknowledges the wider scope of design activity beyond the designer (Luck, 2018b). The direct involvement of users in the design and decision-making process can have a positive impact, leading to extended insight and knowledge (Simonsen and Robertson, 2013).

Research into PD has been a thriving area for decades, particularly in the field of architecture (Sanoff, 1973; Luck, 2003; McDonnell, 2022), architects have evolved their approach to engaging stakeholders in the design of future environments (Luck, 2018a). Research and practice indicate that PD has excellent potential for achieving better results in various areas. PD offers a more precise alignment between design outcomes and users, leading to unique benefits and greater value to users (Kujala, 2003). Essentially, PD enhances user satisfaction, increases efficiency (Hoyer et al., 2010), improves public relations (Alam, 2002), promotes mutual learning and understanding, integrates diverse insight and enhances communication and collaboration among diverse groups, leading to co-creation of new ideas. In some cases, occupants may outperform designers, generating innovative ideas that are better suited to their needs than those of professional developers (Kristensson, Magnusson, and Matthing, 2002; Luck, 2012).

The basic principles of PD in public spaces are as follows (Dubbeling, Bracalenti and Lagorio, 2009; Mirzaean Mahabadi, Zabihi and Majedi, 2014):

- The main participants are active/initiate users.
- Users are given the right and responsibility to participate in the project's decision-making, implementation, monitoring and evaluation.
- Users formulate their needs, find solutions to problems, and develop effective creativity.
- A professional designer provides the expertise to design the project to satisfy the users' needs.

Most post-industrial sites are oriented towards public spaces. The PD of public space emphasises that users are empowered in the design process, allowing them to participant in the planning of public area. In architecture, understanding design is a process of continuous change not only before the construction but also afterwards, as occupants reconfigure it through use (Luck, 2018a). PD is an inclusive process that involves multiple perspectives, people, experts, disciplines, and fields, aiming to find

practical solutions to complex problems. Thus, it is crucial to use PD in post-industrial regeneration projects.

2.2.2 Emotional Design

In recent years, there have been continuous socioeconomic and technological developments, as well as changes in human lifestyles, which have expanded the considerations of architects and designers. As a result, the role of design in shaping the environment and responding to human expectations has become increasingly significant (Hashemnezhad, Heidari and Mohammad, 2013). Furthermore, there has been a trend toward focusing on emotional engagement (Kamvar and Harris, 2009; Giacomin, 2014). Instead of merely focusing on physical function of design, people are seeking higher-level experiences that are aesthetic and emotionally fulfilling (Norman, 2005). It is evident that design is now being given more emotional meaning to meet people's spiritual needs. Scholars from various disciplines have attempted to incorporate emotion into their designs and research. This section aims to review the concepts related to Emotional Design (ED) to provide a comprehensive understanding.

'Emotion' is a psychological term used to express human feelings and experiences (Ortony and Turner, 1990). The concept of emotion has been studied for centuries, with early philosophers such as Plato discussing the role of emotions in human behaviour (Gilbert, 1955). The focus on emotions in previous studies inspired design professionals to explore the relationship between design and emotion. Caroline Roberts suggests that humans are animate beings with feelings and emotions and that factoring this into the design will lift any project beyond a place or space in which humans merely function (quoted in Callahan 2019). Philips (2019) suggests that considering human emotions in product design creates a lasting, enjoyable user experience and provides a sense of safety for the user.

The concept of ED was first introduced in the field of industrial design and has since been applied to various fields. Cooper (1999), an early professional designer in the field of emotion and design, asserted that many existing technological devices left users feeling dissatisfied and frustrated due to poorly designed user interfaces that lacked consideration for their emotions. Overbeeke and Hekkert (1999), who introduced the term 'design and emotion,' their aim in researching this area was to develop tools and methods that support designers to create an emotionally valuable product. As a growing number of scholars became concerned with the relationship between emotion and design, the first

International Conference on Design and Emotion was held at Delft University of Technology in the Netherlands in 1999, where the Design and Emotion Society was established, marking the establishment of research on emotion in design (Desmet and Hekkert, 2009).

As further research has advanced in the fields of design and emotion, scholars have aimed to direct their focus towards users, design outcomes, and designers. Various perspectives on design and emotion research have led to the development of diverse research theories and design methodologies. Among them, two prominent theoretical systems are widely acknowledged by numerous scholars and designers: the three levels of emotional design proposed by Donald A. Norman and the Kansei engineering theory put forth by Mitsuo Nagamachi (Noor et al., 2008; Ding et al., 2010; Irisawa and Nagasawa, 2012; Bouchard and Kim, 2014; Zhou, Ji and Jiao, 2021).

Three Levels of Emotional Design

The concept of three levels of ED was first introduced by Donald A. Norman, a renowned designer and psychologist, in his book *Emotional Design* (2005). Norman stressed that people and products communicate emotionally and that designers should discover and value the special emotional connection that exists between people and things, and that, in some way, the emotional element of design is perhaps more critical to the success of a product than the functional element (Norman, 2005). Based on psychological research into emotional processes, Norman proposed that design and its objectives can be divided into three levels: visceral, behavioural and reflective (Figure 8). These levels describe designs that are emotionally relevant and provide pleasurable experiences that build an emotional relationship with the user.
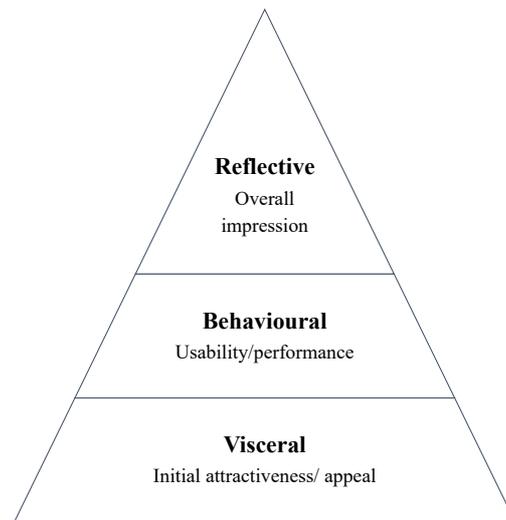
Figure 8: Three levels of Emotional design (self-study).

The visceral level refers to the first impression of a design's physical appearances, such as material, structure, colour, and form (Norman, 2005). This is an immediate, deep-level reaction to a product or system; thus, the visceral level of design is critical, as people never obtain a second chance at making a first impression (Philips, 2019). Research indicates that aesthetics affects perceived usability. Attractive interfaces are perceived to be easier to use, meaning that a well-designed and good-looking product is more enjoyable and can lead to customer satisfaction (Philips, 2019).

The behavioural level refers to the experience of the design outcome during use, focusing on its usefulness and efficiency. The four design elements at this level are function, ease of understanding, usefulness, and physical scenarios (Norman, 2005). The behavioural level of design emphasises the individual's physical or psychological characteristics, personal preference, cognitive capacity, and behavioural ability (Norman, 2005). People do not usually have 'interactive relationships' with products, systems, or environments at the visceral level, whereas at the behavioural phase, people expect to communicate, interact, and form an emotional relationship with products or environments (Philips, 2019). A good behavioural level of design will evoke the emotion of trust in people, eventually creating the desire to use the product or space more often and to maintain it for a long period (Saraswat, 2019).

The reflective level refers to the user's reflections about a design outcome, before, during, and after use. People still think of the design in this phase even when it is not in use. If people share and contribute to the design outcome, this means that the designer can build a relationship with the user at an emotional level. The reflective level is the

most difficult to achieve, it is the function of the first two levels, which produce more in-depth emotions in the user's mind. The reflective level is a complex emotion intertwined with various factors, such as the consumer's personal consciousness, experience, and cultural background (Norman, 2005).

Overall, Norman's ED theory examines design in terms of the emotional interaction between people and products, where the product is not just a commodity but a medium for bringing emotional experiences to people. The visceral and behavioural levels are about the emotions and feelings that arise when using the product, while the reflective level lasts longer and relates to possession, display, and satisfaction in the use of the product.

Kansei Engineering

Kansei engineering (KE) is a product development technology that is centred around the user's perceptions and emotions. The term "Kansei" originates from the Japanese language: it translates as "human feeling" or "intuition" (Nagamachi, 1995). KE focuses on the emotional demands and responses of the user; engineering methods are employed to construct design, mapping models between emotional reactions to guide the post-design practices (Schütte et al., 2004; Xue, Yi and Zhang, 2020) (Figure 9). KE draws its origins from the field of cognitive ergonomics, which was initially developed by Mitsuo Nagamachi in the early 1970s and it has been extensively utilised for developing a wide range of products, spanning from consumer goods to industrial equipment (Yuan, 2002; Schütte et al., 2004; Guo et al., 2020).
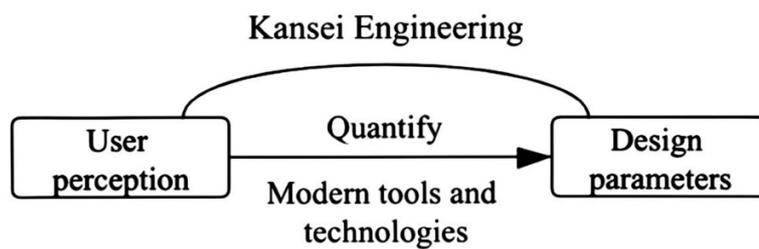
Figure 9: The Kansei Engineering of product design process.
Source: Xue, Yi and Zhang, 2020.

User perception is a complex structure that draws from various scientific fields, such as mechanical engineering, mathematics, psychology, and ergonomics (Schütte et al., 2004; Marco-Almagro and Tort-Martorell, 2012). KE serves as a bridge between these fields, leveraging suitable tools and integrating them into novel approaches to enhance the

design outcomes. Given that user perception often operates on an implicit level, designers are faced with the challenge of identifying and analysing user needs in order to develop products or systems that align with their expectations (Fu et al., 2020). KE plays a critical role in comprehending users' perceived needs within the domain of digital interfaces and interactions imbued with user emotions. By employing KE, researchers have combined perceptual cognition with rational analysis, facilitating the design of optimal product systems and supporting designers in making well-informed decisions. Rather than inventing new theories or tools in different domains, KE encompasses a comprehensive approach that establishes rules for how different tools interact to quantify the impact of specific product features on user perception (Schütte et al., 2004).

Kansei as an internal sense is closely related to the external sense (Nagasawa, 2002). External senses provide the input required to establish perception and respond appropriately. KE utilises this principle to measure the emotional significance of external stimuli (Lee, Harada and Stappers, 2002). Currently, a range of measurement methods has been developed, such as physiological responses (e.g., heart rate, electroencephalogram, galvanic skin response), people's actions and behaviours, factual and physical expressions, and spoken language (Ishihara et al., 2008).

In summary, KE is an approach that employs engineering techniques to gain a deeper understanding of human emotions. It adopts a user-centred perspective, aiming to create products or systems that not only function effectively but also resonate emotionally with users. Due to the subjective nature of emotional perceptions, combining rational data analysis enhances the scientific basis and accuracy of research. The KE approach brings together users, designers, and products to improve user satisfaction and design efficiency.

2.2.3 Human Centred Emotional Design

Norman's theory of three levels of ED is essentially a philosophical concept rather than a specific design methodology. Conversely, KE theory seeks to establish a pragmatic approach that attempts to quantify human emotions and integrate them into the design process. This study endeavours to synthesise these two theories to foster a comprehensive understanding of emotional design, employing Norman's three levels of ED as the theoretical foundation for the study, complemented by the practical methods of KE. The amalgamation of these two theories will henceforth be collectively referred to as human-centred emotional design (HCED) (Guo et al., 2022) (Figure 10).
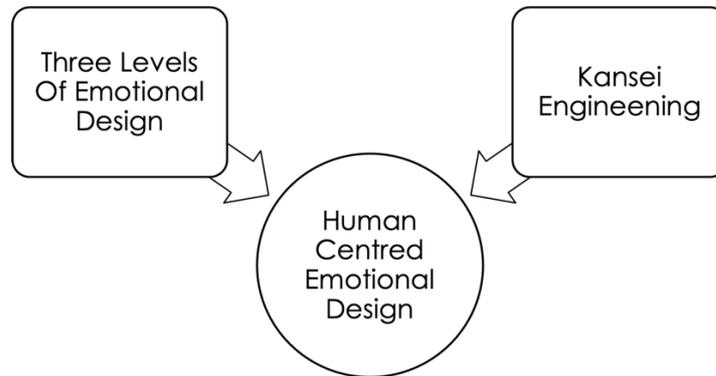
Figure 10: Human-Centred Emotional Design (self-study).

HCED is characterised as a multi-stage problem-solving process that anticipates and accommodates the needs and responses of people in their interactions with products or services. HCED tends to shift focus from users' physical and cognitive characteristics to emotional engagement and experiences of pleasure (Norman, 2005; Chapman, 2015). HCED concerns all the people involved in the process, considering the community's history, culture, beliefs, and environment (Norman, 2019). The research method of HCED aims to collect more data from various backgrounds, such as cultural exploration, aimed at enlightening design practitioners (Gaver, Dunne, and Pacenti, 1999). In practice, HCED often involves user research, prototyping, and testing to ensure that products and experiences are designed to meet the emotional needs of users in a way that is intuitive and satisfying.

An example can illustrate the concept of HCED, which is centred on three different levels, each of which progressively affects the user's perception of and engagement with the product. At the visceral level, the focus is on the initial, instinctive reaction users have to the product's appearance—its form factor. Consider a mobile phone that captivates attention through its sleek design and aesthetically pleasing features. This initial visual appeal is crucial in attracting users and piquing their interest. Moving to the behavioural level, or the interactive stage, users delve into the practicality of the mobile phone. Beyond its visual charm, the device proves itself by delivering an enhanced user experience. The phone's functionality is seamless, boasting an intuitive and user-friendly interface adorned with clear icons and easy navigation. This delightful interaction transforms the user's experience from merely aesthetic appreciation to a recognition of the device's practical superiority. The reflective level marks the culmination of the HCED

journey. Users, having been charmed by the phone's appearance and impressed by its functionality, now establish an emotional connection. This emotional bond translates into a genuine willingness to recommend the mobile phone to friends or family. Furthermore, it may influence future purchasing decisions, fostering brand loyalty. This reflective level encapsulates the lasting impact of a well-designed and user-centric product on users' attitudes and behaviours.

While HCED has primarily been applied to product design, it is also crucial to study its application in architecture design. As an indispensable part of the city, the regeneration of the post-industrial site is not limited to individual buildings but the entire community. By considering the emotional needs of target groups, architects and designers can create a better architectural environment, which will enhance the user experience. Therefore, to optimise aged industrial sites, the application of HCED in architectural design should be considered more comprehensively. Researching human factors in urban regeneration projects from stakeholders' perspectives will contribute to the expansion of HCED into architectural and urban design, ultimately providing competitive solutions that distinguish renovation outcomes in cities and creating architectural spaces that satisfy users' emotional needs.

2.3 Ethnographic Research and Cultural Impact

Post-industrial sites are significant locations within the urban environment, not only because of their physical attributes but also because of the social relations, memories, and emotions they evoke on a daily basis (Low, 2015). This suggests that the post-industrial site is not just a place but is imbued with social and cultural significance. As such, the process of urban regeneration can have a profound impact on the quality and character of post-industrial sites, shaping the way in which cultural expressions and practices are integrated into urban life. Despite the centrality of cultural phenomena to post-industrial sites, traditional research methods within the construction industry have been slow to fully comprehend their significance.

While several research has contributed valuable insights, there is still a need to improve the understanding of the complex social and cultural dynamics at play (Phelps and Horman, 2010). One potential solution to this problem is for the architectural research community to supplement quantitative and case study methodologies with qualitative theory-building methodologies, such as ethnographic studies (Stender, 2020). Ethnography is a systematic approach to studying specific cultural groups or phenomena

and is primarily utilised by anthropologists to answer questions about human behaviour and ways of life (Riemer, 2012). Essentially, an ethnography is a written account of a particular culture, not of a specific place, but of a cultural phenomenon that can exist in one or multiple locations (Geertz, 1973; Fetterman, 1998). As a research method, ethnography offers an illuminating perspective into the complex social world (Draper, 2015), providing researchers with a cultural lens to gain a deeper understanding of a group's behaviours within their specific culture (Bryman, 2016). Ethnographers are concerned with real people and their daily activities in their natural environment. This approach allows researchers to experience and learn about a culture as an insider while also allowing them to express beliefs and values from a neutral perspective in a way that an insider cannot, which provides an effective way to learn about people directly from people and to explore, understand, and describe culture (Roper and Shapira, 2000). In summary, ethnography is a powerful tool that offers researchers a unique opportunity to gain a deeper understanding of a particular culture and its practices, providing valuable insights into architectural research.

Ethnography is particularly important in the construction industry as it enables researchers to gain insights into the implicit meaning of a society's words, actions, and artifacts (Oswald and Dainty, 2020). The overall goal of ethnographic methods is to collect the most comprehensive data possible (Lofland and Lofland, 1995). Such data is obtained by observing behaviours in various forms, and qualitative research methods such as interviews, focus groups, incidental conversations, observations, documents, and nonverbal communication have been incorporated into the umbrella term of ethnographic methods (Ball and Ormerod, 2000; Kawulich, 2005). Fieldwork is an essential aspect of ethnography, which recognises that individuals' beliefs and actions cannot be separated from their context (Riemer, 2012). By conducting fieldwork, researchers can examine people's practices or activities within the context in which they occur. Ethnographic studies involve detailed observations of project contexts, enabling researchers to gain a more nuanced understanding of the social and cultural factors that shape urban sites. By complementing existing research methods with ethnography, researchers can better identify the subtle but significant ways in which cultural practices and expressions are woven into the fabric of post-industrial sites. This, in turn, can lead to more effective and sustainable urban regeneration strategies that take into account the cultural significance of these sites (Degen, 2017).

The consideration of cultural factors in urban regeneration projects is crucial as each city has its distinct cultural characteristics. These cultural attributes, such as beliefs, traditions, and values, are essential to ensure that urban regeneration projects meet the social needs of the local residents. Hence, incorporating ethnographic methods in post-industrial regeneration projects can enhance the focus on the cultural and social impact of the city. This is because cultural changes manifest through various economic, political, and social transformations, which ethnography can effectively capture. Therefore, the utilisation of ethnographic research in post-industrial regeneration projects is imperative for their success.

2.4   Issues Identified in Current Post-Industrial Regeneration Projects

While there have been some successes in the regeneration of post-industrial sites, there are still areas in which improvements can be made. Three critical areas that warrant further attention are the neglect of industrial heritage preservation, the loss of the uniqueness of the regeneration project, and disregard for people's emotional needs.

Neglecting the preservation of industrial heritage

Industrial heritage sites provide a tangible link to the industrial past and serve as important reminders of the progress made in technological advancements, engineering, and design. Such sites are representative of the societal changes that occurred during the industrial era, and they serve as a witness to the development of current societal structures (Cramer and Breitling, 2007; Oevermann and Mieg, 2015). Incorporating industrial heritage into urban planning and development strategies can provide economic benefits, such as increased tourism and heritage-led regeneration. These sites can become hubs for cultural tourism and serve as a catalyst for economic growth in the region. Additionally, preserving industrial heritage sites can also promote sustainable development by repurposing them for contemporary uses, such as office spaces, museums, and cultural centres.

However, the preservation of industrial heritage is not without challenges. The unique characteristics of industrial heritage sites, such as their scale, complexity, and specific materials, require specialised expertise and resources to ensure their preservation. Additionally, the industrial heritage site is constantly changing due to ongoing technological advancements and the associated changes in industrial practices, so preservation efforts must be adaptable and evolve with changing sites to ensure their

longevity (Alfrey and Putnam, 2003; Oevermann and Mieg, 2015). Unfortunately, industrial heritage is not always valued and regeneration projects sometimes neglect heritage conservation, resulting in valuable heritage being demolished or drastically altered. In many developing countries, urban regeneration projects are often responsible for the indiscriminate destruction of historical buildings and sites (Zhang, 2019). This is problematic as it leads to a loss of cultural heritage, character, and sense of place, as well as the erasure of the history of the site. While the public has begun to value industrial heritage, the number of such sites listed for cultural protection remains relatively low (Cossons, 2012). Therefore, the preservation of the post-industrial site remains a challenge today, and it is imperative to recognise its value and undertake preservation efforts to ensure its longevity for future generations.

Losing the uniqueness of the regeneration project

The increasing popularity of post-industrial regeneration projects in recent years has led to a boost in the creative economy of many cities: these projects have been successful in reimagining former industrial sites and repurposing them into vibrant new communities. The success of post-industrial regeneration projects has inspired many other cities to embark on similar initiatives. While the replication of these regeneration projects has undoubtedly served as a promising reference, it has also led to a loss of character and a sense of place in some areas. This trend towards standardisation has resulted in a lack of distinctiveness and originality in the design and implementation of regeneration projects (Sepe, 2018; Zhan et al., 2021; Guo et al., 2021).

The problem is that the replication of similar projects can lead to a lack of diversity in the use of industrial spaces, which can ultimately result in the erosion of the unique identity of a city. Many urban regeneration projects that aim to promote local economic growth fail to incorporate the diversity of industrial projects into their design and planning, thus neglecting the importance of local skills, historical context, cultural heritage, and social narratives that contribute to the identity of the community (Guo et al., 2021). The loss of character and a sense of place can also result in the absence of a distinctive historical and cultural identity, and the standardisation of regeneration projects can lead to the homogenisation of urban spaces, which may result in the loss of the unique character of a particular neighbourhood. This loss of identity can have negative consequences, such as the displacement of long-term residents, the destruction of local culture, and the alienation of newcomers (Diaz-Parra and Jover, 2021).

Overall, the loss of the uniqueness of the post-industrial regeneration project can lead to the erosion of the unique identity of a city. While many current urban regeneration projects on post-industrial sites strive to promote local economic growth, they do not adequately incorporate the diversity of industrial projects into their design and urban planning.

Disregarding people's emotional needs

Commercial regeneration projects are an essential component of urban development as they revitalise urban areas and contribute to economic growth. However, in the absence of scientific guidance and a comprehensive understanding of the needs and expectations of the users, these projects can become excessively profit-oriented and prioritise meeting market demands over sustainable development. This can lead to over-development and environmental degradation and put pressure on urban traffic and infrastructure, as evidenced by research conducted by Zhan et al. (2021).

One of the primary reasons for the lack of attention to user experience and emotional needs is the excessive focus on commercial requirements in contemporary design solutions. These solutions often prioritise financial returns over the emotional attachment and satisfaction of the residents. As a result, residents may not feel connected to the regenerated urban space, leading to dissatisfaction and a lack of attachment to the area. Moreover, the regeneration of post-industrial sites often follows predetermined concepts or commercial forms without consideration of the audience, as observed by Akkar Ercan (2007). This approach can lead to the neglect of the area's cultural, social, and historical significance and result in a lack of authenticity and connection to the community. This, coupled with a lack of attention to public facilities and the environment and little or no upgrading of the area's public facilities, has led to a negative user experience (Carmona, 2021). To address these challenges, urban planners and designers must recognise and incorporate the emotional attachment and satisfaction of the residents in the design process.

2.5   Construction Issues in Factory Transformation

Numerous industrial structures located in urban areas or near cities pose a significant challenge in terms of demolition or reconstruction (Mosharraf and Tümer, 2020). Jane Jacobs (2016) observed that the majority of these buildings are not meticulously preserved but are, instead, ordinary and dilapidated. Furthermore, premises

that have remained vacant for a prolonged period of time are more likely to be in a state of disrepair compared to newly vacated or re-occupied structures. Such structures tend to deteriorate as they fall into a state of neglect, which may be attributed to a lack of maintenance over the years (Ball, 1999). Therefore, renovating industrial buildings is a complex and multifaceted process that requires careful planning and execution to achieve favourable outcomes.

Industrial buildings that are repurposed must undergo a thorough evaluation of their architectural quality, age, and potential use. This evaluation must go beyond considering the physical attributes of the building environment and must also consider the broader context. The following are some of the construction issues that must be considered when renovating industrial buildings.

Building codes and regulations: (Cantell, 2005, Abdallah, 2007; Wilson, 2010; Luo et al., 2015). Industrial buildings are subject to a range of codes and regulations, ranging from fire safety to structural stability. To ensure safety and avoid costly legal and regulatory issues, it is crucial to plan and execute the refurbishment works in line with these codes and regulations. Failure to comply with building codes and regulations can result in injuries, deaths, and property damage, in addition to legal and regulatory issues.

The structural integrity of the building: (Spector, 2003; Cantell, 2005; Wilson, 2010; Blagojević and Tufegdžić, 2016). Before beginning any refurbishment work, it is essential to assess the building's foundations, walls, roof, and other structural components to ascertain their ability to support the renovation and any new loads that will be added to the building. The structural assessment must also consider the building's age and any wear and tear that may have occurred over time. The structural assessment must ensure that the renovated building will be safe and secure for the intended use.

Electrical and plumbing systems: (Spector, 2003; Wilson, 2010; Akadiri, Chinyio and Olomolaiye, 2012). Industrial buildings often have complex electrical and plumbing systems that require evaluation and upgrading as needed during the refurbishment process. Electrical systems may need upgrading to accommodate new equipment or technology, while plumbing systems may require modification to meet new usage requirements. The electrical and plumbing systems' refurbishment must be executed in line with building codes and regulations to ensure safety and avoid any legal and regulatory issues.

Environmental issues: (Ball, 1999; Omer, 2008; Veiga and Magrini, 2009; Akadiri, Chinyio and Olomolaiye, 2012; Vardopoulos, 2019). Refurbishing industrial

buildings can involve various environmental issues, such as the presence of hazardous substances such as asbestos or lead-based paint. These hazardous substances can pose significant health risks to workers and the environment. Thus, refurbishment works must be planned and executed in line with environmental regulations to protect workers and the environment.

Accessibility: (Imrie and Hall, 2003; Goodall et al., 2004). The accessibility of the refurbished building is a critical consideration. The refurbished building must be made accessible to people with disabilities by incorporating features such as wheelchair ramps. Ensuring that the refurbished building is accessible to everyone is essential and can increase the building's usability and functionality.

In conclusion, renovating industrial buildings is a complex undertaking that requires careful planning and execution to ensure a successful outcome. By considering the critical construction issues outlined in this discussion, the refurbishment of industrial buildings can be successfully executed, ensuring that the building is safe, functional, and compliant with regulations.

2.6   Trends in Architectural Design and Urban Planning

The proliferation of post-industrial buildings around the world over the past few decades highlights their significant role in past, present, and future urban development. The conversion of industrial buildings into post-industrial spaces has become an inevitable trend in the evolution of industrial cities into post-industrial cities. In this context, architectural design and urban planning have undergone a paradigm shift towards culturally oriented, human-centred emotional design, which prioritises cultural aspects in design and acknowledges the experiential requirements of building occupants. The aim is to create spaces that are not only utilitarian but also emotionally captivating.

Human Centred Emotional Design

The trend of architectural design has shifted towards a focus on Human-Centred Emotional Design (Zhan et al., 2020; Guo et al., 2021). HCED considers the needs and experiences of the people who will use a building or space and seeks to create environments that are not just functional but also emotionally engaging. This trend is driven by a growing awareness of the importance of well-being in the built environment and a desire to create spaces that are not just functional but also supportive of physical and mental health. Consequently, to make people experience the best sense of living,

designers should translate the emotional needs of users into architectural language and reflect these in the creation of space (Zheng, 2019).

In urban design, a person's emotional memory is activated as a public timeline incorporating various rich emotional combinations. If the design expects to achieve public emotional resonance, it must be in accord with the public's collective memory. There is a delay between these levels: first, it is visceral; second, it is behavioural; and lastly, it is reflective (Norman, 2005). The three levels complement and influence each other, and each level will affect the user's emotional experience. Overall, as modern society attaches increasing importance to the "human", architectural design development should be integrated with the times. A good design must meet the user's needs, whether physically or psychologically.

Culture-led Design

Culture-led urban regeneration is often viewed as a popular strategy for addressing the complex problems facing cities. Many cities have turned to cultural policies as a way to enhance their competitiveness and attract new functions to areas under development (Hospers, 2002; Miles and Paddison, 2005). This approach emphasises the importance of cultural context and heritage, and it is being applied in architectural design and urban planning (Landry et al., 1996; Hall and Robertson, 2001; Amin and Thrift, 2002). The culture-led design process involves considering the local traditions, customs, and history of a place, as well as the site's unique physical and social characteristics. This information is then used to inform the design process, ensuring that the building or space reflects the area's cultural heritage and provides a sense of place and identity (Alsayyad, 2001; Wang, 2009). The preservation and promotion of cultural identity is an important aspect of culture-led regeneration, particularly in the face of globalisation and rapid urbanisation, which can result in cultural identity loss in many cities and communities (Florida, 2005).

Cultural heritage is a key component of this trend, as it encompasses issues of identity and distinctiveness. Architects and designers have been using traditional materials, forms, and patterns in contemporary architecture and integrating cultural symbols and references into building designs to help preserve and promote cultural heritage. This approach can increase the visibility and value of historic buildings and local traditions, as well as enhance the city's international appeal (García, 2004). It is evident that culture-led urban planning and architectural design have played an active role in post-

industrial urban regeneration, including promoting the renewal of the physical environment, stimulating urban economic growth, and reshaping the city's image.

In conclusion, cultural strategies play a crucial role in contemporary urban regeneration, particularly in the reshaping of post-industrial sites. Cultural heritage provides designers with a valuable element through the realisation of HCED at all levels, generating concepts for human-centred opportunities and considering the history, culture, beliefs, and environment of the community. As a powerful tool for transformation, HCED anticipates and accommodates the needs and responses of people in their interaction with the environment or services.

2.7   Summary of Chapter 2

This chapter emphasises the significance and necessity of urban regeneration and post-industrial projects in the broader context of urban development. It highlights that the revitalisation of industrial heritage is not merely a cosmetic overhaul but a fundamental aspect of converting industrial cities into dynamic post-industrial entities.

Chapter 2 underscores the critical role these regeneration projects play in preserving historical identity while facilitating modern urban functionality. This chapter also introduces a classification of post-industrial buildings, shedding light on their diverse typologies. Furthermore, it delves into the policy frameworks governing post-industrial redevelopment, drawing comparisons between China and the UK.

Chapter 2 also introduces theories related to HCD and ED, elucidating the concept and scope of HCED within the study. The incorporation of an ethnographic approach is emphasised, with a focus on its cultural implications and significance.

Finally, this chapter concludes by identifying current challenges in regenerating post-industrial sites, including construction issues associated with factory transformations. Additionally, it offers insights into future trends in architectural design and urban planning. In summary, this chapter serves as a vital foundation for the research, laying the groundwork for a holistic exploration of urban regeneration and HCED.

Chapter 3: Development of Hypothesis

The concept of Human Centred Emotional Design (HCED) is grounded in the idea that emotions are a critical factor in the design of any product, service, or environment. This approach integrates insights from design psychology to analyse and accommodate the diversity of human emotions in the design process. HCED has a universal nature, as it recognises the influence of emotions in shaping human relationships with the physical world. In the context of architecture, the creation of a built environment involves a complex interplay between the physical elements of a space, social factors, and the psychological context of its users (Ujang and Zakariya, 2015). A well-designed space should be responsive to users' emotional needs and generate the desired emotional support. An effective designer should, therefore, be aware of the emotional impact of a building or site on its users and develop design strategies to enhance the user experience and the quality of the environment.

The previous chapter delves into the understanding of urban regeneration and post-industrial sites, exploring the current challenges faced by regeneration projects and presenting a review of HCED. This literature review provides a comprehensive foundation for the proposed hypothesis.

Building upon the insights gathered from the literature review, this chapter presents a refined hypothesis, elucidating how the HCED framework can serve as a transformative tool for restructuring post-industrial sites on three distinct levels: visceral, behavioural, and reflective. The hypothesis proposes that by addressing these levels, designers and planners can develop a more comprehensive and integrated approach to urban regeneration, one that prioritises the emotional needs of the users. The alignment of the HCED theory with the challenges presented in post-industrial sites, as discussed in the chapter 2, underscores the significance of emotional design in the broader context of urban regeneration.

This refined hypothesis serves as a guiding framework for the subsequent research in this PhD thesis. By explicating the relationship between HCED and the restructuring of post-industrial sites, this chapter aims to contribute to a more nuanced understanding of how HCED can inform and enrich urban regeneration strategies.

3.1   Visceral Level: the Initial Impression Given by Architecture

The visceral level in design refers to the initial and instinctive impression that individuals experience when encountering a building or space. Physical sensation is the most direct perception of architectural spaces, the emotional experience of the physical properties of a building through sensory channels. Numerous scholarly investigations have delved into the physical parameters that shape the quality of space, such as form, colour, material, light, sound, and temperature/humidity (Steele, 1981; Reddy, Chakrabarti and Karmakar, 2012). Good design at the visceral level is to attract people, thereby generating an intrinsic motivation to interact with the environment created.

Architectural form is the visual characteristic of a building that endows it with a unique identity (Jennath and Nidhish, 2016). Serving as the foremost perceivable feature, form plays a vital role in shaping users' initial impression of a building (Ching, 2023). Although the minds of humans are complex and unpredictable, there are still certain commonalities in people's appreciation and preferences when it comes to form (Alihodzic, Murgul and Vatin, 2014). For instance, the Sydney Opera House's white, sail-shaped construction immediately evokes associations with Sydney's blue sea and sailboats for most observers. Nevertheless, it is essential to acknowledge that individual perception can also be profoundly influenced by one's personality and background (Hillier, 2011), as exemplified by the differing experiences of Buddhists and atheists when visiting the same temple. Buddhists consider the temple sacrosanct because of their religious beliefs, whereas atheists approach it with a more general concept in mind, appreciating its grandeur, intricacy, and embellishments. This underscores the significance of identifying the target audience during the design process, enabling a focused analysis of the psychological attributes and emotional needs specific to that audience. Reconstruction of the built form is always a challenge when undertaking regeneration projects, as some of the building structures within the industrial site are already established. Designers and architects need to consider restoring or remodelling these buildings. It is important to take into account the original character of these buildings and to retain as many of these unique and often historically significant features as possible. If the original building cannot be seen or appreciated after a major renovation, then it loses its significance as a regeneration project and its emotional connection to the local community.

Norman (2005) discovered that colour is significant during the process of implementing design psychology. Cliff and Chabaneix (2008) believed that colour has

the most powerful, emotional and mysterious influence in spatial design, as it enhances visual stimuli that are perceived by the eyes and transmitted to the brain, producing emotional and psychological effects. Pavlov's (1928) Conditioned reflex theory suggests that different colours can elicit conditioned reflexes and different associations, which are a comprehensive reflection of a human's psychological feelings and spirit. Colour perception produces physiological responses in the body, which are evident in people's emotions, cognitive focus, and motor behaviour (Goldstein, 1942). Due to the different colour combinations, colour can convey temperature, distance, weight, and other visual senses. The visual sense can alter the form and scale sense of architectural space and become an effective means to adjust the spatial image. The experience of colour has its roots in the conscious, subconscious and unconscious processes of human behaviour (Mahnke, 1996). Research on the emotional impact of colour has identified certain general principles regarding the emotional creation of various colours (Kwallek et al., 1997; Hoicowitz et al., 2003), but responses to colour can vary depending on cultural associations, trends, age, and personal preferences (Flynn, 2001; Ambrose and Harris, 2011). Furthermore, colour display and expression are often associated with light.

Light plays a significant role in shaping the perception and response of individuals to their environment, as it defines the form of interior space and reveals it (Brooker and Stone, 2007). There are different sources of light, with natural daylight being the most fundamental, and it enters the building through windows, creating light and shadows. The form, size, and position of windows, along with other light sources, produce varying lighting effects that contribute to distinct spatial feelings. The impact of lighting on individuals' perceptions is well-documented, with many studies noting that lighting can significantly influence mood and behaviour (Heydarian et al., 2016). Reddy, Chakrabarti, and Karmakar (2012) demonstrated that light influences the hormonal secretion and circadian rhythms of body temperature, with implications for sleep/wake state and alertness. Proper lighting enhances the functionality of a building and ensures the comfort and safety of its occupants (Seppanen, Fisk, and Faulkner, 2003). Different architectural spaces require specific and unique lighting requirements, and designers can use light to manipulate spatial perception to better understand the space. Therefore, designers who are renovating former industrial buildings should thoughtfully consider using light for these purposes.

Goldblatt (2020) states that the materials of buildings are often the causal factors that provoke an aesthetic response in people. Niu and Zuo (2013) also note that different

building materials evoke different emotions. Materials provide a profound and subtle experience via human visual and tactile interaction, establishing a direct connection between the user and the building (Wang, 2005; Brooker and Stone, 2007). The visual perception of materials plays a significant role in enriching the facade's level and depth, making the building rich in artistic beauty. The texture of materials serves as the foundation for the interface's detailed features, which can arouse visual associations in viewers (Schifferstein and Wastiels, 2014). For instance, rough stone conveys vicissitudes, while wood abounds with warmth and tenderness. Moreover, different materials offer different tactile sensations, conveying unique architectural connotations (Pallasmaa, 1994). For example, marble usually offers a smooth and hard feeling, whereas metal provides a cool sensation. Exploring the potential of materials fully and combining this knowledge with the distinct requirements of buildings undergoing regeneration in post-industrial sites is of great significance.

The indoor climate, encompassing elements like sound, temperature, and humidity, plays a pivotal role in shaping the emotional and physical responses of users at the visceral level. Sound, for instance, elicits emotional responses and can impact human mood, attention, thinking ability, and behaviour (Algargoosh et al., 2022; Frescura and Lee, 2022). Its significance is closely tied to the intended purpose of a space, and its thoughtful consideration is imperative in the creation of a secure, productive, comfortable, and functional environment (Chen and Ma, 2019). Similarly, temperature and humidity are critical considerations in design, as maintaining a comfortable indoor climate is vital for optimal health and performance (Rao, Wang and Zhang, 2012). The indoor climate significantly impacts both physical and mental well-being and performance, making the control of temperature and ventilation a crucial aspect of designing an optimal user experience (Kapalo et al., 2020). High temperatures can lead to fatigue and lethargy, while excessively cool temperatures can cause irritability, reduce alertness and concentration, particularly in mental work situations (Reddy, Chakrabarti and Karmakar, 2012). Keeping humidity levels within a reasonable range is necessary to avoid negative effects on the health and productivity of occupants (Tsutsumi et al., 2007). Therefore, designers must consider these environmental factors when creating a space to ensure maximum user satisfaction.

3.2 Behavioural Level Affects the Experience of Using Architecture

The behavioural level pertains to the pleasure and efficacy of utilising design outcomes. In the field of architectural design, the emphasis lies on the experience of utilising the building, which encompasses the interaction between the user and the building. The behavioural level highlights an individual's physical or psychological traits, personal preferences, cognitive abilities and behavioural abilities (Norman, 2005). It is anticipated that people will communicate and interact with their environment, forming emotional bonds with it (Philips, 2019). An excellent design at the behavioural level elicits a feeling of trust in people, eventually leading to a desire to use the product or space frequently and maintain it over an extended period (Saraswat, 2019). According to Norman (2005), behavioural design comprises four dimensions: performance, understandability, usability, and physical feel.

Performance

Performance is of paramount importance in behavioural design, and the performance of buildings is a more intricate and multifaceted concept than that of products. Building performance can be measured based on specific criteria, such as physical, social, or environmental considerations. It is an attribute that expresses how effectively a building performs its intended functions (Hensen and Lamberts, 2012). A building with an 'ideal' performance would need to be performing well in terms of economics, environment, comfort and design. If viewed solely from the perspective of the user, the basic performance of a building should provide health, safety and security (Preiser and Vischer, 2006). However, different groups of building users may have varying interpretations of performance, highlighting the need for a nuanced understanding of the term. Some buildings may not perform upon completion as intended by the designer. The difference between anticipated and actual performance may be significant and to the detriment of the users and environment.

Understandability

Understandability is a crucial aspect of behavioural design that concerns the user's ability to comprehend the intentions behind a design. Communication between the designer and the user mostly occurs through the design of the physical space. The user's perception of the physical space is dynamic and shaped by their interactions with it (Hölscher et al., 2006), which means that designers must adopt the user's perspective and design spaces

that are comprehensible to them. For example, the spatial layout is an aspect that reflects understandability, which can impact users' emotions and affect their ability to navigate unfamiliar environments (Mendez-Lopez et al., 2020; Kim et al., 2021). When users cannot navigate in unfamiliar environments, they become frustrated and impatient. An effective spatial layout provides easy access/exit for users and makes spatial orientation easier (Wakefield and Blodgett, 1994). Therefore, designers must enhance the understandability of the space design, which allows visitors to interact and communicate effectively with the space.

Usability

Usability is a complex and multifaceted concept that refers to the extent to which a system, product, or service can be employed by designated users to achieve specific goals with effectiveness, efficiency, and satisfaction in a defined context of use (ISO 9241/11, 2018). This definition underscores the importance of usability as a critical determinant of user experience and emphasises the need to consider various factors when evaluating usability. In the field of spatial design, usability pertains to the ability of users to perform specific tasks efficiently in a given environment (Bevan, 1995; Haron, Hamid and Talib, 2011). The usability of a building is closely linked to its intended function and mission, which can vary widely depending on the type of building in question. For instance, the usability of a library is to enable users to study effectively in the environment, while the usability of a hospital operating theatre is to facilitate safe and efficient surgery. Recent research has demonstrated that the physical design of the environment can have a significant impact on user emotions, stress levels, and memory (Mahmoud Ibrahim, 2019). Consequently, usability has emerged as one of the most crucial criteria for evaluating the behavioural design of buildings.

Physical Feel

The physical feel of all objects in space are affected by their weight, texture and surface. As living beings, much of the human mind is occupied by the sensory system, constantly exploring and interacting with the environment. As a result, elements in spatial design affect the human physical senses, including touch, vibration, feel, smell, hearing and sight (Norman, 2005). Norman (2005) claimed that attractive things work better, which suggests that the physical feel of a product affects the experience of using it. Similarly,

in spatial design, attractive spatial design will bring pleasing sensory sensations to users, which will affect their experience at the behavioural level.

3.3 Reflection Level: an Intrinsic Sympathetic Response between Individuals' Emotions and the Environment

Successful visceral and behavioural levels often lead to a strong reflective level, which is the most challenging to achieve. The combination of the first two levels creates a deeper interplay of emotion, awareness, understanding, personal experience, cultural context, and more in the user's mind (Norman, 2005). After repeated interactions and complex connections with the built environment, people will develop a certain emotional awareness. The reflective level is an intrinsic sympathetic connection between people's emotions and the environment, which integrates the emotions and memories and history experienced by people and buildings, thereby endowing architecture with a 'spiritual consciousness' and revealing the essential relationship between human existence and the creation of architectural spaces (Crang, 1998; Chen, 2010). The essence of reflective level design is that everything is in the user's mind.

Norman (2005) posited that the reflective level is intricately tied to the user's personal consciousness, experience, and cultural background. Consequently, the reflective level necessitates a more profound understanding that extends beyond architecture as merely a utilitarian structure, but rather views it as a vessel imbued with profound meaning and emotional significance. In this context, it becomes imperative for buildings to elicit positive emotional responses from their occupants, establish a sense of belonging, enrich the human experience, foster social connections, and leave enduring impressions on both individuals and communities. The reflective level of architecture manifests through three aspects: Architectural Identity, Sense of Place, and Cultural Context (Corsane, Davis and Murtas, 2008).

Architectural identity

Architectural identity encompasses the distinctive elements that set a building apart from others, such as its style, materials, form, and overall aesthetics (Nooraddin, 2012). Establishing a strong architectural identity is crucial as it fosters a connection between individuals and the built environment. A building with a compelling personality becomes a symbol that represents its purpose, history, and significance within the community. This connection elicits an emotional response and a sense of familiarity, promoting a deeper

emotional bond with the structure. When individuals enter an architectural space, they develop an awareness of their surroundings, followed by a sense of involvement and identity, often referred to as belonging (Corsane, Davis and Murtas, 2008). Therefore, effectively shaping architectural identity can contribute to a heightened sense of belonging for individuals.

Sense of Place

A sense of place refers to an individual's subjective perception and conscious feeling towards an environment, encompassing both descriptive and affective aspects of the environmental experience (Shamai, 1991; Relph,1997). This concept implies that a sense of place is influenced not only by social constructs but also by the tangible reality of the environment (Kianicka et al., 2006). It is shaped by subjective human experiences such as memory, tradition, history, culture, and society, as well as by the objective and external influences of the environment, resulting in various associations with a particular place (Hashemnezhad, Heidari and Mohammad, 2013). Creating a sense of place in architectural design involves crafting spaces that respond to and respect the local context, including the natural surroundings, neighbouring buildings, and cultural heritage. By incorporating elements that resonate with the local environment, such as utilizing local materials or integrating traditional design themes, buildings can evoke a sense of belonging and attachment, thereby enhancing the emotional experience of their occupants.

Cultural Context

Culture encompasses the accumulated historical development embodied in the physical form of a building, reflecting the era, region, or ethnicity associated with it (Jokilehto, 2007). Cultural context refers to the atmosphere generated by human activity in or around a building within a specific environment, based on its purpose and serving as the fundamental reason for the creation and existence of architecture (Thomas and Garnham, 2007). Buildings that are sensitive to cultural context reflect the values, traditions, and aspirations of the people who use them. By considering cultural context in architectural design, architects can create spaces that respect and celebrate local cultures, traditions, and ways of life. This approach not only enhances a sense of community pride and ownership but also provides a familiar and meaningful environment that resonates emotionally with its users.

The reflective level of design entails an organic integration of architectural identity, sense of place, and cultural context, which has relevance and progressiveness. Buildings do not exist in isolation from their histories and the cultures in which they are situated; they often carry narratives with them—representing their place in the history of a specific site and their broader significance within a culture or society (Goldblatt, 2020).

The physical form serves as the foundation and vessel of the spirit of place, while the spirit of place is the emotional attachment and extension of the physical form. The spirit of place cannot be separated from its physical manifestation. In urban regeneration projects, the physical and historical identity of an urban area may stem from its streets, overall scale, and urban character. Therefore, the focus of regeneration initiatives should prioritise preserving the city's identity. An effective design concept for urban regeneration could involve creating a sense of place as a visually tangible physical environment with profound meaning, offering a range of urban activities. Such a concept allows for sufficient flexibility to successfully integrate outdated industrial sites into modern urban development plans.

3.4   Summary of Chapter 3

In order to establish an HCED framework to help designers engage with urban regeneration projects, this chapter clarifies some key factors. Hypothesis are rationally developed based on Norman's three levels of Emotional Design concepts. These design factors will be adopted in the regeneration of post-industrial projects to enhance the uniqueness of the project and the user experience. The next chapter clarifies the methodology of this study to support the hypothesis developed based on the research. The methods related to the methodology used to answer the research question is described.

Chapter 4: Research Methodologies

The establishment of a robust methodology is a significant part of ensuring the success of the research. In the context of design-oriented academic research, it is essential to adopt a multidisciplinary approach that incorporates knowledge and skills from various disciplines. This study aims to investigate the application of Human-centred Emotional Design (HCED) in urban regeneration areas, which involves the study of art, design, psychology, sociology, engineering and more. To achieve this, a combination of qualitative and quantitative research methods has been employed. The qualitative method allows for in-depth exploration of knowledge from diverse perspectives, while the quantitative contribution mitigates the potential bias resulting from subjective interpretation of results. The integration of both methods ensures the reliability and credibility of the study.

This chapter presents the research methodology. First, the nature and framework of design-led research are outlined, justifying the selection of a double-diamond design framework for this study. Then, the implementation of the proposed methodology is illustrated.

4.1   A Conceptual Research Framework

The growing complexity of design-oriented problems necessitates the exploration of innovative approaches. To investigate the interaction between human emotions and their environment, a broad range of knowledge, ideas, and research methodologies from diverse disciplines is required. This study systematically reviews research methodology from a broad frame of reference across multiple disciplines. Various methods have been employed at different phases of the study, including the human-centred participatory design method, which involves all project stakeholders in improving, innovating, and impacting the design by gathering their experiences to better structure services and outcomes. Additionally, ethnography is a research method rooted in the humanities; it plays a significant role in understanding the intricate interplay of social and cultural issues prevalent in the construction industry. The utilisation of ethnographic methods in post-industrial regeneration projects contributes to a heightened focus on the social and cultural impacts of cities. Thus, it is crucial to develop a design-led research framework in this study that incorporates multiple methods. Having compared various design

methodology models, the author ultimately selected the Double Diamond Model as the conceptual framework for this study.

4.1.1 Design Methodology

This study employs a design methodology rooted in Design Thinking (DT), which is a user-centred and multidisciplinary approach that can be more flexible in its implementation and aims to generate innovative solutions to complex problems (Thoring and Müller, 2011; Razzouk and Shute, 2012). The development of design methodology provides a broad range of innovation fields with the opportunity to apply design tools to other problem-solving contexts. It introduces new process models and toolkits that improve, expedite, and visualise the creative process. Additionally, it bridges the gap between creative design approaches to conventional research processes based on planning and rational problem-solving, thus allowing for a more comprehensive and holistic approach to problem-solving.

4.1.2 Double Diamond Research Framework

The Double Diamond model is a widely recognised framework for guiding the design process in an iterative and structured manner. It was popularised by the British Design Council in 2005 and adapted from the divergence-convergence model proposed by Hungarian American linguist Béla H. Bánáthy in 1996 (Tschimmel, 2012). This model is highly regarded for its human-centred approach, placing emphasis on participatory design to connect with all involved and associated with the process (Liedtka, 2018; Senapathi and Drury-Grogan, 2021).

The Double Dimond model comprises two distinct stages, symbolised by diamonds, that delineate the design process (Figure 11). The initial diamond represents a divergent process, encompassing the stages of Discover and Define. During this phase, the focus is on identifying the problem and providing a context for the research, then switches to broad objectives to seek a greater understanding of the problem. Afterwards, the research homes in on specific areas where the insights gathered from the discovery phase can contribute to redefining the challenge in a different way.

The second diamond initiates another divergent phase, centring around the stages of Develop and Deliver. Here, the ideal concept will be selected for prototyping and testing by giving different answers to clearly defined problems. The process begins with

exploring potential solutions and generating a wide range of ideas. Ultimately, the various solutions are tested to bring the ideal product to the market.
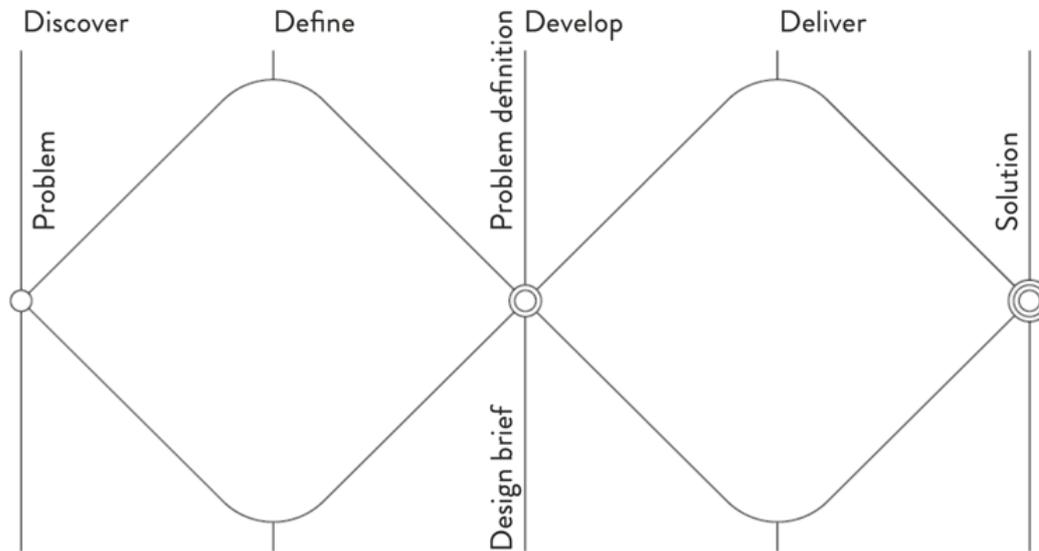
Figure 11: The Double Diamond Framework.
Source: British Design Council, 2005.

The Double Diamond model is intrinsically linked to the principles of Human-Centred Design (HCD), a design philosophy that permeates the iterative design process of the Double Diamond model. By using this methodology, substantial advantages are anticipated in the design process, ultimately leading to an enriched user experience.

4.1.3 Comparison with other design models

Numerous institutions in both industry and academia have put forth their own DT models, several of which have been extensively documented and are considered well-established. One such model is the Stanford d. school's Five Stages, which consists of Empathise, Define, Ideate, Prototype, and Test (Tu et al., 2018). This model is considered iterative and follows a waterfall process (Luka, 2014). IBM has also developed its own model, known as the loop, featuring a two-loop structure that continuously observes, reflects, and makes, resembling the mathematical notation of infinity (IBM, n.d.). Similarly, the design agency IDEO has devised the 3I and HCD models, with the former referring to inspiration, ideation, and implementation (Kwon, Choi and Hwang, 2021), while the latter refers to hear, create, and deliver (Fuge and Agogino, 2015). However, both models primarily focus on the stages of idea generation, rather than the overall design process (Tschimmel, 2012).

Despite variations in strategies (e.g., number of stages, flow), these models share a common goal of solving problems through innovative means. The Double Diamond model distinguishes itself from the others by visually mapping the divergence and convergence phases of the design process. It is the most comprehensive model presented here, with detailed thinking steps that prioritise problem exploration to generate superior solutions (Tschimmel, 2012). While other models are predominantly utilised in product and service development, the Double Diamond model has found wide application in the public sector and other domains (Ganova, 2015; Hawryszkiewycz and Alqahtani, 2020). Therefore, the double diamond model serves as an appropriate conceptual framework for this study.

4.2 Implementation of proposed methodology

This study presents a conceptual framework for the development of a hypothesis-based double diamond model that visualises the research process (Figure 12). The initial phase of the research is Discover, in which a diverse range of methods is implemented in response to the proposed research question. These methods encompass secondary research, field trips, questionnaires, interviews, focus groups and digital footprints. This informs and lays the foundation for the subsequent stage, Define, where a design framework is established. In the third phase of the research, Develop, a conceptual prototype is meticulously crafted based on the design framework. This prototype serves as an experimental model to be further examined and refined. Finally, in the fourth phase, Deliver, the developed prototype undergoes thorough testing and evaluation, and the results are documented and reported.
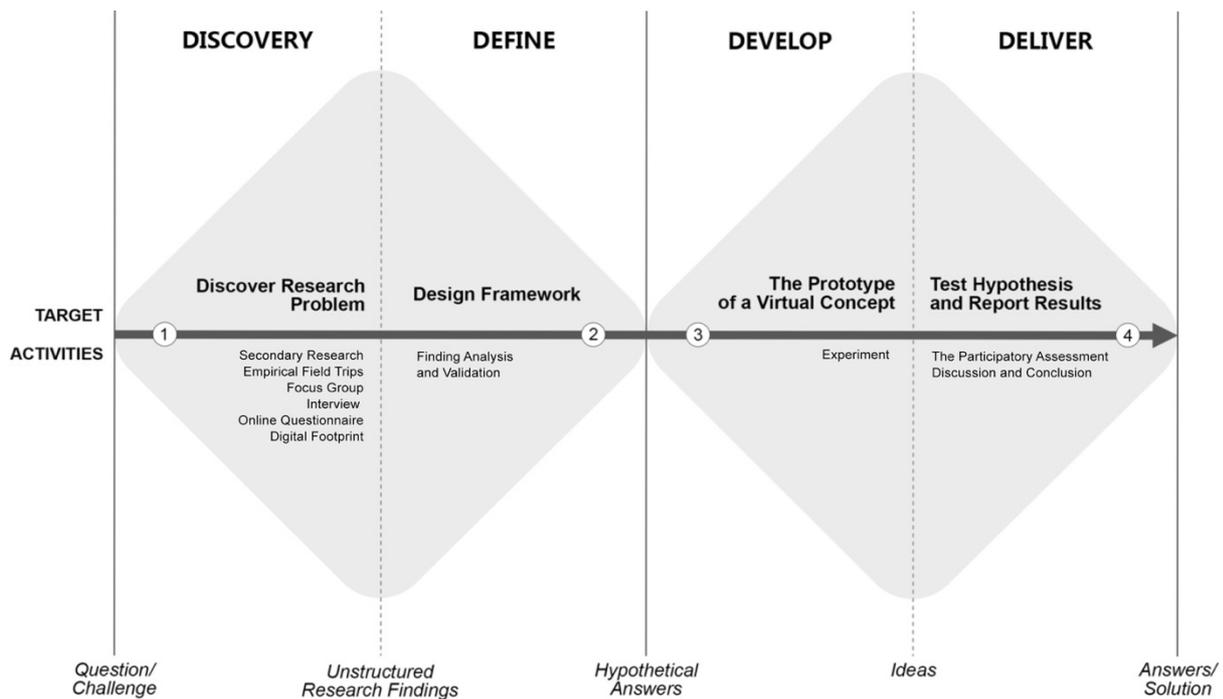
Figure 12: Research framework for this research (self-study).

In the subsequent sections, the appropriate research methods are presented and discussed in detail.

4.3 Development of The Ideal Research Methods for This Study

4.3.1 Empirical Field Trips

In accordance with the objective and research question raised in this study, the location-based case study has been employed as the foundation for investigating the contribution of HCED theory to the regeneration of post-industrial sites. Qualitative empirical case studies are used as a human-centred research method to achieve a deeper understanding of regeneration projects. Post-industrial sites often have unique challenges and characteristics that require a detailed understanding of the local context. Location-based case studies allow authors to delve into site-specific issues, considering their history, environmental conditions, economic factors and social dynamics. Moreover, successful regeneration projects can provide examples for other post-industrial sites facing similar challenges. Location-based case studies document successful redevelopment efforts, providing valuable insights and best practices that can be shared and applied to other sites.

The selection of research methods in this study is guided by ethnographic theory, which considers the diverse cultural contexts of China and the UK. This approach enables an examination of the effects of regeneration projects within the distinct cultural contexts,

as described by cultural theorists Hofstede (2001) and Shenkar (2001). China and the UK were chosen as research sites due to their representation of the social, economic, and cultural contexts prevalent in the East and West, and their significant shares in the global tourism market. Furthermore, these countries have undergone distinct phases of industrialisation (Filimonau, Zhang and Wang, 2020), resulting in varied urban regeneration challenges (Cadell, Falk and King, 2008).

Therefore, the study focuses on current examples of post-industrial sites in both the UK and China and the findings produced a resource of evidence-based research, drawing from a balance of quantitative and qualitative data that elucidated current knowledge of the selected sites and a broader historical overview. The fieldwork conducted within different cultural contexts enables the author to gain a comprehensive understanding of the multifaceted requirements within the research field and contributes to a more profound comprehension of the universal characteristics of post-industrial projects.

4.3.2 Design Practitioners' Insight

Focus groups and questionnaires are employed as data collection methods to gain insights from design practitioners. Focus groups are a widely used qualitative research method that involves gathering a small, pre-selected group of individuals to discuss a topic determined by the researcher (Martin and Hanington, 2013). The inclusion of focus groups in this study contributed to obtaining nuanced information and a deep understanding of designers' perceptions, opinions and attitudes. This approach allowed for a deeper exploration of the themes. Meanwhile, participants had the opportunity to complement and challenge each other's perspectives, thus creating an environment in which the group dynamics revealed perspectives and insights that may not have emerged from the individual interviews. Complementing the focus groups, questionnaires were instrumental in gathering diverse insights and feedback from a broader spectrum of designers, enhancing the generalisability of the results obtained.

Focus groups

This study organised two focus group discussions, one in Beijing and the other in Shenyang. The Beijing designers' focus group consisted of eight highly regarded senior architectural designers with national importance, while the Shenyang group included six university lecturers from Architecture Environment Design programs, who served as

design educators. The participants were requested to share their experiences and knowledge regarding urban regeneration, with specific emphasis on architectural design and urban planning projects, particularly those involving the renovation of post-industrial sites. The discussions were facilitated using a non-directive, structured moderating approach, ensuring that the conversation was unbiased. The event commenced with introductory remarks by the research project leader, who explained the purpose and scope of the project, as well as the research findings from each location's specific case. To generate initial responses and encourage dialogue among participants, a series of open-ended preliminary questions were posed. This was followed by a discussion of interview questions targeting different specific stakeholders to gather qualitative data.

Questionnaires

A questionnaire for designers was designed and distributed to 24 participants from China and the UK. The questionnaire aimed to collect interrelated subjective and objective data and insights. It is worth noting that questionnaires have been subject to criticism regarding their reliability and validity as data collection methods. Issues such as incomplete responses, survey fatigue, and poorly designed questionnaires can lead to inaccurate or unreliable data (Blasius and Thiessen, 2012). To address these concerns, the authors employed the questionnaire format judiciously, conducting a thorough assessment and analysis of the questionnaire prior to distribution. This rigorous process resulted in a well-crafted set of questions that were easy for participants to complete.

The findings derived from the focus group and questionnaire will serve as valuable reference for the development of the study's ultimate design framework.

4.3.3 Audiences' perceptions and feedback

In addition to engaging design practitioners, it is crucial to gather perceptions and feedback from a wider audience. Given the constraints imposed by the pandemic, traditional onsite face-to-face methods are impractical. To bridge this gap, online questionnaires and digital footprints are employed, enabling the collection of valuable feedback from a broader target audience. These approaches not only circumvent

geographical limitations but also aligns with contemporary preferences, allowing researchers to capture user data in the digital realm.

Online Questionnaires

Questionnaires were distributed through the project website (www.urbanregeneration.org), various social media platforms, and directly to specific recipients. The objective was to solicit feedback and consultation from the general public anonymously, capturing personal narratives from individuals with first-hand experience of regeneration projects. The questionnaires were distributed to various user groups, including residents, visitors, municipal service providers, and civic organisations. A total of 116 sets of feedback were received from China and the UK. This approach of utilising online questionnaires to obtain feedback from various stakeholders on their experiences and expectations of current and future regeneration efforts was considered valuable in assessing the effectiveness of currently regenerated industrial sites and understanding how the anticipated audience would perceive future examples of optimal design.

Digital Footprint

The study also employed a digital footprint method to acquire a more comprehensive and focused sample. The term 'digital footprint' refers to the traces of data or information left by individuals when using the internet or digital devices (Shoval and Isaacson, 2007). This approach is cost-effective and can be executed efficiently through automated means, thereby saving time and resources (Önder, Koerbitz, and Hubmann-Haidvogel, 2016). In this particular study, researchers employed a web-crawling technique to collect visitor reviews from third-party websites related to four regeneration projects: Albert Dock, 798 Art Zone, Tate Modern, and the Power Station of Shanghai. The primary objective was to gather first-hand feedback from visitors to these regeneration projects and analyse their potential needs. Two websites were selected for the study: (1) TripAdvisor, a reputable review platform providing popular travel information worldwide, with approximately 30 million monthly visits and over 878 million reviews in terms of geography, travel time, and ratings (TripAdvisor, 2023). (2) Dianping, the earliest global independent consumer review website, offering local life information in China, possessing more than 200 million monthly active users and over 15 billion monthly comprehensive page views (Dazhongdianping, 2023).

Based on existing literature, the researchers identified key factors that influence visitor satisfaction with post-industrial projects. The significance of culture in urban regeneration is widely acknowledged (Evans, 2005; Smith, 2007). Culture has been recognised as a vital tool for enhancing the competitiveness of cities, and cultural heritage has been found to attract new functions to developing areas (Miles and Paddison, 2005; Hospers, 2002). Additionally, studies on urban regeneration have indicated that the form and function of buildings are highly valued by visitors to such projects (Guo et al., 2021). Moreover, non-building elements have been found to play a crucial role in connecting the environment with visitors and preserving industrial heritage (Stratton, 2003; Douet, 2016). Furthermore, there is a desire among visitors to engage with the environment (Zhan et al., 2021). To summarise, the authors have identified five key factors/keywords: cultural heritage, functionality, architectural form, non-building elements, and interaction (Zhan and Guo, 2023). These factors served as measurements in a comparative case study.

The study employed various digital techniques to analyse the textual language of visitors' reviews. The data underwent four main steps: collecting textual reviews from websites through a Python-based web crawler, preparing by removing non-textual comments, extracting keywords through text summarisation technique, and analysing visitors' sentiment feedback through the Nature Language Toolkit (NLTK) and the Chinese Positive and Negative Dictionary (Figure 13). This method aims to gather information about the target audiences' satisfaction, preferences, and expectations with the current regeneration project, as well as to compare different types of regeneration projects across two cultures. Ultimately, the study aims to provide clarity on design factors and drivers that can inform future renovation projects.
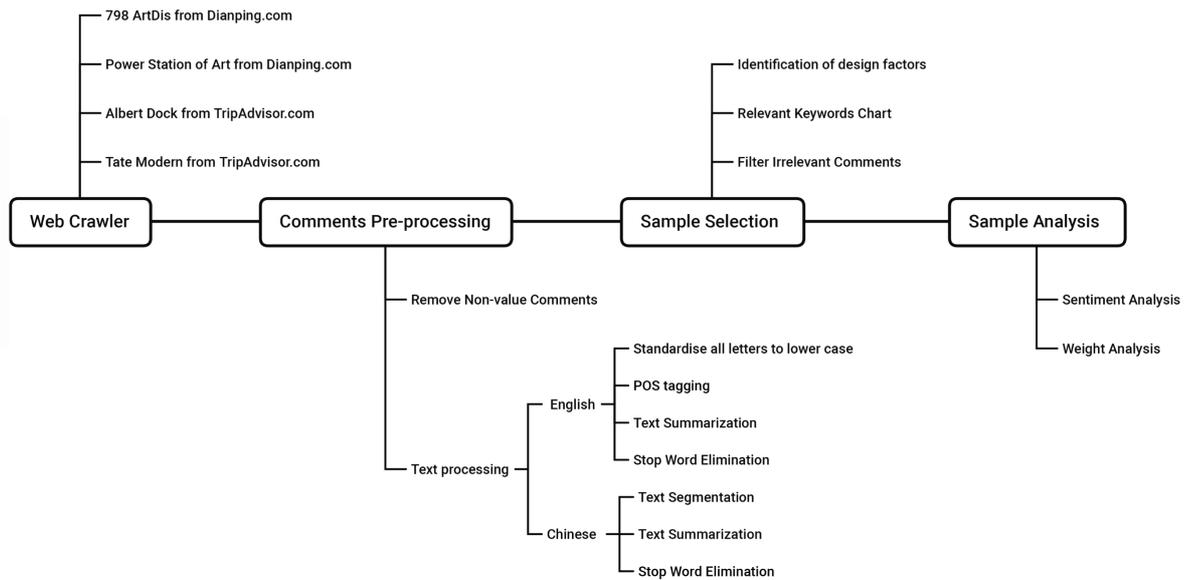
Figure 13: The methodology processes (self-study).

4.3.4 Other Stakeholders' Insights

Following these processes, a series of ethnographic studies were conducted aiming to gain insights from a wider range of stakeholders. Semi-structured interviews and extended 'walking interviews' sought to capture a range of personal narratives of individuals' experiences of living and working in the cities. Interviews were used to gather insights from other stakeholders involved in urban regeneration projects. The interview method is a widely used technique in qualitative research for collecting data through dialogue between the researcher and participants (Fontana and Frey, 2005). Interviews facilitate the researcher to explore the regeneration of post-industrial sites in depth. Interviewees can provide detailed and nuanced responses, allowing researchers to gain a comprehensive understanding.

In this study, the author employed interviews to gather the views of a diverse group of stakeholders, including government officials, project developers, tenants, and business practitioners, to gain a comprehensive understanding of the factors that influence urban regeneration projects. A total of thirty-four semi-structured interviews were conducted in four Chinese cities and one UK city, including 10 Chinese government officials, 9 project developers or managers (2 from the UK) and 15 business practitioners (5 from the UK).

The in-depth and detailed information obtained through interviews allows a thorough examination of participants' thoughts, experiences, and behaviours.

Additionally, the ability to ask follow-up questions and seek clarification can provide a more nuanced understanding of the research topic. To mitigate potential sources of bias in the interview process, the study standardised interview questions and procedures as much as possible and conducted a pilot study to test and adjust the interview questions and procedures prior to conducting the main study. By taking these precautions, the data collected through interviews provided an in-depth analysis of the motivational and contextual factors influencing the regeneration project, ultimately informing the design of a more effective retrofit program.

4.3.5 Smart Photo

The Royal Albert Dock in Liverpool has been selected as a pivotal case study for this research, aimed at showcasing the efficacy of the proposed design framework. To delve into the prevailing challenges associated with visitors at the Albert Dock, the intention was to gather data regarding their movement patterns. Given the study's focal point on charting the conduct and mobility of tourists within the destination, high accuracy, availability, appropriate technique, efficient time frame, the privacy of travelling and affordable price are the main criteria for selecting the method. Upon comparison with existing methodologies, it becomes evident that they fall short of meeting all the stipulated requisites (Zhan, Guo and Robert, 2023) (Table 1).

Table 1: Characteristics of different methods.
Source: Zhan, Guo and Robert, 2023.

Method characteristics	Observation	Interview	Sketching trip on the map	Trip diary	GPS	Digital Footprint	Smart photo
High accuracy					✓	✓	✓
Time-efficient					✓	✓	✓
Cost-efficient	✓	✓	✓	✓		✓	✓
Large sample size					✓	✓	✓
No active visitor participation required						✓	✓
Real-time					✓	✓	✓
Easy to analyse data					✓	✓	✓
Flexible in location	✓	✓	✓	✓	✓		✓

Given above, the study develops a novel approach for mapping visitor behaviour at post-industrial sites, utilising image-based processing. A Smart Photo technique was developed to map tourists' movement through two major steps, including video recording and people detecting, and movement mapping.

Video recording and people detecting

A drone carries a video camera to record 20 minutes of video with a set Full HD resolution of 1920 x 1080 pixels and a frame rate of 60fps. The shooting angle can be adjusted to capture images with a flexible perspective. The method requires automatic recognition of moving targets from the video. While there are existing applications for detecting people in video, they usually rely on Face Recognition Technique, which is ineffective in this case as the videos do not contain human faces. In addition, these applications suffer from the inadequate ability to reduce environmental distractions, such as water reflections and birds. Considering this, an application has been developed to detect people in videos.

Currently, there are three major techniques, Optical Flow (OF), Interframe Difference (ID), and Background Subtraction (BS), which are widely used in current moving target detection (Rymel et al., 2004). OF is the motion of the instantaneous movement of space velocity on the viewing plane to detect the moving objective (Shafie et al., 2009), while ID is detecting the moving targets by comparing two or three continuous images (Cheng and Wang, 2014). Similar to the ID, the BS subtracts current frame images from a continuously updated background instead of subtracting from the adjacent frame image to extract moving objects in different images (Garcia et al., 2020). After a comparative test of these three techniques, BS appears to be the best option in terms of accuracy that satisfies the project requirements. The OF image demonstrates that each optical flow represents a detected tourist, whereas the blue boxes in the ID and BS images represent detected tourists, so apparently, the BS count result is closer to the actual number (Figure 14). Therefore, the application in this study is based on BS technology, developed by python language and OpenCV library to detect people in aerial view videos.
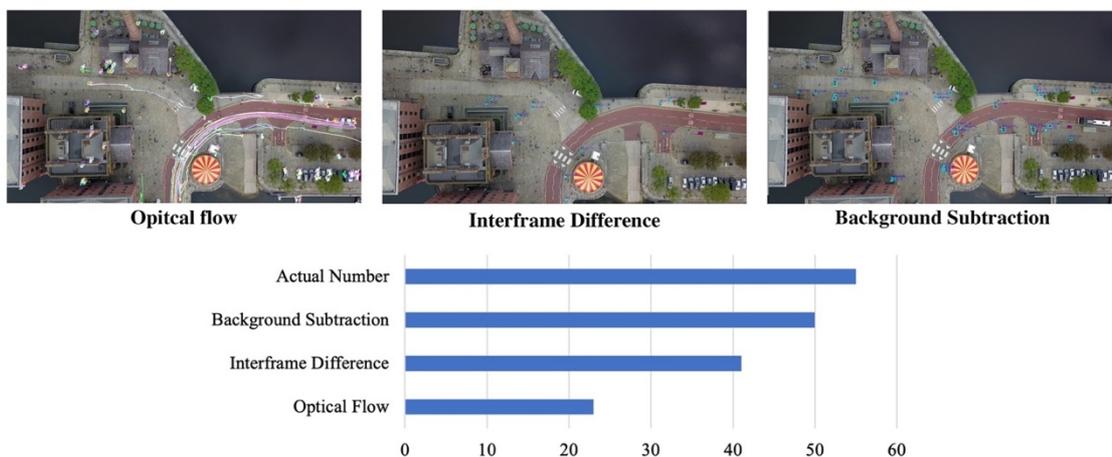
Figure 14: Comparison of three approaches(self-study).

Figure 15 illustrates the workflow of People Detecting. Firstly, a detection area is selected to minimize distractions from the surrounding environment. The next step is to acquire the background image, which is obtained by converting all image frames from RGB format to greyscale and averaging the corresponding greyscale values of all frame images. This process effectively eliminates the presence of people in the background image. To detect people, the image-frames with people are subtracted from the background image and detect people by Gaussian Mixing Model (GMM) approach. Finally, from this process, people are marked automatically.

GMM is the most effective technique for modelling the background and foreground state of pixels (Bouwmans and ElBaf, 2010) and has the ability of universal approximation as they can fit any density function if they contain enough mixture (McLachlan and Basford, 1988). Thus, GMM is selected to initialise the background in this study. Expression is as follows:

$$B(x, y) = GMM f_k(x, y) \quad k = 1, 2 \dots n \quad (1)$$

Where B is the background, n is the total number of frames selected.

After obtaining the background image frame B, the differential image $D_n(x, y)$ is expressed as:

$$D_n(x, y) = |f_n(x, y) - B(x, y)| \quad (2)$$

Where $f_n(x, y)$ is recorded the current video image frame.

The people can be detected by:

$$R_n(x, y) = \begin{cases} 1 & D_n(x, y) > T \ Dected \ people \\ 0 & D_n(x, y) \leq T \ empty \ road \end{cases} \quad (3)$$

Where T is greyscale threshold.

1. Selecting detection area   **2. Obtaining background image**
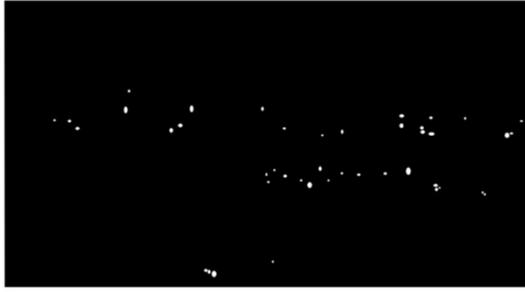
3. Detecting people   **4. Marking people**

Figure 15: The workflow for people detecting(self-study).

Movement mapping

In response to study requirements, the application also includes a movement mapping function that automatically generates a heat map with tourist distribution data (Figure 16). The Heat map consists of the thermal values of each frame image. The thermal value $H_n(x, y)$ for the nth frame of a pixel can be expressed as:

$$H_n(x, y) = \sum_0^n R_n(x, y)/n \qquad (4)$$

Where *n* is the number of a recorded video frame; $R_n(x, y)$ is the *n*th frame of the tourist at *(x, y)*.

Furthermore, the usage rate of each route O_r can be calculated. The formula is：

$$O_r = \sum_0^n H_n(mean)/n \quad (5)$$

Where $H_n(mean)$ the average heat value in the detection area at *n* frame.
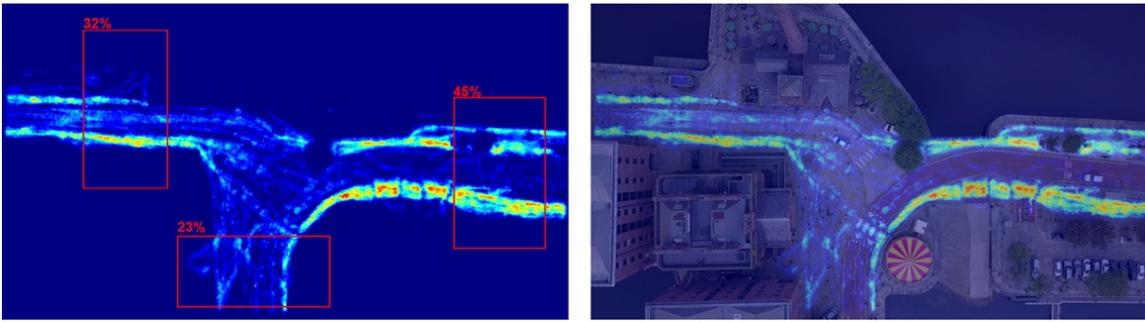
Figure 16: Heat map of Albert dock(self-study).

4.3.6 The Experimental Project

Based on the research findings, the author developed an ideal conceptual model presented it in Virtual Reality (VR) format. In order to establish a comparative basis for the study, an existing design for Albert Dock was also rendered in VR format. The objective of this experimental endeavour was to ascertain the validity of the obtained outcomes. The conceptual design was assessed and contrasted against the existing design using both self-report and machine assessment techniques. Within academic literature, methods for evaluating emotional responses can be broadly categorised into two groups: self-report techniques, in which subjects self-assess their emotional states through questionnaires, and machine assessment techniques, which involve measuring various physiological parameters of the human body (Dzedzickis, Kaklauskas and Bucinskas, 2020). This study sought to employ both methodologies in order to enhance the reliability of the research findings.

The study commences by enlisting participants who are representative of the population targeted by the urban regeneration project. The sample comprises 18 healthy volunteers, all from stakeholder groups associated with the urban regeneration endeavour. Specifically, there are 7 visitors connected to urban regeneration sites, 6 designers and design-related academic researchers, 3 project leaders, and 2 government officials. The age range of participants from 21 to 50 years old. Before engaging in the experiment, participants receive a comprehensive briefing on the study's purpose, procedures, and ethical considerations. Subsequently, they are required to provide their informed consent by signing a consent form prior to participation.

Galvanic Skin Response Technique

Machine assessment techniques for automatic emotion recognition encompass a range of popular methods, including electroencephalography, heart rate, blood pressure, eye

activity, motion analysis and Galvanic Skin Response (GSR) (Dzedzickis, Kaklauskas and Bucinskas, 2020).

GSR is a non-invasive and objective method for measuring emotional arousal, this physiological measure gauges emotional arousal by detecting variations in skin conductance resulting from the activation of sweat glands (Dutta et sl., 2022). When an individual undergoes an emotional reaction, such as excitement or stress, their skin conductance levels rise, a phenomenon that can be quantified using a GSR sensor. The GSR method exhibits remarkable sensitivity, capable of detecting even subtle shifts in skin conductance (Ayres et al.,2021). This characteristic renders it a potent tool for gauging emotional arousal, a trait increasingly employed in both research and clinical environments. Of particular note, GSR requires a reduced number of measurement electrodes, simplifying its integration into wearable devices. This allows for the real-time assessment of an individual's emotional state during routine activities (Sahoo and Sethi, 2015). The equipment essential for GSR measurements is uncomplicated and cost-effective. By utilising commonplace and freely available components such as ADC converters and microcontrollers, measurement devices can be constructed. Moreover, GSR generates less voluminous raw data, especially during extended monitoring periods. This streamlined data collection process facilitates quicker analysis without a heavy computational burden (Bruun, 2018). However, it is important to acknowledge that the GSR signal is modulated by sympathetic activity, a process beyond conscious control (Lidberg & Wallin, 1981). It means the GSR signal conveys the intensity of the emotional response rather than the specific emotion itself.

After a thorough evaluation and consideration of various machine assessment techniques (Table 2) (Zhan, Jiang and Guo, 2023), the GSR technique has been chosen for this study to analyse people's emotional data. This selection is based on several factors, including the practicality and feasibility of GSR, as well as its alignment with the emotional intensity data required for the study. Furthermore, GSR proves to be a cost-effective option, and the subsequent post-data analytical procedures are characterised by their simplicity and clarity, eliminating the need for specialised guidance. In summary, the utilisation of GSR technology in conjunction with self-reporting allows for a more detailed and reliable foundation for examining and interpreting emotional states.

Table 2: Characteristics of different methods.

Source: Zhan, Jiang and Guo, 2023.

Method characteristics	EEG	Blood pressure	Heart rate	Eye activity	Motion analysis	GSR
High accuracy	✓			✓		✓
Emotional intensity	✓					✓
Easy to analyse data		✓	✓		✓	✓
Real-time	✓	✓		✓	✓	✓
Cost-efficient		✓	✓		✓	✓

A Self-Report Questionnaire

A self-report questionnaire was designed with two sections: one asked individual to rate their emotions on a Likert scale, and the other used open-ended questions, allowing participants to describe their emotions in their own words. This questionnaire was based on the findings of the study and was designed on three levels of the HCED, covering participants' first perceptions of the design, as well as satisfaction, engagement, understanding, and likelihood of recommendation. The questions use formal and neutral language and are specific and clear in the aspect they are trying to measure.

The aim of this study is to compare whether the conceptual design elicits a more emotional response from the participants relative to the original design. To achieve this, two comparison projects are selected: the original spatial design of the regeneration project and a conceptual design proposal. The conceptual space design is crafted using virtual reality technology, employing software such as SketchUp and Lumion to generate a detailed 3D model. Concurrently, the original design is captured using a 360-degree camera and then converted into VR format to correspond with the scenario depicted in the conceptual design. The endeavour entails the utilisation of a Raspberry Pi in conjunction with the Grove - GSR Sensor V1.2 for the purpose of acquiring GSR data.

The experiment unfolds in two phases. In the initial phase, participants are instructed to wear a VR headset and a GSR device (Figure 17). They are presented with a plain white space to record their emotional responses, a step designed to mitigate any potential emotional fluctuations stemming from their initial exposure to virtual reality. Subsequently, participants wear both the VR headset and GSR device while engaging with the original design, recording their emotional responses. The duration of this phase varies according to the participant's viewing speed and emotional state, concluding when emotional fluctuations have largely stabilised. The same methodology is then employed to gather emotional responses to the conceptual design (Figure 18). The research team takes measures to control for external factors that could influence mood changes, ensuring a quiet experimental environment to minimize data bias. In the second part of the study,

subsequent to their VR experience, participants complete a brief questionnaire to convey their emotional feelings.
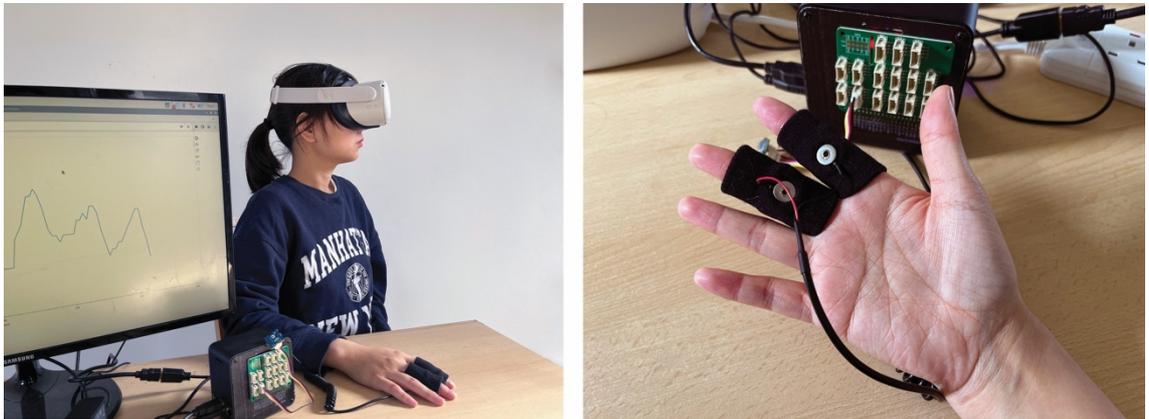
Figure 17: Participants wear both the VR headset and the GSR device(self-study).

Figure 18: Experience existing designs and conceptual designs using VR technology(self-study).

4.4   Summary of Chapter 4

This study employs the Double Diamond Design Process by applying a mixture of qualitative and quantitative research methods. The method bundles established aims to explore the issues of urban regeneration projects, as well as how HCED theory can help regenerate post-industrial sites to improve the user experience. Therefore, the methods bundled have been carefully selected due to their relevance to effectively and appropriately answering the research question.

Chapter 5: Case Studies of Post-Industrial Regeneration

The case study investigation adopts a qualitative approach, including the fieldwork, academic literature review, available documents and an internet search. The author conducted a preliminary study of industrial regeneration projects in four cities across two countries, taking photos and collecting primary information about these projects. From primary and secondary sources, the chapter investigates the national and city context, as well as the historical background and features of regeneration projects, analysing the status of the four projects in terms of three levels of Human Centred Emotional Design (HCED) to determine the factors of their success/failure.

The research takes into consideration the cultural context, as explained in Chapter 4.2, and selects on-site investigations conducted in both the UK and China. These two countries were selected for their different cultural contexts and the importance of global tourism, representing both the East and the West, each facing unique urban regeneration challenges due to their different stages of industrialisation. Additionally, based on the classification of post-Industrial buildings presented in Chapter 2.1, the study selected four projects from the two categories, representing all five types of buildings for a comparative case study, covering the London Tate Modern and Liverpool Albert Dock in the UK, Beijing 798 Art Zones and Shanghai Power Station of Art in China.

5.1 Comparative Case Studies in the UK and China

5.1.1 UK examples

The Industrial Revolution was a period of significant technological and economic change that began in the UK during the late 18th and early 19th centuries (Mohajan, 2019). This period saw the emergence of new technologies and innovations, leading to a surge in industrial activity across the country. However, in the 1960s, the UK began to experience a process known as deindustrialisation, and many factories were forced to close or relocate, leaving behind vast industrial buildings and storage areas that were no longer in use. This shift in the UK's industrial culture resulted in the transformation of once-prosperous industrial urban areas into a mass of idle industrial sites (Mounfield, 1984; Martin and Rowthorn, 1986). It was not until the concept of industrial archaeology emerged that the historical value of the industrial architectural heritage began to be recognised by the government and mainstream academic circles. As a result, the

government implemented Listed Building status on historical architecture, restricted arbitrary demolition, and strengthened the protection of industrial heritage (Dann, Hills and Worthing, 2006).

London Tate Modern

London is one of the world's most culturally vibrant cities, known for its technological readiness, economic clout, and diverse population (Freeman, 2008). The city's economy has undergone a significant shift from a primarily industrial-based economy to a post-industrial one that focuses on high-skilled, high-productivity employment (Kitson and Michie, 2014; Ferm and Jones, 2017). Leisure has become an important part of London's economy, with a quarter of the entire UK leisure economy once attributed to London (Greater London Authority, 2003). The city's cultural site is also highly valued by locals, who consider it an essential component of a high quality of life (Tavernor, 2007). Consequently, London is home to a range of renowned cultural attractions, such as the British Museum and the Tate Modern Gallery, to name but a few.

The Tate Modern in London, located in the Bankside Power Station on the south side of the Thames, is a typical example of industrial heritage regeneration. Transformed from a powerhouse into a gallery, the Tate Modern represents the new type of warehouse gallery with an old industrial shell, which is a symbol of urban and economic transformation and reuse (Dean, Donnellan and Pratt, 2010). The architectural vision was for Tate Modern to create a spectacular landmark in London and a signature building for Britain in the new millennium (Tate, n.d.b). In doing so, a new type of gallery was created; one that was accessible to a wide audience and that offered a broad visual and cultural experience. The iconic power station consists of a stunning turbine hall, a boiler house, and a single central chimney. Now, the Tate Modern is the seminal gallery of modern art, and an attraction where tourists can engage with the cavernous Turbine Hall, visit collections and exhibitions, shop, and socialise (Serota and Hyslop, 2011).

Visceral Level

Considerable attention has been given to the appearance of Tate Modern, as the proper treatment of its exterior is crucial in expressing its industrial character. The gallery consists of the original power station and the extended Switch House (Figure 19a). During the renovation, machinery and some internal structures were dismantled, leaving a brick shell supported by a steel skeleton, and a steel frame was constructed within the existing walls to form seven gallery floors (Tate, n.d.a). The renovation design reflects a strong

admiration for the original structure and demonstrates the value attached to the building's history. It is noteworthy that the chimney that played an instrumental role in the former power station (Figure 19b), is now preserved as an outstanding urban landmark that transcends its purely functional purpose and engages in a dialogue with St Paul's across the Thames. In contrast to the linear form of the power station, the Switch House is strikingly irregular in plan and cross-section, arranged as a unique pyramid-shaped tower, with its exterior structure folding into striking lines as it rises. It reinterprets the brickwork of the power station in a new way, creating a perforated brick screen (Figure 19c) that filters light during the day and glows at night.

Figure 19: The Tate Modern (Exterior) (Personal Photograph).
a. Two parts of Tate Modern: the power station and the Switch House; b. The chimney of Tate Modern as a new landmark; c. A perforated brick screen.

The entrance is the most fundamental factor in determining how the building is accepted and welcomed by the public. The Tate Modern provides a grand appearance, making visitors feel more attracted and inviting them into the structure. The gallery offers visitors a variety of entrance options, but the most dramatic way to enter is from the Turbine Hall; it adopts the concept of repositioning the entrance with a ramp to welcome visitors into the building (Figure 20a). Entering the hall, one can hear the quiet but constant roar of the transformers, which are still running and stored as echoes from the past. Some of the original features have been preserved, such as the crane and the vertical windows. The spiral staircase in concrete inside the building is highly distinctive (Figure 20b), with its form, colour, and texture subtly varying from that of the existing structure, issuing a clear invitation to climb the rather gentle flight to the next level.

The gallery's exhibition rooms vary in size and scale, but they are essentially uniform in form (Figure 20c). The Tate Modern employs both artificial lighting and natural light. The boiler house is mainly lit by artificial light, with white strip lights on

the ceiling. In the Switch House, the route is permeated by daylight after leaving the basement, the quantity and quality of light increase as one climbs upwards. On the south side of the building, the space is enlivened by the ever-changing light that is cast through the complex brickwork and into the interior of the building as the sun moves.

Figure 20: The Tate Modern (Interior) (Personal Photograph).
a. The Turbine Hall; b. The spiral staircase in the building; c. One of the exhibition rooms at the Tate Modern.

Overall, the renovation of Tate Modern retains the industrial character of the space, with the massive hall, bronze brick, and towering steel structure revealing its industrial past. The old and new elements blend naturally into the building, creating a contemporary public space without diminishing its historical presence. The Tate Modern's design is an exemplary model of how to preserve the industrial heritage of a building while creating a new, vibrant space that engages with contemporary audiences.

Behavioural Level

The Tate Modern is a remarkable example of space design at the behavioural level, which has been able to resolve the complexities inherent in accommodating a large number of works of varying genres, sizes, and mediums while simultaneously providing easy access for the visiting public to restaurants, shops, and other facilities. The demands of gallery exhibitions have completely transformed the architectural challenges facing the Tate Modern. The designers have responded by creating larger or smaller gallery room spaces that offer better facilities for the gallery.

The uniqueness of the Tate Modern lies in its creation of a diverse collection of public spaces dedicated to relaxation, reflection, group study, or private study. The Turbine Hall, in particular, is strikingly designed as a space with all the attributes of a street or public place. The design aims to create an accessible shelter that can change character depending on the time of day, the quality of light, and the number of visitors

(Dernie, 2006). Its appeal lies in its hospitality and accessibility, providing a public space for the community.

The Turbine Hall is combined with other spaces distributed throughout the building and connected by a spacious public circulation system that runs through the building. The gallery also offers visitors multiple entrances and various alternative paths so that they can choose their own routes. In essence, the functional replacement of the building has created a successful public area and an atmosphere that engages the public, and the development of new public space as offered is a significant reason for the importance of the building to the contemporary UK.

Reflective Level

The regeneration of the Tate Modern on the site of a former power station presents an interesting case study for the preservation of historic and cultural identity in modern architecture. By retaining key features of the power station's original industrial character, such as the Turbine Hall, the Tate Modern successfully integrates its modern and historical value into the surrounding site. This approach not only expresses the cultural concept of the building but also provides a glimpse into its past, present, and potential future.

The Tate Modern's use of stunning techniques and its unique atmosphere attract visitors and encourage interest in the building's story. Moreover, the Tate Modern is not an isolated structure but is seamlessly integrated into its surrounding area. As visitors move from the historical era based on the North Bank to the industrial era centred on the South Bank, the Tate Modern acts as a compass for the entire precinct, providing a transition between eras. This cultural quarter of London is a representation of British identity, with historical aspects permeating the entire area. The gallery has become a popular phenomenon in the area and occupies a crucial position as a symbolic public space on both the north and south banks of London.

The regeneration of the old power station is a gesture designed to elicit and convey an inner level of awareness and a strong human emotion towards strolling through the area. Its heritage qualities evoke a strong emotional response from visitors, as it is full of memories of the past. This emotional response can be combined with the literal qualities of the place, whether they are scientific or archaeological material layers, to create an experience that resonates with all types of audiences.

Liverpool Albert Dock

As a port city in the northwest of England, Liverpool has always been a gateway to the rest of the world. Its rich cultural and architectural heritage is undeniable, and its artistic and musical output is unparalleled (Liu, 2015). Liverpool is widely known as the pop music capital of the world, with The Beatles, one of its most famous bands, considered the most influential band of all time, attracting a huge number of visitors. In addition, Liverpool boasts more listed buildings than any other city outside London and is among the top five most visited UK cities (Statista, 2022). In recent years, the city has undergone a significant shift from business to culture in order to stimulate creativity and reinvigorate its image, following the success of other post-industrial cities (Connolly, 2013). After decades of economic hardship caused by the industrial recession, Liverpool has invested billions of pounds in regeneration projects (Kokosalakis et al, 2006).

The Albert Dock in Liverpool, which is the largest port area in Britain, represents the successful implementation of urban regeneration in Britain (Purwantiasning, Hadiwinoto and Hakim, 2014). After decay and war, these historic warehouses in the Docklands have been developed into a mixed-use cultural district, supporting retail and leisure, business, and residential functions (Simpatico, 2021). Today, the regenerated Albert Dock is the number one visitor attraction in Liverpool and the favourite multi-use attraction in the United Kingdom outside London (Royal Albert Dock Liverpool, 2023a). It has evolved into a cultural and creative park based on its industrial heritage. By integrating historic capital with modern urban functions, these redevelopment projects have breathed additional life into Liverpool's development and rendered the city highly attractive to entrepreneurs, creative businesses, and social innovation projects.

Visceral Level

It is undeniable that Albert Dock enjoys the inherent advantage of seamlessly blending an urban site with natural beauty, as the vast Mersey River has endowed the Dock with an indescribable charm. Moreover, the architecture of Albert Dock is truly distinctive. As a Grade I listed building, the regeneration of the Dock is designed with conservation in mind. The warehouse complex is required to retain the 1846 plan, the shape and colour of its roof, cast iron structure, and other cast iron products (Cossons and Hudson, 1969). These original features have been repurposed with great success, remaining a key reason why Albert Dock serves as a prime example of successful regeneration

The regenerated Albert Dock has been revived to its past bustling glory. A cluster of quaint red brick warehouses surrounds the dockyard in a rectangular layout (Figure 21a). The walls are constructed from four materials: Scottish granite in the lower part, red bricks above, and coign/voussoir made of red sandstone, with waterproof mortar for handling the details. The warehouse is topped with a cast iron frame and a black roof. At the bottom is the neatly arranged cast iron Doric colonnade, which is one of the features of the Dock, with red bodies echoing the walls, and there are load-bearing arches between every 3 or 4 columns, with some hydraulic machinery (fasteners, hydraulic arms, etc.) kept in place between colonnades (Figure 21b). The boiler and winch preserved in the Dock are part of the outdoor sculpture, but they are also a constant reminder to visitors of the Dock's bustling past (Figure 21c).

Figure 21: Royal Albert Dock 1 (Personal Photograph).
a. The dockyard in a rectangular layout; b. Some hydraulic machinery kept in place between colonnades; c. The boiler and winch preserved in the dock.

Behaviour Level

Once a hive of industrial efficiency, the area has been masterfully regenerated to develop the dockyard into a culturally themed, mixed-use tourist attraction with commercial and residential uses revitalising buildings and waterways. The unique geographical location serves as a natural platform for cultural expression, and the wide and varied spaces enable the conversion of functions. In response to Albert Dock's main objective of developing tourism, appropriate supporting facilities such as car parks, toilets, leisure benches, signage, and power distribution rooms have been arranged around the main building to ensure the best visitor experience.

The dock can be categorised into three areas based on its functions: external display space, interior display space, and single buildings. The exterior display space comprises Canning 1 and 2 piers, providing ample room for exhibiting ships while enabling visitors to acquaint themselves further with the dock's history (Figure 22a). The

interior display space, which is the warehouse area, carries on the history of the city and the dock through pictures, texts, and models, providing visitors with insights into the changes over time. The regenerated warehouse is now a complex with social, cultural, economic, and leisure functions. The single buildings within the dock area have also been repurposed successfully. For instance, the former traffic management office now serves as one of the largest independent television companies in the UK (Granada Television and the northwest regional news studio) (Figure 22b). Similarly, the hydraulic pump station, which previously created a power supply for loading and unloading cargoes, is now a cosy pub (Figure 22c).

The regenerated Albert Dock has become host to many public events, with many of the UK's most successful public events being attracted to this area. For example, in 2015, the Cunard Ocean liner company chose the Liverpool waterfront as the site to celebrate the 175th anniversary of the company, which formerly had Liverpool's Cunard building as its company headquarters (Kinsella, 2020). Similarly, in 2008, 2012, and 2018, the Belgian theatre company Royal de Luxe staged spectacular performances of their giant puppets in Liverpool. The key points in the activities were centred around the Albert Dock, which was attended by several million people and generated £60.6 million for the local economy (Igoo, 2019). The provision of space for such large public gatherings demonstrates the successful implementation of the specific regeneration scheme.

Figure 22: Royal Albert Dock 2 (Personal Photograph).
a. The Edmund Gardner docked at pier 1 and the De Wadden docked at pier 2; b. Granada Television and the
northwest regional news studio; c. The pump station.

Reflective Level

The revitalisation of Royal Albert Dock played a crucial role in Liverpool's successful bid to become the European Capital of Culture in 2008 (Stamp, 2008). Although the current regeneration efforts for the further development of the Docklands have resulted in Liverpool losing its World Heritage status in 2021 (Halliday, 2021), it must be

acknowledged that the regeneration project has contributed to enhancing the quality of the waterfront. Albert Dock has become an integral part of the city's cultural identity, with the former industrial site now serving as a hub for both tourists and locals. The unique aspect of the redevelopment of Albert Dock lies in its ability to intertwine with the daily lives of locals, thus contributing to the development of a distinct urban identity. This continues to be a reason why tourism is increasing in Liverpool and why the city has an excellent reputation as a destination. As visitors stroll from the modern city to the quaint warehouses, they experience a sense of time travel and step back into the industrial era. They can wander and immerse themselves in the rich historical atmosphere and touch the traces of that era, unconsciously triggering fascination and imagination of the docks' past.

However, the regeneration of Albert Dock has elicited varying perspectives, particularly concerning its integration with the surrounding environment. While some observers acknowledge the aesthetic appeal of the Docklands complex (Atkinson, 2007; Nagar and Tawfik, 2007), there are differing views on how well the docks blend with their surroundings. On the one hand, some argue that the distinctive red brick warehouses contrast with the modern architecture in the vicinity, creating a unique effect. On the other hand, others contend that the Docklands complex fails to integrate fully with the broader urban site and remains an isolated landmark on the periphery of the waterfront (Fageir, Porter and Borsi, 2021).

Nonetheless, on the whole, the regenerated Albert Dock supports the historic city of Liverpool and is perfectly in tune with contemporary times, capturing the concept of urban culture and serving as a vehicle for its continuation. The dock's historical significance is embodied in its rise and fall, which has endowed it with an indelible cultural connotation. As a testament to Liverpool's maritime culture, the prosperity of the industrial era at Albert Dock revives the admiration and memory of the city's heritage. The integration of cultural identity, historical heritage, and contemporary fashion in the regeneration project at Albert Dock bridges the gap between the past and the present, contributing to the development of Liverpool's distinct urban identity.

5.1.2 China examples

The regeneration of post-industrial sites in China is an important issue. China has undergone rapid industrialisation over the past few decades, resulting in a large number of post-industrial sites across the country. These sites often have high levels of pollution and pose significant environmental and health risks to nearby communities (Yuan et al.,

2020). Furthermore, as China's economy rapidly develops, it has transitioned from being factory-driven and investment-driven to innovation-driven and focused on wealth creation (Jiang et al., 2019). Seeking new drivers of growth, China has shifted from a model of expansion to one of revitalising its urban areas, particularly post-industrial city sites (Sun and Chen, 2023). This has resulted in an increasing demand for renovation projects of former factories and manufacturing sites, which can improve a city's image and provide better public services. In recent years, the Chinese government has launched several initiatives to promote the regeneration of these sites and encourage sustainable development. While progress has been made, the regeneration of post-industrial sites in China remains an ongoing challenge that requires continued efforts (Niu et al., 2018; Sun and Chen, 2023).

Beijing 798 Art Zone

Beijing, the capital of China, seamlessly blends ancient culture with modern civilisation, making it a popular destination for millions of visitors from around the world each year. As one of four ancient cities in China, Beijing boasts a rich history spanning over three thousand years and offers over two hundred tourist attractions that offer a glimpse into the city's vibrant past (Currier, 2008). Beijing's industrial development took off in 1949 with the National Industrial Plan, which led to the establishment of various industrial estates. However, after being named the political and cultural hub of China in 1978, the city's industrial sector declined (Wei and Yu, 2006). Since then, Beijing has undergone significant changes in its industrial sites and is now entering a new phase of development, characterised by a post-industrial economy where the fusion of culture and economy shapes the city's identity. Acknowledging the symbolic significance of the arts in its financial system and cityscape, Beijing is at the forefront of this transformation, with a critical mass of artists benefiting from the city's abundant cultural resources (Chen, Judd and Hawken, 2016).

One of the successful industrial regeneration projects in Beijing is the 798 Art Zone, which occupies a prime position in the city's modern cultural tourism. The former electronics factory was closed in 2001 due to the economic recession, but its regeneration retained many original features and created distinctive sites and spaces for creative businesses. The 798 Art Zone is a spontaneously born art cluster that lured a mass of artists and studios due to its low rents, then morphed into a mixed-used attraction and appealed to many investors (Waibel and Zielke, 2012).

Visceral Level

The design of the factories in 798 Art Zone follows the Bauhaus philosophy, which emphasises functionality over decoration. The designers used cutting-edge technology and design techniques of the time to create simple and robust factories. Some of them are made of cast-in-place concrete arches, with spacious interiors and sturdy columns. For instance, Pace Beijing is a jagged cast-in-place shell structure with high ceilings that allow plenty of natural light into the workplace. The arched support section of the ceiling curves upwards and downwards along a high, sloping bank or window. This pattern is repeated several times in larger spaces, creating a unique jagged appearance (Figure 23a).

The regeneration of 798 Art Zone happened spontaneously, without a uniform plan. Various artists have adapted it to their own aesthetics, creating a feast of art in all its diversity. Despite the lack of a unified design, the setting maintains its unity due to the efforts of the artists to create works of art that connect with the industrial shell. Respect for the original factory is the consistent philosophy followed for the renovation. The aged factory has been redesigned with minor modifications, preserving its identity as an industrial building while incorporating modernist elements and aesthetics.

Internal spaces have been partitioned or extended to create flexible spaces for new functions. Some spaces retain their original obsolete slogans and disused facilities, creating a sense of historical vicissitudes that impresses visitors (Figure 23b). The facade of the building has been adapted to a variety of styles, such as modern glass and steel frames, rustic wooden facades, and graffiti-covered walls (Figure 23c). The varying facades correspond to different art studios, creating a unique site in the park. In the outdoor spaces, some industrial-era installations have been preserved as public art (Figure 24a). The 798 Art Zone has an ethos that is different from traditional art districts; neither does it resemble a modern fashion aesthetic, but rather a creative cultural and industrial district that fuses traditional features with a realist style.

Figure 23: 798 Art Zone 1 (Personal Photograph).
a. The distinctive jagged roof of Pace Beijing; b. Obsolete slogans; c. Graffiti-filled facade.

Behaviour Level

The formation of the 798 Art Zone is an evolutionary process from an old factory to an artists' colony to a gallery colony. The regenerated 798 Art Zone has changed its function, not only to an art district but also to a commercial centre and office area. The park attracts the public by offering innovative design solutions that highlight its distinctive character and provide functional needs and commercial services. Today, the 798 Art Zone has evolved beyond its roots as a purely artistic centre. The updated district offers a range of amenities, including accommodation, shopping, and entertainment options. Visitors can now stay in boutique hotels or hostels and dine in restaurants that serve international cuisine as well as local delicacies. The district is also home to a variety of shops selling designer goods, handicrafts, and souvenirs, as well as cinemas, theatres, and other entertainment venues (Figure 24b).

Despite its expansion into a multifaceted commercial centre, the 798 Art Zone has retained its artistic character. The district is still home to numerous art galleries, studios, and exhibition spaces, showcasing works by both established and emerging artists. Visitors can explore a wide range of contemporary art forms, including painting, sculpture, photography, performance art, and new media art. The park's success as a commercial destination is undoubtedly linked to its reputation and popularity, which stem in large part from its distinctive character and innovative design solutions. Visitors are drawn to the variety of artworks and public art installations that populate the park, which makes for great photo opportunities and is often shared on social media (Figure 24c). As a cultural and creative industrial park, the 798 Art Zone caters primarily to a bourgeois and fashion-conscious audience (Zhan et al., 2021).

However, the development of the 798 Art Zone was spontaneous and without a unified plan, which has led to some design issues. For example, there is a lack of clear spatial planning, which has led to safety concerns for pedestrians and vehicles alike. The footpaths, pedestrian zones, and vehicle roads within the park are not clearly distinguished, and some one-way streets do not present clear instructions, which has caused traffic jams and honking. Noise pollution has also become a problem, detracting from the experience of visitors to the park.

Figure 24: 798 Art Zone 2 (Personal Photograph).
a. Industrial-era installations; b. Some shops in the park; c. Some visitors taking photographs.

Reflective Level

The 798 Art Zone is a fascinating example of how industrial heritage can be repurposed for artistic and cultural purposes. The park's old factory buildings, rusted gates, and mottled electricity poles are all preserved as testaments to the industrial era, while modern artworks and installations have been added to create a dynamic interplay between the old and the new.

Despite the district's success as an art-led regeneration project, there are concerns about the dilution of its cultural identity due to over-commercialisation. The absence of reflective design means that visitors may not fully appreciate the artistic qualities that the district has to offer, and the rise in popularity has led to rising rents and disruption of the once-quiet environment (McCarthy and Wang, 2015). Some artists have even been forced to move out, while others have felt pressure to produce artwork that caters more to popular tastes in order to afford the high costs of rent.

As the district continues to evolve, it will be important to strike a balance between commercialisation and preserving its unique artistic and cultural identity. By incorporating more reflective design and thoughtful curation, the district can ensure that visitors understand and appreciate its history and artistic significance, while still supporting the creative and commercial activities that make it a dynamic and thriving cultural hub.

Power Station of Art

Known as one of China's four directly administered municipalities, Shanghai is a hub for international trade and finance, the world's highest-earning tourist city, and is depicted as a "showpiece" for China's booming economy (Bowerman, 2014). Throughout its cultural heritage, Shanghai has experienced numerous cultural fusions and has become global through inclusiveness and openness. The city's melting pot has given rise to diversity,

which is now a defining characteristic of its culture. Shanghai was among the first Chinese cities to embrace modern industry. This began with the development of urban infrastructure in the European Concessions in the 19th century and was further accelerated by local crafts in the early 20th century. However, since 1978, both primary and secondary industries have declined, and Shanghai has transitioned to an era of modern service industries, complemented by high-end manufacturing (Chen, Judd and Hawken, 2016). The city now boasts a wide range of industrial sites that are currently undergoing renovation and upgrading due to zero growth in planned building sites. Each site has its unique history and future development directions, which require specific regeneration strategies.

One iconic building that represents Shanghai's cultural development is the Power Station of Art (PSA). The former Nancheng Power station, which had a 165-metre-high reinforced concrete chimney, has been converted into the first state-run contemporary art gallery in China. PSA now serves as a centre for public cultural activities in the city, exhibiting contemporary art, hosting collections, conducting research, facilitating socialisation, and promoting education. Additionally, the venue hosts the Shanghai Biennale, a significant international art event.

Visceral Level

The PSA building has a distinct industrial character, the limited intervention in the original space perpetuates the building's external form and internal space. Numerous original structures have been preserved intact, reflecting the identity of the industrial buildings, such as the towering chimney (Figure 25a), the generators on the platform, the huge cranes, and the four large fly ash separators on the roof (Figure 25b). These characteristic elements left over from history turn out to be real participants in a realistic context.

The renovation design also sought to blur the boundaries between public and exhibition spaces. Unlike traditional exhibition spaces, which are often closed and restrictive, the PSA building's design emphasises openness and interaction. The wide horizontal entrance (Figure 25c), resembling a grand piazza, invites visitors to explore the space and engage with the art. The large steps provide a new perspective on the artwork (Figure 26a), and the generator platform serves as an essential part of the artistic pursuit. The rooftop (Figure 26b), which opens directly from the lobby, is the largest multifunctional outdoor exhibition space and offers stunning views of the cityscape. This

design choice not only provides more space for art but also connects the exhibition space to the wider city, making it an integral part of the urban site.

Figure 25: Power Station of Art 1 (Personal Photograph).
a. The towering chimney in PSA; b. Four huge fly ash separators on the roof; c. The introduction of a wide horizontal entrance.

One of the most striking features of the renovated PSA building is the conversion of a giant chimney into an alternative spiral gallery. The chimney (Figure 26c), which is 16.8 meters in diameter and 165 meters high, is an imposing presence that dominates the space. The conversion design not only adds to the richness of the space but also constitutes the building's identity. The spiral gallery offers a unique way to experience art, with visitors spiralling up the inside of the chimney to view the exhibits. It is a clever way to use a previously unused space and adds to the building's sense of creativity and innovation.

a.	*Figure 26: Power Station of Art 2 (Personal Photograph).*
a. The large steps providing a new perspective on the artwork; b. The huge riverside rooftop; c. A giant chimney.

To combat the weak light in the factory, the designers added an atrium to the middle of the building and installed a skylight at the top. A heliostat on the outside of the skylight brings in natural light, reducing energy consumption and providing a more natural appearance to the exhibits. The natural light also eliminates the 'distance' between visitors and exhibits, creating an opportunity for human interaction with the art. The use of natural

light is a clever design choice that not only enhances the aesthetic appeal of the space but also contributes to the building's sustainability and energy efficiency.

Behaviour Level

The regenerated PSA not only has the essential functions of a museum but also serves as an urban centre for public cultural activities, including research, communication, education, services, and leisure. This 50m-high space is divided into seven floors, each divided into various functional areas. In addition to areas such as the dining room, toilets, and work areas, the PSA has 12 exhibition rooms of varying sizes to cater for different types and scales of exhibitions, as well as a library, research rooms, and lecture theatres, completing the PSA's function as an art platform for the public.

The spatial design continues the character of the industrial building space; a huge, column-free display space, which is an open space with no centre and no deliberate emphasis on spatial order. The renovation follows the philosophy of Human Centred Design, focusing on human interaction in the space and how to expand the artistic impact of the exhibits. The freedom to explore by wandering is the keynote of the layout design. The exhibition space is unsegregated, with the entrance hall, sunlit atrium, east atrium, and north atrium all linked together to form a coherent space that can be combined in any number of ways. The exhibits are arranged according to the theme of the exhibition, without a linear narrative. There are no defined entrances or exits to the galleries or visitor routes, so each exhibition is a reconfiguration of the space. This provides more possibilities for the visitor's path and increases interest in the tour. In addition, the PSA's use of technology also plays a role in behaviour design. The museum has a number of interactive exhibits that use digital and sensory technology to engage visitors and encourage them to participate actively in the exhibits. Overall, the PSA is an excellent example of how behavioural design can be applied to physical spaces. By using size, layout, and technology, the museum encourages visitors to explore, engage, and enjoy their experience in a specific way.

Reflective Level

The PSA in Shanghai is a landmark contemporary art museum that has emerged as a critical cultural institution in the city. As the first public contemporary art museum in Shanghai, PSA has been instrumental in bridging the gap between contemporary art and

the public. Beyond its status as an industrial building, PSA aspires to convey the message to the public that it is open to anyone who wishes to encounter art.

The spatial experience provided by the building and the perception, touch, and feedback of art by the general public is of great concern to the architect. The museum aims to build a bridge between contemporary art and the public, providing an open platform for the public to showcase contemporary art. It hopes to build a connection between art and real life, where art is no longer out of reach but accessible and present in daily life. This mission has been critical in establishing PSA as a cultural institution that serves the broader community.

While PSA is physically constrained by the Power Station, it benefits from its cultural context. The museum's industrial identity and artistic character have become part of the cultural fabric of Shanghai. The regeneration of PSA has helped perpetuate the memory of the city's industrial era, and the exterior features of the building, including its iconic chimney, have been preserved. As a result, PSA has become widely accepted by the public and successfully integrated into the city's culture. Overall, this historic industrial building has not only witnessed the city's dramatic change from the industrial age to the age of information technology but has also provided a rich source of inspiration for artists with its simple yet striking architecture.

5.2   Analysis and Conclusion

This chapter critically examines four regeneration projects, two from China and two from the UK, with the aim of highlighting a few iconic examples of the reuse of post-industrial sites and evaluating which key aspects from the HCED concept can provide good practice for future planners and developers. The chapter concludes with a summary of the characteristics that have been identified (Table 3).

Table 3. Summary of case study characteristics(self-study).

HCED	Key Aspects	Examples
Visceral Level	Integration of industrial elements	Tate Modern: Towering chimneys
	Preservation of historical installations	798 Art Zone: Conserved industrial structures
	Harmony with existing building	Switch House at Tate Modern: Blend of old and new materials
	Retention of unique features	Turbine Hall at Tate Modern, Spiral Gallery at PSA
Behavioural Level	novel and appealing features	Albert Dock
	Commercial activities aligned with primary purpose	Cautionary example: 798 Art Zone
	Inclusion of cultural services	Merseyside Maritime Museum at Albert Dock
	Public spaces for gatherings and events	Albert Dock; Tate Modern
	Consideration of local life and behavior	Albert Dock: Residential transformation
	Interaction between individuals and spaces	PSA: Strategic tour routes for user experience
	Incorporation of high-technology elements	Tate Modern, PSA: Utilization of innovative technologies
Reflective Level	Historical and cultural value of industrial buildings	Cultural heritage in Merseyside Maritime Museum
	Connection between regeneration project and surroundings	Tate Modern's integration with its environment
	Preservation of building's identity	798 Art Zone: Conserved industrial structures

Visceral Level

Enhancement of the industrial aesthetic of a building can be effectively accomplished by integrating prominent elements derived from its previous industrial operations, thus creating a visual narrative that emphasises its historical significance. Noteworthy exemplars of this approach can be found in architectural projects such as the Tate Modern and PSA, which have successfully incorporated towering chimneys, originally vital to their industrial function, into their new designs. Similarly, preserving installations possessing historical identity can significantly contribute to the overall industrial aesthetic. The 798 Art Zone serves as a prime illustration, as it has conscientiously conserved numerous industrial structures, while the Albert Dock showcases remnants of equipment from its bygone era as a bustling dock.

The new design should be in harmony with the existing building, which often has an emotional value to the local community. This approach acknowledges and respects the community's deep attachment to their heritage, thereby fostering a sense of pride and identity. In this regard, regeneration projects that incorporate existing materials tend to

yield superior outcomes and elicit more favourable responses, as they effectively capture the essence and character of the location. Moreover, aligning the new design with the existing building ensures visual cohesiveness, preventing gaps between old and new elements. By doing so, an aesthetically pleasing and harmonious overall appearance is achieved.

However, it is essential to note that harmony in this context does not imply replicating the existing structure entirely. Instead, it signifies the judicious use of new materials and techniques to create a dynamic interplay of contrast and unity. A notable example of this approach is exemplified by the Switch House at the Tate Modern, where the incorporation of the original building's bricks alongside innovative features like a 'breathable' wall design achieves a harmonious integration of old and new.

Instituting or retaining a spectacular feature in the design of a regeneration project serves to enhance its memorability and make a lasting impact on the viewer. By capturing the viewer's attention, this remarkable feature increases the likelihood that the design will be remembered and recognised. Moreover, such a distinctive characteristic possesses the potential to evoke emotional responses and establish a meaningful connection with the viewer. By triggering positive emotions, curiosity, or interest, this feature can effectively enhance engagement with the design. The ability to resonate emotionally with the audience plays a significant role in capturing and retaining their interest, fostering loyalty, and inspiring advocacy. Examples of successful features that have left a lasting impression include the Turbine Hall at the Tate Modern and the Spiral Gallery at the PSA.

Behavioural Level

In the realm of regenerative construction, the integration of novel and appealing features can substantially enhance the value of buildings. By incorporating these functions, the utilisation of urban areas becomes more diverse, resulting in a livelier and more dynamic environment that fosters the introduction of new activities, businesses, and amenities. A fundamental principle underlying this approach is to promote a well-balanced amalgamation of residential, commercial, recreational, and cultural spaces, catering to the varied needs and preferences of the community.

Nevertheless, it is crucial to ensure that these additions remain in line with the original purpose and trajectory of the building. The 798 Art District serves as a cautionary example where commercial activities have taken precedence over the district's initial artistic function. This case underscores the significance of considering commercial

pursuits alongside the primary objectives of renovation to prevent deviation from the original purpose.

The provision of cultural services plays a vital role in preserving the cultural value of industrial heritage buildings. When such buildings solely serve basic physical functions, their cultural significance cannot be adequately replicated. Therefore, certain reconstruction projects consider the inclusion of cultural services, such as the restoration and transformation of industrial sites into exhibition centres, as a means to honour and showcase the tangible and intangible cultural heritage associated with the site. The Merseyside Maritime Museum at the Royal Albert dock serves as an exemplar of this approach, as it serves as a testament to the historical significance and cultural heritage of the site through its restoration and repurposing.

Providing space for public gatherings, celebrations, art, and cultural events are common features in such cases. The construction of public space helps to enhance community cohesion and incorporating it into the function of the regeneration project can effectively promote community participation and cultivate residents' sense of belonging. The provision of dedicated public spaces for arts and cultural events not only preserves and showcases local traditions, heritage, and artistic expression but also provides a platform for artists, performers, and artisans to exhibit their work, celebrate diversity, and facilitate cultural exchange. Consequently, such spaces contribute to the development of a strong community identity and instil a sense of pride among community members. Moreover, by attracting tourists, the regeneration project further extends its reach and popularity, thereby positively impacting the overall influence and appeal of the endeavour.

Urban regeneration design must conscientiously consider the intrinsic characteristics of local life and behaviour. Each city and community possess its own distinct cultural background, encompassing a plethora of traditions, customs, and social norms. A profound comprehension of these cultural dimensions and their subsequent integration into the design process assists in establishing a tangible sense of place and identity. Such an approach guarantees that revitalised urban spaces align with the values of local communities, safeguard their heritage, and foster a profound sense of belonging. Through a comprehensive understanding of local lifestyles and behavioural patterns, designers can tailor spaces to address the particular requirements and activities of the community. This user-centric methodology enhances the usability, functionality, and overall enjoyment of the regeneration area. An illustrative instance of this approach can be observed in the redevelopment of Albert Dock, where consideration was given to the

residents' way of life, transforming the Docklands into a residential enclave, rather than solely a tourist attraction.

The significance of the interaction between individuals and their surrounding spaces cannot be overstated. This interaction plays a pivotal role in shaping the functionality and efficacy of architectural structures. By studying the movement patterns, perceptual processes, and experiential aspects of visitors, designers can ensure that the layout, circulation patterns, and amenities of a building are meticulously planned and tailored to meet the specific needs of its users. For instance, in the case of the PSA, various tour routes are strategically offered, allowing visitors to select paths that align with their preferences and requirements. This thoughtful consideration of user experience exemplifies the deliberate efforts made by designers to harmonise the human-space interaction and optimise the overall functionality and satisfaction derived from the architectural environment.

The incorporation of high-technology elements assumes a paramount role in the regeneration project. These elements offer architects and designers an extensive array of pioneering tools, materials, and techniques for exploration. Through the utilisation of high-tech elements, designers are empowered to transcend the limitations of conventional architectural practice, thereby engendering exceptional, avant-garde designs that captivate and ignite inspiration. The deployment of such technologies proves efficacious in augmenting the visitor experience, fostering accessibility, bolstering adaptability, and optimising overall comfort within the built environment. Notably, the regenerative design principles employed in the Tate Modern and the PSA underscore the importance attributed to leveraging novel technologies and materials to heighten the visitor experience.

Reflective Level

The preservation of local cultural qualities and the acknowledgement of historical significance are crucial factors to consider when regenerating industrial buildings. Such structures not only serve as physical manifestations of a city's historic character and cultural accumulation but also possess an inherent historical and cultural value that deserves the utmost attention and priority throughout the regeneration process. Industrial buildings often bear witness to the heritage and identity of a community, having played integral roles in the local economy and possessing historical, architectural, or cultural significance. Demonstrating respect for and actively preserving the historical essence of

these buildings not only pays homage to the past but also upholds a tangible link to our shared heritage. While written accounts of history certainly provide valuable information, the experiential encounter with a historic building can genuinely transport individuals to the past and elicit a profound sense of historical connection.

The correlation between the regeneration project and its surrounding environment constitutes a significant aspect worthy of consideration. The spatial context in which a building is situated plays a pivotal role in shaping the distinctive identity and character of a given locale. Furthermore, it serves as a crucial manifestation of the overall sense of place. Consequently, in the realm of regeneration design, it becomes imperative to account for the pre-existing architectural style, urban fabric, and cultural milieu prevalent within the surrounding area. Through the preservation of a harmonious and continuous relationship with the immediate environs, areas subject to regeneration can seamlessly integrate, thereby fostering a profound sense of place and augmenting the overall aesthetic quality. The Tate Modern exemplifies a commendable instance of a building that actively fosters integration with its surroundings, thereby cultivating a sense of communal engagement. In contrast, Albert Dock stands relatively isolated from its surroundings, failing to establish a similar level of integration.

The preservation of a building's identity holds significant importance, particularly in the context of industrial structures. It is essential to uphold the original character and historical significance of such buildings during the process of regeneration. By maintaining a harmonious connection to its industrial past, the revitalised building can effectively embody the cultural heritage of the city. Regeneration initiatives have the potential to serve as emblematic representations of a city's identity, fostering a collective sense of pride and belonging to the local community's heritage. Consequently, these projects have the capacity to gradually anchor individual identities by instilling a shared cultural identity through the emotional investment of residents.

5.3 Summary of Chapter 5

This chapter undertakes a comprehensive examination of four regeneration cases from the perspective of HCED, identifies the factors of their success or failure and concludes with a preliminary summary of the characteristics of these regeneration projects. The resultant outcome is an incipient design guide tailored for the revitalisation of post-industrial sites. The empirical foundation for this guide is established through rigorous

on-site fieldwork, ensuring the acquisition of reliable insights into the dynamics of the actual regeneration projects.

The next chapter of this study will summarise the opinions and feedbacks from stakeholders representing different professional backgrounds. This collaborative engagement is intended to enhance and refine the design guidelines, thereby providing a more comprehensive and nuanced framework for the regeneration of post-industrial sites.

Chapter 6: Preliminary results and pilot analysis

This study follows the concept of participatory design and values the views and feedback of stakeholders from diverse backgrounds. Benefiting from the AHRC Newton Fund project, a range of methods, including focus groups, questionnaires, digital footprints and interviews are employed to establish recognition of the different stakeholder agendas and viewpoints. The primary participant groups in this study are a) designers and design educators who have connections with post-industrial regeneration sites; b) target audiences of regeneration projects, such as residents, customers and interested members of the public; and c) other general stakeholders, such as government officials, project developers, tenants, and business practitioners. The findings aim to develop a shared understanding that respects the diversity of concerns amongst a broad constituency of voices on the research topic.

6.1 Design practitioners' insights

To gain insight into the regeneration of post-industrial sites and resonate with designers and design educators, this research employed focus groups and questionnaires to collect data from this cluster (refer to Section 4.3.2). Two focus group discussions were conducted for this study—one in Beijing with eight senior national-level architectural designers, and another in Shenyang with six university lecturers from Architecture Environment Design programs. Additionally, a questionnaire tailored for designers was designed and distributed to 24 participants from China and the UK. Design participants shared valuable design experience in focus groups, such as the application of materials and techniques, construction issues, and design solutions. By combining the outcomes derived from the questionnaires with the input gathered from the focus groups, the research acquired broad feedback that enriches our understanding of designers' practices. The ensuing findings are presented and discussed below.

Design practitioners have observed that regeneration projects differ from new projects in that they require careful consideration of the existing conditions of the sites; these endeavours place a particular emphasis on the preservation and safeguarding of heritage buildings, as well as the repurposing of existing facilities. The overarching goal of regeneration projects is not to embark on complete reconstruction following the total obliteration of the site but to judiciously utilise the accessible resources and, when necessary, undertake minimal disruptions during the rebuilding process. This "constraint"

presents significant challenges for designers as they strive to execute their creative concepts within these parameters.

Regarding the redevelopment of industrial sites, design practitioners expressed a strong desire to retain as many former factory components as possible, especially those with unique architectural features and historical significance that are valuable for social development. Notably, some Chinese designers have highlighted the importance of conscientiousness regarding the conservation of industrial heritage, citing early instances of urban regeneration where a lack of awareness resulted in the irreversible destruction of significant heritage resources. However, designers and educators have suggested that components devoid of discernible industrial features or those that present safety hazards that cannot be effectively mitigated should be subjected to removal.

Incorporating new design elements into regenerated sites entails a significant focus on maintaining coherence and compatibility with the original design. Designers have proposed two distinct approaches to achieve this objective. The first approach, known as restorative design, involves integrating architectural elements that align with the style of the original structure. For instance, in the case of the 1933 Old Millfun in Shanghai, the designers meticulously restored the site and utilised the same materials sourced as the original building in the new interior design. This approach resulted in a cohesive design style that harmoniously blended the new and old elements (see Figure 26a).

The second approach involves ensuring that the new design aligns with the functional purpose of the building while potentially introducing design elements that deviate from the original context to attract visitors' attention. It is essential, however, for these added elements to maintain a connection with the building's intended use, rather than detracting from it. An illustrative example can be observed in the Tate Gallery at Liverpool's Royal Albert Dock, where a vibrant and attracting sculpture has been installed (see Figure 26b). This sculpture serves as a prominent marker, guiding visitors towards the gallery and denotes a shift in the building's identity. By carefully balancing contrast and harmony, the sculpture adds value to both the building and its immediate environment while preserving its functional purpose.

Figure 27: Combining original and new elements (Personal Photograph).
a. The interior of 1933 Old Millfun, Shanghai; b. The colourful sculpture at Albert Dock.

Designers have identified numerous challenges involved in repurposing industrial buildings for civilian use. The integration of new businesses within existing industrial environments can be a complex task due to inadequate infrastructure, which often introduces uncertainties. If renovation efforts are unsuccessful, they can give rise to various hazards, such as the absence of fire escapes or weak foundations, thereby posing risks to occupants and the surrounding environment. During the process of transforming former industrial sites, several construction-related aspects, including structural dimensions, ventilation, insulation, fire suppression systems, and overall safety, must be carefully considered. Different types of businesses are subject to specific laws and regulations and adhering to national standards can contribute to the successful redevelopment of these structures, ultimately enhancing infrastructure, introducing new functionalities, and reforming the buildings' structural framework and appearance. It is imperative to safeguard the inherent characteristics and value of industrial space while ensuring compliance with relevant legal and regulatory requirements.

Designers contend that the future trend of urban regeneration hinges upon the fusion of technology and intelligence with historical and cultural heritage. Novel materials and technologies will be used to reinforce the structural integrity of obsolete building while unlocking the latent potential of the former industrial spaces. Moreover, imbuing designs with technological advancements and futuristic elements can augment user engagement and foster a more profound emotional attachment to the locale.

Ecological and environmentally conscious solutions, alongside thoughtful architectural landscaping and spatial utilisation, ought to be taken into account. Designers consistently observe that successful urban regeneration projects incorporate native ecosystems into their design schemes. Indeed, an escalating emphasis on enhancing

sustainability and fostering ecological diversity has emerged as an objective in the realm of future architectural development. On one hand, the incorporation of green energies, such as solar or wind power, and the utilisation of natural ventilation and water recycling technologies, are imperative for the realisation of intelligent and ecological design concepts that ameliorate energy efficiency and user satisfaction. On the other hand, the repurposing and preservation of existing elements constitute an additional avenue through which sustainable development can be consolidated, as such an approach minimises the need for new energy consumption and resource allocation.

The designer posits that the post-industrial site possesses a distinctive local character and emphasises the importance of respecting and appreciating the historical and cultural significance of buildings in order to augment their reflective level. Going beyond the generic design project by incorporating specificity can yield a deeper impact and create greater emotional value. The designers state that the regenerated building should reflect the original building and not be an opportunity to express the architect's originality. A proficient architect engaged in the revitalisation of industrial sites asserts that the sustainable reuse of old industrial resources is a vital component of contemporary urban cultural development and serves as a significant vehicle for urban public art.

The designer concurs that a sense of place is indispensable for individuals to establish their personal identity. The absence of this sense runs the risk of place disintegration and the erosion of civilisation. Emphasising the specificity and distinctiveness of a locality helps individuals feel grounded and secure in their connection to that place. Such emphasis on the particular attributes of a site enhances the observer's sense of place and personal identity. Consequently, the designer highlights the geographical character of post-industrial sites as a cultural factor that must be taken into account during the design process. This considerably enhances the perception of a place in terms of topography, climate, environment, and humanity, thereby fostering a sense of place. Incorporating local culture and way of life can attract residents and visitors, adding a reflective dimension of meaning.

Simultaneously, the designers propose that while the function of an old site may have been replaced, its identity as a former industrial building should be retained. This not only aids in preserving and fostering public memory but also enables individuals to comprehend their current position in history and the path that led them there. Industrial buildings possess a unique additional dimension in that they serve as sites of production and consumption, with the spaces within and surrounding them embodying social

relations and identity. Thus, comprehending the design and utilisation of space within industrial complexes is of the utmost importance. Retaining traces of their former function and showcasing how society has evolved and progressed would benefit human sensibilities. Ultimately, factories and workshops represent physical manifestations of human behaviour that necessitate recognition and commemoration. Therefore, it is imperative to respect and value the history and culture of these buildings in order to heighten their reflective significance.

6.2 Audience's perceptions and feedback

In the context of regeneration projects, the perception and feedback received from the target audience hold significant value as they offer fundamental insights into the preferences and expectations of individuals. Such insights serve as crucial design drivers for project designers during the ideation phase. With this in mind, this study employs two methods for data collection from audiences: online questionnaires and digital footprint analysis (refer to Section 4.3.3). The questionnaires were distributed via the project website, social media, and directly to specific recipients to gather anonymous feedback from the general public, the surveys targeted residents, visitors, municipal service providers, and civic organisations. In total, 116 sets of feedback were collected from participants in China and the UK. Concerning the digital footprint, researchers obtained visitor comments from third-party websites linked to the four regeneration projects: Albert Dock, 798 Art District, Tate Modern, and Shanghai Power Station. This effort resulted in the collection of over 42,445 original comments. The combination of these methods enables a comprehensive and multifaceted understanding of audience perceptions and feedback, thus enhancing the effectiveness and relevance of regeneration projects.

6.2.1 Online questionnaire

This section presents findings from questionnaires that aimed to understand audience impressions of current post-industrial regeneration projects and their expectations for future regeneration projects. The questionnaire comprised two sections: one that focused on the services or facilities offered by current regeneration projects and another that explored audience expectations for future projects.

Impressions of current regeneration projects.

In terms of the services or facilities offered by regeneration projects, audiences generally identified DIY studios and boutiques (68.1%) as the most common form of service currently offered by regeneration projects, followed by cultural industrial centres (65.52%). Below these are restaurants (50.86%) and conference/exhibition centres (46.55%). Office space and children's playgrounds are less valued, at 29.31% and 28.45%, respectively (Figure 27).
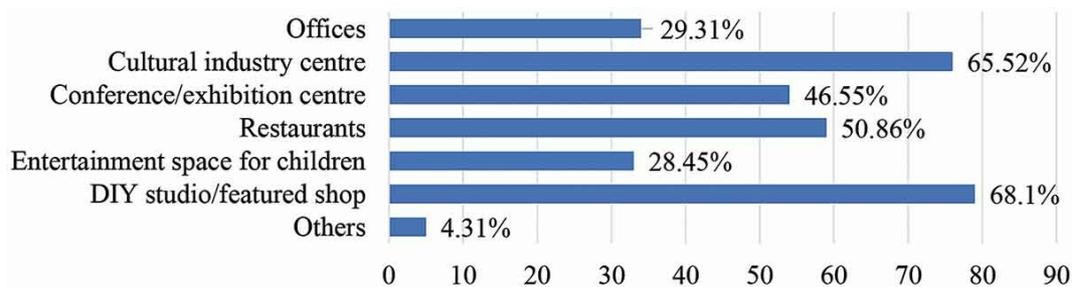
Figure 28: Services or facilities offered by existing regeneration projects(self-study).

Most people approve of current regeneration projects and believe that these projects enrich the local tourism offering as the spaces provide unique identity and remind users of their personal connection to the place. Indeed, 50% strongly agree and 43.1% agree (Figure 28). Meanwhile, 30.17% and 56.03% of people believe that the projects significantly or slightly stimulated the local economy (Figure 29).
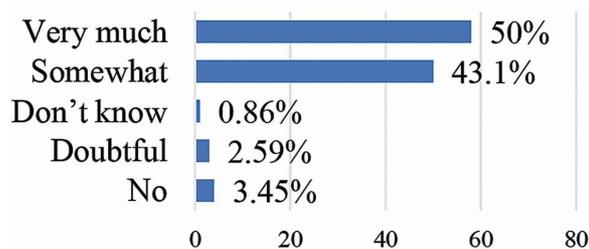
Figure 29: Enrich local tourism resources(self-study).
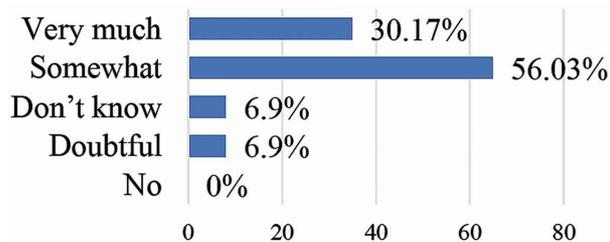
Figure 30: Stimulated local economy(self-study).

Compared with new development projects, people believe that renewing existing projects adds extra value in terms of protecting industrial heritage (52.59%), endowing the city with special features, preserving the history (58.62%), enriching local tourism resources (48.28%), blending traditional and modern features together (53.45%) and helping with environmental protection efforts (43.1%) (Figure 30).
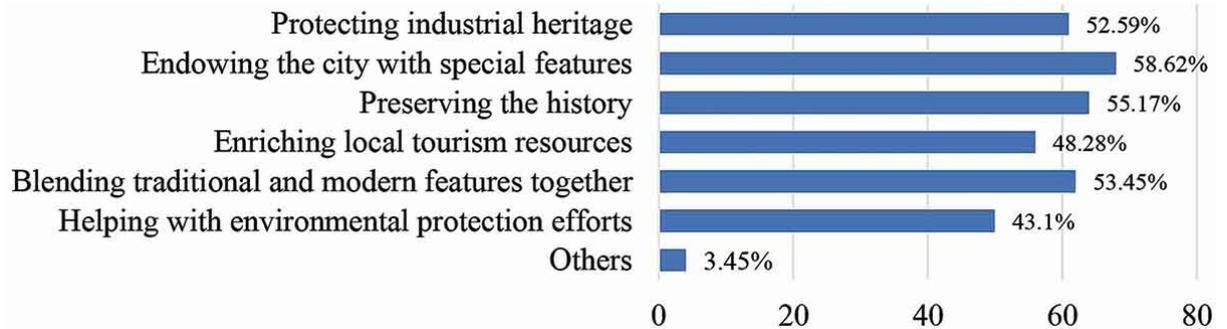
Figure 31: Regeneration projects added extra value compared to new development projects(self-study).

Expectations for future regeneration projects.

Cultural experience (78.45%) is identified as the most desirable function for audiences in post-industrial sites, followed by entertainment experiences (48.28%). However, the demand for family activities and space for small businesses are of lesser concern at 33.62% and 24.14% respectively (Figure 31).
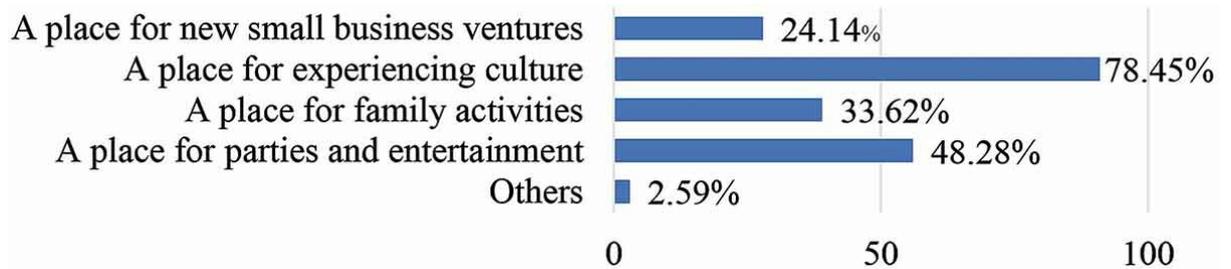
Figure 32: The ideal form of regeneration projects expected by audiences(self-study).

Preserving historical elements was ranked by 76.72% of the audience as the most important concern; thereafter 74.14% considered that highlighting or respecting the original character and style of the building is essential. Clearly, there is a desire to retain the connotations of the building's former use and thus indulge in the resulting emotions and feelings of nostalgia. Meanwhile, 69.83% value functionality and convenience and 53.45% desire convenient services for local community. Only 38.79% of respondents hope that the projects can create new jobs, which surprisingly indicates a level of altruistic or community-focused feeling and not just self-interest (Figure 32).
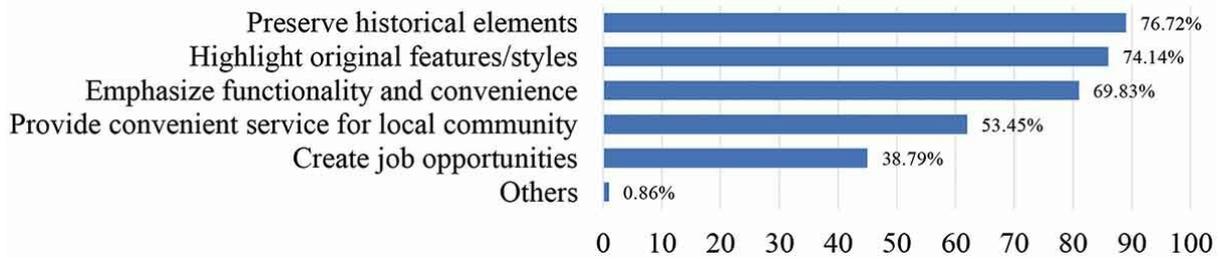
Figure 33: Expectations of future regeneration projects(self-study).

The findings suggest that current regeneration projects are somewhat too commercialised, and audiences expect more cultural experiences in post-industrial sites. Additionally, audiences expect regeneration to retain historical elements and highlight the original character and appearance of old factories, buildings, or facilities, thus providing a unique experience and enriching the city's tourism offer. The findings also suggest that there is a desire for regeneration projects to provide functional and convenient services that benefit the local community.

6.2.2 Digital footprint

This study aims to gain a deeper understanding of audience perception factors for regeneration projects by collecting visitor feedback from four different projects in China and the UK, as posted on third-party websites. Building on the post-industrial site measurement discussed in Chapter 4 (refer to 4.3.3), this study categorises visitor feedback into five factors: architectural form, non-building elements, functionality, interaction, and cultural heritage.

The high-frequency phrases used to define the five factors within this study are shown in Figure 33. The list of high-frequency phrases has been derived from visitors' reviews in each regeneration project. The letter size represents the level of frequency.
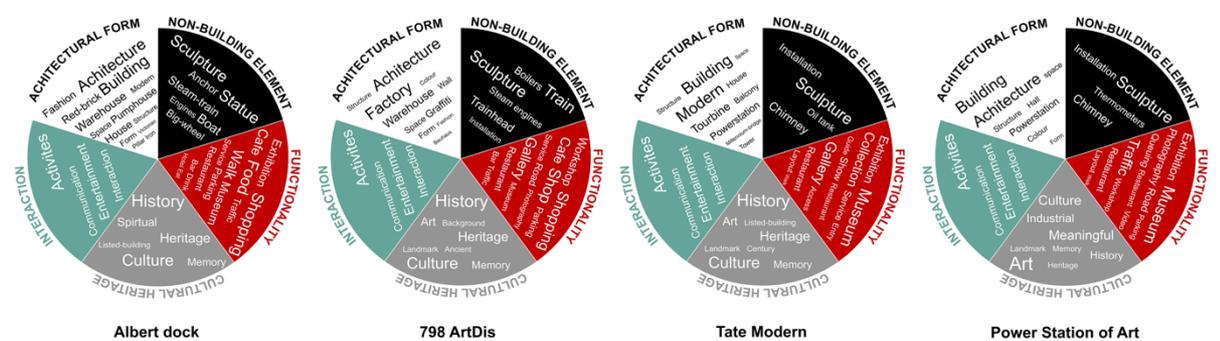
Figure 34: The five categories of high frequency phrases identified through Python(self-study).

Figure 34b demonstrates that the mixed-use projects from the two cultures share some similarities, where all the forms of line presented a "W" shape. Apparently, visitors value the functionality of the project in both Albert Dock and 798 Art Zone, while non-building elements and interaction received less attention in both projects. This suggests that visitors desire similar factors in a mixed-use project regardless of the country, although they may vary in some details.

Likewise, this outcome appears to be clear in the single-use projects. Figure 34a indicates that visitors to Tate Modern and Power Station of Art appreciate extremely similar features, where the architectural form received the most attention, followed by functionality. The non-building elements, however, did not attract much attention. The major difference between the two types of projects is that visitors place greater emphasis on functionality in mixed-use projects. In contrast, architectural form is the dominant factor in single-use projects.
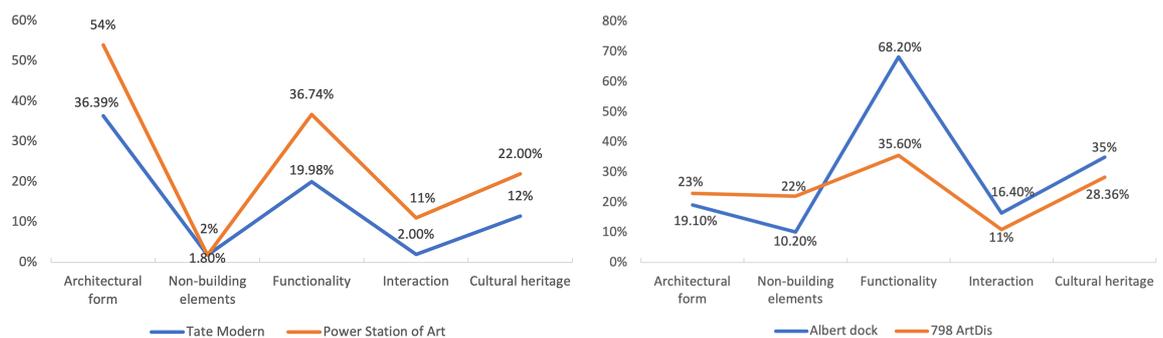
Figure 35: Visitors' expectations of different project types(self-study).
a. Single-use projects; b. Multiple-use projects.

Sentiment intensity analysis is a computational method used to identify the polarity of a given text, classifying it as positive, negative or neutral. This analysis process is often referred to as "opinion mining", deriving the opinion or attitude of a speaker. In the English language context, the Sentiment Intensity Analyzer function of NLTK was used to analyse visitors' sentiment and attitudes. For sentiment analysis in Chinese, the methodology draws on the Chinese Positive and Negative Dictionary by Li Jun of Tsinghua University. As a result, the study yielded the percentage of positive ratings associated with each design factor. Visitors' sentiment feedback is generally positive across all cases, as all cases scored above 83% (Table 3). This outcome suggests that the design and the service provided by these four regeneration projects satisfied most visitors. Specifically, Albert Dock received the highest score, with all factors rated above 93%.

Overall, the lowest score across the four projects appeared in functionality. Apart from Albert Dock, other projects score this aspect below 90%, which may suggest that functionality does not attract visitors emotionally.

Table 4: Visitors' sentiment feedback on four projects(self-study).

	Architectural form	Non-building elements	Functionality	Interaction	Cultural heritage
Albert dock	98%	97%	93%	99%	98%
798 ArtDis	91%	92%	85%	97%	92%
Tate Modern	95%	95%	83%	90%	94%
Power Station of Art	93%	96%	89%	94%	93%

The preliminary results indicate that architectural form is the primary influence on perception of the visitor in single-use projects, as it informs the visitor's first impression. Both the Power Station of Art and Tate Modern were converted from power stations with a distinctive industrial-era character, where the internal and external forms of the buildings and environment present a strong impression to visitors. In contrast, the architectural form attracted lower attention in mixed-use buildings. This may indicate that the form of preserved industrial buildings may not be attractive in mixed-use projects and may require better representation to catch the eyes of visitors.

Non-building elements offered additional attraction in mixed-use projects than in single-use ones. The abandoned boilers and winches presented in Albert Dock presented a constant reminder of the dock's past prosperity. Likewise, the pipes and locomotive preserved in 798 Art District expressed historical memory and generated a great visual impact on the visitor. While non-building elements kept in both the Power Station of Art and Tate Modern received less attention, this may be due to the extra space required for the presentation, which is difficult for single-use projects.

Functionality is essential in both types of projects, especially in mixed-use projects. This may reveal that visitors spent more time in mixed-use projects than in single-use ones due to the size of the project. The planning and construction of Albert Dock incorporated excellent infrastructure and service facilities, such as restaurants, cafes, toilets, and shops, and enabled a smoother traffic flow than its counterparts, which further reflects that 798 Art Zone lacked project planning at the beginning due to its feature of tenants being spontaneously driven by commercial factors. Likewise, many visitors complained that Tate Modern lacked signage, resulting in difficult navigation, whereas

the Power Station of Art is blamed for its long queues, and the excessively long flow of the exhibition has led to a sense of fatigue that detracts from its appeal.

Interaction received lower attention across all cases, although it received more feedback in mixed-use projects. This may indicate either a lack of interactions offered at the moment, resulting in limited opportunity for visitors to give feedback, or the current design did not satisfy the visitors. This may offer a good opportunity for designers to focus.

Cultural heritage is key to regeneration projects and a point that distinguishes them from other types of projects. The four projects have earned a sterling reputation for cultural heritage presentation. Albert Dock incorporates the Beatles Story, reminding people of the passionate scenes created by the Beatles. The 798 Art Zone kept its initial stale slogans, although visitors still accused it of being polluted by over-commercialisation, which resulted in the cultural atmosphere being diluted. Similarly, the Tate Modern and Power Station of Art retain the industrial symbols of a bygone era, which are represented using creative design solutions and fashion elements to showcase their distinctive cultural context, offering visitors a unique experience.

6.2.3 Discussion and Summary of Audience's Insights

Results from the digital footprint analysis, combined with responses to the online questionnaire, provide reliable insights into determining audience preferences and expectations. The findings are highlighted as follows:

The distinctive architectural form in post-industrial regeneration projects attracts visitors, although it may be a challenge for mixed-use projects due to their old-fashioned buildings, which require creative re-presentation. People favour a combination of historical features and atmosphere with modern design solutions. Therefore, project designers are expected to integrate old and new elements to create visual stimulation for visitors. In other words, designers need to emphasise cultural heritage by retaining or re-presenting the original form of buildings while satisfying the functional demands of the project.

Non-building elements can offer additional attractions to visitors in regeneration projects, expressing historical memory and creating a strong visual impact. This is especially advantageous in mixed-use projects. With more significant space offered in these projects, symbolised building identity and historical symbols perform functions

beyond their role as public art, offering visitors an interactive opportunity and generating intrinsic motivation.

Functionality is the fundamental factor in both types of projects. Infrastructure and public facilities offered in mixed-use projects have a direct impact on the visitor experience. These include smooth traffic flow, convenient restaurants, and featured shops, among others. Creative industrial services also provide visitors with interactive activities, establishing an emotional connection and enhancing their experience.

In addition, local cultural and historical context is essential in regeneration projects. A renovative design solution creates not only physical forms but also an expression of culture. Integrating local culture, industrial heritage, and lifestyle into the physical environment is desirable for residents and visitors.

In conclusion, the research findings indicate a shared perception and expectation regarding post-industrial projects among visitors from Chinese and British cultural backgrounds. The study reveals that visitor from both groups place value not only on the physical aesthetics and functional aspects of industrial buildings, but also on their historical significance and industrial heritage. Moreover, individuals express a preference for innovative, modern, and distinctive design solutions, while also displaying a keen interest in interactive opportunities with the surroundings and objects. These insights highlight the importance of incorporating Human-Centred Emotional Design (HCED) principles that cater to the visceral, behavioural, and reflective levels of user engagement.

6.3 Other stakeholders' insights

The present study sought to gain a comprehensive understanding of the factors that shape urban regeneration projects by soliciting insights from a range of stakeholders, including government officials, project developers, tenants, and business practitioners. To gather this information, the author conducted a series of interviews (refer to Section 4.3.4). Thirty-four semi-structured interviews were conducted in five cities (four in China, one in the UK), involving 10 Chinese government officials, 9 project developers or managers (2 from the UK), and 15 business practitioners (5 from the UK). The resulting data allowed for an in-depth analysis of the motivations and contextual factors that influence these projects, ultimately informing the design of more effective retrofit solutions.

6.3.1 Government Officials' Insights

Interviews with government officials have allowed the author to gain an in-depth understanding of the motivations that influence urban regeneration. It is apparent that sustainable development, revitalisation of communities, optimisation and remodelling of economic organisation and industrial upgrading are the motivations for relocation or transformation of enterprises in Chinese cities.

Urban regeneration has been recognised by interviewees as a key strategy for advancing sustainable development in urban areas (Liu, 2018; Wang, 2019a; Hao, 2019, Tang, 2019). This approach involves repurposing derelict land and buildings (Hao, 2019), reducing demand for peripheral development, and developing more compact cities (Wang, 2019a; Kui, 2019). However, some interviewees highlighted that previous regeneration efforts have prioritised economic objectives over environmental protection (Kui, 2019). In recent years, there has been greater recognition of the need to integrate environmental considerations into urban regeneration initiatives. This has led to a shift towards more sustainable approaches, such as industrial heritage conservation, which not only promotes the preservation of cultural and historical resources but also seeks to minimise negative environmental impacts and promote the long-term sustainability of the built environment (Wang, 2019a; Hao, 2019, Tang, 2019).

Reusing massive and aged buildings promises to revitalise communities (Ma, 2019a). It is apparent that former industrial site regeneration plans can positively impact city planning strategies, as they can create functional areas and upgrade industries, while also providing new landmarks for regional development (Ma, 2019a). According to the views of those interviewed, urban regeneration can also bring benefits such as calming traffic, increasing the availability of public facilities (Xiong, 2019; Ma, 2019), expanding urban development space, and attracting high-quality talent (Wang, 2019a; Ma, 2019a). Meanwhile, some participants are concerned that the regeneration brings some negative effects, such as the loss of jobs (Xiong, 2019). However, others argue that this impact is minimum, as much of the workforce were approaching retirement age after working at the factory for many years and younger members were offered different employment nearby, leading to no real negative impacts from factory closures (Liu, 2018; Kui, 2019). Overall, the successful regeneration of disused factories needs to consider economic benefits, such as increased employment and a more diversified economy that offers satisfying work opportunities.

Apart from capital and investment issues, the significant challenge of renovation is to attract customers and sustain profitability to enhance economic growth (Kui, 2019). Every Chinese city aims to enhance the leading local traditional business/industry (Liu, 2018; Wang, 2019a; Xiong, 2019; Ma, 2019a) by investing in the digital economy, finance and robotic technology (Hao, 2019; Kui, 2019). Renovation can create impressive landmarks, where disused equipment can be heritage, and by transferring value from industry to culture, consequently enhancing the image of the city, with the aim of attracting tourists and stimulating consumption (Kui, 2019). Therefore, the necessary design concept includes existing well-designed tourist products. Good designers are critical for preserving and transforming industrial environments carefully into cultural sites (Wang, 2019a). In order to fully realise the design, construction requires good coordination and communication between developers, suppliers, government, and local communities.

Insights from government officials have shed light on how various factors can influence urban regeneration projects. The research suggests that successful regeneration is often preceded by good governance, particularly in preserving industrial heritage and maintaining the local environment. Additionally, efficient use of existing resources and minimising waste through closed-cycle processes are crucial to the regeneration process. Skilled designers play a pivotal role in carefully preserving and transforming industrial environments into cultural sites, while pre-existing well-designed tourism products are also essential. Once the area to be restructured has been determined, future renovations should prioritise functional diversity, cultural heritage preservation, the exposure of traditional values, and the highlighting of unique characteristics. Such efforts will also aim to attract investments from local government, enterprises, and regional cooperation. The creative and cultural industries can then capitalise on emerging trends, technologies, and growth markets, further fuelling regeneration efforts.

6.3.2 Project Developers' Insights

Project developers often have a clear vision for regeneration projects. There are two types of project developers in this sector but they play similar roles of management. One acts as a department or subsidiary company of a large group (property owner); another is an independent company who offers professional services for managing the project/business. In this research, the team interviewed four from each type of developer. Four interviewees

have creative industry experience or design backgrounds; others are in a pure management role but have a passion for working in creative industries.

Findings indicate that most redevelopments are based on former heavy industrial sites such as steel mills, foundries (Wang, 2019b), refrigeration plants (Xu, 2019), and a few are light industries, for example, a knitting mill, tannery, fashion clothing factory and print works warehouses (Abbott, 2019). Turning abandoned factories into creative business zones appears to be a desirable solution for most renovation projects. Expanding the uses of space for arts purposes and establishing art studios, historical-heritage museums and other culture-related businesses are popular: "Current business users are ranging from small start-ups who take a desk in one of our two co-working spaces, through to a fast growing make up brand 'Sample Beauty', who has outgrown two incubator spaces and now taken a larger unit where she can grow" (Abbott, 2019). Likewise, 'Incubators' and Small and Medium-Sized Enterprises (SMEs) are also typical tenants of Chinese projects. Design/photography studios, DIY shops and coffee bars are forms of business that were mentioned by most Chinese interviewees (Jiang, 2019). Other regular services include events and exhibition space hiring that host many different events and networks for fashion show and brand launches (Shang, 2020). Therefore, creative and service industries are the most popular regenerations in both cultures. "Generally, we like those tenants who can add interest to our community", space manager, Jason Abbott (2019), stated. "We probably wouldn't take an accountant's or solicitor's office- as an example of what we are not". Likewise, another manager, Roy Jones (2020), agreed that SMEs should be the target users for these sites- for example, the Castle Fine Art foundry in Liverpool's Baltic Triangle is the ideal.

In general, most regeneration projects benefit the area that is beyond the city. By creating an art space, the park provides a platform for cultural appreciation, leisure and entertainment for residents and visitors, and enriches their cultural life (Dong, 2019). For example, the development of Wisdom Park in Dalian China recorded the urban regeneration process; utilising the relics of the former factory, the renovation created a regional cultural landmark and expanded public activity spaces (Xu, 2019). In the UK, Liverpool's The Tapestry fashion district won the Inspired Spaces North award, 2018, and has thereafter hosted delegations from London School of Economics, the Portuguese fashion trade and Norwegian regeneration experts (Abbott, 2019). The Tapestry manager now plans to develop new spaces and activities: "From there the focus will be on developing the community and keeping momentum going to bring more creative

businesses to the District" (Abbott, 2019). Similarly, aided by the British Council, a group of Russian officials visited the Baltic Triangle in Liverpool, asking for advice on revitalising such cities. The manager, Roy Jones (47), hosted the group of twelve Russians for three weeks and made extensive explorations of the Baltic Triangle and other areas of Liverpool. Later, Roy was also invited to Russia as a Consultant to Moscow and Krasnoyarsk, where he worked with local politicians, artists, craftspeople, and citizens (Jones, 2020).

UK developers work closely with local governments. The Liverpool Fabric District Community Interest Company (CIC) was formed to develop conversations with the city. They host monthly meetings to progress matters affecting the area and receive great support from various councillors and council employees (Abbott, 2019). The Baltic Triangle in Liverpool, (another CIC), however, appears to discourage politicians' involvement. The interviewee argued that the regenerated area should be used by creatives, instead of for construction of high-volume student accommodation supported by local councillors, that often exhibit poor specifications and are built on the minimum legal allowances. Single living should not be the goal; instead, families should be encouraged (Jones, 2020). Not every Chinese developer works closely with government, unless the sites are identified as a key project by the local government, and/or the project was listed as a new urban cultural landmark. Keeping in line with the government plan will ensure full support from the city (Xu, 2019; Jiang, 2019).

In China, a favourable location, high quality services and well-designed public spaces/facilities are factors that attract tenants and new users (Ma, 2019b). Furthermore, some developers offer the government's preferential tax policies for their tenants. Others attract tenants by forming an alliance of enterprises, to supply the members with some free services and resources (Xu, 2019). While in the UK, tenants are attracted through word of mouth and social media, and investment is courtesy of bank loans (Abbott, 2019). The restructuring of abandoned factories, retaining their heritage features, granting old buildings/spaces with new functions and integrating new environments appears to be a great challenge (Ma, 2019b). However, others believe cross-disciplinarity and fusion of cultures are more difficult (Wang, 2019b). Practically, the cost of regeneration requires more capital, talents and physical resources compared with conventional project developments (Wang, 2019b; Jiang, 2019). Therefore, in order to reduce cost, Abbott (2019) has adopted many roles and juggled workload to ensure that work and health and safety regulations are all undertaken. He completes marketing for and secures tenants,

arranges for the completion of legal documents, helps the tenants to move in and co-ordinates their business fit-out. Besides this, his role as Chair of the Fabric District CIC has its own challenges which are again down to manpower as it is a voluntary organisation.

6.3.3 Tenant and Business Practitioners' Insights

Fifteen business practitioners and tenants were interviewed, with businesses including three design studios, nine crafts/DIY shops, one bookshop, and one coffee shop. 70% of the interviewees held art or design degrees at the higher education level; the others (30%) did not have such degrees, but all had a passion for arts and related careers.

Most interviewees agreed that, unlike a newly built environment, industrial regeneration projects offer a unique site and a desirable atmosphere, which appears to be the major attraction for tenants and small business owners engaged in creative, arts, and culture-related industries. Renovated industrial sites provide them with a relaxed working environment and a hub for artists and designers to communicate with each other. They also offer a sense of community, where tenants can share resources, collaborate on projects, and build a network of like-minded individuals (Eva, 2018).

Many post-industrial regeneration projects focus on the arts and creative industries, drawing in art enthusiasts to explore and engage in cultural activities. According to Wu (2019), "People seem to be more attracted to the strong art scene in the post-industrial site." Wang (2018c) concurs, stating, "This place attracts many art lovers every year to shop and experience art/cultural activities. Locals also come here regularly for coffee or to read books in the bookstore," she further notes that the rough factory appearances with exquisite interior space create a strong visual impact for visitors, increasing customer satisfaction with design services. Li (2019) also appreciates this well-designed environment and creative atmosphere pleases him greatly as it matches his brand. Dodd (2019), coming from Liverpool's Baltic Triangle, a developing creative cultural district, and feels that "Being located amongst other creative practitioners is important to us".

Research data indicates that current services offered at renovation projects are satisfactory in both cultures. Dodd (2019) states that "I think that everything here is running very well and can think of no other suggestions". Holmes (2019) concurs: "The landlords have been very supportive. They do wish to improve the area and see the Studio as a positive thing". This is also noted by Threlfall (2019): "A great thing is that our landlords inhabit the buildings on a daily basis that demonstrates they are invested in the

buildings and clearly understand the local context. Therefore, seeing a landlord's motivation is key to a tenant's sense of trust". In addition, other provisions, for example comfortable size, affordable price, safety and good location with convenient parking space are also concerns for tenants and users from both cultures. Feedback is positive from most interviewees; in particular, the rent is noted to be very reasonable for such a big space (Yang, 2019; Dong, 2020). "The landlord enables us to share the studio, which makes running the studio financially easier" (Threfull, 2019). "Our landlord has agreed to a manageable rent that helped with setting up the business. The lease is very flexible, and I can give a short notice if needs be" (Holmes, 2019). Dodd (2019) feels that "The units are affordable, as I don't pay Council Tax because of size and the rural location", and Threlfall (2019) believes that the "workshop location affords good levels of local interaction, with people physically engaging in workshop practice". "The price is much lower than it would be in a more affluent place, as the position is very central for many people to come for the workshops" (Holmes, 2019) and Dodd (2019) also notes the significance of location: "The government is trying to get more businesses into rural locations".

Keeping heritage features is important, as people like to see industrial relics. However, health and safety needs to be improved and there needs to be safety access and egress. Free parking is also very important, as visitors make a day of it to come to the sites and have lunch whilst they are shopping. There needs also be a disabled access, as some spaces are inaccessible for people with mobility difficulties. In addition, there is a demand for exhibition space for art students. Dodd (2019) asserts that "it would be good to have students' work on display and for them to be able to hire workbench space". Many Chinese interviewees comment that renovation projects focus heavily on commercial development. They suggest that reducing commercial projects and developing more cultural industries would be desirable (Wang, 2018). Placing some cutting-edge public art works in the redeveloped public space will establish a relationship between old industrial features and with new design (Shang, 2020). Likewise, Czarnecki bemoans that many UK redevelopment projects do not include artists but are geared around technology and web design companies (Czarnecki, 2019). The Baltic Triangle is the only provision in her area for artists without a commercial practice. For the future, tenants and users hope that landlords will create multiple spaces and interactive services to attract visitors; in particular, they want to attract local residents who have visited before, but would be willing to come back again (Dong, 2020). Enriching the current service chain sustainably,

to attract more cultural and creative business practitioners to set up businesses is essential (Wu, 2019), as is "upgrading management approach scientifically to benefit both the landlord and tenants" (Lin, 2020), Yang states, "I hope to grow with 1905 together, to flourish our business via both online and offline promotions" (Yang, 2019).

6.3.4 Discussion and Summary of Insights from Other Stakeholders

The discussion above establishes that different stakeholder agendas and viewpoints exist between local government policy, industry, residential and business practitioners. Findings illuminate that it is essential to reflect the diversity of concerns amongst the wider constituency of voices, and it pinpoints the development challenges of cities when respecting local culture, industrial heritage, and economic transformation. China calls for strategies for regenerating post-industrial buildings and sustainable development of cities and this paper suggests that highlighting the geographical characteristics of each city will build its unique image and distinguish it from others. This study concludes that regenerations should create a new product that combines the characteristics of both industrial resources and new formats. Findings have also identified that local government policy holders, business investors/developers and creative industry practitioners are the three major stakeholders that impact on city revitalisations. These stakeholders share similar insights in most aspects and expect to work together with a synchronous vision for redevelopments to be successful. Meanwhile, local geography, history, culture, politics, economy and ethnography have been identified as important factors that impact on project design and development during urban transformations.

In the West, government policy makers and programmes play a key role in urban renewal strategies and the transition of local economies, and developers work closely with local governments. However, there is no national government policy in China. Instead, each city has its own ambition and targets local traditional business/industry to lead the sector. Conversely, factory site redevelopment plans impact on local city planning strategy. Moreover, Chinese investment policy and the level of attention paid to nature, culture and the system are different from the West. Chinese developers place great emphasis on commercialisation, whereas those in the West value further the reuse of old industrial sites and cultural continuation.

6.4 Conclusion

This chapter critically examines the diverse perspectives of various stakeholder groups engaged in post-industrial regeneration efforts in both China and the UK. The research employed a combination of qualitative and quantitative methods to collect and analyse data from these different groups. The stakeholder factions under investigation encompassed design participants, target audiences, government officials, project developers, and tenants and landlords. While the needs of these stakeholders exhibited some variation based on their backgrounds, several common themes and concerns emerged across all parties.

The demands articulated by stakeholder groups pertaining to urban regeneration initiatives extend beyond visceral level considerations, such as the distinctive architectural style/form of the site, to encompass more intricate behavioural aspects, particularly the intended functionality of the building. Of even greater significance is the reflective level, which delves into the cultural connotations associated with the site. Human Centred Emotional Design (HCED), acknowledged as a potent instrument for regeneration, engenders a human-centric conception of opportunities that duly accommodates the community's history, culture, beliefs, and environment. HCED proactively anticipates and adapts to the needs and responses of individuals as they engage with the environment or avail themselves of services. Consequently, the resultant redevelopment endeavours enhance the overall visitor experience while simultaneously showcasing the unique geographical characteristics of each respective city.

6.5 Development of Design Drivers for The Experimental Project

Drawing on the findings of the chapter and the case studies derived from fieldwork, it can be deduced that the concept of HCED holds significant potential for guiding the process of regeneration in post-industrial areas. This design approach facilitates regenerative efforts on three distinct levels; namely, the visceral, behavioural, and reflective levels.

Visceral level design:

- Emphasise the industrial aesthetics of the building and highlight its historical value.
- When incorporating new design elements into regenerated sites, it is critical to pay close attention to maintaining consistency and compatibility with the original

design. The new design should be sympathetic to the existing architectural style or aligned with the current function of the building.

- Incorporate spectacular features that leave a lasting impression on viewers.
- Consider the existing conditions of the regeneration project site, with particular emphasis on preserving and protecting heritage buildings and reusing existing facilities.

Behavioural level design:

- Integrate new and attractive features to expand the essential functions of the industrial building.
- Cultural services play a vital role in preserving the cultural value of industrial heritage buildings.
- Provide public spaces for public gatherings, celebrations, and other artistic events.
- Foster harmony and cultural identity by carefully considering the intrinsic characteristics of local life and behaviour.
- Focus on the interaction between individuals and the surrounding space.
- Address the challenges of transforming industrial buildings into civil spaces, such as structural dimensions, ventilation, insulation, and safety.
- Promote the integration of technology and intelligence with historical and cultural heritage in urban regeneration.
- Encourage environmentally friendly and eco-friendly solutions while also considering site and spatial functions.

Reflective level design:

- Preservation of local cultural qualities and recognition of historical significance are crucial factors to consider when regenerating industrial buildings.
- Focus on the connection between the regeneration project and its surroundings to enhance the sense of place and identity of the building and its environs.
- It is important to preserve the identity of the building and retain the public memory of the former industrial site while creating new positive memories.
- The geographical character of the post-industrial site is a cultural factor that must be taken into account in the design process. This significantly enhances the perception of a place in terms of topography, climate, environment, and humanity, thereby contributing to a sense of place.

Overall, HCED offers a promising approach to transforming post-industrial sites in a holistic and sustainable manner, creating urban spaces that are not only functional but also preserve historical heritage and cultural identity. In the following sections, the HCED-based design drivers summarised in this chapter are applied to the design of an experimental project, and its effectiveness is validated.

6.6   Summary of Chapter 6

Chapter 6 presents the responses and opinions of stakeholders from a variety of backgrounds. Through analysis and summarisation of these inputs, a definitive conclusion is reached, asserting that the theory of HCED holds substantial potential as an efficacious instrument for implementing retrofitting strategies within urban regeneration design projects. Furthermore, the study's findings serve as the basis for formulating a comprehensive HCED design framework tailored specifically for the purpose of retrofitting post-industrial sites.

Chapter 7: The Experimental Project

The Albert Dock in Liverpool, UK, is chosen as the experimental subject of this study to demonstrate a novel and desirable conceptual design project based on Human Centred Emotional Design (HCED) criteria and principles. The aim of this chapter is to explore the potential of HCED for enhancing the regeneration of post-industrial sites. In this regard, the chapter briefly introduces the historical and cultural context of the Albert Dock and its significance in Liverpool's industrial heritage, along with a rationale for its selection as the experimental subject. Subsequently, the key challenges currently faced by the dock are identified through an innovative method (Smart Photo) and these findings will support the development of conceptual design prototype. Then, a design prototype is developed based on HCED criteria and principles and compared/evaluated against the existing design of the dock using both objective and subjective methods. The study's findings will be used to draw conclusions and offer recommendations for the application of HCED in the regeneration of post-industrial sites.

7.1 Selection of Sample Area

The city of Liverpool, located in the northwest region of England, is situated on the eastern bank of the Mersey River. As one of the eight core cities of England, Liverpool boasts a population of approximately 520,000 and serves as the capital of Merseyside (Sykes et al., 2013). Historically, Liverpool played a significant role as a trading port but experienced a decline in the aftermath of World War II (Rodwell, 2008). In recent years, the city has undergone a process of regeneration with a focus on conserving and redeveloping heritage sites such as industrial buildings and docklands. The redevelopment of Liverpool's Docklands, particularly the Albert Dock, has become a central aspect of the city's regeneration efforts.

As described in Chapter 5, Albert Dock is distinguished by its distinctive architectural features and historical importance, serving as a host to prominent cultural landmarks such as The Beatles, the Tate Gallery, and the Maritime Museum. Apart from London venues, Albert Dock has emerged as the preeminent mixed-use industrial heritage attraction in the UK, drawing over six million visitors annually (Royal Albert Dock Liverpool, 2023b). Moreover, it constitutes a significant component of Liverpool's UNESCO World Heritage Maritime Commerce City (Royal Albert Dock, 2023c).

By meticulously conserving the dock's original structure and appearance, Albert Dock has assumed a novel role as a historical attraction while concurrently stimulating the city's economic and social advantages (Kokosalakis et al., 2006). The revitalisation of the docklands has engendered employment opportunities and fostered economic growth within the locale. Additionally, the cultural significance associated with Albert Dock has augmented Liverpool's reputation as a heritage-based tourist destination.

As supported by prior investigations (Sadiq et al., 2003; Kostopoulou, 2013), the redevelopment of Albert Dock stands as a noteworthy exemplar of successful heritage-based tourism revitalisation. Consequently, it is frequently cited as a triumphant paradigm of post-industrial site redevelopment, owing to its historical eminence, architectural heritage, mixed-use development, adaptive reuse strategies, and contribution to waterfront rejuvenation. Given its significance, the project was chosen as an experimental subject for the present study, thereby bolstering the reliability and comprehensiveness of the findings.

7.2   Specific Issues Identified in Albert Dock

To enhance the validity of the experimental findings, an additional research technique known as Smart Photo (refer to Section 4.3.5), was developed for evaluating regeneration of post-industrial sites. The Smart Photo method collects behavioural data from visitors, which identifies potential issues that exist in the post-industrial site. It is an image-based method that acquires video data via drones and uses the Background Subtraction technique to process the data, ultimately making it possible to map tourist behaviour within the destination.

The study employed the Smart Photo method to examine Albert Dock and identify specific issues present in the dock. The findings provide heat maps of each location: the redder the colour, the higher density of tourists (Figure 36). It is evident that there are more tourist clusters at locations 1, 2, and 6. Further calculations of usage rates can be derived (Figure 37); for instance, the external roads at Albert Dock are more heavily utilised than the internal roads. Specifically, the Red Line roads have the highest usage rate, at 27.79%, while the Orange and Yellow Lines account for 22.07% and 21.8%, respectively, followed by the Blue Line at 16.51% and the Green Line the least at 11.83%.
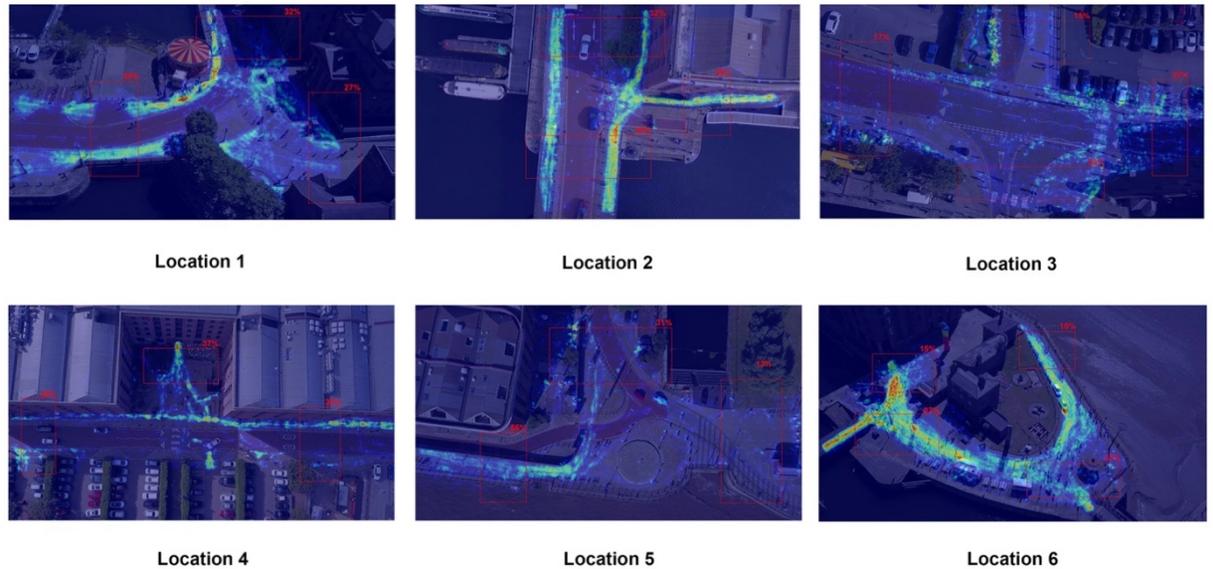
Figure 36: The heat maps at junctions(self-study).

Preliminary results reveal that there are two potential challenges at Albert Dock. First, Location 6 experiences overcrowding during peak periods, with the red-line route being substantially more heavily used than other routes. Second, the internal road (the green line) experiences lower usage, which means that few people visit or engage with the historic building, as they prefer to walk along the riverside.

It is noteworthy that most businesses of Albert Dock have their storefront facing the green line; however, the data indicates that this area has the lowest footfall, with 88% of movement occurring around the exterior. Although Albert Dock is a popular post-industrial attraction, there is still potential for spatial planning improvement, which should be given further consideration by planners and designers.

One potential solution to these issues is to construct a pedestrian bridge at the red point (Figure 37), which could enhance connectivity between Albert Dock and Canning Dock while also reducing traffic pressure. Additionally, this new bridge could attract more visitors to Canning Dock by providing new attractions, which is consistent with the future improvement of Albert Dock (Department for Levelling Up, 2023). As a result, after conducting further studies, a new experimental design will be established on Canning Dock to evaluate the effectiveness of the proposed solution (Figure 38).
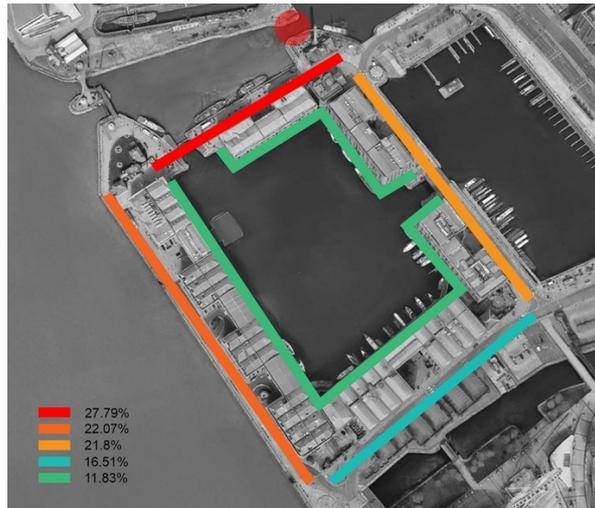
Figure 37: The usage rate for each route(self-study).

Figure 38: Location of the design prototype(self-study).

7.3   The Prototype of a Virtual Concept

This study employs virtual reality technology to generate a three-dimensional (3D) model using software tools such as SketchUp and Lumion. The proposed design philosophy aligns with the principles of HCED. Specifically, the prototype aims to address the visceral, behavioural, and reflective levels of the HCED framework.

At a visceral level, the prototype is conceptualised as an open shipping container, designed to attract the attention of and welcome visitors (Figure 39). The deliberate choice of this form ensures its independence from the surroundings while maintaining a direct link to the surrounding dockland environment. This connection is achieved through the use of materials such as rusted iron and modern glass (Figure 40). By adopting the familiar form of a shipping container, commonly seen in the docklands, the structure aims

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to enhance its acceptance among people. The lighting design of the structure is adjustable, allowing for the creation of different moods and atmospheres (Figure 41). Contrasting with its weathered exterior, the interior of the structure features modern materials, advanced technology, and cutting-edge design techniques. This design approach creates an immersive atmosphere for visitors, emphasising a stark contrast between the interior and exterior spaces.
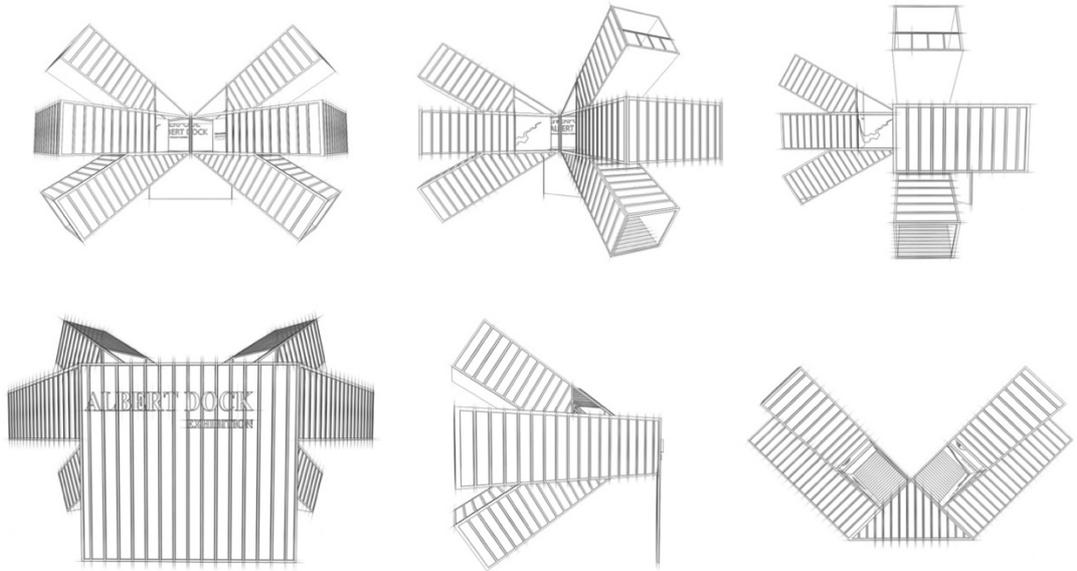
Figure 39: Form of the design prototype(self-study).

Figure 40: The materials of the design prototype(self-study).

Figure 41: The design prototype in different lights(self-study).

At the behavioural level, the design prototype exhibit is structured in a dichotomous manner, comprising two distinct pavilions, one representing the historical aspect and the other embodying the futuristic aspect (Figures 42, 43 and 44). Visitors are not restricted to a specific tour route and are free to choose which pavilion to enter. To access the historical pavilion, visitors are required to enter through a "time tunnel," which provides them with a visual journey through the dock's history. This experience is facilitated through the use of mirrors that create an infinite spatial illusion, enabling visitors to immerse themselves in the historical context of the dock. Within the historical pavilion, there is a video room that allows visitors to engage with narratives from individuals associated with the dock's past. On the one hand, the futuristic pavilion is entered through a shattered spatial configuration, which serves as an emblem of the fragmentation of space that characterises future-oriented discourses. Within the pavilion, a range of futuristic design features is juxtaposed with industrial design elements, with the express purpose of evoking a sense of curiosity and marvel among visitors who engage with the dock's future prospects. Furthermore, both pavilions are equipped with lifts that transport visitors to the top of the structure, providing a panoramic view of the dock in its current state. This design aims to promote a sense of exploration and understanding of the dock's past, present, and future for visitors.
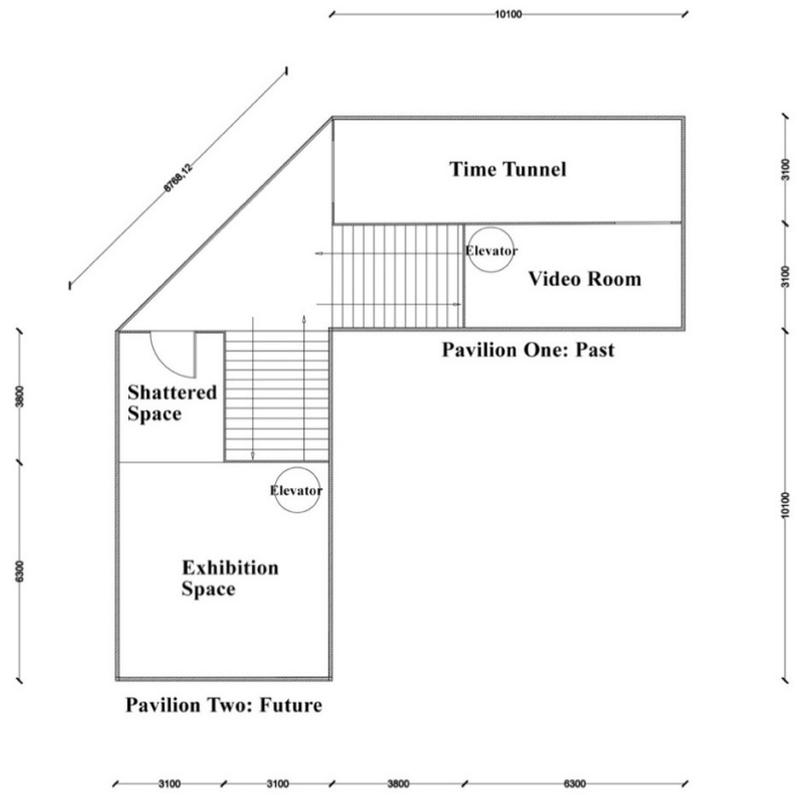
Figure 42: Plan of pavilions(self-study).

Figure 43: Entrance to the design prototype(self-study).

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| Time tunnel | Video room |
| Shattered space | Exhibition space |
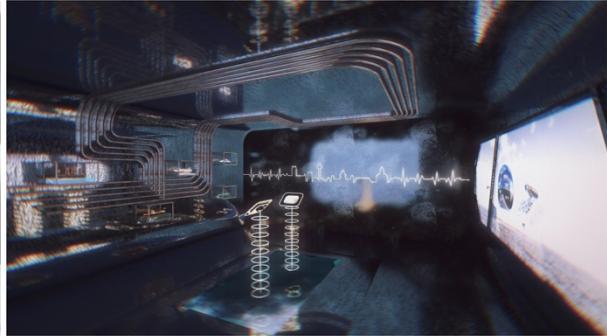
Figure 44: Interior design of the design prototype(self-study).

At a reflective level, the design prototype demonstrates a deep consideration of the structure's context, including its historical, cultural and geographical significance. The design of the prototype effectively incorporates local symbols, such as the city map, the Mersey river's shape, and the city's skyline, to provide visitors with a strong sense of place and enhance the design's contextual significance. Furthermore, the design acknowledges the industrial identity of the building by utilising the form of shipping containers that are commonly found in the docklands, thereby maintaining consistency with the surroundings. The design also incorporates some water elements to strengthen its connection with the context of the docklands. Additionally, the design theme of Time highlights the significance of the industrial heritage, where heritage serves as a testament to the passage of time. Visitors can experience the design and gain a deeper understanding and appreciation of the history and culture of the docklands.

Overall, this comprehensive design approach aligns with the principles of HCED, seeking to create a visually striking and functional structure while promoting a more profound appreciation of the unique character and importance of the site. Ultimately, the goal is to provide visitors with a more enriching and engaging experience.

7.4 The Participatory Assessment

To determine the effectiveness of the conceptual design, a participatory assessment experiment was devised, which incorporated Virtual Reality (VR) technology as a means to enhance the realism and immersion experienced by participants, thus enabling an accurate assessment of the emotional response to the design solution. The Maritime Museum located at Albert Dock was chosen as the existing design for this experiment, owing to its historical and cultural significance to the docks. Three interior scenes - the Albert Dock History Showroom, the Video Room and the Exhibition Room (Figure 45) - were captured with 360-degree cameras and transformed into VR format. These three scenes correspond to the three scenes in the conceptual design. The aim of this comparison was to evaluate the validity of the HCED theory by assessing the emotional responses of users to the existing design as compared to the concept design. The experimental results would provide evidential support for the HCED theory, in case the conceptual design elicits a greater emotional response.
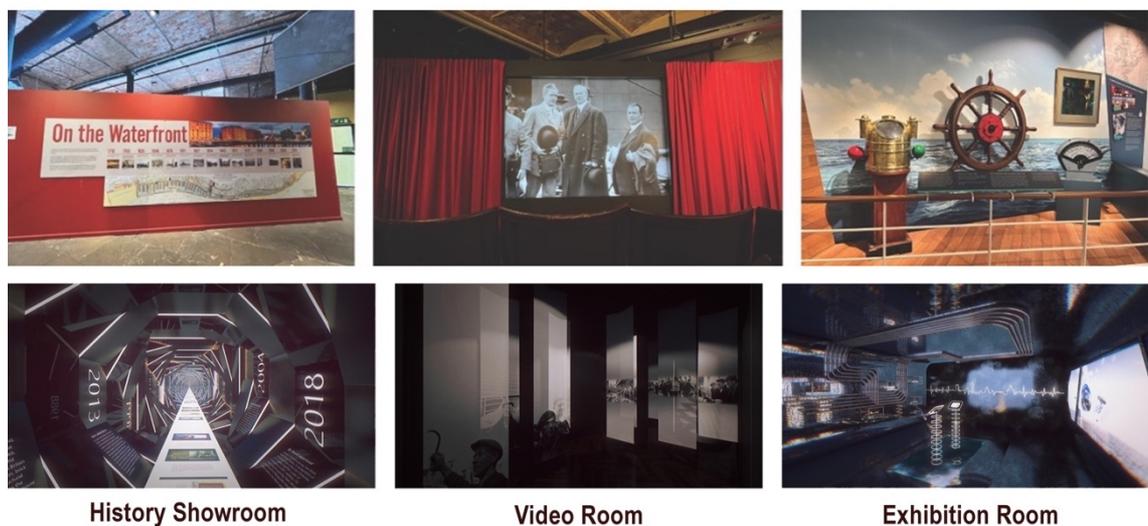
Figure 45: Comparison of existing design and conceptual design(self-study).

This study used a mixed method approach including a self-report questionnaire and a galvanic skin response (GSR) technique to collect data on participant feedback (refer to Section 4.3.6). The study starts by recruiting 18 healthy volunteers representing various stakeholder groups involved in an urban regeneration project: 7 visitors, 6 designers and researchers, 3 project leaders, and 2 government officials aged 21 to 50. Participants receive a detailed briefing on the study's purpose, procedures, and ethics before giving informed consent through a signed form before participation.

Galvanic Skin Response

The findings indicate that the GSR values exhibit high inter-individual variability, implying that the physiological state of each person is not consistent and is subject to time and situational variations. Consequently, the absolute magnitude of GSR values cannot be considered as a reliable indicator of the participants' emotional state. Instead, the study focused on analysing the fluctuating changes in GSR data to determine the emotional arousal levels of participants across different design solutions. The GSR data is presented in the form of a line graph (Figure 45), which depicts the changes in participants' emotional arousal levels across different design scenarios. Specifically, a greater magnitude of mood swings denotes a stronger emotional response to the design solution, while lower emotional responses suggest less impact of the design scenario on the participants.
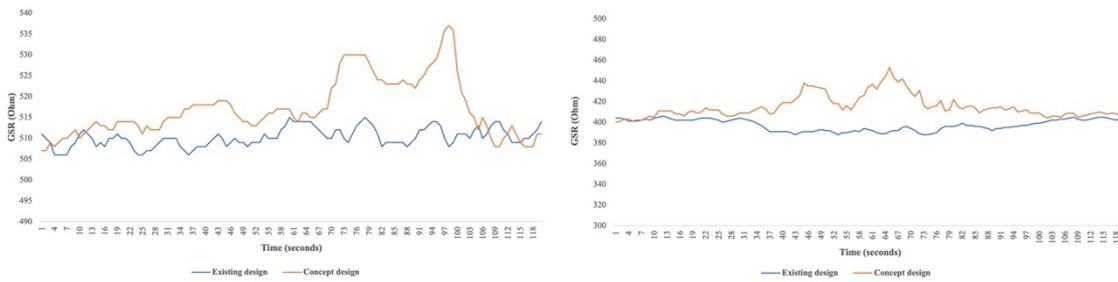
Figure 46: Sample of emotional changes in two participants(self-study).

To further clarify the results of the experiment, the emotional fluctuations of participants towards the existing design and the conceptual design were analysed. As there were multiple sets of comparison design scenarios and the primary objective of the experiment was to obtain participants' emotional responses to the overall design, to achieve this objective, the mean GSR of each participant was calculated across the different design scenarios. GSR_p can be expressed as:

$$GSR_p = (\sum_{s=1}^{ps} GSR_s)/ps$$

where *p* represents the participant, *s* represents the design scenario and *ps* represents the number of design scenarios. Subsequently, the emotional fluctuation rate EFR_p for the

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overall design was determined for each participant. It can be calculated using the following formula:

$$EFR_p = \left(\frac{\max(GSR_p) - \mu_p}{\mu_p}\right)$$

where μ_p represents the average of the GSR values within the stable mood state for each participant. Finally, the average emotional fluctuation of all participants was calculated and expressed as *EV*, using the following formula:

$$EV = \left(\sum_{p=1}^{np} EFR_p\right)/np$$

where *np* is the number of participants. The resulting *EV*-value for the existing design is 1.0721, whereas the *EV*-value for the conceptual design is 1.1939 (Figure 47). These findings indicate that participants exhibited a much stronger emotional response towards the conceptual design.
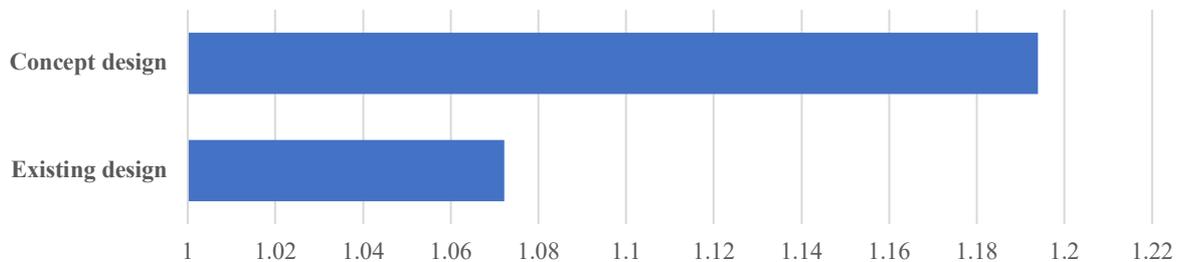
Figure 47: The intensity of participants' emotional responses to conceptual design and existing design(self-study).

Self-report Questionnaire

The second part of the study involved a questionnaire survey to obtain feedback from participants on their experience with both designs, which further validated and extended the findings of the GSR study.

For the study concerned, the results seem to suggest that a notable portion of participants expressed a higher level of satisfaction with the overall conceptual design compared to the existing design. Approximately 37% and 31% of participants mentioned they were either very satisfied or satisfied, respectively. In contrast, evaluations for the

existing design mainly fell into the fair (39%) and dissatisfied (28%) categories (Figure 48).
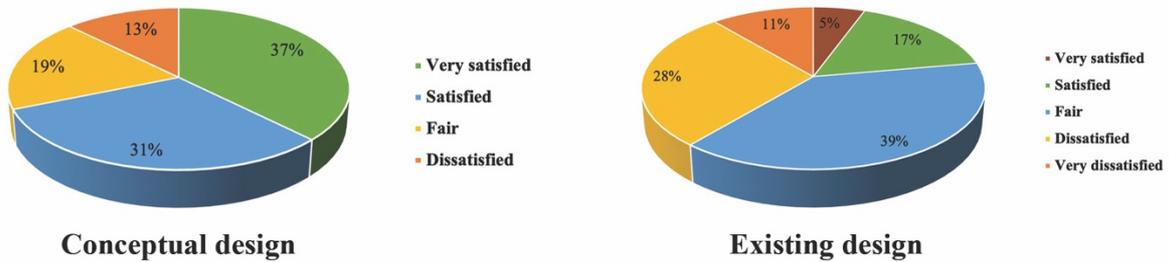
Figure 48: Participants' satisfaction with the overall design(self-study).

Participants seemed to lean towards favouring the conceptual design, rating it as more attractive and interactive than the existing design. A notable portion, more than half, found the first impression of the conceptual design to be very attractive, in contrast to only 17% who expressed similar satisfaction with the first impression of the existing design (Figure 49). The interactive elements of the conceptual design received generally positive ratings from 78% of participants. Conversely, satisfaction with the interactive elements of the existing design was lacking among most participants (Figure 50).
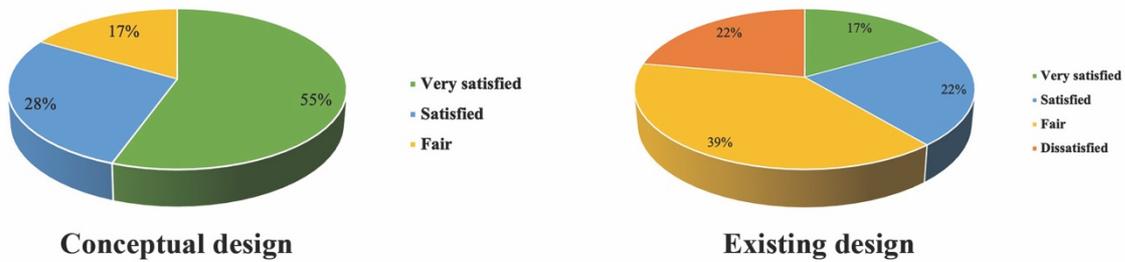
Figure 49: Participants' satisfaction with their first impression of the design(self-study).
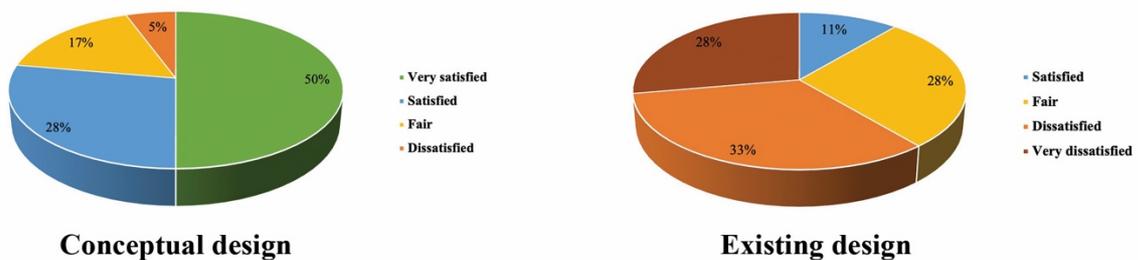
Figure 50: Participants' satisfaction with interactive elements of the design(self-study).

The conceptual design seemed to be perceived as having a relatively stronger connection to the geographical context of the building. A bit more than half, specifically 55% of participants, expressed a sense of a strong connection between the conceptual design and the geographical context of their location. In comparison, the existing design had recognition from only 44% of participants for its relevance to the geographical context (Figure 51). Furthermore, it was noted that the conceptual design was reported by the majority of participants to make it somewhat easier to empathize with and understand the culture and history behind the structure. However, in the case of the existing design, only 22% of participants found it similarly easy to connect with the cultural and historical aspects (Figure 52).
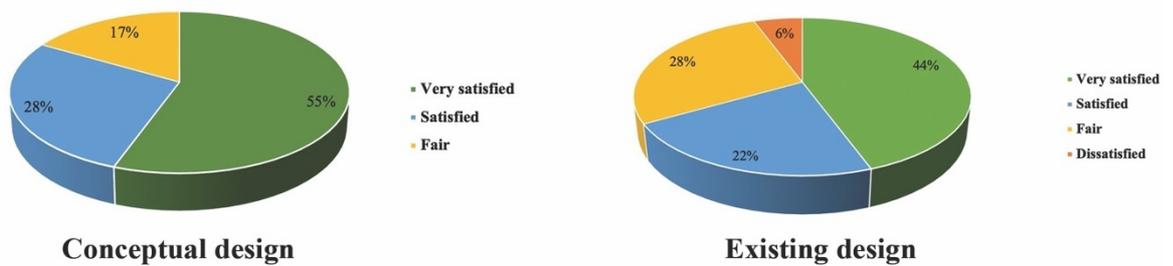
Figure 51: Participants' perception of the relevance of the design to their geographical context(self-study).
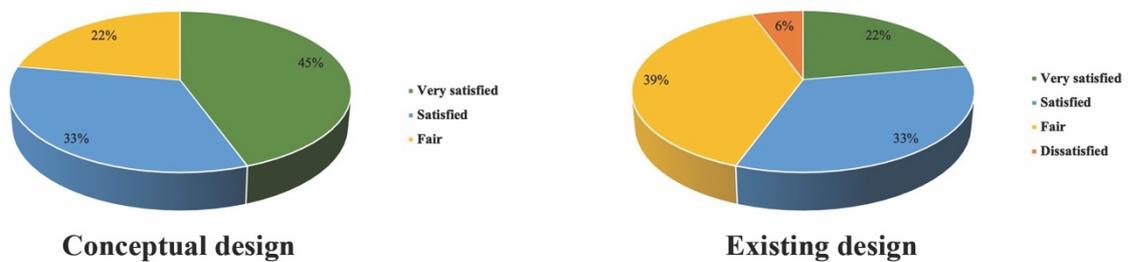
Figure 52: Participants can easily learn about the history and cultural knowledge behind the design(self-study).

Lastly, according to the data, around 90% of participants seemed inclined to recommend the concept design to others. The results indicate that the conceptual design was perceived as highly creative and provided a better experience through its theme of time travel and interactive elements, establishing a deeper connection with its context. This suggests that the conceptual design was more successful in enhancing user satisfaction and engagement, thereby significantly influencing user recommendations.

Overall, by combining the findings of questionnaire with GSR study, it can be concluded that HCED can significantly affect user satisfaction and recommendations. As a result, the incorporation of HCED principles into future regeneration projects can enhance the overall success of such projects.

7.5 Summary of Chapter 7

The primary objective of this chapter is to examine and evaluate the implementation of a design concept rooted in HCED principles within the context of regenerating post-industrial sites. The selection of the Albert Dock as the focal point for this investigation is predicated upon its historical significance as an industrial heritage site. The research also develops an innovative approach (Smart photo) to assess the potential challenges of the current design in Albert Dock, which serves as convincing support for the conceptual design solution. Using research findings as a basis, a conceptual design for the Albert Dock that incorporates HCED principles is developed.

To compare the effectiveness of the conceptual design with the existing design of the docklands, the two designs are presented in the same VR format and evaluated by participants. The evaluation was conducted using a combination of objective and subjective measures. Participants were fitted with GSR sensors to measure their emotional response to each design while also completing self-reporting questionnaires to capture their subjective impressions. Analysis of the data collected revealed differences between the two designs, with participants reporting higher levels of emotional engagement and empathy for the HCED-based conceptual design compared to the existing design.

In conclusion, this study provides strong evidence to support the adoption of HCED principles in the regeneration of post-industrial sites such as the Albert Dock. By prioritising user empathy, aesthetics, and sensory experience in the design process, more engaging and emotionally impactful environments can be created that are better able to connect with visitors and revitalise local communities. This study also highlights the value of using innovative research methods such as smart photography and virtual reality to inform the design process and evaluate the effectiveness of different design concepts.

Chapter 8: Discussion

This chapter endeavours to articulate the responses to the research question posed. The chapter systematically lays out how each research question was addressed, as well as describing the strategies used to achieve the stated objectives and scrutinising the veracity of the hypotheses initially proposed.

The core question guiding this research is how to effectively transform post-industrial sites into vibrant, liveable urban spaces with a focus on improving the overall quality of the visitor experience. This study is dedicated to investigating the implementation of Human Centred Emotional Design (HCED) in the field of urban regeneration and draws on insights from different disciplines such as art, design, psychology, sociology and engineering. The main objective of this research is to develop a comprehensive design framework for the regeneration of post-industrial sites with a focus on addressing the emotional and psychological needs of the people.

The research methodology is based on the double diamond model as a framework to study design issues in the regeneration process of post-industrial sites. To achieve the research objectives, a comprehensive literature review was conducted, including existing studies on urban regeneration, post-industrial transformation, HCED theory and design methodologies. The review aims to identify the scope and definition of HCED. Additionally, it highlights current issues faced by post-industrial regeneration projects, challenges in constructing factory transformations, and potential trends for future urban regeneration projects.

Based on the research question, a hypothesis was developed about the potential of the theory of 'human-centred emotional design' to contribute to the regeneration of post-industrial sites and to enhance the visitor experience. In order to empirically assess this hypothesis, a variety of research methods were used, including case studies centred on fieldwork to gain nuanced insights into various regeneration projects in different cultural contexts. In addition, participatory design methods such as focus groups, questionnaires, interviews and digital footprints were used to obtain the perspectives and feedback from stakeholders with diverse backgrounds.

The findings obtained from the case study and stakeholder engagement inform the development of a design framework based on HCED theory. The framework is then validated through the development of a conceptual design, which is compared with the existing design of Albert Dock. The existing and conceptual designs are created in virtual

reality (VR) for participant comparison. The feedback obtained from participants is analysed using Galvanic Skin Response (GSR) technology and self-report questionnaires to assess their emotional responses.

The experimental results indicate that participants were generally more receptive to the conceptual design based on the HCED theory and found it more appealing on all three levels. Thus, it can be concluded that the HCED-based design framework proposed in this study is effective and can significantly enhance the visitor experience in post-industrial regeneration projects.

Chapter 9: Conclusion

The final chapter is a comprehensive conclusion to the overall thesis, reviewing the contributions made by the thesis to the field of urban regeneration and architectural design. It provides a critical assessment of the inherent limitations and shortcomings of this thesis, thereby illuminating areas that merit further research in future research endeavours. In addition, this chapter is dedicated to the publication of the research findings, thus confirming the academic significance and scholarly impact of the work done.

9.1 Conclusion

(1) In order to create a human-centred regenerative design, it is important to involve users and stakeholders in the design process. This means developing a human-centred design model that allows the users of the design to be truly involved in the design process. This approach recognizes that the emotional experience of the user cannot be ignored, and good designers need to use the design outcome as a medium to bring an emotionally positive experience.

(2) Stakeholder feedback and suggestions also need to be valued in regeneration projects. The design process should develop a shared understanding that respects the diversity of concerns of a wider group of people about the research topic. This means involving stakeholders in the design process and actively seeking their input on design decisions.

(3) The study found that both Chinese and UK users share similar expectations for post-industrial regeneration projects. They want more cultural experiences, preservation of historical elements, and convenient services that benefit the local community. However, there are differences in government policies and developer priorities. In the UK, government policies and developers work closely, whereas in China, each city has its own ambitions and focuses on traditional local businesses. Chinese developers prioritise commercialisation, while Western developers prioritise site reuse and cultural continuity.

(4) The study proposes the use of Human-centred HCED as a framework for regenerating post-industrial sites. HCED can help regenerate post-industrial areas on three levels: visceral, behavioural and reflective.

- At the visceral level, HCED underscores the significance of industrial aesthetics in architectural design, particularly concerning the historical value of buildings.

When integrating new design elements into regenerated sites, it is crucial to ensure consistency and compatibility with the original design. The new elements should align with the existing architectural style or the building's current function. Additionally, it is advisable to incorporate remarkable features that leave a lasting impression on viewers. The existing conditions of the regeneration project site should be taken into account, with a particular emphasis on preserving and protecting heritage buildings and utilising existing facilities.

- At the behavioural level, HCED emphasises the integration of new and appealing features that expand the essential functions of industrial buildings. Cultural services play a vital role in preserving the cultural value of industrial heritage buildings. Therefore, providing public spaces for gatherings, celebrations, and artistic events is crucial. Harmonising with the local life and behaviour is essential for fostering cultural identity. Attention should be given to the interaction between individuals and the surrounding space. Transforming industrial buildings into civil spaces entails addressing challenges such as structural dimensions, ventilation, insulation, and safety. Moreover, the integration of technology and intelligence with historical and cultural heritage in urban regeneration is encouraged. Environmental sustainability and eco-friendly solutions should be considered alongside the functions of the site and space.

- At the reflective level, HCED underscores the importance of preserving local cultural qualities and recognising the historical significance of industrial buildings during regeneration efforts. It is essential that the sense of place and identity of the building and its surroundings should be enhanced through a connection to the broader context. Maintaining the identity of the building and retaining the public memory of the former industrial site while creating new positive memories are crucial objectives. The geographical character of the post-industrial site, including factors such as topography, climate, environment and humanity, significantly contributes to the perception of a place and should be considered in the design process.

In conclusion, the design criteria based on the HCED concept identified in this study contribute to the uniqueness of the renovation project and improve the user experience of the visit. Human-centred design models that value stakeholder feedback and consider the emotional experience of users are essential to creating sustainable and socially responsible design outcomes.

9.2 Contributions

This research project, rooted in design methodology, seeks to address a lacuna in the emotional dimensions of urban regeneration design, particularly within the context of post-industrial sites. The endeavour contributes an interdisciplinary design solution, encompassing standards, principles, and methodologies tailored for the realm of urban regeneration. Furthermore, the thesis provide a design guiled about how post-industrial sites can be transformed into vibrant and liveable urban spaces that consider the emotional needs of visitors.

The contributions of this PhD study are detailed below:

Theoretical Contributions:

- **Comprehensive Understanding of Urban Regeneration Projects:**
  Offers an extensive and nuanced grasp of the multifaceted domain of urban regeneration projects.

- **Expansion of HCED Concept to Urban Planning and Architectural Design**:
  Extends the theoretical framework and principles of HCED to the domains of urban planning and architectural design.

Practical Contributions:

- **Design Criteria for Enhanced Emotional Experiences:**
  Proposes a set of rigorously evaluated design criteria aimed at enhancing the emotional experience of visitors. This provides designers with tangible guidelines for instigating successful urban regeneration initiatives.

- **Application of Double Diamond Model Framework:**
  Develops a specific application of the Double Diamond model framework tailored to post-industrial regeneration areas. This framework serves as a strategic guide for the design process.

Overall, this study makes significant contributions to the field of urban regeneration design. Its findings are valuable for improving the social context of urban regeneration and contributing to different design fields as well as to design education. The interdisciplinary design solution presented in this thesis shares design expertise between different countries, universities, faculties, and benefits industries. Ultimately,

this work is expected to improve sustainable development, community revitalisation and contribute to economic development.

9.3   Limitations of the Study

The author of this doctoral study has identified several limitations that need to be taken into account. First, the study is limited by the small number of location-based case studies that were included in the analysis. Due to time and cost constraints, only four regeneration projects from China and the UK were studied. While each regeneration project has its unique characteristics, a larger number of case studies would have provided a more comprehensive understanding of the complexities and variations within the regeneration field. With more cases, the study's findings could have been further validated and enhanced in terms of their reliability, generalisability, and applicability.

Additionally, the effectiveness of the experimental projects based on virtual reality (VR) technology necessitates improvement. The current conceptual design merely features static 3D interior design, restricting the immersive visiting experience for participants. The inclusion of sound, temperature, and other factors could enhance the experimental results, rendering them more realistic.

Finally, the research endeavour, constrained by limited time and funding resources, exclusively permitted experimentation on a diminutive conceptual model of the regeneration project. Consequently, the scope of the experimental results remains somewhat restricted. It is anticipated that subsequent investigations will involve more intricate and exhaustive experiments concerning regeneration projects.

In conclusion, the present study has made significant contributions to the regeneration domain; however, it is essential to recognise and address these limitations. Researchers must account for these limitations while interpreting the findings, and future studies should aim to overcome these constraints, providing a more robust and reliable understanding of regeneration projects.

9.4   Further Works

There are still challenges to be addressed in terms of making the best use of emotional design in the field of urban regeneration. To overcome these challenges, it is essential to adopt a multidisciplinary approach that integrates knowledge from different disciplines,

such as psychology, engineering, design, and education. Future research in architecture will need to focus on several key areas.

One of the key areas for future research in architecture is the refinement of the concept of HCED in architectural design. To develop a more comprehensive understanding of HCED, more case studies and practical applications are necessary to complement and refine the HCED concept. Furthermore, including case studies from diverse cultural backgrounds will help extend the generality of the findings.

In addition, design criteria based on HCED need to be further developed and tested for their reliability. Future work is likely to focus on innovations in new technologies that can bring a better sense of experience to users through high-tech design.

Another key area for future research is the development and application of objective design assessment methods. The Smart-photo method proposed in this research is a promising approach for assessing the design of current regeneration projects. Future work is expected to further develop this method, such as using visitor data from Smart-photos to create a library of models that can simulate the conceptual designs of visitor models and detect potential risks. In addition, while the GSR currently detects the intensity and variability of participants' emotions, it needs to be combined with questionnaires to refine the results. In the future, more advanced techniques are likely to be utilised to detect specific emotional characteristics.

Lastly, virtual reality-based concepts have the potential to play a significant role in assessing the emotional impact of design features. To fully utilise virtual reality-based concepts, more research is necessary to develop more realistic and sophisticated virtual environments that accurately reflect people's emotional responses. For example, by providing multi-sensory (visual, auditory, and tactile) stimulation to the participants, virtual reality can help to simulate real-life scenarios and provide a more objective assessment of designs.

In conclusion, emotional design is an essential aspect of urban regeneration, and there are still several challenges that need to be addressed to effectively implement emotional design in this field. Future research in architecture will need to focus on refining the HCED concept, developing and communicating HCED-based design standards, developing objective design testing methods, and utilising virtual reality-based concepts to assess the emotional impact of design features. By adopting a multidisciplinary approach and focusing on these key areas, it is possible to create spaces

that effectively meet people's emotional needs, promoting positive emotional experiences and well-being.

9.5 Publications

This section lists the published studies conducted in the course of this research work. The research conducted within this present thesis has been demonstrated to satisfy the requirements associated with publication in an academic format, such as in the following journals:

Journal article:

- Zhan, X., Guo, F.B. and Roberts, E., 2023. Image-based research methods for mapping tourist behaviour: smart photos. *Tourism Recreation Research*, pp.1-7.
- Guo, F.B., Roberts, E., Zhan, X. and Johnston, K., 2021. Consideration of human-centred emotional design and cultural strategy in urban regeneration in China. *Journal of Urban Design*, 26(6), pp.764-780. DOI 10.1080/13574809.2021.1921569
- Guo, F. B., Roberts, E., Zhan, X., & Johnston, K. 2023. Driving renovation: A comparative research project in urban regeneration across cities in China. *Journal of Urban Regeneration & Renewal*, *17*(2), 172-189.
- Zhan, X., Jiang, B. and Guo, F.B, Emotional Responses to Spatial Design in a Regeneration Project: A Study Using Virtual Reality and Galvanic Skin Response Methodology. *Art and design review* (In press).

Conference publications:

- Zhan, X., Guo, F., Fairclough, S. and Lee, D., 2021, July. Psychological Impact on Design: Empirical Case Studies in City Regeneration of Post-industrial Sites. *In International Conference on Applied Human Factors and Ergonomics* (pp. 320-327). Springer, Cham. DOI org/10.1007/978-3-030-80285-1_38
- Zhan, X. and Guo, F., 2022. Experiencing the History and Cultural Heritage: A Tourist-Centred Map Design of Liverpool City. *AHFE International: Industrial Cognitive Ergonomics and Engineering Psychology*. 2022 Jul 21; 35:125-33. DOI org/10.54941/ahfe1001611

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Appendix A: Focus Group and Questionnaires for Designers

Focus Group of Designers

设计师专题讨论

讨论的问题尤其是涉及个人隐私的部分，您可以不回答，但是它对我们理解数据和提高未来旧工厂改造项目的质量非常有帮助，所有如果您不介意提供答案的话我们将非常感谢！These questions in particular those regarding personal nature but will help us better understand the data we collect and contribute improving industrial regeneration projects in the future. We would really appreciate you completing as many as possible.

我同意采访信息被用作研究使用/I consent to the data being used by researcher.

Site & location 地点：

Date of Focus Group 日期：

Researcher 主持人：

Participants 参加人员：

1. 您之前有做过老工业区改造项目吗？
   Have you ever carried out regeneration projects of post-industrial sites?
   □ 有 YES
   □ 否 NO

2. 设计过程中，客户最常见的要求/诉求是什么？
   What are the common requirements of the clients during the design process?

3. 最常见的空间（功能）改造方案是什么？
   What are the common spatial (functional) plans of the project?
   □文化产业基地（如影视中心等）Cultural industry center (TV & film production center)

   □会议和展览中心 Conference and exhibition hall

   □餐饮服务 Restaurants

   □儿童娱乐空间 Entertainment space for children

   □DIY 工作室、特色商店 DIY studios and specialty shops

   □其它, 请详细说明 Others, please specify

4. 您认为国内外有哪些工厂改造项目做得比较成功？为什么？
   What regeneration projects do you think are successful in the world? Why?

5. 国内外的成功案例有什么差别？为什么？

What are the main differences of the successful regeneration projects between China and the western countries?

6. 您会参考国内外成功案例吗？对您有哪些影响？

Will you take international successful regeneration projects as examples? How have they influenced you?

□会，请详细说明 YES，please specify

□不会 NO

7. 老工业区改造项目同一般性的设计项目有什么区别？

What are the differences between regeneration projects of post-industrial sites and other common design work?

8. 旧工厂改造的优势和弊端是什么？

What are the advantages and disadvantages of regeneration of old factories?

9. 把工业建筑改造成民用建筑，需要注意哪些问题？

What issues should be taken into consideration when transforming industrial buildings into civil buildings?

10. 在做此类项目时，有哪些问题需要重点考虑？

What issues should be given greater priority in such regeneration projects of post-industrial sites?

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11. 在设计过程中，是否遇到不在自己专业范围内的问题？如何解决？
    Have you ever met the problems that are irrelevant to your major? How will you solve them?
    □是，如何解决 YES, how to address?

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    □否 No

12. 在改造过程中，如何解决遗产学的问题？
    How will you solve the problem related to heritage during the whole regeneration process?

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13. 从设计师的角度，您觉得什么样的旧建筑/设施有改造价值？为什么？
    What old buildings/facilities do you think are worth regenerating from the perspective of a designer? Why?

    □具有历史价值和时代意义 with historical and modern value
    □具有城市特色 with local features
    □具有优越的地理位置 with good locations
    □具有特色的空间结构设计 with typical special design
    □其它, 请详细说明 Others, please specify

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14. 设计中，您是否考虑地域因素？为什么？
    Will you consider geographic factors in your design? Why?

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15. 设计中是否考虑新科技的应用？有哪些? Will you consider the application of new technology in your design? What are they?
    □是，请详细说明 YES，please specify

□否，为什么 NO，why

16. 未来旧工业区改造项目的设计趋势是什么？
What is the future trend of regeneration project of post-industrial sites?

Appendix C: Online Questionnaires for Audiences

关于老工业区的改造 About post-industry regeneration

我同意问卷信息被用作研究使用. 关于我们如何使用您的个人信息，请查看我们关于个人隐私声明的链接。I consent to the data being used by researcher. Please see link to the Privacy Notice for further information on how we will use your data)

1. 您的城市有哪些旧厂房改造的项目？**Are there any old industrial buildings that have become regeneration projects in the place where you live?**

2. 您觉得改造后的项目是你想要的吗？**What do you believe is the ideal renovated site?**
   - ☐ 一个聚会和娱乐的场所 A place for parties and entertainment
   - ☐ 一个适合家庭活动的地方 A place for family activities
   - ☐ 一个体验文化的地方，比如欣赏艺术品 A place for experiencing culture- such as viewing art
   - ☐ 一个经营小生意的地方 A place for new small business ventures
   - ☐ 其他, 请详细说明 Others, please specify

3. 改造后的场所提供哪些服务或设施？**What services or facilities can the renovated sites provide?**
   - ☐ 办公空间 Offices
   - ☐ 文化产业基地（如影视中心等）Cultural industry center (TV and film production center)
   - ☐ 会议和展览中心 Conference and exhibition hall
   - ☐ 餐饮服务 Restaurants
   - ☐ 儿童娱乐空间 Entertainment space for children
   - ☐ 工作室、特色商店 DIY studios and specialty shops
   - ☐ 其它, 请详细说明 Others, please specify

4. 这些服务和设施在当地受欢迎吗？**If they exist nearby, are renovated former industrial sites popular in the local area?**
   ☐ 非常 very much   ☐ 一般 somewhat   ☐ 不知道 don't know   ☐ 不确定 doubtful   ☐ 完全不 no

5. 您的城市有哪些著名的旅游资源（景点）？**What are the typical places of interest in your city?**

6. 改造后的场所是否算是一个景点或者丰富了当地的旅游资源? **Have renovated former industrial sites improved the tourism resources of the city?**
   ☐ 当然 very much   ☐ 也许是 somewhat   ☐ 不知道 don't know   ☐ 不确定 doubtful   ☐ 完全不 no

7. 该改造项目是否促进了当地的经济发展？**Have the renovated former industrial sites improved the economic development of the city?**
   ☐ 明显 very much   ☐ 有一些 somewhat   ☐ 不知道 don't know   ☐ 不确定 doubtful   ☐ 完全没有 no

8. 如果您认为促进了当地经济，是哪些方面？ **If so, in which way?**

9. 请用一个词描述您对这个项目的感受？ **Can you use one word to describe your impression of the site?**

10. 改造后的场所能否改善你的社交圈？ **Can this renovation project have potential to improve your social life?**
    ☐ 明显 very much ☐ 有一些 somewhat ☐ 不知道 don't know ☐ 不确定 doubtful ☐ 完全没有 no

11. 改造后的场所与全新开发的项目相比，有什么特点？ **Compared with newly-developed projects, what are the features of renovated sites?**
    ☐ 保护工业遗产 Protecting industrial heritage
    ☐ 赋予城市特色 Endowing the city with special features
    ☐ 保存历史传承 Preserving the history
    ☐ 丰富当地旅游资源 Enriching local tourism resources
    ☐ 传统和现代混搭的风格 Blending traditional and modern features together
    ☐ 更环保（对现有设施/材料的再利用）Helping with environmental protection efforts (by re-using materials)
    ☐ 其它, 请详细说明 Others, please specify

12. 您的城市有什么特色？（多选）**Are there any special resources in the place where you live? (multiple answers)**
    ☐ 自然风光 Natural scenery
    ☐ 节日民俗 Festivals and customs
    ☐ 特色美食 Special local food
    ☐ 民间工艺 Folk arts & crafts
    ☐ 历史古迹 Historical sites
    ☐ 传统文化 Traditional culture
    ☐ 其它，请详细说明 Others, please specify

13. 这些特色和旧工厂改造的场所之间有什么联系吗 **Is there any relationship between special resources and the regenerated industrial site/s?**

14. 您认为旧工厂改造项目应注重下列哪些因素？ **What elements should be taken into consideration in the renovation projects?**
    ☐ 保留历史符号 To preserve historical elements
    ☐ 突出/尊重原始特征/风格 To highlight/respect original features/styles
    ☐ 重视功能性和多样性 To emphasize functionality and convenience
    ☐ 为居民生活提供方便 To provide convenient service for local community
    ☐ 提供就业机会 To create job opportunities
    ☐ 其它 Others

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15. 改造后的场所，有哪些建筑外观是你喜欢或不喜欢的？Is there anything about the visual appearance of the regenerated building that you enjoy or dislike?

16. 您对当地的老工业区改造项目有什么意见/建议？What are your suggestions towards the regeneration projects of old industrial buildings?

Appendix D: Interviews for Other Stakeholders

政府工作人员访谈

访谈问题尤其是涉及个人隐私的部分，您可以不回答，但是它对我们理解数据和提高未来旧工厂改造项目的质量非常有帮助，所有如果您不介意提供答案的话我们将非常感谢！ The questions in particular regarding personal nature but will help us better understand the data we collect and contribute to improving industrial regeneration projects in the future. We would really appreciate you completing this section.

我同意采访信息被用作研究使用/I consent to the data being used by researcher.

Site & location 地点：
Date of Interview 访谈日期:
Interviewer 采访人:
Interviewee 受访人:

1. What is your job role/position and which government department are you from? 您来自什么政府部门？您的职位和工作分工是什么？

2. What are the pillar industries of your city?
   您所在城市的支柱性产业有哪些？

3. Are there other projects/sites that need to be regenerated?
   您所在城市还有多少需要改造的老工厂项目？

4. Which is the most successful project or your favourite project? Why?
   您觉得现有的改造项目里，哪个最成功或者您最认可？为什么？

5. Expectations of the project/site, and how these fit in with the city?
   政府对这类（旧工业区改造）项目有什么政策和规定，这些政策如何适应整个城市的规划？

6. Historical reasons for closing the factory/site, and does this decision have any impact upon the city?
   关闭或搬迁这些工厂的历史原因是什么，这些决定对整个城市有什么影响？

7. If any impacts exist, does the planned redevelopment of the site seek to address these issues? (the impacts could be positive or negative)
   如果有影响，这类（旧工业区改造）方案是否要解决这些问题？（这些影响会是正面的还是负面的）

8. Are there any prevailing local skillsets or employment issues? How might local skillsets be utilized within the redevelopment, or support opportunities for re-skilling local workforce?
   当地的职业分布与城市发展对职业的要求是否存在矛盾？当地主要职业如何适应城市再发展或为城市劳动力再培训提供帮助？

9. What is the future plan and ambitions for the local economy and industries?
   当地未来的经济和产业规划是什么？

10. Does the planned redevelopment support any future transportation or accommodation needs?
计划中的（这类）改造项目是否对未来交通和住宿的需求提供支持？

11. How does the plan for redeveloping the factory/site impact the local urban planning strategy for the future?
这类（旧工业区）改造项目对未来的城市规划政策有什么影响？

12. Are there details for the redevelopment already in place, such as spatial plans, business developer expectations? How investment is attracted to the site? Diversity of the businesses on site?
您是否有已经规划好的较详细的案例，比如空间设计方案或者开发商的商务提案等？该类项目是如何吸引投资的？都有什么不同的商业门类？

13. Are there any opportunities for the site to pursue a particular area of the creative/cultural industries, exploiting emergent trends, technologies or growth markets that could fuel the local economy?
是否有机会对为文化创业产业推出一个特别的区域，利用新兴趋势，技术和增长市场来助推当地的经济？

14. What is the anticipated broader impact of the project/redevelopment to the area beyond the city?
这类（旧工业区）改造项目预计会对城市以外地区（所在省，地区甚至国家范围内）有什么更广泛的影响？

15. What do you consider to be the biggest challenges or difficulties for the redevelopment?
对您来说，这类项目最大的困难或者挑战是什么？

16. What is the industrial structure of your city in the past of your city in the past &/or the future?
您的城市过去和/或未来的行业结构是？

17. What do you expect from your project？
项目会给您带来哪些回报？

Structured Interview for Project Developers

项目发展商访谈

访谈问题尤其是涉及个人隐私的部分，您可以不回答，但是它对我们理解数据和提高未来旧工厂改造项目的质量非常有帮助，所有如果您不介意提供答案的话我们将非常感谢！The questions in particular regarding personal nature but will help us better understand the data we collect and contribute to improving industrial regeneration projects in the future. We would really appreciate you completing this section.

我同意采访信息被用作研究使用/I consent to the data being used by researcher.

Site & location 地点：
Date of Interview 访谈日期:
Interviewer 采访人:
Interviewee 受访人:

1. What is the industrial sector of your organisation/company in the past, present and expected to be in the future?
   贵公司在过去和现在做什么业务，属于什么产业类型，未来的计划？

2. What is your job role within the project? What is your background and how did you come to be in this position?
   你在该项目中的职务是什么？你的专业背景是什么？

3. What used to be the function of the building that you operate? Can you tell us a bit about the building's history?
   这片场地和建筑在过去是做什么的？您能简单介绍一下它的历史吗？

4. What sort of people / businesses now use your building?
   目前是什么样的个人或公司在租用您的场地或建筑？

5. Have you got a vision for how the building/s should be used in the present and future?
   您的项目近期和远期的规划是什么？

6. Do you work closely with (government) officials in your city? How do your expectations fit in with those of the people who lead the city?
   您的工作与政府联系密切吗？您如何把企业的愿望和政府的规划取得一致？

7. Do you think that your building can make an impact on the city? If so, could you give details?
   您觉得你们的旧区改造项目对城市规划有什么影响？

8. What are the required skill sets for the future of your city? How might the skill set be utilised by the businesses / people that use your premises?
   您觉得你们城市未来需要什么样的人才和技能？这些技能对租用您的项目的个人或公司有用吗？

9. How does your project relate to the urban planning strategy of the future?
   怎样才能把你的项目与你们城市未来的规划策略关联起来？

10. Do you have any specific plans with urban design and how space should be used in your building/s?
   您对你们项目在空间规划上有什么具体的想法？

11. How do you attract new tenants and investment?
   您打算如何吸引新的租户和投资商？

12. Are there any types of businesses that you seek or reject and how do you ensure balance across the business types that rent your spaces?
   在招商引资上，您喜欢那类的企业或业务，或者拒绝哪些商业门类？您如何在即保证收入又不违反原则上保持平衡？

13. What will be the broader impact of your spaces to the area beyond the city- e.g. to the province or country?
   您觉得你们的项目（旧工业区改造）会对这座城市，省，甚至国家有哪些影响？

14. What is the biggest challenge / difficulty for the project?
   在经营该项目时，您最大的困难或者挑战是什么？

15. Are there any large global challenges that you have to consider- e.g. environmental / political / trading issues / cultural differences etc.?
   您是否需要考虑全球性的问题，比如环境、政治、贸易问题、文化差异等？

16. Did you take/think of any ideas from successful national/international examples that helping your project development in terms of business/space planning?
   在选择业务类型和空间规划方面，您是否打算或已经借鉴任何国内或国际的成功案例或者受到启发？

项目从业人员（租户）访谈

访谈问题尤其是涉及个人隐私的部分，您可以不回答，但是它对我们理解数据和提高未来旧工厂改造项目的质量非常有帮助，所有如果您不介意提供答案的话我们将非常感谢！The questions in particular regarding personal nature but will help us better understand the data we collect and contribute to improving industrial regeneration projects in the future. We would really appreciate you completing this section.

我同意采访信息被用作研究使用/I consent to the data being used by researcher.

Site & location 地点：
Date of Interview 访谈日期:
Interviewer 采访人:
Interviewee 受访人:

1. What is your role?
   您是做什么的？

2. What type of art do you make?
   您是做那类艺术或经营哪类艺术品的？

3. What is your background?
   您是什么背景？（专业）

4. What does your spiritual entertainment include? (e.g. watching movies, physical exercises, playing games, reading books, travelling, etc.)
   您的精神文化生活有哪些？（如看电影、体育活动、玩游戏、看书、旅游等）

5. What are the impacts of the projects on your daily life?
   您所在城市的老工厂改造项目对您的日常生活有什么影响？

6. Why did you choose to take a space here?
   您为什么租用这里的空间？

7. Has it been a good way to make a living?
   您觉得租用这里的空间来做生意还好吗？

8. Is there anything else that you would like to say about this project?
   对这个项目（改造后的空间/场地）有还有什么想说的吗？

9. Is it of interest or relevant that this building used to be an industrial space?
   您对这个空间之前是个工厂感兴趣吗？

10. Is there anything that can be learned in other areas of the city from this project?
    您觉得这个项目的哪些地方可以被推广/借鉴城市的其他地方？

11. How long will you stay here?
    您在这多久了？

12. Which is the most successful project or your favourite project in your city? Why?
    您所在的城市或地区里，您觉得做的最好的老工厂改造项目是哪个？为什么？

13. Are there any regeneration projects that are under construction or to be constructed?
    您知道在你们的城市里，还有哪些正在建和将要改造的旧厂房项目吗？

14. What are you most concerned about during the regeneration? (e.g. transportation, facilities or marketing, etc.)
    老工厂改造项目，您最关系担忧哪些问题？（如交通、配套设施或市场营销等）

15. What services do you think the regeneration project should provide?
    您希望老工厂改造后可以提供哪些服务项目？

16. Will the regeneration project and building typical cultural brand of the city promote the urban transformation?
    您觉得老工厂改造项目和建设城市个性文化品牌是否有助于城市转型？

17. Will the regeneration project provide relevant job opportunities?
    您所在城市的老工厂改造项目是否提供相关就业机会？

18. Is there anything you would like to suggest to your landlord from your personal perspective?
    有什么个人对租房者的建议吗？

Appendix E: Self-Report Questionnaires

QUESTIONNAIRE ON EMOTIONAL DESIGN

Part One: Consent Form

I, hereby confirm that I understand the nature and purpose of this survey, and that my participation is completely voluntary. I understand that my responses will be kept confidential, and that my personal information will be collected, stored, and used in accordance with the privacy policy outlined below. I give my informed consent to participate in this survey.

I agree to:

The session being audio/video-recorded (cross out as appropriate).

The use of photographs and video recordings for the purpose of documenting the findings from this study.

I understand that the information collected in this study is for research purposes only and that my name and image will not be used for any other purpose. I relinquish any rights to the recording.

I understand that participation in this usability study is voluntary, and I agree to immediately raise any concerns or areas of discomfort during the session with the study administrator.

I confirm that I have read and understand the information on this form and that any questions I might have about the session have been answered.

Date: _____

Please print your name: _____

Please sign your name: _____

Thank you! We appreciate your participation.

Part Two: Questions

1. On a scale of 1 to 5, please rate your satisfaction with the overall design of the building:

   _____

2. On a scale of 1 to 5, please rate your first impression of the building's design:

   _____

3. On a scale of 1 to 5, please rate the desirability of the interactive elements within the building:

   _____

4. On a scale of 1 to 5, please rate the level of connection between the building's structure and its geographical context.

_____

5. On a scale of 1 to 5, please rate the ease of learning the history of the Albert Dock:

_____

6. On a scale of 1 to 5, how likely are you to recommend this attraction to others? And give reasons.

_____