WAYFINDING SYSTEM DESIGN IN THE URBAN ENVIRONMENT

Combining External Features and Internal Representations to Enhance Cities' Unique Image

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This thesis is submitted for the degree of Doctor of Philosophy (PhD)

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Declaration

I hereby declare that this thesis is my own work and has not been submitted in substantially the same form for the award of a higher degree at any other institution.

As part of the work towards this PhD thesis, two conference papers have been presented:

- Exploring the scope of wayfinding system design in urban environments and its representation of urban culture, presented at AMPS Urban Futures – Cultural Pasts conference, 2025.

- Explore the elements of wayfinding images to design wayfinding systems in the urban environment, presented at AMPS Livable Cities London conference, 2025.

Acknowledgements

The journey has been long and challenging, but thanks to the support and companionship of certain people, it has also been filled with fun, enthusiasm, and moments where flowers seemed to bloom everywhere.

I sincerely thank my two supervisors, Paul and Serena. Your wisdom, patience, and encouragement have always guided me. You tolerated my explorations and ensured I never went astray. I cannot imagine having better supervisors. I'm truly fortunate to have had you both.

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Abstract

A city's image is constructed from a process of wayfinding. The city image is an important research area, for urban planning, but also for legibility and mobility for citizens. Wayfinding was a term coined by Kevin Lynch to refer to the process of finding one's way between places. Lynch's work and methods have been used as an approach for people to understand and cognise cities. However, there is a research gap on how place-based wayfinding can be designed visually to contribute to understanding of the city. The visual elements include physical signage, mapping both digital and analogue as well as the built environment as iconography amongst other elements. This thesis focuses on the process and experience of wayfinding in the city to establish a new design method and framework for application.

The thesis employs mixed methods research to establish a design framework including, back casting to review the past to look forward and understand urban futures. The thesis tests and reviews Kevin Lynch's approach to wayfinding and his city legibility system, which includes the five elements (paths, nodes, districts, edges, and landmarks). A case study of Manchester England and wayfinding workshops are also utilised.

The thesis findings emerged through investigation of a city centre site in Manchester, UK, and the cultural districts were selected as a research context. Data was collected in two parts: through thirteen walking interviews in Manchester city centre with a total of seventeen participants. Three workshops were also undertaken with a total of thirty-two participants. Results indicated the viability of Lynch's wayfinding methods which are still relevant today as a basis for designing wayfinding system. However, certain extension and variances occurred. The mixed methods approach findings demonstrated that when people wayfind in the urban environment, they extract information from their

surroundings to not only support movement but also as an essential medium of perceiving the city, which includes buildings, streets, shops, heritage, districts, and the salient artefacts represented by maps, signages, texts and posters. This extracted information supports the wayfinding process as well as understanding of the city, which should be integrated into wayfinding system design.

From the data and results of wayfinding images of various areas in Manchester city centre a framework was established for a wayfinding system. The images derived four elements: point, line, plane, and timing from the data analysis which correlates with Lynch approaches but also contains variances and extension. These four elements imply tiers of wayfinding system design and correspond to diverse design methods that include signage, icon and graphic design, information design, direction guide design and cartography. Combining the four elements with the design approaches, this thesis proposes a design framework. The outcome of this thesis is a set of cards, namely the Wayfinding System Design Support Cards (WSDSC), based on this framework. WSDSC is intended as a tool to support and assist the design of urban wayfinding systems. The WSDSC was tested twice in the Mill Race area of Lancaster, with one participant each time. The contribution of this thesis to knowledge is that based on the work of Kevin Lynch, the design method of wayfinding systems is expanded. Four elements are proposed as a design framework and a deck of cards with clear instructions was produces to assist designing wayfinding systems with cultural districts as the core to enhance people's experience in the city and thus enhance the cities' unique image.

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Chapter 1. Introduction

1.1. Foreword: Wayfinding, Wayfinding System and I

Wayfinding is a complex concept and research area that was initially introduced by the American urban planner Kevin Lynch in his book *The Image of the City*. Lynch (1960, p. 3) defines it as:

> *...a consistent use and organization of definite sensory cues from the external environment.*

Since then, the definition of wayfinding has evolved and developed. The definition of the term has been elaborated and debated by several authors. Some authors believe that wayfinding is the process of from a starting point (Arthur & Passini, 1992; Correa de Jesus, 1994), traversing the space to reach the destination (Casakin et al., 2000; Downs, 1977; Kaplan, 1976; Passini et al., 1998), a process that involves orientating oneself (T. Brunyé et al., 2010), determining the destination, finding the nearest route and determining one's arrival (Carpman & Grant, 2016). Wayfinding plays a crucial role in the construction of urban image and has been recognized as a specialized field of study (Berger & Eiss, 2002). Further discussion on evolution of wayfinding, wayfinding systems and their definition will be provided in the Chapter 2. Briefly, wayfinding involves finding a route between two points, and a wayfinding system comprises tools designed to facilitate this process. These tools commonly include artefacts such as signage strategically placed at specific locations. Additionally, wayfinding systems serve as an important means to help individuals familiarise themselves with and

understand urban environment and culture, playing a key role in shaping people's impression of cities.

The wayfinding behaviour of humans is a complex process that involves navigating through various types of spaces. This thesis focuses specifically on wayfinding within urban environments. According to Lynch (1960), the urban landscape has a significant impact on individuals' wayfinding processes and behaviours. Lynch introduced the term *legibility* to describe and explain this concept. A city's appearance and visual characteristics serve to understand cities. Therefore, the wayfinding process also prompts people to think about the city and shapes their perceptions. The city, the wayfinding system and the people all influence each other, and together, they shape the image of the city.

My research motivation in urban wayfinding systems stems from a particular observation, which dates back to 2017. I noticed a growing trend of homogeneity among some Chinese cities, including my hometown, cities where I have resided for extended periods, and cities I have visited occasionally. This uniformity is not naturally occurring, but rather a result of deliberate interventions. Notably, all shops on city streets display identical signage. These placards have a uniform colour scheme, with shop names in identical fonts, whether they are small independent shops or chain stores with distinct logos and features. The uniformity in signage is usually due to regulations from urban planning authorities in China. The excessive uniformity in signage has sparked media coverage and discussions on social media in China.

In my personal experience as a city dweller, I find the uniformity of city signage visually unappealing. The unique character of the city has been diminished by artificial

interventions. Moreover, the uniform signage often causes confusion and difficulty in navigating, as certain destinations and streets become hard to distinguish. Despite advancements in electronic navigation, finding my way still provokes negative emotions such as anxiety, confusion, and worry. I constantly fear taking wrong turns at junctions and spend a significant amount of time confirming my location and route. This frustrating experience stems from the overly similar streetscapes and neatly organised signage. I find myself traversing streets that appear almost identical, struggling to visually distinguish between them.

I have noticed that this frequent feeling of being lost is a result of the overly similar city streetscapes, which is a peculiar phenomenon, especially considering that many Chinese cities have their own distinctive features. For example, Chinese people can easily distinguish between cities such as Beijing, Shanghai, Nanjing, and Tianjin, each known for its unique cultural characteristics. *Xiangsheng* (a traditional Chinese performing art, sometimes translated as 'Crosstalk') is never mistaken as a specialty of other cities, as it is strongly associated with Tianjin. Similarly, landmarks like the Forbidden City and Tiananmen Square are unmistakably linked to Beijing, not to other cities.

Despite these distinct cultural identities, I find that, when navigating through these cities, they all feel strikingly similar. This vivid culture and character stand in stark contrast to the indistinguishable cities I encounter. This realisation prompted me to pose the research questions: why are cities losing their unique identities, to the extent that tourists and even residents struggle to navigate them? The wayfinding process is a means through which people shape the city, and in turn, the city shapes our understanding and feelings through that very process. These understandings and feelings, or people's overall impressions and perceptions, shape the image of the city. How are these cities images presented to people? How do the cities, their wayfinding

systems, and people's experiences converge to become integral parts of the city's identity, serving as vehicles for its image? As a graphic designer, how can I contribute to addressing these challenges?

With these considerations in mind and driven by a keen interest in pursuing doctoral research, I embarked on an exploration of the intricate interplay between local urban elements, wayfinding behaviours, and the urban wayfinding system.

Therefore, this thesis explores the information from the urban environment that people use as references and cues during the wayfinding process, and how this place-based information can be incorporated into wayfinding system design to enhance the city's image. I focus on the development of design principles rather than prescribing specific design solutions or addressing the visual aesthetics of the wayfinding system. In addition, I propose potential directions for future development in the design of urban wayfinding systems.

1.2. Urban Culture and Cultural Districts

To establish the research framework, a significant challenge lies in identifying the unique characteristics of a city and understanding what inherently appeals to individuals. This inquiry prompted me to delve into the essence of urban identity and contemplate how a city's image is shaped. As Hall (1997, cited in Rose, 2022, p. 17) states, culture relies on people meaningfully engaging with their surrounding in similar ways and understanding the world roughly the same way. Whilst I believe that all streetscapes in a city confer an understood and formed perception of the city, as the aim of the research was to highlight cultures that are unique or local to the city, I began to

wonder if there are such clusters or areas of culture in the city that make it extraordinarily meaningful to make sense of one's environment. According to McCarthy (2005 and 2006, cited in Chapain & Sagot-Duvauroux, 2020), if the heritage and history of the area are not considered, the promoted cultural image may not align with the area. Some city areas have a concentration of heritage, historical buildings, and cultural facilities. As a result, I became intrigued by the concept of cultural districts and saw it as a fit for my research.

Spaces dedicated to entertainment, arts, and cultural activities have long been integral components of urban landscapes (S. Y. Kim, 2017). These designated areas, often termed *cultural districts*, have been various defined in the literature. Cultural district, sometimes also referred to as cultural quarters, cultural neighbourhoods, cultural milieus, or cultural clusters, are geographic areas located primarily in towns, cities, or metropolitan areas, where arts and cultural activities are concentrated, typically supported by architectural structures dedicated to such functions (Suwala, 2015). Wynne (1992, cited in W. B. Kim, 2011) characterises a cultural district as an area within a city or town that contains the highest concentration of cultural and recreational facilities. Similarly, Frost-Kumpf (1998, cited in Brooks & Kushner, 2001) defines cultural districts are defined as an easily recognisable, labelled area in a city that is mixed-use and has a high concentration of cultural facilities to act as an anchor for the city's attractiveness. Santagata (2002) offers a more production-oriented perspective, defining cultural districts as areas characterised by the production of specialised goods based on creativity and intellectual property rights. He further identifies industries such as film, audiovisual media, industrial design, arts and crafts, museum services, and the eno-gastronomic sector as being culturally rooted in the original community and thus forming part of such districts. In other words, cultural districts can be understood as urban areas with a concentration of cultural, creative, historical, artistic, and recreational buildings, sites, and facilities. These include, but are not limited to, art galleries,

museums, theatres, historically and culturally distinctive buildings, heritage sites, parks, city attractions, public performance squares, and other relevant urban spaces.

The use of culture as an urban attraction has become a means of increasing the competitiveness of cities (Kavaratzis, 2004). Thus, cultural districts play a role in representing a city's attractiveness, serving as symbols of its character and unique culture. Many authors have highlighted the positive contributions of cultural districts to urban economies, including enhancing and developing urban competitiveness (Riza et al., 2012) , as well as attracting tourism and investment (Richards & Wilson, 2004). Although this thesis does not focus on the economic aspects, it is clear that—beyond their economic impact—cultural districts significantly contribute to the attractiveness and broader development of cities

The image of the city—in the past, present, and future—has become a noteworthy and increasingly relevant domain in the pursuit of urban competitiveness (Riza et al., 2012). Cultural districts have emerged as a popular strategy for promoting tourism, revitalising city centres, and fostering economic development by leveraging urban culture. Research by Brooks and Kushner (2001) has demonstrated that cultural districts not only meet the cultural and aesthetic needs of urban residents but also enhance liveability, stimulate urban tourism, and generate a range of positive benefits.

The prevalence of cultural districts is on the rise in cities across Europe and the United States (S. Y. Kim, 2017). In Asia, the concept of the international city has been embraced to cultivate a robust cultural identity that enhances competitiveness and attracts foreign talent, tourists, and investment (Cunningham, 2004; Marcotullio, 2003; Yeoh, 2005). Consequently, Asian cities are increasingly recognising culture as a key

factor in improving urban competitiveness (Cho, 2007). In China, this is evident in the emphasis on both the internationalisation of cities and the development of their unique cultural image.

In the UK, local authorities at all levels have developed cultural strategies (Gilmore, 2004), reflecting a policy-level recognition of the role of arts and culture in urban development. The promotion of creative cities and cultural spaces has become a global phenomenon (G. Evans, 2009). Cities are increasingly leveraging cultural activities to enhance their image and competitiveness (Richards & Wilson, 2004). However, a long-standing issue in this field remains: how to meaningfully integrate urban culture into the city's image in ways that enhance competitiveness while preserving its unique character and attractiveness in today's globalised environment.

Therefore, finding the cultural districts in a city provides a better understanding of the culture within the city as well as its overall image. The wayfinding process of locating cultural districts becomes a means for people to experience the city's characteristics and serves as a bridge through which the city communicates its identity. Wayfinding system design, as a vehicle—along with the wayfinding process it supports—can help people understand the city and enrich their cultural experience. Although it cannot be the only approach to enhancing a city's attractiveness or building its image, it offers a meaningful way to build upon cultural districts and, in doing so, shape the city's image. Therefore, there is no doubt that cultural districts can define the context of this thesis's research question.

1.3. Research Question

The wayfinding process also constructs people's understanding and feeling of the city, in which the city image is shaped. This construction process is mutual and dynamic. While the wayfinding process constructs the city image, the city image also shapes people's wayfinding in the city. City image and wayfinding are two fields of study that intersect, and what exists within the intersection is people's experience in this mutual construction process. To enhance this experience, it is necessary to explore the wayfinding system design that enhances it from this perspective. Accordingly, this constitutes the research focus of the thesis (Figure 1). Based on this focus, the thesis seeks to address the following research questions:

How can a design framework that combine external features and internal representations be proposed for a wayfinding system in the city that enhances the uniqueness of city's image and people's experience in the city?

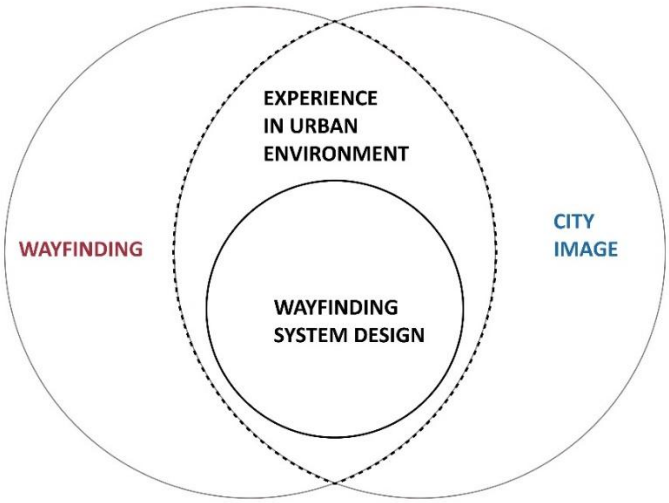

Figure 1 Research area of this thesis. Drawn by the author.

To delve deeper into this inquiry, the following specific research questions (RQs) were formulated:

- RQ1: How can external features in the urban environment that support the wayfinding process and need be incorporated into wayfinding system design be extracted?

- RQ2: How can the extracted external features be visualised and designed as a wayfinding system to enhance the uniqueness of the city's image?

To respond to these two research questions, four interrelated parts are developed in the following chapters:

- What kind of information constitutes the external features that support the wayfinding process and affect people's perspectives in the city? Regarding this question, Chapter 6 analyses the types of information that can serve as references for wayfinding in the urban environment.
- How can external features from the urban environment be incorporated into internal representations, such as cognitive maps? In relation to this, Chapter 7 explores how these features are perceived and cognitively transformed by individuals into internal spatial representations.
- How can external features be extracted from the urban environment to form the city's image? This is addressed in Chapter 8, which introduces four key elements to structure and represent the city's image from a wayfinding perspective.
- How can the extracted external features and internal representations be visualised and designed as a wayfinding system that enhances the uniqueness of the city's image? This is discussed in the latter part of Chapter 8 through the

development of the Wayfinding System Design framework and an accompanying set of design cards.

Design activities and artefacts can be a significant element of knowledge generation, and design can bring specific and unique contributions to research (Stappers & Giaccardi, 2017) . Traditional scientific research methods cannot effectively address design practices involving projective, imaginative, and uncertain spaces (Prochner & Godin, 2022). Creative processes and future scenarios are needed for wayfinding system design, and wayfinding systems are confronted with the city's complex and changing environments and needs. The uncertainty and subjectivity of the wayfinding system design are precisely the reason for developing this unique research methodology. Therefore, in this thesis, a design-oriented approach is adopted to craft wayfinding system designs that reflect the essence of the city's culture. This involves facilitating discussions and integrating designs into maps, illustrations, and artefacts. Accordingly, participatory and visual design are included as core components of the research methodology. The study also expands its scope to involve a wider range of stakeholders beyond designers alone. Ultimately, this research aims to identify effective strategies for advancing wayfinding system design in urban environments and fostering a distinctive urban experience.

1.4. List of Key Terms and Conceptions

This subsection briefly explains and clarifies some of the terminology and concepts used in the thesis, some of which are discussed, reflected upon, and addressed in detail in Chapter 2 of the Literature Review.

Wayfinding

In this thesis, wayfinding refers to individuals' movement from a starting point through urban environments and spaces and, ultimately, to their destination. This process usually consists of several phases that can form a cycle: locating oneself, finding the direction and the right path, and judging whether one has reached the destination.

Wayfinding System Design

Wayfinding system design refers to systems intended to aid and support the wayfinding process, with an emphasis on visual design and information communication. In Subsection 2.1.3, the theoretical development and scope of wayfinding system design are described, explored, and contextualised. This review focuses on its theoretical foundations. In Chapter 3, the components and scope of wayfinding system design are further examined by reviewing the historical development and evolution of its design elements through selected practical examples. In addition, by reflecting on and analysing contemporary design practices, the scope and constituent elements of wayfinding system design are clarified, offering insights into its future directions.

City image/image of city

City image and image of the city are synonymous terms and are used interchangeably depending on the context of the writing. In this thesis, both terms refer to people's shared and subjective impression of the city's characteristics—a mental picture formed based on people's perception and experience of the urban environment.

Urban environment

In this thesis, the urban environment refers to the built environment, social dynamics, economic activities, and overall lifestyle, encompassing the physical, social, and cultural dimensions of a city (Martínez-Bravo & Labella-Fernández, 2024). According to Ompad et al. (2007), urban resource infrastructure is also considered part of the urban environment. Broadly speaking, the term denotes the overall setting formed by surrounding buildings, streets, vegetation, artefacts, public spaces, people, and other elements typically present in urban centres.

Cues/references/information (in the urban environment)

Cues, references, and information are three closely related terms used in this thesis to describe the forms of environmental support that aid people in wayfinding. Cues refer to concrete elements that help individuals find their way in urban settings and may also include certain abstract features, such as architectural style. References also indicate environmental support, but more often denote widely recognised objects or landmarks. Information refers to data or knowledge that assist navigation and environmental understanding, including maps, signage, and directions. It tends to have a broader scope than cues or references. While there are minor distinctions among the three, they are largely overlapping in meaning and are used interchangeably or separately throughout this thesis, depending on the context.

Urban culture

Urban culture is a wide-ranging term that covers a complex range of meanings, as culture itself is a term that encompasses many things. In this thesis, urban culture refers to that which encompasses cultural practices as well as spatial embodiment, which is the shaping of urban life, including the material landscape (physical spaces and structures in the city, such as buildings, streets, and parks), the discursive landscape

(language, symbols, narratives, and ideas in the city), and the social landscape (non-material elements in the city, such as language, symbols, narratives, and ideas).

Experience

Experience is a concept often used in this thesis to refer to people's experiences in the city. Experience in the thesis refers to the combined feelings, emotions, interactions and behaviours of individuals in the urban environment.

1.5. Research Site

As this research is focused on urban environments and real-life experiences, it necessitates conducting the study in actual cities rather than virtual environments. Therefore, selecting an appropriate research site is crucial. After careful consideration, Manchester, UK, was chosen for several reasons. Manchester has a large population and is renowned for its rich local culture and architecture. The city offers a blend of historic buildings and neighbourhoods alongside modern structures and streets, providing a diverse urban landscape for exploration. Moreover, Manchester is highly accessible to me personally. Located approximately 42 miles from my residence, the city is easily reachable by train, with a travel time of just one hour. This proximity enables me to make multiple visits in a single day, thereby facilitating efficient and flexible data collection.

Manchester's importance extends beyond its industrial legacy; it is currently undergoing a transition from heavy industry to a vibrant creative economy. Widely recognised as the world's first industrial city, Manchester experienced rapid expansion during the 19th

century, marking a pivotal moment in its development (Aspin, 1981; Kidd, 2006). This transformation offers valuable insights for Chinese cities currently undergoing rapid urban and economic change (Wu, 2016).

Furthermore, Manchester serves as a thriving cultural hub for the creative industries. It hosted the UK's largest art exhibition, The Treasures of British Art, in 1857 and has a rich literary heritage, evidenced by its exceptional libraries and cultural venues. These include the Manchester Art Gallery, Whitworth Art Gallery, Chinese Arts Centre, Central Library, Chatham Library, and Porch Library. The city is also home to several museums—such as the Greater Manchester Police Museum, the Manchester Jewish Museum, and the Manchester Museum—all located within a walkable central area. By contrast, cultural districts in Liverpool tend to be more spatially dispersed.

Manchester's architectural landscape is equally notable, characterised by a harmonious blend of historical and contemporary structures. Neo-classical and Victorian buildings from the early 19th century stand alongside modern skyscrapers, while some structures feature Venetian influences, contributing to the city's preserved historic charm.

Manchester's cultural vibrancy also extends to its sports and music scenes. The city is renowned for its diverse range of bands and musical events, catering to a wide spectrum of audiences. Additionally, football significantly contributes to Manchester's international identity, with the city serving as a global hub for football culture and enthusiasts.

The unique amalgamation of a vibrant cultural quarter, diverse architectural styles, and a plethora of cultural events makes Manchester an enticing and dynamic location for

academic study and exploration. Overall, there are several reasons for choosing Manchester as the location for the study, which are discussed in detail in subsection 4.3.

1.6. Framework of the Thesis

The structure of the thesis closely follows the research process, reflecting a practice-based approach to understanding people's wayfinding experiences in real-world settings and exploring ways to inform wayfinding system design. The thesis is organised into four main parts.

1.6.1. Theoretical Framework

The first part provides the theoretical and conceptual framework for the research and primarily consists of Chapters 2 and 3. Chapter 2 presents a literature review that examines key definitions, theoretical perspectives, and the research scope related to wayfinding and wayfinding systems. It identifies two essential elements: internal representations (namely cognitive maps) and external features (namely information from the urban environment). The review of theories concerning cognitive maps and wayfinding strategies addresses internal representations involved in wayfinding and system design. The exploration of the city focuses on the concept of the city image, Lynch's urban theories, and related ideas such as city identity, which together inform the construction of external features relevant to wayfinding. Collectively, these strands constitute the theoretical foundation of this thesis.

Chapter 3 builds on this foundation by analysing wayfinding system design in both historical and contemporary contexts. It evaluates and reflects critically on past design practices and constituent design elements, while examining the complexity and mobility of wayfinding systems within urban environments. The chapter concludes by offering recommendations and insights for the future development of wayfinding system design.

Based on the findings and discussions in these two chapters, a research methodological strategy for the study is proposed.

1.6.2. Methodology

Chapter 4 provides a detailed and candid description of this thesis's methodology and research approach. In this chapter, I begin by explaining this study's research philosophy and strategy, introducing the three research methods used in this thesis: backcasting, Kevin Lynch's methods, and case study. I also describe the research location of Manchester in this chapter. In addition, this chapter discusses the methods for collecting data. The methods include walking interviews in Manchester and workshops conducted in a laboratory environment. I explain how walking interviews and workshops are designed in detail. Moreover, I outline the transcription method for data and the analytical approach, which is content analysis.

1.6.3. Findings and Discussion

Chapters 5, 6, and 7 constitute the results and findings sections. Chapter 5 presents the detailed process of data collection and introduces the collected data. Chapter 6 focuses on explaining the objects and information in the city that are meaningful to wayfinding, as well as the role each of these elements plays in the wayfinding process. Chapter 7 then maps the images of Manchester city centre based on the research data and provides detailed explanations and interpretations of these images.

1.6.4. Outcome and Conclusion

The final part, comprising the discussion of the results and findings and the conclusions drawn from them, consists of Chapters 8 and 9, which explain in detail the four elements that emerged from the research. Chapter 8 first introduces the four elements—points, lines, planes, and timing—that were derived from the findings, along with the associated design methods and strategies. It then presents a framework that integrates these elements into a system for wayfinding design. To implement this framework, I developed a set of cards called the Wayfinding System Design Support Cards (WSDSC) and provide a detailed explanation of their structure and usage. Finally, I discuss the two experiments conducted to test the WSDSC. In Chapter 9, the conclusions of the thesis are presented: the contribution to knowledge is clarified, the research questions are addressed, the limitations of the study are acknowledged, and directions for future research are proposed. A detailed Research Map illustrating the structure and content of the thesis is provided to offer a more intuitive visualisation of the work (Figure 2, next page).

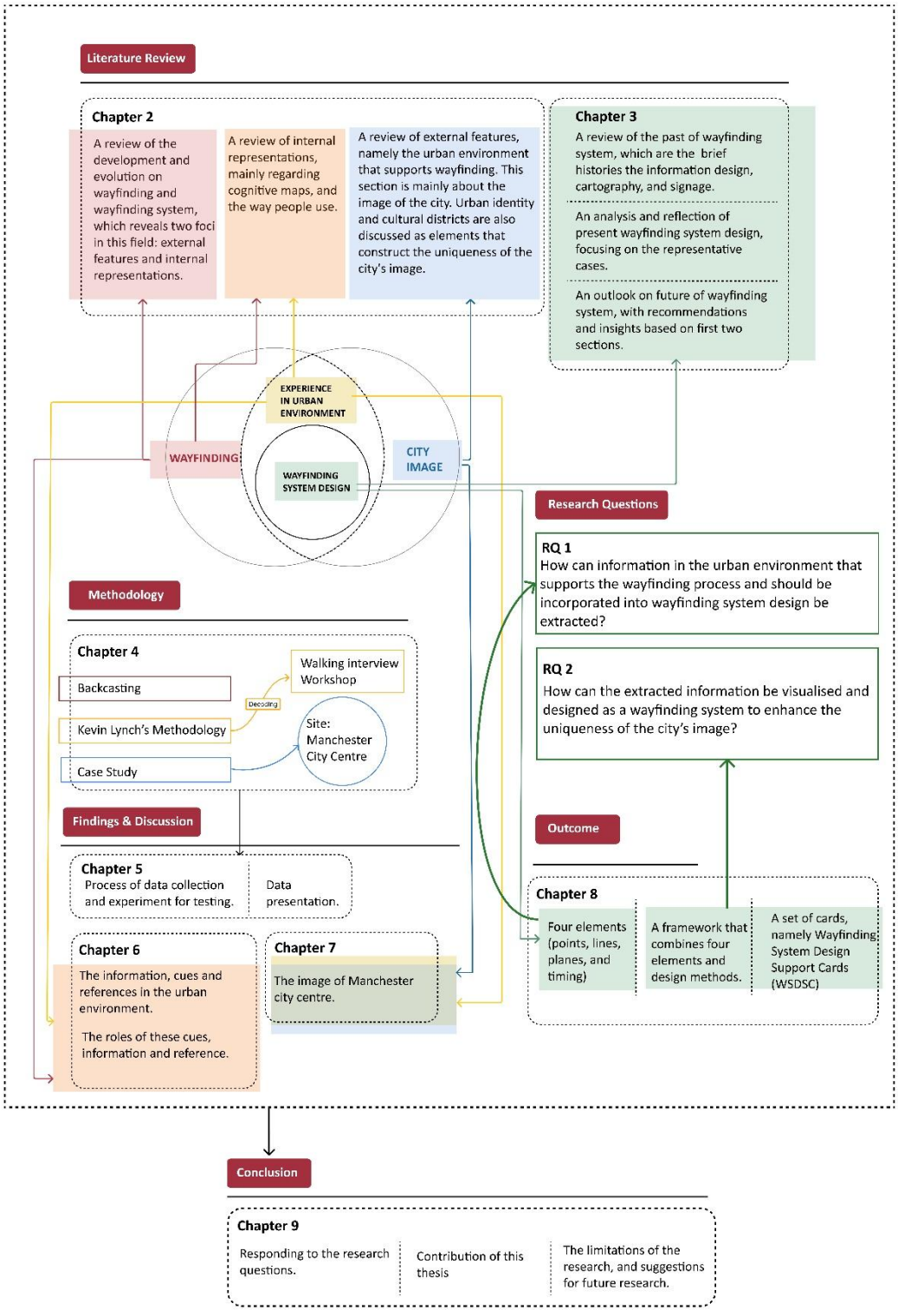

Figure 2 Research map of this thesis. Drawn by the author.

Chapter 2. Literature review

Wayfinding is a complex concept, and the scope of research it encompasses requires greater specificity. As Passini pointed out, the research of wayfinding is:

> *The term wayfinding, although it has appeared in the literature on environmental psychology, psychology, geography and even anthropology, does not encompass a field of study in its own right. Studies most closely related to wayfinding appear under the headings of spatial orientation, cognitive maps and imagery. (1981, p. 17)*

Hunt et al. (2016b) also note that there is no single field that fully addresses wayfinding. They state that wayfinding is shaped by specific knowledge bases, methods of enquiry, and disciplinary traditions, involving disciplines that may include fields such as architecture, cartography, engineering, psychology (both cognitive and environmental), geography, gerontology, graphic design, information sciences, public health, transport, universal design, and urban planning. They also observe that most experimental research on wayfinding originates from psychology, geography, and information science. Achieving a comprehensive understanding of wayfinding is therefore a highly complex task. Based on the research aim and main the main research question of this thesis, the literature review focuses on the following key areas: the terminology of wayfinding and related theories of its evolution and development; the scope and constituent elements of wayfinding systems; wayfinding behaviours and strategies in urban environments; cognitive maps; urban image; urban culture; and experience.

In order to screen the literature relevant to the research, I conducted an extensive literature search via Google Scholar, Scopus, and the OneSearch tool of the university library. The literature was screened using Scopus. First, several key terms related to this

thesis were identified. In the initial stage, these included wayfinding (and its alternative spelling, way-finding), wayfinding system, wayfinding system design, Kevin Lynch, and navigation. I limited the search criteria to include at least one of the terms within the keywords of the papers. This approach allowed the Scopus result analysis tool to help identify the main research fields associated with these keywords, as well as the leading authors. For example, when I searched for the keyword 'wayfinding' in Scopus, there were 3,499 results. When I applied filters to limit the results to include keywords such as 'wayfinding,' 'navigation,' and 'way-finding,' 1,632 results were displayed. As shown in the figure below, an analysis of these results by Scopus indicated that the main research areas of the literature containing these keywords were: computer science (25.6%), social science (14.3%), and engineering (14.1%). In addition to these three dominant fields, there were several other less prominent research areas. It is clear that social science is more relevant to my research, while computer science and engineering are less pertinent. Among the research fields that account for a smaller proportion, environmental science and arts and humanities are more relevant to my study. This process helped define a general scope for the literature search. I then selected literature based on their titles, followed by a detailed review of the abstracts to determine their relevance to my research.

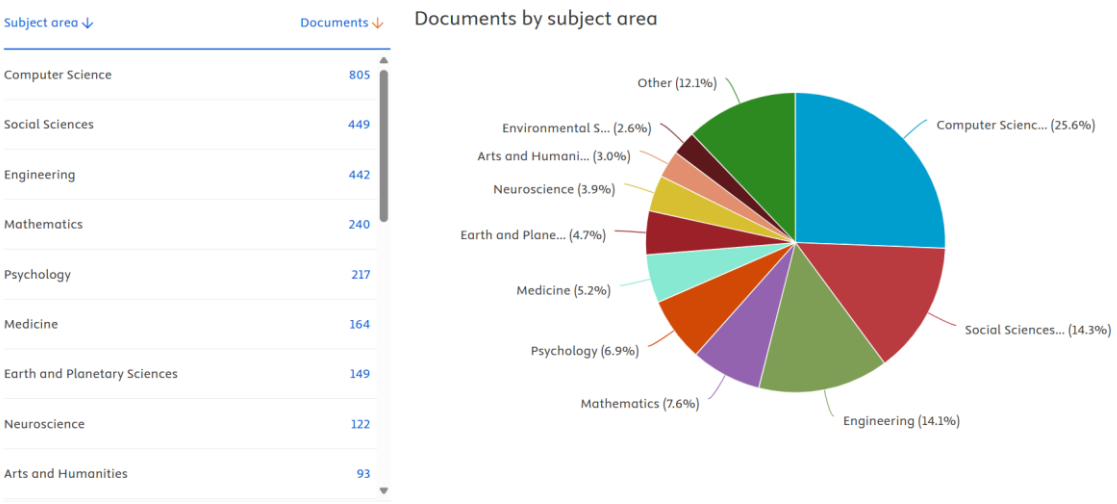

Figure 3 *Map generated by Scopus showing the research fields of documents containing the keywords 'wayfinding', 'way-finding', or 'navigation'.*

In the second stage, additional keywords related to those identified in the first stage emerged the process of reviewing the initial literature. These new keywords were derived from the content of the first-stage literature. The second-stage keywords included: cognitive map, mental map, wayfinding strategies, city image, landmark, district, edge/boundary in cities, cultural districts, urban culture, information design, city identity, legibility, imageability, cultural experience, signage, evolution/development of wayfinding, map, cartography, wayfinding behaviour, urban wayfinding, signage design, environmental design, mobility, visibility, and others, along with synonyms and alternative spellings of some of these terms (such as evolution/development of wayfinding/wayfinding system design). Once again, I used Scopus to examine the relevant research fields, authors, and so on, repeating the process from the first stage.

Some of the literature was obtained through another method, namely from the references of the reviewed documents. Among the relevant literature identified, many works included theories, ideas, concepts, and experiments closely related to this research, with the authors clearly citing their sources. As such, tracing references from these papers proved to be a valuable approach. Additionally, some literature was recommended by my supervisors.

In summary, through these methods, I have compiled literature closely related to my research, which forms the foundation for the literature review and the subsequent chapter titled Past, Present, and Future of Wayfinding Systems.

The objective of this chapter is to critically review the existing literature on wayfinding, cognitive maps, and external features within urban environments, with a particular focus on wayfinding theory, wayfinding systems, and their relationship with the environment and culture. Kevin Lynch's theory serves as the key theoretical framework for this chapter. This chapter consists of three parts. The first part addresses the definition and theoretical development of wayfinding and wayfinding systems. Lynch's classic definition is discussed first, followed by an examination of the term wayfinding and its theoretical and conceptual development, a comparison of definitions of wayfinding and navigation in the existing literature, and a preliminary outline of the concept and scope of the wayfinding system. The second part focuses on wayfinding behaviour and strategies, particularly in urban environments. In this part, the significance of cognitive maps and environmental information for the wayfinding process is discussed, and the typical steps involved in wayfinding in urban areas are explored. Since the thesis focuses on wayfinding in urban environments, the third section explores theories related to this aspect. This section includes a discussion and reflection on the city image, followed by an examination of a related concept—city identity. It then explores how urban culture and experience are shaped through the process of wayfinding.

2.1. Wayfinding and Wayfinding system

2.1.1. The Term Wayfinding

Wayfinding is not a practice or action unique to humans. Many animals have distinct wayfinding and navigation abilities. For example, bees are thought to use the sun to navigate and find their way around, as well as using information from their

surroundings, including odours and visual cues provided by flowers (Gould, 2004) . Many animals are capable of path integration (Collett & Graham, 2004). For example, hamsters use visual landmarks to integrate their paths (Etienne et al., 2004, cited in Collett & Graham, 2004). However, this research focuses specifically on human wayfinding, with particular attention to people's behaviours and experiences in urban centres.

Wayfinding seems to date back as far as the navigation techniques used by the Polynesians in the 15th century (Spiller et al., 2015), who used techniques such as stars, birds' flight paths, and the direction of ocean currents for wayfinding, and used the terms mountainward (Mauka) and seaward (Makai) to indicate direction (Hunt & Waller, 1999). The example of the Polynesians supports the importance of place-based information in the wayfinding process.

The term *wayfinding*, as it is now used, first appeared in 1960 as a term defined by Lynch, an academic and urban planner at MIT, in his book *The Image of the City* (Originally 'way-finding'). According to Lynch, wayfinding is:

> *... a consistent use and organization of definite sensory cues from the external environment. (1960, p. 3)*

Lynch's explanation of the term wayfinding emphasises the importance of cues from the physical world in the environment. In addition, he highlights that these sensory cues are not random or variable, but rather continuous and consistent. According to Lynch, cues refer to specific physical signals in the environment that can be perceived through various senses—such as sight, smell, hearing, and touch—and help individuals navigate and orient themselves. Examples include street numbers, bus signs, and maps. These

explicit sensory cues are specific, recognisable, organised, and used continuously by the individual. Lynch's explanation underscores that the critical support for wayfinding lies in environmental sensory cues, which must exhibit three key properties: consistency, organisation, and continuity.

In the *Oxford English Dictionary*, wayfinding is explained as 'The act of finding one's way to a particular place; navigation' ('Wayfinding, n. Meanings, Etymology and More | Oxford English Dictionary', n.d.). In this succinct explanation, wayfinding and navigation are treated as synonymous, with no reference to the tools or specific methods used. In the *Oxford Dictionary of Human Geography, Oxford Reference*, wayfinding is defined as 'The task of traversing between two locations using environmental or spatial cues such as direction signs or a map' (Rogers et al., 2013), while the navigation is interpreted as 'the process or activity of accurately ascertaining one's position and planning and following a route' ('Navigation', n.d.).

It should be emphasised that wayfinding and navigation are two closely related terms. In some sources, the terms are used interchangeably; in others, navigation is considered a subset of wayfinding, while in still others, wayfinding is seen as a subset of navigation. According to Montello (2005), navigation comprises two components: wayfinding and locomotion. Locomotion refers to the movement of the body within an environment, focusing on real-time actions such as avoiding obstacles. In contrast, wayfinding involves purposeful, planned movement within a specific environment, with the objective of reaching a particular destination. This suggests that wayfinding is conceptualised as a subset of navigation. In a subsequent paper, Montello and Sas (2006) further elaborated that wayfinding pertains to the need for individuals to know both where to go and how to reach their destination. This process involves decision-making tasks, such as planning routes, identifying landmarks, finding shortcuts, and

organizing trip sequences. Locomotion, on the other hand, represents the real-time aspect of navigation, in which individuals must coordinate their movements with the environment to navigate safely in the intended direction. This distinction places greater emphasis on direct interaction with the immediate surroundings in locomotion, while wayfinding involves spatial planning and cognitive processes. Accordingly, the development and evolution of navigation and wayfinding theories will be discussed in section 2.1.2.

2.1.2. Development and Evolution of Wayfinding and its Theories

After Lynch, the conception, definition and theories of wayfinding have been further developed, evolved and refined by later researchers and scholars.

Kaplan (1976) points out how humans form cognitive maps through environmental cues. Although Kaplan did not define wayfinding, his research provides an essential theoretical foundation. Expressly, wayfinding can be understood as the process by which an individual determines a location in the environment, chooses a path and reaches a destination. This process typically involves the formation and use of cognitive maps.

Passini has conducted a significant body of research on wayfinding. He states that wayfinding concerns the dynamics of purposeful movement and describes the cognitive and behavioural abilities involved in reaching a spatial destination as a form of spatial problem solving (Passini, 1984). In an earlier work, he outlined a conceptual framework, defining wayfinding as an activity involving cognitive and behavioural processes through which individuals interpret and utilise environmental information to

reach a destination. He further proposed that wayfinding includes processing environmental information, formulating a decision, and executing that decision (Passini, 1981). This concept has been interpreted to encompass not only human representations of space (such as cognitive maps), but also all mental processes associated with purposeful movement (Passini, 1996). As he elaborated in a later publication, wayfinding is conceptualised as the ability to solve spatial problems in order to reach a destination (Passini et al., 1998). Passini's definition divides wayfinding into two key components: first, information processing and decision-making, which involves cognitive and mental abilities and depends on knowledge of the environment and available cues; and second, executive decision-making, which refers to the physical movement of the body through space.

Allen (1999) categorises the wayfinding task into three types: commute (travelling between two known places along a familiar route), explore (travelling to unfamiliar territory and learning about one's surroundings), and quest (travelling from a familiar place to an unfamiliar destination). Wayfinding is understood as a series of cognitive activities involving goal-directed movement through an environment. According to Allen, these three wayfinding tasks rely primarily on human cognitive abilities—referred to as wayfaring means—which include repetition of locomotion, piloting, path integration, and navigation by cognitive map. His work underscores the central role of cognitive abilities, particularly in spatial understanding.

Raubal and Egenhofer (1998) define wayfinding as the process of navigating from place to place, relying on specific cognitive frames and environmental cues. These cognitive frames are developed from everyday spatial experience. They further state that wayfinding is a lifelong activity occurring in various contexts where people apply spatial geographic knowledge. This conceptualisation treats wayfinding and navigation

as synonymous, while emphasising both the universality of the process and its dependence on geographic knowledge. A similar definition describes wayfinding as the act of navigating from one place to another—a fundamental activity people engage in throughout their lives (Trulove et al., 2000).

Casakin et al. (2000) consider wayfinding as moving through space to reach a spatial destination. This concept is also understood as a process of solving spatial problems involving cognitive and behavioural abilities. Casakin et al.'s theory emphasises that this process is primarily goal-directed spatial movement.

Golledge et al. (2000) state that there are two ways to describe the process underlying human movement: navigation and wayfinding. Navigation refers to planning a route between an identifiable starting point and a destination, in which individuals process spatial information about location and travel speed. Wayfinding, in contrast, refers to selecting paths from an existing network and connecting these paths while proceeding along a chosen route, emphasising decision-making during travel. They also state that wayfinding is a purposeful activity guided by clear direction and motivation. The view of Golledge et al. distinguishes navigation—which focuses on route planning and spatial metrics such as location and speed—from wayfinding, which is centred on dynamic adjustments and real-time path selection during movement toward a destination.

Another definition of wayfinding is offered by Darken and Peterson (2001, p. 1), who state that 'wayfinding is the cognitive elements of navigation'. According to them, wayfinding does not involve any physical movement, but rather the tactics and strategies that guide movement. They argue that wayfinding constitutes the cognitive

element, while motion is the motor element, and navigation encompasses both. In their framework, wayfinding is conceptualised as a subset of navigation.

Fewings (2001) argues that wayfinding involves the process of navigating through a geographical or built environment, which requires recognising one's current location and understanding how to reach the destination. He further states that wayfinding has been described as 'the influence of the physical environment on the performance of individuals in finding their way under various environmental conditions' (Fewings, 2001, p. 177). Meanwhile, Fewings proposes a classification of different types of wayfinding by distinguishing between two kinds of choices: static choices, which involve selecting among known routes, and dynamic choices, which involve searching for new ones. He also identifies three types of individual wayfinding: recreational, which provides opportunities for problem-solving; resolute, which emphasises the efficiency of the wayfinding method; and emergency, which focuses on reaching the destination as quickly and effectively as possible.

Loomis et al. (2001) suggest that human wayfinding consists of two distinct functions: (1) sensing obstacles and hazards in the surrounding environment, and (2) navigating to remote destinations beyond the immediately perceptible environment. This concept implies that navigation is a subset of wayfinding. Loomis et al. also highlight the role of modern technologies, such as GPS, as tools that assist and enhance the wayfinding process.

Raubal and Winter (2002) further extend the conceptual scope of wayfinding. They point out that it encompasses the processes of self-orientation and spatial navigation and aims to explain how—and on what basis—people find their way in the real world, how

directions are communicated, and how verbal and visual abilities affect wayfinding. Raubal and Winter's explanation emphasises the underlying cognitive mechanisms and the information requirements involved in the wayfinding process.

Montello is another author who has written extensively on wayfinding. Montello and Sas (2003) defines wayfinding as a component of navigation, emphasising that it requires a defined target destination. This view aligns closely with that of Darken and Peterson (2001), who distinguish between physical movement and cognitive decision-making. Wayfinding is understood as a complex behaviour that depends on mental representations of physical space—whether experienced directly or indirectly (C. J. Bae & Montello, 2019; D. R. Montello, 2005). Montello (2005) also maintains that technological assistance can offer significant support in many cases, particularly in complex or unfamiliar environments.

Ruddle (2006) defines wayfinding as a subset of navigation, arguing that navigation encompasses wayfinding, interpreted as travelling between locations. However, Ruddle's perspective is based primarily on virtual environments rather than real-world natural or urban contexts. A similar view is presented by Ishikawa et al.(2008), who argue that navigation involves planning a route and moving through space to reach a destination.

Brunyé et al. (2010) state that wayfinding refers to moving purposefully from a place of origin to a destination, describing it as a highly complex yet common human task. They also emphasise that wayfinding involves locating oneself within an area and reaching the destination as quickly and efficiently as possible. Furthermore, they note that wayfinding can occur independently, with individuals relying on mental representations

of known or previously experienced environments, or dependently, through external environmental representations such as road maps and GPS. This distinction highlights that wayfinding processes may rely on both internal cognitive resources—such as perceptions of landmarks, roads, and a sense of direction—and external navigational tools, including paper maps, e-navigation applications (such as Google Maps), and GPS devices. However, their work does not explicitly address the possibility of integrating internal and external representations. Exploring how these two sources of information interact and may be combined forms a central concern of this thesis.

Wiener et al. (2009) proposed a taxonomy of wayfinding, distinguishing between aided and unaided wayfinding. They note that aided wayfinding involves support from external aids such as maps, signage, routing instructions, and modern hand-held navigation tools, whereas unaided wayfinding occurs without such assistance and includes two forms: undirected and directed wayfinding. Undirected wayfinding refers to navigation without a specific destination, where individuals may still pursue other goals, such as the enjoyment of scenic environments. It is primarily exploratory in nature. Directed wayfinding, by contrast, involves navigating toward one or more clearly defined destinations. In such cases, individuals may need to perform two types of search tasks: search, where the navigator does not know the exact location of the target, and target approximation, where the exact location is known. Wiener et al. also highlight the role of spatial knowledge in influencing wayfinding behaviour. They identify three types of spatial knowledge: destination knowledge (awareness of the target location), path knowledge (understanding the route from origin to destination), and environmental knowledge (understanding spatial relationships among multiple locations). This spatial knowledge informs the cognitive strategies used in different wayfinding tasks. They suggest that individuals exhibit different wayfinding behaviours

and rely on different types of spatial knowledge depending on the type of wayfinding task. This perspective provides important theoretical support for understanding how people use spatial information, particularly in unfamiliar environments.

According to Farr et al. (2012), wayfinding involves using environmental cues to identify a route and reach a destination in both familiar and unfamiliar environments. Carpman and Grant (2016) state that wayfinding encompasses what people perceive, think, and do to move from one place to another. This definition frames wayfinding as a behaviour that integrates both subjective perception and physical action.

Symonds et al. (2017) note that wayfinding is often regarded as simply identifying the fastest or shortest route between two points. However, they argue that existing research has largely neglected the physical dimension of the experience, and that to fully understand the dynamic nature of wayfinding, it must be conceptualised as an embodied process. As such, they propose the following definition: 'The cognitive, social and corporeal process and experience of locating, following or discovering a route through and to a given space' (2017, p. 9). This definition introduces a social interaction perspective into the understanding of wayfinding, highlighting the importance of bodily engagement while reaffirming the role of cognition. It broadens the conceptual scope of wayfinding research by integrating cognitive, physical, and social dimensions.

Ekstrom et al. (2018) identify two core components of navigating in space: the path integration system and the memory for the location of spatial landmarks—namely, cognitive maps. Navigation, in this sense, is understood as a dynamic process involving cognitive abilities such as attention and memory. A cognitive map refers to the mental representation of the locations and spatial relationships among multiple landmarks in

the external world, enabling individuals to navigate by memorising landmarks, paths, and regions. The concept of cognitive maps will be discussed in detail in Subsection 2.2.1. Although they use the term navigation, it is used interchangeably with wayfinding in this context.

Dalton et al. (2019) characterise navigation as a routine, everyday activity that draws on a range of cognitive functions, including perception, declarative and non-declarative memory, imagination, language, reasoning, decision-making, and emotion. Wayfinding, in this context, is described as a decision-making process grounded in individuals' perception of the environment, memory of past experiences, spatial learning, motor activity, and emotional and cognitive evaluations. The process involves determining where one is, where one wants to go, and how to get there.

Hegarty et al. (2023) define spatial navigation as the ability to plan routes to places of interest, identify correct paths while travelling, and return safely. Although they use the term spatial navigation, it is treated as synonymous with wayfinding throughout the article, and the two are used interchangeably.

In addition, a related term is *wayfaring*. Ingold (2008) explains wayfaring as a mode of travel in contrast to transport, emphasising the experience and interaction with the surroundings during the journey. Lanng and Jensen (2016) describe wayfaring as the situational and embodied qualities of wayfinding. They suggest that wayfinding and wayfaring together offer an integrated perspective for the design of public spaces, leading to the concept of mobilities design (2016, p. 250). This approach emphasises spatial mobility, complex interactions, and communication during the search for environmental information, while incorporating social, cultural, and experiential

dimensions into wayfinding. Lanng and Jensen's perspective resonates with the objectives of this thesis, particularly in providing a cultural and experiential lens on wayfinding from a design standpoint.

In addition to cognitive interpretations of wayfinding—such as those involving cognitive maps, spatial problem-solving, urban navigation, route planning, mental representations, and bodily movement—some literature offers philosophical and narrative perspectives on the concept. For instance, Ingold (2000) argues that wayfinding is not simply navigation but a narrative act: a retrospective reenactment of past actions. His interpretation adopts a more philosophical and humanistic stance. Dening (2008) meanwhile, emphasises the symbolic dimension of wayfinding, describing it as an interpretive craft—a system of symbols that the universe imprints on the environment. These perspectives provide a more humanistic and symbolic argument for wayfinding from a non-functional and philosophical standpoint.

In summary, based on a reading of the literature and a synthesis of previous definitions, although it is difficult to define wayfinding comprehensively due to its interdisciplinary nature, it can nevertheless be defined through an integrated perspective that draws on cognitive psychology, mental representation, path planning, and urban layout. For the purpose of this thesis, wayfinding refers to the process of travelling through space from a starting point to a destination. This involves cognition, decision-making, and movement, and relies on spatial cues and environmental information. In this process, individuals draw on environmental information, spatial cues, and their own perceptions and knowledge—both pre-existing and newly acquired from the environment—to construct cognitive maps, plan routes, make decisions, and execute those decisions in order to reach a destination. Depending on the situation, the urgency of wayfinding may vary; for example, emergency scenarios may require greater accuracy and timeliness, though this is not the focus of the present study. Spatial and environmental support is

undoubtedly crucial in the wayfinding process, and many of the definitions discussed in the literature emphasise the use of such cues. Integrating spatial and environmental information helps to facilitate and support wayfinding, which is the key function of the wayfinding system.

2.1.3. Framing Wayfinding System

Wayfinding system is likewise a broad and loosely defined concept. In this research area, various terms have been used to describe similar—or even identical—ideas. These terms often overlap in meaning, making it difficult to draw clear distinctions between them. Referring back to Lynch, his description of the wayfinding system is:

> *We are supported by the presence of others and by special way-finding devices: maps, street numbers, route signs, bus placards.(Lynch, 1960, p. 8)*

The information and objects in the environment that support wayfinding are referred to as ‘way-finding devices’ rather than a wayfinding system in Lynch’s work. Despite the difference in terminology, these devices play roles that support and aid the wayfinding process. Therefore, such information and objects function as resources and tools that facilitate wayfinding. Lynch’s primary focus is on the field of urban studies, and his theories will be discussed in detail in Subsection 2.3.2.

The term wayfinding devices is rarely used in later literature and practice, having been largely replaced by wayfinding systems and wayfinding design. Although these terms are sometimes used interchangeably across different sources, they essentially convey the same meaning.

Arthur and Passini point out that Lynch's work had no direct influence on signage and graphics (1992), with *signage* being a term they coined in their book *Wayfinding: People, Signs and Architecture* (Gibson, 2009). Later, Passini (1996) presented additional thoughts on wayfinding design. He argues that wayfinding, as a design problem, involves the organisation of spatial environments, circulation systems, architecture, and graphic communication. Among these, layout and circulation routes define the wayfinding problem—such as whether a destination can be reached—while architecture and graphic communication are responsible for conveying information. According to Passini, wayfinding design involves all aspects of the built environment. It presupposes the planning of people's behaviours in natural settings and considers how individuals perceive, select, and interpret information in complex and stimulating environments. In other words, the core of wayfinding design is to understand and support people's navigational behaviours in complex environments, helping them to perceive spatial information effectively, interpret spatial features, and make informed navigational decisions. This design logic is grounded in an understanding and analysis of wayfinding behaviour. Although Passini does not explicitly use the term wayfinding system, he proposes relevant design principles and outlines the scope of design. He notes that imperfections in signage can significantly hinder wayfinding and that the form in which information is presented is critically important. According to Arthur and Passini (1992), the main components of wayfinding system design are spatial planning and environmental communication. The wayfinding system conveys orientation, direction, and other relevant information through signage, architectural features, and other communication media in a structured environment to help people reach their destinations. Passini has identified the typical elements of a wayfinding system, including maps, signage, information display design (graphic design), and knowledge of routes and spatial organisation, all of which should be tailored to the characteristics of the environment.

In terms of the concept of environmental communication, Correa de Jesus (1994) points out that built environments are contexts that are not only physical structures, but also convey functions and organise activities through their design, providing a sense of direction and navigational support to their inhabitants. In addition, he suggests that the planning of wayfinding requires visual support, the selected forms of representation (such as icons and maps), and the structure of information (such as typography), which are crucial. It is therefore constructive to address the problem of wayfinding from three different perspectives: cognitive, semantic, and perceptual.

Another related term is *architectural design*. In the 1970s, several architectural graphic designers joined to form the Society of Environmental Graphic Designers (SEDG) (Gibson, 2009). Later, the organisation's name was changed to the Society for Environmental Graphic Design, and finally, in 2014, it was rebranded as the Society for Experiential Design. As the organisation evolved, the term *architectural design* was replaced by *environmental design*, a form of graphic design targeted at non-architects, meaning non-architectural open spaces such as roads, cities, theme parks, and others (Calori & Vanden-Eynden, 2015). Whether referred to as experiential or environmental design, the terms denote an interdisciplinary field involving graphic and visual elements to communicate environmental information, enhance people's experience of public spaces and buildings, and make complex environments easier to understand and navigate. Disciplines within this field may include signage systems, brand experience or branding, information displays, public art, and signage for safety and functionality.

Dogu and Erkip (2000) showed that graphic and textual signage can be used to optimise different aspects of wayfinding and serve as a complement to architecture. This notion was subsequently extended. Fewings (2001) suggests that signs and maps are essential

components of a wayfinding system. However, Fewings' study was based on the context of airport wayfinding, which represents a very different environment from the city. Subsequently, Berger and Eiss (2002) proposed several design principles for urban wayfinding systems, including the placement, size, maintenance, installation, and management of signage, as well as fonts, colours, symbols, and logos. Berger and Eiss focused on urban wayfinding, with particular emphasis on the visual aspects of signage design.

After that, Gibson (2009), who authored a handbook on wayfinding system design, notes that today, environmental graphic design is the preferred umbrella term for describing any communication used in spatial applications, from wayfinding signage programmes to branded spaces, exhibitions, and even public art. Gibson also emphasises that map design and symbol design are important components of a wayfinding system. Here, map design is used rather than cartography, highlighting the aesthetic and functional aspects of maps, with a focus on visual representation and user experience, rather than the processes of data collection, map production, and analysis. Gibson suggests that there are four types of strategies for the design of a wayfinding system—namely, connectors, districts, landmarks, and streets—which is closely aligned with the theory proposed by Lynch.

Montello and Sas (2006) also point out that signage influences orientation and wayfinding convenience, and that maps are equally important. While Montello and Sas's study places limited emphasis on the design of wayfinding systems, it clearly recognises the support that signage and maps provide in the wayfinding process. A similar contribution is found in the *Wayfinding Design Guidelines*, a handbook by Apelt et al. (2007). Apelt et al. state that wayfinding is primarily concerned with effective communication, and that there are four main elements of wayfinding design:

architectural, graphic, audible, and tactile communication. They point out that signs, maps, colour coding, banners, websites, and directional information are all examples of graphic communication. Apelt et al. comprehensively discuss the principles of wayfinding design; however, the focus of their study lies in graphic design, signage installation, and placement, and pays limited attention to the influence of environmental information and human mental representation, such as cognitive maps, on wayfinding.

Fendley (2009) reviews the design rationale and development process of Legible London, a pedestrian guidance system implemented in London, and goes on to propose a set of urban wayfinding design principles: seamless journeys, human scale, naming the parts, progressive disclosure, do not make the user think, and parsimony. The work presents a highly practical framework and sets of design principles, using Lynch's work as a foundation and further developing it. However, Legible London, by comparison, primarily focuses on making the city more legible and encouraging pedestrian movement, with little attention paid to shaping the city's image.

Mollerup (2013, 2016) proposes another related term, *wayshowing*, which refers to the professional activity of planning and implementing orientation systems in buildings and outdoor areas. In other words, wayshowing refers to the measures taken by designers to aid wayfinding through the creation and placement of environmental signage, maps, and other informational media. Although Mollerup argues that 'the professional activity was incorrectly described as wayfinding' (2013, p. 6), the term wayshowing has a meaning that is closely aligned with the concept of wayfinding system design. However, Mollerup later acknowledges that wayfinding and wayshowing are two related concepts, like writing and reading: the designer is responsible for the transmission of information (wayshowing), while the wayfinder is responsible for interpreting and using the information (wayfinding). The concept of wayshowing thus refers specifically to the

design activities and methods involved in creating wayfinding systems, including graphic design, information display, colour schemes, and other visual elements.

In their research, Jeffrey (2019) introduced the term *wayguiding* as an alternative to wayshowing as defined by Mollerup. The author explains wayguiding as 'Wayguiding is used in this study to mean the activity of guiding people to a particular place through the design of environmental cues and navigation aids, creating a wayguidance system' (p.16). The author also points out that the term wayguiding distinguishes the designer's perspective from that of the wayfinder. Despite the difference in terminology, I would argue that this concept is highly similar—if not essentially identical—to that of a wayfinding system, as both rely on design elements aimed at guiding people to their destinations through the use of environmental cues, navigation aids, and other supporting features. Jeffrey further notes that the factors contributing to people getting lost can be attributed to three groups: architects, information designers, and wayfinders. Signage, the clarity of maps, and the legibility of destination names are influenced by design interventions made by information designers, indicating that the design of the wayfinding system is a key factor correlated with whether or not a wayfinder gets lost.

Vilar et al. (2014) state that there are typically two main foci in wayfinding research: external information, such as environmental features, and internal information, such as cognitive representations. They identify two types of traditional indoor signage systems: one that groups and repeats destinations, adding arrows to indicate the correct route; and another that draws lines on the floor, wall, or ceiling—often colour-coded—to signify different destinations. Later, Vilar et al. (2015) further explored the role of signage in the environment, suggesting that signage, as explicit information, may still be preferred by users when it conflicts with implicit cues in the environment, such as the brightness or darkness of a corridor. Although their research focuses on indoor wayfinding system

design—which represents a fundamentally different setting from the city—it nonetheless offers valuable insights into visual design approaches.

Calori and Vanden-Eynden (2015), in their book *Signage and Wayfinding Design*, proposed the term *environmental graphic design* (EGD), which refers to the communication of information in the built environment through graphic means. They suggest that EGD comprises three main components: signage, placemaking, and interpretation. According to the authors, wayfinding is also related to branding strategy, as a brand can be reflected in the visual identity of the wayfinding system. Signage is a crucial part of EGD, consisting of graphics, information, and hardware—a vehicle for conveying information—which may take various forms, such as maps, text, shapes, symbols, and colours. Calori and Vanden-Eynden define the information presented on signage, referred to as the information content system (2015, p. 22), and classify it into several categories: identification (for identifying places and destinations), directional (to express directions), warning (alerting people to safety or danger), regulatory and prohibitory (regulating behaviour in the environment), operational (informing people about how the environment is used), and honotic (conferring honour on individuals involved in the environment, such as donor placards). They also emphasise the need for a hierarchical approach to organising this content, with primary and secondary structures being fundamental. Calori and Vanden-Eynden address wayfinding systems comprehensively in terms of visual aspects, including graphics, text, typography, information systems, colour, and the hardware materials used in physical signage, thereby forming a complete framework for wayfinding design. Although their work offers a thorough treatment of visual design as an independent system, it places less emphasis on environmental information, cognition, and human mental representations of space. While they acknowledge that the environment undoubtedly impacts wayfinding, this aspect is not the primary focus of their research.

Yavuz et al. (2020) state that as urban and architectural spaces evolve, there is an increasing need for information boards, directional signs, and landmarks—especially for individuals who do not speak the local language. The wayfinding design proposed by Yavuz et al. primarily consists of information design and directional design, which represent branches of graphic design that draw on multiple professional disciplines and fields, including architectural design, interior design, urban design, landscape design, industrial design, communication, ergonomics, psychology, and computer technology. The relevant design elements they identify include graphic language, directional cues, signage, interrelated directionality, and consistency in composition, colour, and layout. The ideas put forward by Yavuz et al. make a significant contribution by highlighting the key components that contemporary wayfinding systems should encompass.

Shamsuddin et al. (2022) provided a definition and used the term *wayfinding information system* (WIS), which refers to a system designed to help people move efficiently from one point to a predetermined destination while experiencing space in a physical environment. In this context, environmental cues play a vital role in conveying information. At the same time, they outline the scope of a WIS as including signs, maps, landmarks, site layout, and the structural characteristics of the environment. They also emphasise that wayfinding is not solely dependent on signage but also involves perception, spatial knowledge, information processing, memory, and problem-solving. This is a process that requires assessing the context of the surrounding environment and understanding spatial features, provided that the relative positions of the environment and potential destinations are known. Shamsuddin et al. offer a framework for understanding wayfinding systems that integrates multiple components, encompassing both environmental and psychological aspects.

Iftikhar and Luximon (2023) also use the term wayfinding information system to state that the system consists of two types: static media (such as signage and information maps) and mobile media (such as digital navigation applications such as Google Maps). They argue that one of the leading causes of wayfinding difficulties is the inefficient transfer of information, emphasising the importance of information communication for the wayfinding system. Jeffrey (2017) also highlights the importance of information communication, arguing that information content and design lie at the heart of a wayfinding system.

In summary, the wayfinding system is a concept that spans a wide range of disciplines. Several related terms have been used in the literature, including wayfinding devices, wayfinding design, architectural design, and environmental graphic design. After reviewing the existing literature and considering the aim of this thesis, I propose that a wayfinding system can be defined as a set of aids—both physical and non-physical—designed to help people navigate the environment. It is supported by environmental information and cognitive maps, and involves a combination of components, including information design, signage systems, and maps (both map design and cartography). The importance of signage, graphic design, maps, and information systems as essential components of a wayfinding system has been widely emphasised in previous studies. In addition, elements such as landmarks, site layout, and environmental structure also play significant roles. Although there exists a body of literature and theory within the field of wayfinding systems, it remains a primarily practice-based discipline, often reflected through design projects and real-world applications. Therefore, research into the practice of wayfinding is necessary. By reviewing the historical development of wayfinding, examining its constituent elements, and analysing contemporary design applications, this thesis aims to identify future trends and potential directions for innovation. The analysis of both the historical and current practices of wayfinding systems will be discussed in detail in Chapter 3.

2.2. Internal Representation

This thesis focuses on human wayfinding, and therefore, it is essential to examine the behavioural patterns and underlying logic of how people navigate. To complete wayfinding tasks, individuals acquire, identify, and coordinate both external and internal information (Ishikawa, 2016), using a variety of methods and strategies (G. L. Allen, 1999). These types of information include environmental features and mental representations—namely, environmental cues and cognitive maps. People's knowledge of places, locations, landmarks, and other components of routes varies greatly (Golledge et al., 2000), and so do their interpretations of environmental information. However, common patterns and shared tendencies do exist. The purpose of designing and implementing a wayfinding system is to communicate with users; it represents a form of human–environment interaction, integrating human cognition with external environmental information (Hunter et al., 2016a). In this sense, a wayfinding system acts as a medium that combines and transmits the internal and external knowledge individuals need to navigate successfully. Therefore, understanding human wayfinding behaviour and strategies is essential for the effective design of wayfinding systems.

2.2.1. Cognitive Map

Before the formal emergence of wayfinding as a term, various theories had already emerged as its foundations and prototypes, most related to human perception, cognition and spatial information processing. The first unintentional attempt to understand wayfinding was Gestalt psychology, founded by Wertheimer, Koffka and Köhler (Sternberg et al., 2012, cited in Jamshidi & Pati, 2021). Since then, numerous related

theories have emerged. However, it is challenging to provide a comprehensive overview of these theories, as they span multiple disciplines and encompass diverse perspectives.

Jamshidi and Pati (2021) summarise several contemporary theories related to wayfinding, which, in my view, can be broadly categorised into four groups. The first category concerns theories of perception, including Gestalt theory, the theory of direct perception (also known as ecological theory), perceptual cycle theory, template theory, and constructivist theory. These theories focus on how humans perceive environmental information and the underlying mechanisms of the perceptual process. The second category includes theories of cognitive maps and spatial knowledge representation, such as cognitive map theory and Lynch's theory of legibility and imageability. This group is more concerned with how humans mentally construct and represent spatial knowledge. Although not mentioned in Jamshidi and Pati's paper, Tversky (1993, p. 12) introduces the concept of cognitive collages, emphasising that people often form fragmented, patchwork-like representations of space, rather than coherent, unified maps. During wayfinding, individuals frequently rely on such incomplete spatial information. Later, Tversky (2003) further argues that cognitive collages are more appropriate than cognitive maps for describing mental representations of large and complex environments. The third category addresses the development of spatial knowledge, and includes Piaget's theory of spatial development and Siegel and White's theory of spatial knowledge acquisition. These theories explore how spatial understanding is acquired and evolves, particularly throughout childhood. The final category focuses on cognitive processes and modalities related to wayfinding, including problem-solving and individual differences. Theories in this group include the TOTE model, the hunter-gatherer theory, and progress monitoring theory. Collectively, these theoretical frameworks reveal the complexity of wayfinding as a process that involves perception, cognition, environmental information, and decision-making. They offer a multifaceted foundation for understanding wayfinding and underscore both the importance of

environmental cues and the central role of cognitive maps. For the purposes of this thesis, the most relevant theories for wayfinding system design are Lynch's theory of legibility and imageability, and the theory of cognitive maps. Lynch's framework provides the basis for forming a clear mental image of the environment, while cognitive map theory is key to understanding how spatial information is mentally constructed and represented in the mind of the wayfinder.

Tolman first introduced the concept of cognitive maps in 1932, and his experiments in 1948 demonstrated that rats were capable of forming mental representations of their environment (1948, cited in Ghamari & Sharifi, 2021; Hegarty et al., 2023; Peer et al., 2021). Based on these findings, Tolman argued that all organisms use internal cognitive models to navigate their surroundings (Jamshidi & Pati, 2021). To move efficiently from one location to another, individuals rely on internal representations of the spatial structure of the world (Ishikawa & Montello, 2006; Peer et al., 2021). Cognitive maps are closely related to spatial memory (Ghamari & Sharifi, 2021), and serve as mental representations of how humans perceive and interpret the natural world (Raubal & Egenhofer, 1998). These representations include the spatial relationships between features and objects, such as the relative position and distance of one object in relation to others (Golledge et al., 2000). Human spatial behaviour is determined by what individuals know about space (Ishikawa, 2016), that is, by the contents and structure of their cognitive maps (Downs & Stea, 2011). According to Downs and Stea, cognitive mapping is a process involving a sequence of mental transformations through which individuals acquire, encode, store, retrieve, and interpret information about the relative locations and attributes of phenomena in everyday spatial environments. People rely on spatial information derived from cognitive maps to support orientation and wayfinding (O'Neill, 1992). As they move through space, they gradually acquire spatial knowledge about the relationships between locations and construct mental representations that form the basis of their cognitive maps.

Spatial knowledge is the result of integrating different types of spatial information, including landmark knowledge (visual details of specific locations), procedural knowledge (the sequence of actions required to follow a route), and survey knowledge (the configurational relationships between locations and paths), all of which are synthesised through cognitive maps (J. L. Chen & Stanney, 1999). Cognitive maps play a crucial role in wayfinding because they integrate multiple levels of spatial information, enabling individuals to construct mental representations of their surroundings. They provide essential knowledge for navigating from one location to another and for communicating spatial understanding to others. According to Golledge et al. (2000), cognitive maps involve the encoding, storage, and manipulation of empirical and perceptual georeferenced information. Cognitive maps offer two fundamental types of information necessary for everyday spatial behaviour: the location and attributes of objects. This includes both where an object is situated and what characteristics it possesses, as well as how a set of spatial and attribute information can together define an object (Downs & Stea, 2011). Downs and Stea note that spatial information is inherently complex, often requiring individuals to store and process considerable amounts of distance and directional data to function effectively in a spatial environment. Attribute information complements spatial information, and the integration of both is essential for efficient navigation. Therefore, it is necessary to explore how this information-processing activity can be supported in practice, particularly through the externalisation of cognitive maps in applied contexts.

Some scholars have emphasised that, despite the term map, cognitive maps are not literal maps; rather, the term reflects a functional analogy rather than a resemblance in physical form. Spatial information can be represented in various formats, and its expression is often context-dependent (Downs & Stea, 2011; Golledge et al., 2000). The

communication of spatial information, therefore, needs to be as flexible and adaptive as the spatial information itself. A related and complementary concept is that of spatial schemas. Farzanfar et al. (2023) argue that spatial schemas guide the encoding of urban layouts and spatial elements, with Lynch's theory of five elements—landmarks, nodes, edges, districts, and paths—serving as a prominent example. Spatial schemas function by identifying and integrating recurring features across multiple environments, while cognitive maps provide more detailed, context-specific spatial representations. In other words, the development of cognitive maps contributes to the formation of spatial schemas. Although the relationship between the two is complex, they are fundamentally complementary in supporting human spatial understanding and navigation.

Ghamari and Sharifi (2021, p. 586) introduced the concept of wayfinding cognition, stating that cognitive functions refer to mental processes that involve knowledge acquisition, information processing, and reasoning. Moreover, they also pointed out that much of the research on wayfinding cognition relies on Siegel and White's (1975, cited in Ghamari & Sharifi, 2021) classification of spatial memory into survey knowledge, landmark knowledge, and route knowledge. Survey knowledge, or configurational knowledge, refers to an understanding of the overall spatial layout of the environment and the spatial relationships between places and objects within it. Landmark knowledge refers to remembering objects and places based on their visual appearance in the environment, but not necessarily their spatial relationships. As defined by Siegel and White, route knowledge is the sequential knowledge that connects different places or objects.

Peer et al. (2021) have shown that spatial navigation relies on two central internal representations, Euclidean-based cognitive maps and graph-based cognitive maps. Euclidean-based cognitive maps are classical spatial representations used to encode

environmental factors, including locations, landmarks, and goals, while graph-based cognitive maps are composed of nodes connected by paths. These two concepts are complementary. Although Peer et al.'s study focuses on neurological representations, the two representations they refer to shed light on wayfinding system design. Euclidean-based maps provide wayfinders with a holistic view of the space when real wayfinding occurs. In contrast, graph-based cognitive maps emphasise the connection of paths and nodes and might be more suitable for environments with complex buildings, twisting streets, and restricted views.

Kuipers (1978) proposed a model of mental space that is considered common-sense knowledge for human beings, known as the TOUR model (p.130). The model categorises spatial knowledge into five aspects: first, routes (actions that take the wayfinder from one place to another), secondly, topology of the street network (descriptions of streets and places, including knowledge of locations on the street and the geometry of street intersections), thirdly, coordinate frames of relative positions (establishing coordinate systems to describe the spatial relationships between different locations), fourthly demarcation lines and grid structures (used to delineate spatial area boundaries and define the relationships between areas on either side), and fifthly, an area structure of containment relationships (containment relationships between different areas). The model aims to simplify and organize spatial information through topological structures. The authors also introduced the concept of skeleton streets (p.146), which refers to key streets that play a connecting role in the route-finding process, and whose spatial relationships with the starting point and the goal are known, thus providing structural support for route planning and reducing the complexity of path selection. Later, Kuipers et al.(2003) further discuss the concept of the skeleton as a subset of the main paths that expert pathfinders (those highly familiar with the environment, such as cab drivers) typically rely on in complex environments. These paths, as skeletons, assist in constructing effective navigation routes through their known spatial relationships

with the starting and ending points; they do not represent all the paths in the environment, but rather the paths that have key connecting roles. Based on this theory, Modayil et al. (2004) introduced a method that combines topological skeletons and metric maps to construct global metric maps, where the main role of topological skeletons is to provide a structured way of organizing the main paths and key locations in the environment. The concept of skeleton streets may establish a core spatial framework for wayfinding system design, providing a clear basis for path planning, highlighting the main paths and key nodes in space, and further organizing and filtering useful information, thereby reducing the cognitive burden on the wayfinder.

Another important theoretical contribution to the study of wayfinding systems, particularly from architectural research, is the theory of Space Syntax, first introduced by Hillier and Hanson (1984). It refers to a method for analysing spatial configurations, aiming to represent the basic structure of space through its geometric relationships, to demonstrate how these structures are interconnected to form a coherent system, and to combine them into more complex structures. This method seeks to explain how spatial configurations influence social behaviour. Hillier and Hanson argue that space is composed of interconnected parts, and that understanding these connectivity relationships is essential for comprehending and explaining human behaviour within these spaces.

Figure 4 Spatial configuration of Manchester modelled by the Space Syntax OpenMapping GB project, using integration values to represent the spatial accessibility of streets. Source: Space Syntax, OpenMapping GB, 2017.. https://spacesyntax.com/project/openmapping-gb/

Dalton and Bafna (2003) illustrate the relevance of space syntax to the urban elements defined by Lynch. The authors redefine the spatial properties of the five urban elements proposed by Lynch (Node, Path, Districts, Edge, and Landmark) through the framework of space syntax, particularly using spatial descriptions such as axial lines (the longest and shortest sightlines) and isovists (the visible area from a specific viewpoint). They argue that the concepts of intelligibility and imageability, previously considered separate, can be unified and understood through space syntax, revealing the relationship between spatial structure and human cognition. Furthermore, they point out that an imageable city must be intelligible, but an intelligible city is not necessarily imageable. Dalton and Bafna's study demonstrates that the image of a city is not solely dependent on visually distinctive features, but also closely linked to spatial structure, with space syntax playing a key role in understanding urban perception. This insight suggests that,

when designing a wayfinding system, it is crucial to consider how people behave in space, such as the impact of landmark visibility on wayfinding.

In addition to the work of Dalton and Bafna (2003), more recent studies have further emphasised the close relationship between Lynch's theoretical framework and space syntax theory. Filomena et al. (2019) proposed a method for quantifying Lynch's theory of the Image of the City and incorporating it into GIS, combining perspectives from space syntax, cognitive mapping, and information theory to computationally identify the five urban elements (paths, nodes, districts, landmarks and edges), and comparing the results with Lynch's original cognitive map of Boston. Their findings revealed that while there were discrepancies in the identification of landmarks, the other four elements showed a high degree of correspondence. Similarly, Gohari (2019) examined the relationship between space syntax and the five urban elements defined by Lynch. Using Bojnourd City as the study area, the author compared citizens' hand-drawn cognitive maps with axial lines and isovists generated through space syntax analysis. Gohari argued that paths and nodes can be effectively modelled using space syntax, whereas edges, landmarks and districts rely more heavily on visual and semantic cues, and thus require additional support from field-based perceptual investigation. This suggests that fieldwork and cognitive investigation conducted within the actual environment remain necessary.

Farr et al. (2012) suggested the relevance of space syntax to wayfinding, proposing that space syntax provides tools and measures for analysing and defining spatial structures (layout attributes), offering a quantitative approach for studying architectural and spatial configurations in wayfinding research. However, as the authors state, the space syntax has limitations in that it ignores the district environment's overall shape and layout, and

the environment's surface features (such as colour, pattern, and texture). Thus, although space syntax provides essential insights into understanding the relationship between spatial configuration and human wayfinding behaviour, it still highlights the importance of cognitive maps and environmental information.

In summary, human spatial behaviour depends on their spatial knowledge, which is integrated at multiple levels in cognitive maps. Cognitive maps contain representations of spatial relationships between environmental features and objects, which construct individuals' perceptions of their environments and enable them to form mental representations of space for effective wayfinding in space. The theory of environmental information and cognitive maps provides a framework for wayfinding system design and designers to integrate environmental information and human cognition, thus providing guiding principles for design.

2.2.2. The Strategies of Wayfinding

After discussing cognitive maps, it is also important to note how people use them for wayfinding, which involves the strategies employed in navigating space and the cognitive processes involved. Wayfinding entails multiple cognitive functions, including the perception of environmental information, the creation and maintenance of spatial representations in both short-term and long-term memory, and the use of these representations during spatial navigation (Piccardi et al., 2019). Therefore, it is essential to understand how individuals employ various methods and strategies to wayfind in urban environments.

Downs and Stea (1973) defined four steps in the wayfinding process: orientation, route selection, route control, and destination recognition. Their theory provides a useful framework for understanding people's wayfinding behaviour in space. Later, they further explained this process as a series of mental operations through which individuals acquire, encode, store, recall, and decode the relative positions and attributes of objects in everyday spatial environments. Downs and Stea's perspective once again highlights that wayfinding is a cognitively demanding activity that relies heavily on spatial information.

Arthur and Passini (1992) pointed out that wayfinding can be divided into three stages: decision-making (developing a plan of action), decision execution (translating decisions into appropriate behaviour at the correct time and place), and information processing (utilising perception and cognition to acquire, understand, and process spatial information). They further explained that wayfinding requires individuals to recognise different types of information from the environment (such as maps, directions, and landmarks) and to use internal cognition to decide how to reach their destination. This theory has since served as the basis for numerous studies and has been expanded and applied in various contexts. For example, Bryden et al. (2023) adopted Arthur and Passini's framework to explore the effects of age and cognitive functioning on wayfinding in unfamiliar areas. Casakin et al. (2000) applied the same theory to examine the role of spatial elements in the physical environment in the graphical representation of wayfinding maps. They also emphasised that the availability of environmentally relevant information is essential to the decision-making process.

Carpman and Grant (2016) state that wayfinding consists of five steps: individuals must know their current location, know their destination, identify and follow a valid route to reach the destination, recognise the destination upon arrival, and find their way back to

the starting point or proceed to the next destination. These five steps may appear simple but require substantial environmental knowledge and complex cognitive processing.

Vandenberg (2016) suggests that wayfinding consists of four essential components: decision-making, orientation, path integration, and closure. Vandenberg's viewpoint is consistent with the first stage of Arthur and Passini's theory. The author then extends and elaborates on this theory by offering a more detailed explanation of decision-making, including route selection based on individual needs. Information processing is also further developed, incorporating multiple cognitive processes that support wayfinding. In this sense, Vandenberg's perspective can be seen as a continuation and refinement of Arthur and Passini's framework.

Vaez et al. (2020) state that wayfinding involves several critical tasks, such as destination decision-making, route planning, navigating to locations that are out of sight, and the use of cognitive maps. In addition, they note that navigational aids—such as signage systems, paper maps, the Global Positioning System (GPS), and digital maps—can assist individuals in their wayfinding process, particularly in unfamiliar environments.

Casakin et al. (2000) point out that the availability of environment-related information is an important factor in the decision-making process. Montello and Sas (2003) similarly argue that wayfinding is a process that relies on memory, which consists of both internal neural memory and external artefacts. Internal memory involves the perception and experience of the spatial environment, including landmarks and paths, while external artefacts—such as maps—represent this spatial knowledge. They further note that wayfinding also requires problem-solving, which includes selecting a path to

follow, orienting toward imperceptible landmarks, creating shortcuts, and planning trips and their sequences.

Hölscher et al. (2011) proposed two types of strategies: graph-based and direction-based. Graph-based strategies rely on topological knowledge of the urban network structure—such as the connectivity between streets and locations—to determine routes. In contrast, direction-based strategies make use of directional information. The authors point out that direction selection is an integral part of any route planning process, and many researchers have described it as a predominantly visual process, supported by knowledge of the relative positions of landmarks. When graph-based and direction-based strategies are combined, they form a comprehensive spatial approach that enables individuals to obtain more complete wayfinding information.

Hegarty et al., (2023) suggest that wayfinding can be accomplished through two main strategies: response strategies, which involve following familiar routes or discovering new paths; and place strategies, which rely on flexible spatial representations based on the configuration of the environment, such as cognitive maps.

The study by Bock et al. (2024) focuses on decision-making strategies at intersections. The authors propose five specific strategies for wayfinding: serial order strategy, associative cue strategy, beacon strategy, relative location strategy, and cognitive map strategy. Bock et al. further note that wayfinding decision-making depends not only on these specific strategies but also on more general cognitive processes.

Golledge (1995) discusses that when choosing a path, the criteria that people use to choose a path include the shortest distance, least time-consuming, fewest turns, most

scenic/aesthetic, first noticed, longest leg first, many curves, many turns, different from the previous one, and shortest leg first (p.6). Although the shortest and most time-efficient routes are often chosen in laboratory settings, in real-world environments, where more attention is paid to path familiarity, accessibility, and visual comfort, aesthetic factors also become important considerations in path selection. The authors point out that route choice does not depend solely on the shortest and least time-consuming criteria but is a diverse decision-making process in which people flexibly adjust their choice criteria according to the specifics of their environment.

Dalton (2003) used a virtual city environment with virtual reality helmet simulations of wayfinding environments as a research methodology, discussing how individuals choose routes that are as straight as possible and minimize angular deviation, which the author refers to as ‘following their noses’ (p. 108). The study shows that people do not make arbitrary decisions at intersections and that path choice is influenced by the complexity of the environment. At intersections, people try to follow straight lines in order to avoid winding paths. One of the key factors influencing path choice is the least angle, which means choosing the path with the least deviation from the current direction, emphasizing the straightness of the path rather than merely focusing on the shortest and quickest route.

Hochmair and Karlsson (2005) studied individuals' path choice preferences in unfamiliar environments, focusing mainly on the least angle strategy and initial segment strategy, and pointed out that in real life, wayfinding decisions do not rely on a single strategy, but rather on the interaction of multiple strategies. The authors propose the minimum angle strategy and the initial segment strategy. Additionally, the authors introduced the concept of the ‘minimum triangle path’ (p. 88), which is a mechanism suggesting that, in path selection, people will try to reduce the total length of the path,

particularly by minimizing the triangle distance between the initial segment and the target. This strategy is highly correlated with the least angle strategy.

Quercia et al. (2014) pointed out that affective factors should not be neglected in wayfinding and therefore affective dimensions such as beauty, quiet, and happiness should be included in path recommendation systems. The authors investigated how these affective dimensions influenced the path recommendation system in the city of London, using an affective scoring system based on crowdsourced data. Subsequently, a qualitative study was conducted for comparison in Boston for validation. Their study showed that despite the recommended paths being slightly longer than the shortest path, most users still preferred these emotionally pleasing paths over simply the shortest path. This seems to confirm Golledge's findings that people also consider the aesthetic aspects of paths in real-world wayfinding. Emotional dimensions and emotional perceptions become part of people's wayfinding strategies.

Despite focusing primarily on indoor wayfinding, Jeffrey's PhD thesis (2019) on wayfinding strategies and wayfinding behaviours, particularly in relation to getting lost, remains highly relevant. In her thesis, Jeffrey provides a comprehensive discussion of why humans get lost and summarises theories suggesting that people get lost for several reasons, including factors related to the wayfinder (such as emotional state, wayfinding ability, and the completeness of cognitive maps), building design, and navigational information. The author identifies five key factors that contribute to getting lost (p.41): difficulty in forming a cognitive map layout, lack of recognisable landmarks, multiple building entrances, multi-storey construction, and unclear wayfinding guidance (such as signage and maps). Relevant to this thesis are three of them, namely wayfinder's difficulty in line-level cognitive map layout, lack of recognisable landmarks and unclear guidance information. Although this thesis does not aim to solve the problem of people

getting lost in cities, which is what this thesis is concerned with. Jeffrey concludes that route knowledge, survey knowledge, and landmark knowledge are three widely cited wayfinding strategies in academic research. She argues that the success of a wayfinding strategy is closely related to the legibility of the environment and the manner in which information is presented, and the author discusses the importance of clear signage and map design for wayfinders.

Several authors have highlighted individual differences in wayfinding strategies, including variations in spatial ability, cultural background, and language use (Farr et al., 2012; Hegarty et al., 2023; Hund & Minarik, 2006; Ishikawa & Montello, 2006; Lawton, 1996; Padgitt & Hund, 2012; Saucier et al., 2002). Coutrot et al. (2018, p. 1) developed a game called Sea Hero Quest to test individual differences in wayfinding tasks. Their research showed that spatial navigation ability declined with age; males showed some advantage, but the more gender-equal countries were, the smaller the difference was; different countries could be categorised into five clusters with clear geographic correlations; and the higher the GDP of a country, the better the overall navigation ability of its inhabitants. Later, Coutrot et al. (2019) further research using the game showed that wayfinding differed between genders, with males outperforming females in wayfinding tasks, that the difference was greater in the virtual environment than in the real world, and that this gender difference could not be explained by the presence or absence of more video game experience. Individual differences do exist, and research from this perspective offers valuable insights into the structure and processes of spatial knowledge, as well as practical implications for the design of personalised wayfinding systems. However, there remains a need to interconnect and integrate individually acquired spatial knowledge within a common framework (Ishikawa, 2023).

Overall, wayfinding strategies are essential in helping individuals reach their destinations and interpret environmental information. Based on the literature, although wayfinding processes, steps, and strategies are derived from different perspectives, they share common features: they rely on accessing and utilising environmental information (such as landmarks, streets, directional signs, and spatial cues); involve the construction and application of cognitive maps; and require processing spatial information and making navigational decisions. The importance of visual cues is repeatedly emphasised across the literature, particularly the critical role of landmarks in the wayfinding process. A review of these processes and strategies highlights the significance of constructing cognitive maps to integrate environmental information. For wayfinding system design, it is equally important to support both overall spatial cognition and local visual cues in response to different wayfinding strategies and steps. Ultimately, optimising and integrating environmental information is essential for enhancing wayfinding effectiveness.

2.3. External Features

Wayfinding is a complex and lifelong activity that can occur in any environment. This thesis, however, focuses specifically on wayfinding in urban environments. Successful wayfinding results from human–environment interactions (Farr et al., 2012), and environmental perception plays a key role in the wayfinding process. An important factor influencing environmental perception is the layout and structure of the environment (J. L. Chen & Stanney, 1999). As discussed in previous sections, environmental information is one of the core components that support the wayfinding process. Therefore, it is essential to understand the specific environment in which wayfinding occurs.

2.3.1. City, City Centre and Urban Environment

This thesis focuses on wayfinding in cities. As Lynch (1965) points out, when addressing physical issues in the urban context, particular attention should be paid to the characteristics of the city centre, where peaks of activity and interest dominate the urban landscape due to their symbolic significance and frequency of occurrence. The concept of a city can be defined from multiple perspectives. For example, the Centre for Cities (2015, p. 1) introduces the concept of the Primary Urban Area (PUA) from an economic perspective, referring to the concentration of a significant amount of economic activity within a relatively small geographic area.

City centre refers to a city's commercial, cultural and often historical, political and geographical core. According to the *Oxford English Dictionary*, the definition of city centre is 'central part of a city, esp. that which forms its main business or commercial district; now frequently attributive, as city centre office, city centre shop, etc' ('City Centre, n', 2024). The term is widely used in many English-speaking countries and has equivalents in other languages. In Chinese, for instance, the corresponding term is '市中心', which can be seen as a direct translation of city centre. A related term, *town centre*, carries similar meanings and is sometimes regarded as a synonym. Pissourios (2014) notes that the conceptual definition of the town centre is difficult to establish. Even if it can be described, different academic disciplines offer varying perspectives, making it challenging to develop a universal definition. Although Pissourios uses the term town centre, in this context it is treated as synonymous with city centre. Zhu and Sun (2017, p. 22) define the city centre as the economic and social core of a city. Their study proposes a spatial clustering method—based on spatial proximity and attribute similarity—to identify and delineate city centre boundaries.

The urban environment—including both the city and its centre—is the focus of this thesis, as it constitutes the physical setting where wayfinding occurs. It serves as the external environment within which the wayfinding process takes place. The urban environment is a complex and multifaceted concept, situated at the intersection of both the social sciences and natural sciences (Sénécal, 2007). Joynt (2021, p. 1) introduces the concept of a well-functioning urban environment, identifying multiple interacting domains, including the built, social, cultural, and natural environments. In the context of wayfinding and wayfinding system design, the urban environment refers to the external spatial context through which people navigate, shaped by buildings, streets, greenery, artefacts, public spaces, cultural elements, and human activity. The urban environment in which wayfinding takes place is often described as a complex environment—an environment characterised by unclear and confusing navigational, spatial, or geometric cues (Iftikhar et al., 2020). Information from the city influences the wayfinding process and contributes to the formation of internal representations in people's minds. These mental representations are gradually integrated into a coherent whole, supporting navigation and simultaneously shaping people's overall impression of the city. In the following section, I turn to the concept of city image and related theoretical perspectives.

2.3.2. City Image and Kevin Lynch's Theories

There is little doubt that places influence people. Humans and cities are inextricably linked: people create cities, live and work in them, and in doing so, shape not only their physical structures but also the meanings associated with those structures (Paulsen et al., 2018). The city image is typically formed in people's minds through distinctive characteristics of the city (Jannah et al., 2014, cited in Chan et al., 2021). In other

words, it is a concept shaped by individuals' subjective impressions of the urban environment.

There is little doubt that it is essential to revisit Kevin Lynch and his seminal work *The Image of the City*. Lynch (1960) suggested that as people move through a city, they interpret spatial knowledge gained through observation and translate it into a mental image. He further proposed five elements that constitute the city's image: paths, edges, districts, nodes, and landmarks (1960, pp. 46–48), and introduced two key concepts, *legibility* (1960, p. 2) and *imageability* (1960, p. 9). Lynch's concern lies in the formal identity of the city and the structure of the city image that individuals retain and mentally reconstruct (Q. Stevens, 2006). His theory is especially important because it supports the idea that the cognitive maps shared by individuals can be synthesised into an overall city image. When a city is legible—meaning it is easy to read, remember, and navigate—people can quickly grasp its layout and orient themselves more easily (Yavuz et al., 2020). If a city has imageability, it allows observers to form vivid mental images and derive meaning from the urban environment.

Lynch's contributions to the study of cities are numerous and span various aspects of urban form, layout, and development. For example, he characterised the structure of the metropolis in terms of size, grain, density, and shape (1954). He also identified critical elements of urban development, including structural density and condition, circulation systems, the location of fixed activities, and metropolitan patterns such as the dispersed sheet, urban star, core city, ring, and galaxy of settlements (1961). In a later work, Lynch (1965) observed that cities can enhance quality of life through design and policy innovations, particularly by improving large-scale urban structures. Another study (1972) examined how urban environments shape people's perception of time and how cultural and social changes affect the experience of time in cities. Despite his many

contributions to urban theory, it is Lynch's discourse on the image of the city—including the concepts of legibility, imageability, and the five elements—that forms the methodological foundation of this thesis.

Lynch introduced the concepts of legibility, imageability, and the five elements of the city in his book The Image of the City (1960). These concepts were subsequently developed and applied in a wide range of later studies.

Lynch stated the legibility as:

> *...the ease with which its parrs can be recognized and can be organized into a coherent pattern. Just as this printed page, if it is legible, can be visually grasped as a related pattern of recognizable symbols, so a legible city would be one whose districts or landmarks or pathways are easily identifiable and are easily grouped into an over-all pattern. (1960, p. 3)*

Following Lynch, Weisman (1981) also notes that the legibility of the environment is crucial for wayfinding. King and de Jong (2016) describe legibility as being centred on reading—reading cities and streets in much the same way as reading a map—and consider it highly relevant to wayfinding from an urban planning perspective. Yavuz et al. (2020) define legibility as the ability to read and understand the environment, noting that readable environments make it easier for individuals to find their way. Taylor (2009) argues that legibility is critical in urban planning, though its perception is essentially cognitive rather than affective or aesthetic. Silavi et al. (2017) further elaborate that a legible city is one in which roads, landmarks, and paths are easily recognised and mentally constructed. Overall, the concept of legibility emphasises the

clarity and readability of the environment. Cities and regions with high legibility tend to generate clearer cognitive maps, thereby reducing the difficulty of wayfinding.

Lynch described the imageability as:

> *...that quality in a physical object which gives it a high probability of evoking a strong image in any given observer. It is that shape, colour, or arrangement which facilitates the making of vividly identified, powerfully structured, highly useful mental images of the environment. (1960, p. 9)*

Lynch's concept emphasises the imageability evoked by physical objects in the city, focusing on the functionality of spatial perception. Following Lynch, Silva (2013) states that a highly imageable place evokes a strong image of that place, leaving a lasting impression and memory in the mind. Alamoush and Kertész (2021) state that imageability refers to the unique, recognisable, and memorable qualities of a place that define the character and identity of a city. They also suggest that imageability is associated with attracting attention, evoking emotion, and creating lasting impressions. Their view may further extend Lynch's perspective by incorporating emotional responses.

As can be seen, legibility and imageability are two closely related but distinct concepts. Legibility emphasises the clarity and organisation of the urban environment, focusing on whether the city's spatial structure is logical—in other words, the functional and spatial legibility of its layout. Imageability, on the other hand, relates to uniqueness and highlights a city's ability to be easily remembered and to form a strong impression. It is often associated with distinctive landmarks, unique spatial configurations, or

remarkable urban features. While legibility focuses more on the readability and navigational functionality of a city, imageability emphasises the lasting impressions and character-defining qualities that contribute to the identity of the urban environment.

The five elements proposed by Lynch then include paths, landmarks, edges, districts and notes, defined respectively (1960, pp. 47–48) :

Paths: ‘Paths are the channels along which the observer customarily, occasionally, or potentially moves.’

Edges: ‘Edges are the linear elements not used or considered as paths by the observer.’

Districts: ‘districts are the medium-to-Iarge sections of the city, conceived of as having two-dimensional extent, which the observer mentally enters ‘inside of,’ and which are recognizable as having some common, identifying character’.

Nodes: ‘Nodes are points, the strategic spots in a city into which an observer can enter, and which are the intensive foci to and from which he is traveling’.

Landmarks: ‘Landmarks are another type of point-reference, but in this case the observer does not enter within them, they are external.’

Lynch’s five elements serve as a critical cognitive framework for understanding the image of a city, helping people to comprehend, recognise, and remember a city through

its physical features. As urban planning has continued to evolve and the research field has expanded, many scholars have proposed alternative interpretations and extensions of these elements. While some of these scholars do not explicitly base their insights on Lynch's theory, their perspectives nonetheless offer new ways of analysing and understanding the concepts he introduced.

The paths in a city, such as streets and sidewalks, are carriers of human activity and play a key role in maintaining both the physical and psychological safety and accessibility of urban environments (N. Stevens & Salmon, 2014). Paths are also considered one of the most crucial elements in urban design. The clarity of the road network and the quality of directional pathways help individuals develop more accurate mental maps and enhance the visual clarity of the urban image (Mohidin & Ming, 2023). The significance of paths in urban design has been well established (Carmona, 2010), and they are a fundamental factor influencing the accessibility of places within the city (Ortega et al., 2021). Koohsari et al. (2013) found that specific attributes of the built environment, such as road connectivity, are associated with recreational walking and transportation. The accessibility and availability of destinations—such as local shops, green spaces, services, and transit points—are also recognised as key environmental factors that encourage walking. Paths serve not only as channels for mobility but also as spaces for activity. An ideal street should accommodate multiple functions and serve as a focal point for ecological, social, and cultural life (Macdonald, 2011). The importance of paths as navigational corridors in wayfinding is widely acknowledged, and they are equally integral to the image of the city.

Oktay (2002) points out that districts serve both as identifying features in the evaluation of urban form and as markers of new urban expansion. Creative design of the regional environment can enhance local uniqueness and create memorable places by reinforcing

these areas. The concept of districts differs from that of urban blocks. An urban block is a physical unit in the city, defined and connected by roads, and generally refers to a single building unit (Carmona, 2010). In contrast, Lynch defines a district as a part of the city that individuals recognise in their cognitive maps and associate with a sense of commonality or identity. This is fundamentally a cognitive concept.

Another term related to districts is *neighbourhood*, described by Lee (2017), as: 'the place where their neighbours live and their neighbours are the people who live in the place' (p. 91). Lee points out that a neighbourhood is an area that people psychologically identify with, an area that holds both social and spatial significance, and a unit of psychospatial space formed by residents based on their experiences of interacting with people and places. Taylor et al. (1984) explored the relationship between neighbourhood naming and place attachment, and pointed out that residents express their identification with and emotional attachment to the area by naming the place they live in. Naming, as a cognitive activity, reflects the close connection between residents and their living environment.

On the other hand, Bae and Montello (2018) explored the relationship between residents' perceptions of the neighbourhood and how they define its boundaries, and the officially defined neighbourhood. The study shows that residents' perceived boundaries are often influenced not only by geographic location but also by social, cultural, and physical characteristics. Residents construct their understanding of the neighbourhood's boundaries through cognitive maps and socio-cultural information. Similarly, Dalton and Hurrell (2023) also investigated the boundaries of the neighbourhood, attempting to define and map these boundaries. The authors viewed the neighbourhood as an ambiguous space subjectively perceived by its inhabitants, finding that its boundaries vary from person to person with subjective ambiguity. In other words, the

neighbourhood is not just a geographical area but also a space with personal emotional and social meanings that influence how residents experience the city and interact with other residents.

In a sense, neighbourhood and districts can be regarded as synonyms, as both represent spatial units in the city used to describe and define common areas. Both are tied to the division of space in urban environments and are shaped by people's psychological perceptions and cognitive maps, reflecting their mental images and emotional connections to certain parts of the city. Both concepts are more subjective than physical boundaries, incorporating social, cultural, emotional, and psychological factors. While they are similar in meaning, there are small distinctions between the two. Neighbourhood tends to emphasize individuals' subjective social and emotional attachments, whereas the criteria for dividing districts also include more objective factors, such as the functional characteristics of the area. Additionally, neighbourhood places emphasis on the perceptions and psychological impressions of local residents in their daily lives, while districts, though based on urban residents' perceptions in Lynch's study, are not limited to local residents' perception of the city.

Cultural districts are among the most frequently mentioned and commonly discussed types of districts. Noonan (2013) argues that cultural districts have clear boundaries, although his research is limited to cases in the United States. In contrast, other scholars place less emphasis on the precise boundaries of cultural districts and focus more on whether an area contains cultural facilities—such as museums and theatres—and whether it serves as a concentration point for cultural and artistic activities (Brooks & Kushner, 2001; Grodach, 2011; Mccarthy, 2006; Santagata, 2002; Suwala, 2015). This understanding appears to align more closely with Lynch’s concept of districts, whereby areas are recognised based on characteristic commonalities. In this sense, a cultural

district is defined by the concentration of cultural, artistic, and historical institutions and activities. As such, cultural districts are an important component in shaping and enhancing the uniqueness of a city's image.

Edges, by contrast, have received less scholarly attention and are more directly related to a city's legibility. Lynch emphasises that many cities have identifiable edges and notes that these often function as dividing lines between districts—boundaries that emerge from the junction of two or more distinguishable areas. Carmona (2010) reports that some researchers argue clear community boundaries may enhance internal functioning, social interaction, and the sense of community and identity within them. However, this view is contested. As Lynch himself later said (2001), planning a city as a series of discrete communities is ultimately futile. A well-designed city should possess a continuous, integrated structure rather than a fragmented, honeycomb-like configuration.

For wayfinding, nodes and decision points are related but not equivalent concepts. Decision points are typically locations where a choice of direction or action must be made (De Cock et al., 2019). In urban contexts, these are often intersections—critical points in the path selection process (Klippel, 2003). Nodes, on the other hand, are key intersections or gathering places in the city that serve as focal points for social activities and urban functions. These locations do not necessarily involve decision-making during wayfinding, which is the most significant distinction between nodes and decision points.

There has been extensive discussion of landmarks. Cheirchanteri (2021) suggests that successful landmark features may derive from visual attributes (such as appearance, shape, colour, and visibility), semantic qualities (such as cultural and historical

significance), and structural characteristics (such as location at critical spatial reference points). Lamit (2004, p. 75) defines a landmark as: ‘any urban landscape feature with manifested or inherent attributes which is physically or spiritually unique, influential, impressive and generally in contrast with its contextual characteristics which encompasses components such as towers, buildings, open spaces and special urban features.’. Caduff and Timpf (2008) argue that the most common requirement for a landmark is that it must be perceptually distinctive in some sense—whether in terms of attributes such as size, shape, texture, and colour, or in terms of its spatial location relative to other elements in the environment. Montello (D. R. Montello, 2005) states that landmarks are distinctive spatial features that are often used as reference points to identify a destination or to confirm that one is still on the correct route. These definitions consistently highlight the distinctive, unique, and standout qualities of landmarks. However, unlike Lynch, a significant portion of these later definitions places greater emphasis on the meaning and symbolic value of landmarks—dimensions that Lynch himself paid comparatively less attention to.

Another concept that may have been overlooked by Lynch is *communicability*. Dalton and Bafna (2003) state that urban space is easier to navigate if its local connectivity is consistent with its overall structure, meaning the structure is intelligible. The authors note that the visual differentiation of cityscapes depends on the structural hierarchy and functional zoning of the city itself, meaning that a good urban structure can visually distinguish parts of the city through clear hierarchical divisions. Although the authors do not use the term communicability, it clearly conveys the idea that if the spatial structure of a city is multilayered and hierarchical, the relationship between different areas will be clearer, thus enhancing intelligibility. This contributes to a better understanding of how the city is organised, making the task of navigating it simpler, as well as enhancing the understanding and communication of information. This, in fact, means that such a city

has communicability and is able to effectively communicate and share spatial information.

Dalton et al. (2019) also point out that wayfinding is a social activity in which other people (including passersby and peers) in the environment influence the wayfinder's decision-making, meaning that information is passed between the group, the individual, and the environment. The authors summarise four types of social wayfinding, namely: synchronous strong type, synchronous weak type, asynchronous strong type, and asynchronous weak type (p. 3). In these four types, the role of information exchange is particularly emphasised. The authors point out that the difference between strong and weak wayfinding lies mainly in the intention and extent of the communication as well as information exchange. Strong wayfinding involves mutual, conscious exchange and transfer of information between people, whereas weak wayfinding refers to the unidirectional transfer of communication from the sender to the receiver in the wayfinding process. This also highlights the importance of communicability in wayfinding, particularly in the social wayfinding framework proposed by the authors.

Overall, according to Lynch, these five elements constitute the structure of the city, making urban spaces more recognisable and easier to navigate. Enhancing a city’s legibility facilitates wayfinding, while greater imageability helps create a lasting impression. A high degree of legibility and imageability enables individuals to form a clear and comprehensive cognitive map of the city. As can be seen, Lynch’s research focuses primarily on the city itself rather than on wayfinding. Although he defines the term, he treats wayfinding more as a means to study the city and to understand how people perceive and make sense of urban environments. His aim is not to solve a particular wayfinding problem but rather to render the city more comprehensible, thereby enhancing its legibility and imageability.

Subsequently, Lynch proposed five performance dimensions in his subsequent work, *A Theory of Good City Form*, namely vitality, fit, sense, access and control (2001, p. 118). These are presented as the essential criteria for evaluating a good urban form. Vitality refers to the city's ability to support and sustain human physiological needs, such as health. Fit means that the city should correspond to the needs of its inhabitants. Sense indicates that the city should be easy to perceive and understand—people should be able to quickly grasp and interpret its form—which is conceptually related to legibility. Access refers to the ease with which individuals can reach different elements of the city, including activities and resources. Control concerns the degree to which people can exercise authority over the use, access, and management of spaces and activities, including their creation and maintenance. In addition, Lynch proposed two meta-criteria: adaptability, which considers the long-term cost and flexibility of the first five dimensions, and justice, which addresses the equitable distribution of environmental benefits and burdens across society. Among the five dimensions, sense is the one most closely related to wayfinding, as Lynch links it to the notion of formal structure. At the scale of smaller places, this refers to the feeling of how individual parts come together, whereas at larger scales, it is associated with orientation and a sense of direction. Identity and structure are key components of the dimension of sense.

Since then, Lynch (1984) has reflected on and reviewed his work in *The Image of the City*. He acknowledged the problem of insufficient sample size in his earlier research and recognised the limitation of focusing on the static image of the city, whereas cities should be understood as dynamic entities. In addition, Lynch admitted that his work paid limited attention to the meaning embedded in urban space. He also addressed the potential misuse of his research as a tool for designers and advocated for a participatory design approach that allows citizens to be actively involved in urban design processes.

Nonetheless, Lynch emphasised that good cities are characterised by order, and that this order should emerge as it is perceived by residents. Cities, he argued, ought to offer a gradually unfolding complexity that enables people to gain new insights through continual exploration. He further asserted that environmental aesthetics should not be overlooked or treated as secondary. Urban planners and policymakers, he urged, should consider perceptual and visual experiences as integral to public policy.

Lynch's theories have significantly contributed to the fields of urban design, urban planning, and city form. Since their publication, his ideas have been emphasised, further developed, and widely applied as a foundational perspective across urban-related disciplines. For example, Liu et al., (2016, p. introduction) developed a project called C-IMAGE, which uses Lynch's theory of five elements as a research framework to measure, detect, and analyse people's urban perceptions through geo-tagged photographs. The authors argue that the results can partially validate and align with Lynch's theory. Another project based on Lynch's work is Place Pulse (active from August 2010 to August 2014), which uses pairwise image comparisons to generate image ratings and explore differences in city perception (Salesses et al., 2013).

In addition to these practical applications in urban perception modelling, data analysis, and urban research, Lynch's theories have equally guided contemporary wayfinding system design. A prime example is Legible London, a citywide wayfinding system operated by Transport for London, which aims to provide a consistent visual language and navigation system across the entire city, encouraging people to walk and avoid getting lost (T-Kartor City Wayfinding, 2011). Data from the official website of the design team, T-Kartor, shows that early results from the pilot project revealed a 16% reduction in pedestrian journey times. Additionally, 23% of respondents reported feeling more confident in wayfinding, and 32% stated that their sense of being lost was reduced

(T. Pearce, 2018). The success of the Legible London project demonstrates that Lynch's theories continue to inform urban wayfinding design today, offering a theoretical framework and methodological foundation for constructing a clear city image that enhances urban identity and spatial clarity. Thinking through the lens of Lynch's five elements enables designers to analyse key image-forming features in existing environments, both actual and potential (McGlynn et al., 1985).

There are also some criticisms of Lynch's work. For example, Stevens (2006) argues that Lynch's approach emphasises the visual and abstract structure of the city while overlooking the symbolism of urban form and the multi-sensory spatial experience (such as olfactory and tactile perception), potentially overstating the similarities between different groups and individuals. However, as reviewed by Pearce and Fagence (1996), Lynch's emphasis on the connection between the physical environment and sensory experience remains a major influence, and it provides the theoretical foundation for this thesis.

Forming a city image is a two-way process involving the physical representations of the city (such as buildings, streets, and landmarks) and people's perception and interpretation of these representations (Al-ghamdi & Al-Harigi, 2015). Strong and coherent images help individuals form a clear mental representation of the city, which is crucial for guiding movement through the built environment and facilitating a more complete and meaningful urban experience (Costa Bomfim & Santos Cruz, 2023). According to Costa Bomfim and Santos Cruz, a key function of the city image is to evoke sensory experiences that can lead to lasting memory and a sense of identity with the city. A typical example is the importance placed on city image as a strategy in tourism planning, where it is closely linked to wayfinding. In leisure and tourism design, there is a planning philosophy that focuses on creating unique, imaginative,

authentic, sustainable, and participatory places, with the ultimate goal being the formation of the tourist's overall impression of the city—referred to as the tourist image (Baud-Bovy, M, 1977). Although this example is situated within the context of tourism, it illustrates the broader importance of city image in shaping how people understand and perceive urban environments. On the other hand, difficulties in wayfinding can lead to negative perceptions of the physical environment and harm an organisation's reputation(Passini, 1996). Moreover, frustration during the wayfinding process can affect perceptions of both the public realm and the quality of services provided (Basri & Sulaiman, 2013). Therefore, the wayfinding experience of tourists in a city directly influences their emotional responses and overall experience, which in turn impacts the city's image.

As roles, fixed environments, service providers, and recreational areas (Kotler, 2002), elements in the city—such as buildings, public squares, parks, streets, and other similar components—convey various types of information to individuals during their spatial experience, ultimately contributing to the formation of the city's image in people's minds (Dai & Zheng, 2021) . The city image results from a combination of personal knowledge, experience, emotion, and external stimuli that shape the interaction between the city and the observer (Osóch & Czaplińska, 2019). The formation of a city image can be understood as a dynamic process: the urban environment conveys information that is received and interpreted by individuals, leading to the formation of personal cognitive maps. These individual maps are then integrated, and their commonalities contribute to the construction of the public image of the city. In the context of wayfinding, the city image can be regarded as the synthesis of many individual cognitive maps, enhancing environmental awareness, enabling information communication, and building a clear spatial understanding, which in turn provides a foundational framework for wayfinding system design.

City image reflects shared commonalities in public perception maps, and its importance for wayfinding system design has been demonstrated in previous discussions. However, shaping a city image does not necessarily mean making it unique. As mentioned earlier, uniqueness is more directly related to the concept of imageability. Another closely related concept that influences the distinctiveness of the city image is *city identity*. Lynch (2001) later proposed that city identity refers to the extent to which a person can recognise or recall a place as distinct from others, a notion closely aligned with imageability. Therefore, exploring this concept is important, as it provides further guidance on understanding the strategic role of wayfinding systems in enhancing a city's unique image.

Like individuals, cities also have their own personalities and characteristics, composed of multiple features and recognisable elements (Oktay, 2002). City identity is a unique form of collective identity, based on the perception of a place's distinctiveness and significance (Jones & Svejenova, 2017). Jones and Svejenova identify three components of city identity: the material sign system (topographical features and physical assets such as rivers, streets, and parks), the visual sign system (styles encoded into material forms, such as buildings), and the rhetorical sign system (interpretations of material and visual signs that assign meaning to them). Hatch and Schultz (2002, p. 991) argue that identity requires theorising about both culture and image, and they propose a dynamic model that interrelates the three. This model consists of four key processes: mirroring (the projection of identity through others' perceptions), reflecting (the embedding of identity within cultural understanding), expressing (how culture manifests itself through identity), and impressing (how identity shapes impressions on external audiences). According to this model, identity is not static but dynamic, formed through the ongoing interaction between internal culture and external image. In other

words, culture is expressed through identity, identity influences external perceptions (images), and those images, in turn, shape and reflect back into internal identity. Ultimately, this cycle of identity reflection feeds back into culture, continuously reshaping both culture and identity.

City culture—expressed through elements such as architecture, art, and public space—directly influences the public's perception and impression of the city, helping to construct a unique city identity and form a distinctive city image. Therefore, when attempting to shape a city's uniqueness, it is logical and meaningful to focus on urban culture.

2.3.3. Culture, Cultural Districts, and Experience

Culture is a term that spans multiple disciplines and research fields. Broadly speaking, it consists of relatively enduring and widely shared representations, values, and events (Clark, 2003). As Stevenson (2003) notes, it is impossible to define cultural studies as a unified field of inquiry or discipline, as culture itself is a highly fragmented concept. In the context of urban culture, the term generally refers to the culture of cities and towns, encompassing any patterns of behaviour in urban areas—past or present, of all types (Bolzonella, 2016). According to Stevenson, urban culture possesses a duality: it is both the physical city and the represented or imagined city, and these dimensions are deeply intertwined in the construction of urban culture. In other words, urban culture incorporates both external features and internal representations. Similarly, Miles (2007) suggests that urban culture comprises cultural practices and spatial embodiment—that is, the shaping of the physical landscape that constitutes urban life.

Culture is a relatively abstract concept, but it needs to be concretely embodied in the city's image and in wayfinding system design. Its tangible forms are primarily reflected in the physical environment of the city, such as buildings, streets, landmarks, and more. As Bassett (1993) points out, many cities in the UK have adopted cultural strategies and initiatives, often built upon cultural infrastructures such as museums, theatres, and concert halls. According to the report (2018) from World Cities Culture Forum —an international network comprising more than forty cities that significantly influence cultural policy and the creative industries—dozens of cities, including Amsterdam, London, Shenzhen, Guangzhou, and Hong Kong, are actively developing cultural infrastructure. This includes UNESCO World Heritage Sites, other heritage and historic sites, museums, galleries, art exhibitions, cinemas, and film festivals. The Forum's 2022 report further notes that the pandemic exposed and intensified inequalities in cities, underscoring the need for inclusive approaches to urban problem-solving across diverse populations and geographies—particularly concerning how people connect with cities (World Cities Culture Forum, 2022). The report emphasises that culture plays a central role in enhancing cities' flexibility and responsiveness in the face of urban challenges. Through festivals and cultural events, museums and venues, historic buildings, and public art projects, people develop a stronger sense of responsibility and belonging toward their cities. Furthermore, cultural heritage—such as buildings, monuments, archaeological sites, and museums—makes a unique contribution to public policy. In other words, cultural facilities are a key component in exploring the tangible manifestations of urban culture in the physical environment. They host cultural programmes and are essential to fostering communication between people and the city, facilitating social connections and shaping the city's future. As a core element of the physical dimension of urban culture, cultural facilities integrate the built environment with people's feelings, perceptions, and practices of urban culture. A closely related concept here is that of cultural districts.

Cultural districts, sometimes referred to as cultural quarters, cultural neighbourhoods, cultural milieus, or cultural clusters, are geographic areas located primarily in sizable towns, cities, or metropolitan areas, and are defined by the presence of architectural structures dedicated to arts and cultural activities (Suwala, 2015). In response to the concept of cultural districts, many authors offer overlapping definitions, describing them as concentrations of cultural activities and communities of cultural facilities (Chapain & Sagot-Duvauroux, 2020). Ponzini (2009) emphasises the importance of cultural heritage and the arts. Newman and Smith (2000) place cultural districts in the context of global attractiveness, branding, and city positioning. Therefore, the cultural district is a concept that brings together the physical environment, culture and cultural activities, cultural infrastructure, cultural heritage, and the arts. It influences people's experiences, emotions and perceptions, and is closely related to city image and identity, thus providing the context.

2.4. Summary

Overall, based on the literature review and the summary of definitions and scopes of wayfinding and wayfinding systems, the various definitions provided by different scholars are listed in the table below (Table 1).

Table 1 Summary of the concept and definition of wayfinding.

Author(s)	Definition	Keyword(s) and Field(s)
Lynch, 1960.	The organisation of information about the external environment.	Information about external environment.
Kaplan, 1976	Performing cognitive maps through environmental information.	Environmental information. Cognitive map.
Passini, 1981.	An activity that involves	Cognitive map.

Passini, 1984. **Passini et al., 1998.** **Raubal & Egenhofer, 1998**	cognitive and behavioural processes, interpreting and using information about the environment to reach a destination.	Space problem-solving. Use of environmental and spatial information. Destination.
Allen, 1999	A series of cognitive activities for goal-directed movement in the environment.	Cognitive map. Movement. Destination.
Darken and Peterson, 2001.	Cognitive elements of navigation.	Cognitive elements.
Golledge et al., 2000	A purposeful activity involving the selection and connection of routes within an existing network, with an emphasis on path choices made during movement.	Wayfinding. Route selection.
Fewings, 2001	The process of finding your way through a geographic or built environment, including recognise current location and get destination.	Destination. Self-orientation.
Loomis et al., 2001	A process of sensing obstacles and hazards in the surrounding environment and navigating to remote destinations beyond the immediate perceptible environment.	Destinations.
Farr et al., 2012.	A process of using environmental information to find the way and reach the destination.	Environmental information. Destination.
Trulove et al., 2000. **Casakin et al., 2000.** **Ruddle, 2006.** **Ishikawa et al., 2008.** **Brunyé et al., 2010.** **Carpman and Grant, 2016.**	The process of moving from one place to another in space.	Movement. Between places. Destinations.
Raubal and Winter, 2000.	Processes of self-orientation and spatial navigation	Self-orientation. Spatial navigation. Environmental information affects wayfinding.
Montello, 2005. **Montello, 2006.** **Bea and Montello, 2019.** **Ekstrom et al., 2018.** **Dalton et al., 2019.**	The cognitive process of goal-directed path selection and navigation in the environment.	Cognitive map. Destinations. Route integration. Environmental information.

Hegarty et al., 2023	Planning routes to places, finding the right path when travelling these routes, and getting home safely	Destination.
Symonds et al, 2017.	The physical, social, and cognitive experience and process of locating oneself and finding a route to a specific destination.	Location, route, destination, physical experience, social experience.
Dening, 2008. **Ingold, 2000.**	Emphasise the narrative and symbolic significance of wayfinding.	Philosophy, Narrative.

The table clearly shows that although different authors define wayfinding in different ways, there are commonalities among their definitions. They generally agree that wayfinding is a goal-oriented process involving movement through space in search of a destination, where information and cues from the environment, as well as the knowledge and experience of the wayfinder, are essential. The process typically includes self-orientation and route selection. The most critical elements of wayfinding are the mental representations of the wayfinder—such as the cognitive map—environmental information, and destination orientation. Navigation is sometimes considered synonymous with wayfinding, encompassing it, while at other times it is treated as a subset of wayfinding. In this thesis, I will only focus on aspects directly related to wayfinding. Although some scholars view cognition and movement as separate stages in the process, the core definition of wayfinding refers to the act of moving from an origin to a destination.

Wayfinding systems are multidisciplinary and wide-ranging in nature. Most existing studies focus on what should be included in a wayfinding system and how it should be designed. The following table summarises the key points raised by multiple authors regarding wayfinding systems (Table 2).

Table 2 Summary of the elements, keywords, covered fields, and terms of wayfinding system design.

Author(s)	Element(s)	Keyword(s) and Field(s)
Lynch, 1960.	The sensory cues in urban environments, such as maps, street numbers, route signs and bus placards.	Way-finding devices.
Arthur and Passini, 1992. **Passini, 1996.**	Spatial environment organisation, circulation system, architecture and graphic communication. Signage. Map.	Architecture, art and design, sign design, psychology and environmental studies.
Correa de Jesus, 1994.	Built environment, visual presentation, information structure. Signage, map, and typography.	Cognition, Semantics, Perception.
SEDG	Graphic and visual design, map, signage system, symbol and icons, public arts, brand experience and branding.	Architectural design. Environmental graphic design. Experimental graphic design.
Dogu and Erkip, 2000. **Fewings, 2001.**	Graphic, signage, map.	
Gibson, 2006	Environmental design, visual design, signage, information design, map design.	Environmental communication, graphics and information communication.
Montello and Sas, 2006.	Signage, map, information design, graphic design.	Wayfinding convenience. Wayfaring.
Apelt et al., 2007	architectural, graphic (including signs, maps, colour coding, banners, websites and directional information), audible and tactile communication.	Effective communication.
Fendley, 2009	Signage, map, graphic design.	Legibility of cities. Encouraging walking.
Mollerup, 2013, 2016	Environmental signage, map, graphic and visual design.	Information communication.
Vilar et al., 2017	Signage, colour coding.	Environmental features, cognitive representations.
Jeffrey, 2019	Environmental cues. Navigation aids.	Environmental information.
Calori et al, 2015	Signage, map, brand, graphic and visual design, information structure, colour coding, typography.	Information communication. Environmental graphic design.
Yavuz et al., 2020	Signs, maps, landmarks, site	Wayfinding information

Shamsuddin et al., 2022	layout, digital navigation applications.	system.
Iftikhar and Luximon, 2023		Environmental knowledge, information communication, spatial features.

Unsurprisingly, the most common components of a wayfinding system include maps, signage, and graphic design, with information communication being the most frequently emphasised element. Visual design—such as graphic design, typography, and colour coding—serves as the visual expression of information design. Information derived from the environment and spatial features provides essential context for the wayfinding system. The wayfinding system encompasses two crucial dimensions: external features, which include environmental information, architecture, spatial features, and other environmental data that provide the design content; and internal representations, which consist of human mental maps and spatial knowledge, offering the principles and logic to be followed in the system. Design, particularly visual design, plays a vital role in representing the wayfinding system, acting as the communication bridge between environmental information and users. The design of wayfinding systems is highly flexible, and although numerous design principles and methods have been proposed, this field remains practice-oriented, meaning that the forms of visual design and artefacts involved are not fixed.

Overall, wayfinding is a process in which individuals rely on both external and internal knowledge to navigate from a starting point to a destination. The wayfinding system, meanwhile, is a tool designed to support and facilitate this process and can take various forms, such as signage, maps, and modern digital navigation applications. Although the content of wayfinding system design is flexible, it is primarily expressed through visual design, including information communication, graphic design, colour coding, typography, environmental graphic design, symbols, icons, brand design, and other

visual elements, which form the essential manifestation of the system. Wayfinding systems not only enhance the efficiency and accuracy of navigation but also convey perceptual, social, and cultural aspects of the city, enriching people's urban experience. Furthermore, by enabling interaction and communication between people and the city, wayfinding systems help shape the city's image and improve its legibility. Past research on wayfinding systems has largely focused on design principles, particularly within the visual and graphic design domains. However, there remains a gap in the development of a specific design methodology that integrates external features (namely environmental information) and internal representations (namely cognitive maps) to combine culture, sensation, and experience into an effective wayfinding system. Such a system would enhance both people's experience of the city and the city's overall image. Addressing this gap is the primary focus of this thesis.

The internal representation of an individual primarily concerns cognitive maps, which form the foundation of wayfinding. An individual's spatial knowledge underpins their spatial behaviour. This knowledge may include the location and attributes of objects, visual information about specific places (such as landmarks), knowledge of routes, the relative positions of objects to one another, and other related information. People acquire, encode, store, recall, and decode this spatial knowledge, integrating environmental information to form a mental representation of space, known as cognitive maps. Cognitive maps encompass various internal representations, including graph-based and Euclidean-based maps, which can be flexibly applied, communicated, and externalised in multiple ways. When wayfinding occurs in the real world, individuals recognise information from their surroundings, interpret it, and translate it into decisions and actions. Throughout this process, they employ various strategies to aid navigation, such as graph-based, direction-based, and place strategies. The entire wayfinding process results from the combined influence of environmental information and cognitive maps. Therefore, incorporating external environmental information in

wayfinding system design—via cognitive maps—is essential, as it provides robust support for creating effective real-world wayfinding aids.

Information from the environment and space is another crucial factor in wayfinding. Since this thesis focuses on wayfinding in the city, external features are limited to the urban environment. Specifically, this refers to the surrounding environment in which people navigate within the city, consisting of a combination of physical and non-physical elements (including buildings, streets, public spaces, artefacts, people, and culture). Individuals' impressions of these elements contribute to their cognitive maps, and the commonalities among these maps form the city image. External features and internal representations together constitute the theoretical basis and framework for wayfinding system design.

However, within this framework, wayfinding system design—as an integral part of the city and a medium of communication between people and the city—carries further significance. It plays a role in enhancing the attractiveness and uniqueness of the city's image. A related concept is city identity, which is discussed in the context of creating a unique city image. Cultural elements serve as key identifiers of a city's uniqueness, and cultural districts form an essential component of the physical expression of urban culture. People's interactions with cultural districts, including participation in cultural events and festivals, shape their perceptions of urban culture. Cultural districts are also considered vital to urban attractiveness and identity formation, valued as cultural infrastructure that supports the development of urban culture and cultural programmes. They are the core carriers of urban culture as well as fundamental pillars of urban image and identity formation. Therefore, the urban environment centred on cultural districts constitutes the context of this thesis. It should be clarified that the context refers to the

urban environment with cultural districts at its core, not solely to cultural districts themselves.

In summary, as illustrated in Figure 5, this chapter, after discussing wayfinding and wayfinding systems, argues that two key factors are external features and internal representations. External features include the urban environment, particularly the city centre. Internal representations consist of the communal integration of multiple individual cognitive maps, namely the city image. The cultural district is a significant element of the urban environment because it connects the cultural and physical characteristics of the city. Together, the external features centred on the cultural district and the internal representations centred on the city image form the theoretical framework of this thesis for constructing a wayfinding system design that enhances the attractiveness and uniqueness of the city's image. This chapter establishes the theoretical framework and provides the foundation for the thesis.

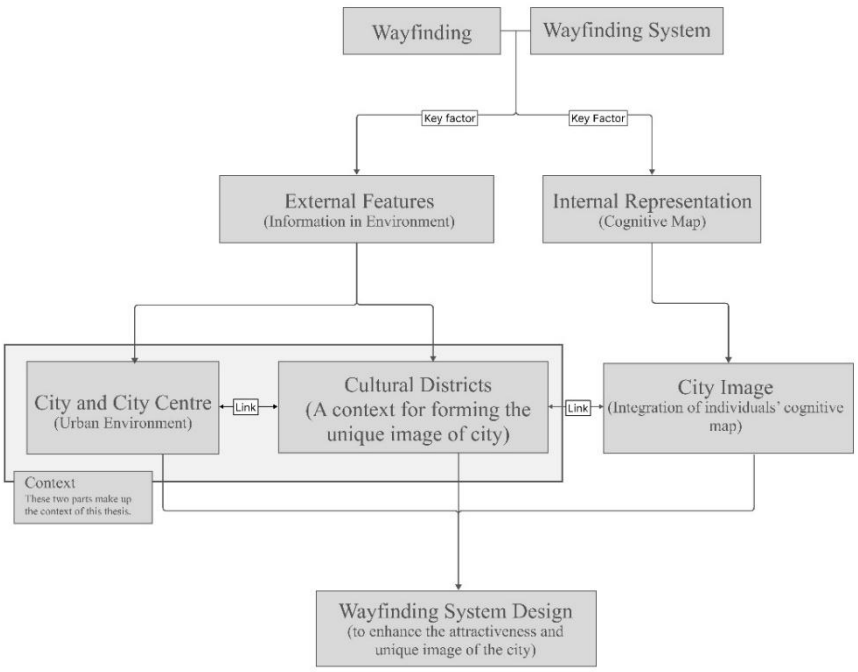

Figure 5 The diagram of theorical framework in this chapter. Drawn by author.

However, it must be recognised that wayfinding system design is a highly practice-oriented subject, with a significant portion of its outcomes presented in the form of projects and design works. Therefore, reviewing the practical applications of wayfinding systems is equally important. By reflecting on its past and analysing its present, we can better anticipate its future and provide guidance for the practical implementation of the results of this thesis. The next chapter will analyse this in detail.

Chapter 3. The Past, Present and Future of Wayfinding System Design

Wayfinding and wayfinding systems are relatively recent concepts, having emerged only in the past few decades. However, human wayfinding behaviour has always existed, as has the use of graphics, maps, and other media to convey information that supports navigation. These early behaviours and tools have laid the foundation for contemporary wayfinding. Therefore, reflecting on the past and analysing the present are essential for gaining crucial insights and guiding future research. As discussed in the previous chapter, wayfinding system design mainly involves three essential components: information communication, signage, and maps. These encompass graphics, text, directional design, typography, colour schemes, and many other elements.

This chapter aims to explore the past, present, and future of wayfinding systems. By reviewing historical developments and analysing current design practices, it will examine their impact on wayfinding system design and speculate on future trends and directions. The chapter is divided into three parts. The first part reviews relevant past human practices from the perspectives of signage, maps and cartography, and information design. The second part analyses the design of wayfinding systems in the present, referring to the period after the term wayfinding was coined in 1960. Finally, based on the past and present, a desired goal state for the future of wayfinding systems is proposed.

3.1. The Evolution of Information Design, Map and Cartography, and Signage

3.1.1. Information Design

Information design is a specialised discipline. According to Baer (2022), information design encompasses printed matter, information graphics, interactive, environmental, and transformative design, with signage and maps also falling under its umbrella. Like wayfinding, information design emerged later as a distinct discipline, but its practices have existed for a long time. I will separate these topics because information design primarily relates to design methods, the communication of information in a designed manner, and the use of symbols and graphic text. Maps and signage, on the other hand, represent applications of information design within specific contexts.

Information design focuses on visual presentation, particularly information graphic design (Kindel, 2017). Wayfinding-related information design is a subset of this field. As early as prehistoric times, humans marked objects in their environment with symbols for hunting, food gathering, and tool making (Costa et al., 2020). A case in point is the cave paintings in Lascaux, France , dating from approximately 20,000 to 40,000 B.C.E. (Calori & Vanden-Eynden, 2015). These petroglyphs are believed to be the earliest known form of conveying information, with historians suggesting they indicated details such as the location of prey or weather conditions (Dreyfuss, 1991). However, interpretations of these symbols remain subject to debate.

Over time, these primitive symbols developed along two main lines. The first is early hieroglyphics, such as ancient Egyptian hieroglyphs, which appeared around 3300

B.C.E. and are considered the earliest symbolic representation of language (Ben-Dor Evian, 2021). Houston and Stauder (2020) point out that the Anatolian Hieroglyphs (c. 1500-700 B.C.E.) and Mesopotamian (c. 3400 B.C.E.) are also graphic systems. Another early form of graphic symbols and ancient script is the Chinese oracle bone script, dating back to around 1300 B.C.E. Studies, including one by Wang et al.(2022), have analysed how oracle bone inscriptions evolved into today's Chinese characters.

Another direction in which the original symbols evolved was graphic. Sproat (2023) provides a relatively comprehensive account of this and notes that many of the symbols are iconic. The author suggests that the Neogene Göbekli Tepe (c. 9000 years ago) in present-day Turkey may offer an early example of this evolution, with many motifs depicting animals and some more abstract figures. Contemporaneous with Göbekli Tepe are the numerical markings used in Mesopotamia to record goods. According to Sproat (2023, p. 28), these primitive symbols include heraldic systems, guild symbols, religious iconography, formal systems, performative systems, narrative systems or 'prompt' texts, and purely decorative systems.

The meanings of many graphic symbols have been lost over time, leaving only guesses as to their original significance. It is difficult to determine which symbols and pictograms are directly related to wayfinding throughout its long history, so only a brief exploration is possible based on currently available information. The more relevant symbols may include some signs indicating locations. For example, Sproat (2023) mentions the barber pole, with its red, blue, and white spiral pattern, which is widely recognised as a symbol for barber shops and serves as a typical example of a symbol representing a place. Another example is house marks, which have been widely used in Europe to identify buildings and properties such as cemeteries.

Signs are often used as symbols of brands. The earliest branding signs were a form of naming something (such as a cow, a slave, or a prisoner) and later evolved into symbols of ownership and reputation (Bastos & Levy, 2012). Related examples include the Japanese family coat of arms, the Kamon. Some Japanese businesses use the founding family's Kamon as a corporate identity, which has subsequently evolved into brand representation. For example, the icon of the car manufacturer Mitsubishi evolved from the Kamon of its two founding families ('What's the History of the Mitsubishi Symbol?', n.d.). The European coat of arms is often discussed alongside the Japanese Kamon. European coats of arms tend to be more complex, incorporating many design elements, intricate graphics, and delicate ornamentation, such as the Royal Coat of Arms of the United Kingdom. Both, however, have little relevance to wayfinding and thus will not be explored in detail here.

While wayfinding is not the primary purpose of these branding and advertising signs, they do serve to direct people towards routes and destinations. For instance, in China's Song Dynasty (960–1120), advertising campaigns emerged that directed people to shop locations. One example is the White Rabbit Brand of Sewing Needles, which combined words and images in a manner resembling a modern advertising poster. The poster displayed the store's address and guided people to find the shop (Beard, 2017). It was square and divided into several sections: the top featured the store's name, translated as 'Jinan Liu Kung Fu Needle Shop'; the middle showed a white rabbit administering medicine, the shop's sign; the text on both sides indicated 'The door is marked by a white rabbit icon' to help customers locate the store accurately. At the bottom was a slogan similar to those seen today, roughly translating to 'We use the finest steel bars as raw materials to create exquisite embroidery needles for home use, ensuring your satisfaction; the more you buy, the cheaper it gets.' Although this advert resembles today's promotional posters, it undoubtedly played a role in wayfinding by providing destination information to guide customers in finding and identifying the shop.

A case similar to the White Rabbit advert is the signage of English pubs and inns, which was made compulsory for all pubs and inns by King Richard II in 1393 and continues to be displayed on the outside of English pubs to this day. In this context, the signs take on additional meaning, becoming symbols of a place (usually a specific area or functional building) and serving a wayfinding function: people recognise the destination by locating the sign. This type of symbol carries a dual meaning of branding and wayfinding. Even today, such symbols remain common in wayfinding systems. For example, a coffee cup symbol on maps or signage typically indicates the presence of a café.

In the 20th century, designers began to imbue logos with greater meaning. ISOTYPE (International System of Typographic Picture Education) emerged as a graphic education system, aiming to create a set of symbols to communicate across languages (Neurath, 1974) , attempting to standardise symbols and graphics to convey complex information (Lupton, 1986). The core approach of ISOTYPE is to increase the number of graphics rather than change their size to represent complex information (Kinross, 2017). It has been described as ‘a prototype of modern information designer’ (Walker, 2017, p. 117). ISOTYPE is more functional than decorative and focuses on presenting complex information through ‘transformations’, with communication at its core. Despite its limitations, ISOTYPE had a profound impact. Building upon ISOTYPE, Dutch designers later developed a set of symbol signs. Today, the number of such designs is enormous. Searching keywords like symbol design, sign design, or icon design online yields countless results, and many rules remain universal today, such as bathroom signs.

Additionally, graphics that express direction—usually arrow graphics—are essential for wayfinding. Another highly relevant form of signage design is traffic signage, where

designs and standards often vary between countries. Since traffic signs generally take the form of signage, this topic will be discussed further in section 3.1.3 of this chapter.

In addition to signs and graphics, text and colours often play an essential role in wayfinding systems. Text is closely associated with type design and typography. Type design is generally linked to print design, and many renowned type designers and typefaces have emerged over time. Tselentis et al. (2012) provide a detailed discussion of the history of typography from the seventeenth century onwards. They list numerous designers and classic typefaces, including Baskerville, Fournier, and Caslon (17th and 18th centuries), Bodoni and Clarendon (early 19th century), Franklin Gothic, News Gothic, Century Old Style (mid to late 19th century), Century Schoolbook, Goudy Old Style, and Gill Sans (20th century). In wayfinding, the most important aspect of font design is clarity and ease of recognition. For example, the French national railways use Achemine, Italy uses Alfabeto Normale and Alfabeto Stretto, most Chinese rail systems use Arial for English signage, and the Tyne and Wear Metro in the UK uses Calvert.

Colours are often used for coding purposes but also carry artistic and aesthetic significance. A typical wayfinding system uses colour to indicate functions or areas—for example, one colour might denote entrances and another stores. Colour coding rules are usually developed by designers or design teams, sometimes based on stakeholder requests, and tend to be applied with uniform standards only on a small scale. For instance, one colour coding scheme may be specific to a single airport.

A brief review of the history of information design reveals that, despite the term itself only emerging around 1984 (Stiff, 2017), its origins trace back to prehistoric times. Historically, the development of information design has oscillated between simplicity

and complexity, but this differs from the primitive symbols of prehistory, which likely conveyed only superficial information, such as weather conditions and prey locations. As communication evolved, writing emerged, combining words, colours, and graphics to convey specific meanings, which could range from simple to complex. With the formal establishment of information design as a professional discipline and the contributions of many outstanding designers, the field has shifted again towards simplicity—aiming to convey as much intuitive information as possible in a concise and recognisable manner. Today, information design, as a specialised discipline, encompasses print, information graphics, data visualisation, interaction design, and environmental design. It intersects with wayfinding (see Figure 6). The design components within this intersection include colour coding, type design and typography, map design and cartography, environmental information design, signage, and graphic and sign design. These provide the design methods and approaches for wayfinding system design. From the perspective of wayfinding system design, information design primarily focuses on communicating environmental information and facilitating communication with people, mainly through text, graphics, symbols, words, and maps. Recognisability is essential, with graphics generally being more intuitively symbolic.

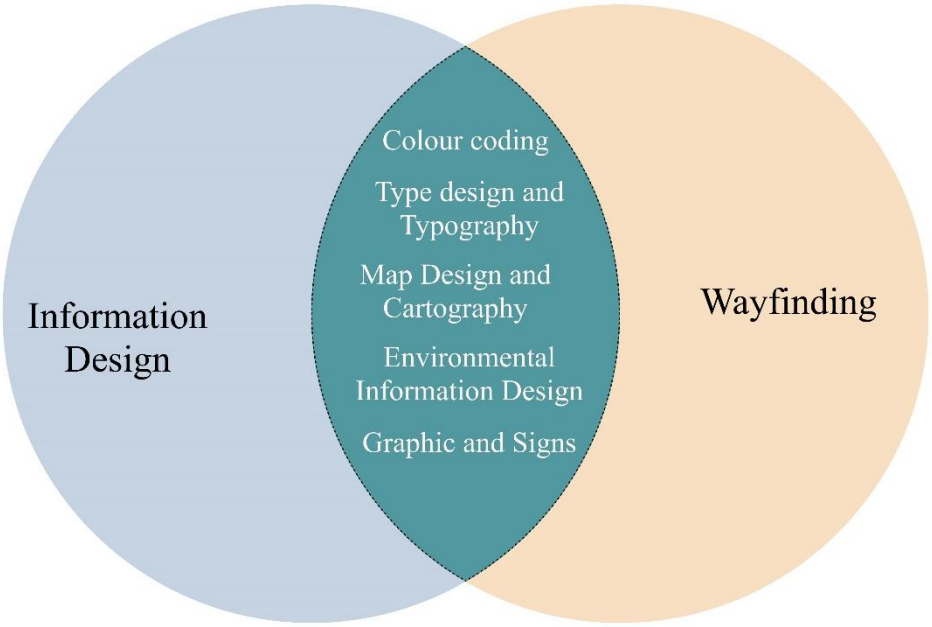

Figure 6 Diagram of the intersection between wayfinding and information design, drawn by the author.

3.1.2. Map and Cartography

It is unlikely that a complete review of the world of maps and cartography will be possible, nor is it necessary, as many books and articles already provide comprehensive coverage of the subject. This section briefly discusses some past trends in map design and cartography, with a focus on their role in wayfinding.

The earliest navigation behaviour dates back to around 3000 B.C.E., when ancient Polynesians mapped their routes by observing natural markers such as stars, waves, and bird paths. These maps, known as stick charts or rebbelib, were constructed from bamboo poles and shells. Straight bamboo lines indicated the directions of winds, islands, and currents—systems that were difficult for outsiders to interpret but enabled

Polynesians to navigate to places like Hawaii. Their navigation system was highly sophisticated.

The oldest surviving maps reflect some geographical knowledge but also include many fictional elements, representing how people of the time imagined the world's geography. Typical examples include the Babylonian World Atlas, the Bedolina Map, the map attributed to Anaximander, and the Hecataeus Map. The Babylonian World Atlas, dating from around 2300 B.C.E., is now housed in the British Museum. It consists of two concentric circles, with the inner circle representing the central region of the world and showing Babylon as its centre. The Bedolina Map is a topographical map inscribed on prehistoric rock slabs around 1000 B.C.E. and is interpreted as depicting cultivated land, mountain passes, and villages with several distinct shapes. Anaximander, who lived circa 611–546 B.C.E., is considered the first Ancient Greek to map the known world, though unfortunately all his maps have been lost. The Hecataeus Map, drawn around 500 B.C.E., depicts Greece as the centre of the world.

According to Wang et al.(2022, p. 830), there have been three major periods in the history of cartography. The first is the formation of ancient cartography, highlighted by Pei Xiu's Yugong geographic map of China in eighteen chapters (224–273 B.C.E.) and Ptolemy's geographic guide of Ancient Greece (90–168 B.C.E.) as landmark achievements. The second period, the formation of early modern cartography, is marked by large-scale triangulation and topographic mapping, aerial photogrammetry, map compilation, and photographic plate printing technology. The third period, the formation of modern cartography, is characterised by the advent of computerised map-making. Wang et al.'s review is quite comprehensive, though primarily focused on the evolution of cartographic technology.

The first geographically realistic map is attributed to Ptolemy, who drew a world map around A.D. 150. In his book *Geographia*, Ptolemy provided numerous maps, including the earliest known world map. He introduced three different mapping methods and recorded the coordinates of geographical features of over 8,000 places known to him. Ptolemy also invented the concepts of latitude and longitude, which remain in use today. Unfortunately, most of his original maps have not survived. In contrast, Pei Xiu's Yugong Atlas was the earliest large-scale atlas in China created using scientific mapping methods, visually depicting the distribution of mountains and rivers.

As another essential part of wayfinding, maps have continuously evolved and gradually become more diverse. The technology of map-making has also advanced, resulting in increasingly accurate maps. Gerardus Mercator (1569) developed a mapping method known as the Mercator Projection, which remains in use today. During this period, Chinese maps also became more elaborate. Instead of simple drawings, many illustrations were added to express geographical features, including city walls, gates, residential areas, mountains, and rivers. A typical example is the Complete Map of Qiong County (琼郡舆地全图), painted around 1820. This map holds great artistic as well as geographical value. Beautiful paintings in a typical Chinese style depict geographical features with exquisite textures and colours. Moreover, cultural features are included. Many lifelike figures appear on the map, all dressed in period costumes and engaged in various social activities, such as children playing and merchants selling goods. In addition to geographic information, it is unclear whether these correspond to local vegetation. The Complete Map of Qiong County may reflect a developing trend in maps, where the focus extends beyond accuracy to include design and narrative. Maps began to convey information beyond geography, incorporating street scenes and socio-cultural and everyday life activities of the time.

Maps have also developed the ability to convey additional information, becoming carriers of visual information. A notable example is *A Moral Map of London*, drawn by Charles Booth in the 1880s. In this map, houses are colour-coded according to criminal propensity, with yellow areas representing 'affluence' and black areas indicating 'the lowest class'.

By 1919, the London Underground hired Edward Johnston to design the company logo used in its wayfinding system. This design introduced brand identity into the wayfinding system. Johnston also created a unique font for the London Underground wayfinding system, which is still in use today. More significantly, Harry Beck's 1939 subway map employed different colours to indicate various subway routes. Beck's map is non-geographical, showing no specific routes or distances between stations; instead, metro lines are represented in distinct colours, with lines curving only at ninety or forty-five degrees. Beck's map has since served as a model for many urban transport systems worldwide. There has been some debate over whether Beck's work should be considered a map or a diagram (Cartwright, 2012).

Degani (2013, p. 7) proposes an analytical approach to information organisation involving three levels: abstraction of data into representational elements, integration of these elements to form a coherent information structure, and configuration of this structure through an underlying order. Degani argues that Beck's map is an excellent case study of this approach.

YAH (You-Are-Here) maps are common wayfinding-related maps found on physical wayfinding signage today. These maps are usually statically installed in the environment—often on walls or signage—and feature a You-Are-Here symbol

indicating the map's location within the environment (Richter & Klippel, 2002). They typically include signs and labels that highlight architectural and natural cues and are placed at entrances, exits, and decision points.

Heads-up maps are another type of map closely related to wayfinding and frequently used in modern systems. Unlike traditional North-up maps, the top of a Heads-up map corresponds to the direction the user is facing. This design downplays geographic directions such as east, west, south, and north, instead emphasising the user's orientation. Research has shown that Heads-up maps are influenced by cognitive maps used in urban visualisation (Wessel et al., 2013).

Another type of map that may be relevant is the orientation map. This map is specifically designed for orienteering and is highly detailed, featuring a standardised symbol system (Zentai, 2023). It is discussed here because of its detailed information coding, with different colours representing various terrains and distinct markers indicating geographic features. This approach to information processing and communication has undoubtedly influenced wayfinding maps.

In summary, cartography can be traced back to ancient times, although early maps were often filled with imaginative elements. Cartography has undergone three main phases, driven by continuous advancements in map-making techniques, geographic surveying, and technological tools. In the context of wayfinding, the most significant changes involve how information is conveyed, improvements in user experience, and the increasing versatility and detail of maps. Modern maps serve not only as carriers of geographic information but also as vehicles for design, narrative, user experience, and culture—all emphasised in contemporary cartography. As Kelley and Francis (2005)

state, maps are not merely representations but also reflections of the environments people inhabit and shape together. Thus, maps contribute to the reproduction of culture. From their origins as navigational tools in ancient times, maps have evolved into instruments for information transfer and communication, both responding to and shaping the cultures that create them.

3.1.3. Signage

The term *signage* was coined by Arthur and Passini (1992), meaning ‘Signs collectively, esp. commercial signs or those on public display; the design and arrangement of these’ (‘Signage’, 2023). In the field of wayfinding, signage refers to signs used to guide people during their navigation, commonly manifested as physical road signs. In ancient times, people used the most primitive means to convey information and mark routes. Most wayfinding carriers then were made of stone, such as steles, rock walls, and stone road signs.

There is very little relevant literature in this area. The few sources available suggest that the ancient Romans and Greeks developed the early prototypes of wayfinding systems. The eítuns inscriptions at Pompeii, dating from around the 1st century B.C.E., provide an example. Researchers believe these inscriptions, carved into stone pillars and including at least eleven landmarks, seven figures, and a road, conveyed announcements to Allied soldiers unfamiliar with Pompeii about assembly points and directions (Henderson, 2015). These inscriptions also referenced specific locations between landmarks—such as towers and gates—and public and private buildings, and were thus quickly recognised as a form of signposting (Willi, 2020). The ancient Romans also used milestones marked with distances, the most famous being the Miliarium Aureum (Golden Mile), thought to indicate the distance to Rome (Pisani Sartorio, 2004).

However, the interpretation of the milestone's inscriptions remains controversial. These milestones suggest the existence of an early form of signage in Ancient Rome, providing information on landmarks, roads, buildings, and directions.

The origins of today's signage coincided with the development of vehicles and roads, although the term itself was only coined in the 1980s. Before wayfinding and signage became established terms and fields of study, much of the signage related to wayfinding likely took the form of road and traffic signs. According to *The Portugal News* (TPN, 2024), the earliest traffic signs appeared in Portugal. Castro et al. (2023) note that in 1686, King Pedro II decreed that at least 24 signs be erected in the city—most were destroyed in an earthquake, with only three surviving. These signs were mainly placed in locations where traffic was difficult and referred to landmarks such as churches, palaces, prisons, monasteries, and other important sites. In the 1880s, the National Cyclists' Union in the UK established danger boards to warn cyclists of hazardous roads and accidents. The *Manual on Uniform Traffic Control Devices* (MUTCD), a US guidebook setting standards for traffic signs, signals, and pavement markings on roads and motorways, has an official webpage (https://mutcd.fhwa.dot.gov/index.htm) that states that in 1905, the Buffalo Automobile Club installed a network of road signs in New York State (Federal Highway Administration, 2023). It also records that the first STOP sign in the US was installed in 1915. By the early 1920s, teams of representatives from Wisconsin, Minnesota, and Indiana developed standardised sign shapes, many of which remain in use today. The first official MUTCD was published in 1935 and later approved as the national standard for the United States.

Around the same time, the visual identity of the London Underground and the subsequent development of posters and maps were emphasised (Harland, 2020). The visual identity of the London Underground was relatively uniform and evolved into a

complete brand. In 1903, four national signs were created in the United Kingdom under the Motor Car Act 1903. However, these sign codes were only suggestive at the time and therefore not uniform.

In 1957, Margaret Calvert and Jock Kinneir designed a signage system for British motorways. Calvert and Kinneir improved upon the chaotic state of road signs in the UK by standardising colours, shapes, and symbols and creating the Transport Heavy and Transport fonts (Capece, 2020). This new set of road signs follows strict rules to organise information, in line with the 1949 *Geneva Protocol*: triangles indicate warnings, circles give commands, and rectangles convey information. Motorway signs have blue backgrounds with white letters for place names and yellow letters for road numbers; main roads have green backgrounds, and auxiliary lanes use white backgrounds with black text. These signs are printed on large panels, with stringent regulations on spacing to aid tourists and motorists in identification. The symbols on these highway signs are simple and based on geometric shapes, making them easy to recognise. The most common are road patterns—long, narrow rectangles with stylised ends resembling arrows—which intuitively indicate directions. This set of arrow signs is clear and straightforward. Kinneir and Calvert also developed a series of road signs conveying other information. For example, the 'Beware of Children Crossing' sign features two simple human figures. This message is easy to understand and recognise.

3.1.4. Summary

In summary, despite limited information, the earliest signage prototypes were very primitive but already incorporated landmarks, roads, directions, and architectural information. Following this, the evolution of signage throughout history is less well documented until the 17th century. During that period, some signage may have been

combined with graphics, as discussed in section 3.1.1; a typical example is the signs hanging outside pubs in the UK, which clearly indicate location. Technological advances and changing human needs have been the main external drivers of signage evolution, with signage gradually taking on an increasing number of functions, as exemplified by traffic signs. Changes in materials and technology are evident, from primitive stone inscriptions to metal signs still in use today, while graphic design and branding have also become part of signage development. Another noticeable trend is the standardisation of design.

In the past, information design may have begun as simple graphics, maps were very abstract navigation tools, and signage existed in the form of milestones and inscriptions. Since then, these elements have evolved, although they may not yet have been fully integrated to form a comprehensive wayfinding system. It is clear that information design, maps and cartography, and signage have gradually transformed into new forms as time has passed, and technology has advanced. One clear trend is the innovation of technology, and the media used. Another important trend is the increasing role of visual design—including graphic design, typography, and layout—both for aesthetic appeal and functional effectiveness.

3.2. The Present Wayfinding System Design

I have already reviewed the theories of wayfinding systems in Chapter 2. Since Kevin Lynch defined the term wayfinding, much theoretical literature has been published on the subject. However, the amount of literature specifically on wayfinding system design is relatively small and is mainly found within the fields of visual communication design, graphic design, and information design. Today, wayfinding system design is more

commonly presented through design projects and works, which far outnumber the related literature, and many classic or acclaimed design examples are easily found. Therefore, these design examples and works should be considered when studying wayfinding system design and anticipating future development trends.

It is difficult to determine exactly when and how information design, maps, and signage were combined to form the more mature contemporary wayfinding system. Gibson (2009) suggests that the origins of the wayfinding system lie in the 1960s, with related disciplines developing alongside it, including architectural graphics, signage or sign-system design, environmental graphic design, and wayfinding itself.

Wayfinding systems are now used in a variety of venues and locations. Based on my collection and understanding of design examples, I have roughly categorised them into several groups. Firstly, there is the **wayfinding systems in the city**, which is the focus of this thesis. **Wayfinding systems on university campuses** a distinct branch, considered complex wayfinding environments characterised by dispersed paths, multi-storey buildings, decentralised facilities, and multicultural communities (Iftikhar et al., 2020). University campuses are also unique in that their wayfinding systems often require both outdoor and indoor components. **Large open spaces** constitute another category, including zoos, parks, playgrounds, and public spaces. Such spaces are typically large-scale and require design considerations for natural elements such as vegetation, water bodies, and topography, as well as accommodating multiple functional areas. Moreover, crowds in these open spaces are often dynamic. A specific type of wayfinding system design within this category is the system designed for the Olympic Games. **Transportation hubs** form a clear category, including airports, underground stations, and large train stations. Finally, **indoor wayfinding**, refers to design within building complexes such as shopping malls, libraries, and museums. Within this

category, wayfinding system design for hospitals is often singled out and treated as a specialised area.

Practical work emerged almost simultaneously with theory, and in some cases even slightly earlier. Jane Davis Doggett was one of the representative designers during the early years, with her most notable contributions focused on wayfinding system design for airports (PBS, 2019). Doggett's earliest work dates back to 1959, when she designed a wayfinding system for Memphis Airport. This system included numerous directional signs with arrows, as well as the typeface Alphabet A, which she created specifically for this project (*Jane Davis Doggett - Graphics Built Into Architecture*, 2011). The term wayfinding was coined the following year.

Beginning in the 1960s, Lance Wyman made significant contributions. Wyman was one of the most influential graphic designers in the field and helped define environmental graphic design. His works can be viewed on his website (https://lancewyman.com/). Dating back to 1963, his Chrysler Pavilion Graphics for the Chrysler Pavilion at the New York World's Fair embraced wayfinding ('Chrysler Pavilion Graphics', n.d.). This set featured a unified visual identity, including branding, signs, safety posters, and signage design. A prominent element was a large outdoor wayfinding sign designed as a hand, with the place's name—such as "parking" or "assembly line ride"—and the index finger pointing in the direction of the location. This signage exemplifies typical physical wayfinding design. Around the same time, Jayme Odgers designed a set of signage for the IBM Pavilion that consisted solely of text and signs (Sandhaus, 2023).

In 1966, Wyman and his team worked on a series of designs for the 68th Mexican Games, characterised by strong unity and a clear visual identity ('Mexico 68 Olympic

Games', n.d.). While this design set was not primarily focused on wayfinding, signage elements were present to guide viewers in the right direction. Various pictograms, arrow graphics, and colour coding were employed to convey locations. These visual communication methods are still widely used today.

Wyman's first explicit wayfinding system design—beyond branded graphics—was for the Mexico City Metro System in 1968 ('Mexico City Metro System Graphics', n.d.). This marked the first time Wyman clearly labelled his designs as logos, icons, and wayfinding signs. Landmark shapes were used as pictograms, accompanied by a comprehensive set of icons representing different locations throughout the underground system. Wyman has made numerous outstanding contributions to wayfinding, including the 1975 design for the National Zoo, which incorporated animal pictograms, geometric shapes, and colour coding for street signs ('National Zoo Exhibit Icons & Wayfinding', n.d.); a 1997 wayfinding design for Jeddah International Airport ('Jeddah International Airport Wayfinding', n.d.); and other projects. He also contributed to urban wayfinding system design, such as the City of Detroit Wayfinding in 2000 ('City of Detroit Wayfinding', n.d.). Wyman's work generally features geometric shapes, pictograms, colour coding, and arrows, with a strong emphasis on branding and overall graphic design consistency.

In 1973, SEDG emerged as an organisation focusing on environmental graphic design, as discussed in subsection 2.1.3. To this day, SEDG's official website states that they specialise in wayfinding, place-making, and experience design (*About SEGD*, n.d.). Their work remains highly relevant in the field of wayfinding design today.

The earliest pedestrian wayfinding programme in a city was Walk! Philadelphia in 1995 (Badger, 2012), North America's largest pedestrian wayfinding signage system, consisting of over two hundred disk maps and more than 400 directional signs (Centre City District, n.d.; 'Philadelphia, PA', 2017). This system also employs colour-coded signs and colour-coding on the maps. The maps are heads-up maps that divide the Central City District into five colour-coded areas and include You-Are-Here icons. The system also features pictograms. There is no information indicating that Philadelphia's wayfinding system was explicitly based on Lynch's theory of the city. However, the system does include pictograms of landmarks, divisions of districts, and markings of nodes, which are clearly noted on the maps.

Legible London, in use since 2007, is a project that must be included in this discussion. Its core approach to processing information is based on mental mapping, emphasising that any wayfinding system should support people in constructing mental maps (T-Kartor City Wayfinding, 2011). The wayfinding system is grounded in Lynch's theory. The heads-up maps include You-Are-Here icons, 3D pictograms of buildings, and estimated walking times. The placement of physical signage has been rigorously calculated to ensure effectiveness. The design is visually consistent, featuring a walker pictogram on a yellow background at the top, making it easily recognisable. Colour coding in Legible London's design appears minimal or absent, possibly limited to yellow sections representing recognisable buildings and landmarks contrasted with blue sections representing other areas. The physical signage is designed with sustainability in mind, equipped with solar power and prepared for future integration. Legible London's design company, T-Kartor City Wayfinding, has also developed wayfinding systems for New York, Toronto, Birmingham, and many other cities, projects that are, to some extent, representative of the current state of contemporary wayfinding systems.

Jeffrey (2019) mentioned that there is a trend for graphic designers to move into the architectural profession, and that wayfinding is beginning to be recognised as a specialist skill, although it still needs to be taken more seriously. She describes the evolution of wayfinding behaviours within buildings, where wayfinding systems have evolved from ‘just signs’ to becoming part of the organisation's brand experience and a reflection of culture (p.72). Although the focus is on the integration of architectural design and wayfinding within buildings, this still seems to reflect a broader trend in wayfinding system design over recent decades. Jeffrey also points out that research into design practice is limited, and it is unclear whether designers refer to academic research when carrying out their practice, which implies a disconnect between design practice and relevant academic research. As she emphasised, there is a need to better link academic research to design practice.

Today’s design strategies and approaches to wayfinding are often closely linked to commercial interests in the field. Gibson (2009) proposes a design process consisting of three phases: planning (including research planning, strategy, and programming), design (covering schematic design, design development, and construction documentation), and implementation (including bid support and construction administration). This process represents a comprehensive approach to commercial wayfinding system design, starting from initial research on design scenarios and user groups, through the creation of design solutions, and concluding with bid support and construction oversight. Calori and Vanden-Eynden (2015) emphasise the client’s involvement in the process and propose a framework including pre-design (data collection and analysis), design (schematic design, design development, and documentation), and post-design (bidding, fabrication and installation observation, and evaluation). This also reflects a thorough business process. Mollerup (2013) argues that design strategy for wayshowing reflects the mindset of graphic designers, highlighting the importance of signs, messages, and typography, including considerations of layout, colour, size, formatting, as well as

installation and placement. The design principles for pictograms, icons, typefaces, and typography in wayfinding systems align closely with those in graphic design, as wayfinding design is inherently part of the graphic design discipline.

Today, design methods and principles related to wayfinding system design are often found in handbooks and guide manuals. For example, the report by ID/Lab (2016) on wayfinding system design for Edith Cowan University summarises the design's colour scheme, signage setup, and criteria for graphics and typefaces. Similarly, the design report for the Royal Docks area of London (Royal Docks Team & 5th Studio, 2021) describes colour coding, area improvements, and physical signage, with the masterplan aiming to highlight the unique and positive aspects of the docks' culture and heritage, as well as the coherence of the area.

Moreover, the experiential aspect of wayfinding—especially relating to the culture, history, and people of the city—is becoming increasingly popular. Walking tours showcasing city features are common in Europe, with many websites and applications offering such programmes. Examples include the well-known London Walks (https://www.walks.com/), which offers a variety of walking tours in London, and GPSMyCity (https://www.gpsmycity.com/), which provides numerous self-guided walks in multiple cities, suggesting locations and sights to visit.

In 2020, when I initially began researching this topic, there was limited related information available in China. However, from 2022 onwards, an activity called City Walk became popular, sparking heated discussions, widespread social media attention, and official reports. For example, CCTV News (Online Version; 2022) covered how City Walks are organised and recommended various routes. People's Daily Online

(2023) r reported that the cityscape serves as a carrier of urban life and development, and that City Walk is designed to explore these aspects. Contemporary Chinese youth are eager to walk in cities to deeply experience and explore the cultural, emotional, historical, and human dimensions of urban life. City Walk involves wandering through the city and observing the streetscape, which relates to the phenomenon mentioned at the beginning of this thesis—that the similarity of modern city streetscapes does not support the formation of a unique city identity. City Walk also includes deliberately seeking out local scenery, especially cultural districts and heritage sites. From walking tours in Europe to the rise of City Walk in China, the search for cultural features remains a significant aspiration and element of wayfinding.

The technology and carriers of wayfinding systems have undoubtedly evolved over the years. As discussed in section 3.1.3, if we look back to the early days, the original carrier for wayfinding systems was probably stone. If we consider the Song Dynasty White Rabbit commercial advertisement (see section 3.1.1) as a vehicle for conveying wayfinding information, paper also became a medium for the wayfinding system. Today, the forms of carriers for wayfinding systems are diverse, including wood, stone, glass, plastic, resin, metal, and others (Calori & Vanden-Eynden, 2015). In terms of technology, a variety of technologies have been applied to contemporary wayfinding systems, with handheld electronic devices like Google Maps being the most common. In addition, several intriguing technologies and devices have been developed for wayfinding. For example, Pielot et al. (2009) introduce a technique that uses a vibrotactile belt to assist users in mapping paper maps to real-world physical features. This device guides the user towards a goal using touch and has been shown to be effective in improving the user's sense of direction and reducing the likelihood of getting lost, particularly in unfamiliar environments. On the other hand, Zelek et al. (2003) introduced a haptic glove as a navigation device, which provides feedback through vibration motors that vibrate different parts of the glove depending on the

direction of obstacles. This technique is particularly helpful for visually impaired individuals. The results of the study demonstrate that, with real-time haptic feedback, users can effectively sense and avoid obstacles, thereby improving the efficiency and safety of wayfinding.

In summary, contemporary wayfinding system design primarily focuses on the graphic aspects, with particular emphasis on wholeness, consistency, and prominence within the context. A clear trend is the integration of design and branding, especially the reflection of brand identity in the design, enhancement of visual consistency, improvement of graphics, fonts, and pictograms, as well as a move towards standardised design. Viewing the wayfinding system as graphic design integrated into the city itself is another emerging trend. From an information design perspective, the wayfinding system must deliver and filter a diverse range of information, as both an excess and a shortage of information can cause problems.

The design process and methodology of wayfinding systems are becoming increasingly commercialised, bringing greater importance to stakeholders and user experience. Regarding the user, beginning with Legible London, the perception of the city and environment has become increasingly significant, with cognitive maps forming the foundation of design. Technology integration is also a crucial consideration, including digital displays for physical signage, mobile applications, and potentially augmented reality technologies such as AR and VR. Sustainability is another emerging trend, encompassing the wayfinding system itself—such as materials and energy-saving solutions for physical signage—as well as its broader impact on people and cities, for example, encouraging walking to reduce carbon emissions.

3.3. The future of Wayfinding System Design

One vision for the future of wayfinding systems is that physical wayfinding systems will be replaced as mobile devices become more popular and wayfinding applications become increasingly common. However, this view is controversial and has faced criticism from several designers. For example, Calori and Vanden-Eynden (2015) highlight many advantages of physical wayfinding systems, such as not requiring mobile devices, signals, or battery power.

Current trends can be divided into two parts: technology and devices, and design content. While devices and technology are important, they should not be considered in isolation. These may include digital displays, mobile navigation apps, interactive signage, digital kiosks, tactile maps, voice-guided navigation, and potentially, augmented reality technologies like AR and artificial intelligence in wayfinding. However, all these technologies and devices serve as carriers of content. As Calori and Vanden-Eynden (2015) emphasise, the key word is enhance—technology and digital devices are means to enhance wayfinding and its content. Another important trend is sustainability, which will undoubtedly continue to play a significant role in the future vision of wayfinding.

The trend towards design content emphasises two key aspects: the effectiveness of information presentation and communication, and the consistency and wholeness of design. Wayfinding requires more than just graphic design; it also involves interaction design (such as interface design) and information design. Trends in design consistency include the incorporation of branding, alongside aesthetic demands that cannot be overlooked. Standardisation is another design trend, and it is not incompatible with aesthetic needs. Emotion and culture are also prominent current trends, and it is

reasonable to assume they will shape the vision for the future. This vision has two parts: firstly, the wayfinding system as an integral part of the city and urban landscape, with its design reflecting culture, emotion, and urban character; secondly, the wayfinding experience itself, whereby people following the system in the city simultaneously engage with local culture, life, history, and stories. Furthermore, as user experience becomes increasingly important in wayfinding system design, public participation in design is likely to become a key aspect of the future vision.

Based on a review of the wayfinding system's past and an analysis of the present, my research hypothesis is that, in today's context of rapid technological advancement, the development of applications such as Google Maps should be seen as part of wayfinding system design rather than a replacement for traditional wayfinding systems. New technologies and devices have introduced new design methods and display platforms to wayfinding systems. Physical wayfinding systems cannot be entirely replaced, especially considering sustainability concerns and the need to mitigate unforeseen situations, such as loss of signal or power on users' mobile devices. Wayfinding system design should integrate environmental information, cognitive mapping, urban character (including cultural, historical, and human elements), visual coherence, public participation, and personalisation of the wayfinding system.

3.4. Summary

In this chapter, I have thoroughly explored the development trends of wayfinding systems. Initially, I examined the evolution of wayfinding systems in the past. Since the term *wayfinding* emerged relatively recently, early wayfinding systems manifested in the form of related disciplines. Information design, which is an integral part of

wayfinding systems, traces its origins back to primitive symbols from prehistoric times, eventually evolving into pictographs and graphical representations. Graphics, closely associated with wayfinding, have developed into a variety of forms. Map design and cartography, also fundamental to wayfinding, have a long-standing history. Maps serve not only as geographic representations but also as carriers of diverse types of information. Finally, signage is a crucial component of wayfinding systems. The earliest forms of signage included milestones and inscriptions. Over time, the basic concepts of signage emerged alongside the development of vehicles and roads, with traffic signs being the most closely related aspect of signage to wayfinding. These elements evolved gradually in the past but were not yet systematically integrated into a unified system.

The current wayfinding system is believed to have originated in the 1960s and encompasses several categories, including wayfinding systems in urban environments, large open and public spaces, university campuses, transportation hubs, and indoor settings. In this section, I reviewed several classic wayfinding system projects and analysed the design strategies and principles of contemporary wayfinding systems. Contemporary wayfinding system design is closely linked to the commercial sector, with many design methods and principles outlined in design manuals and handbooks. Additionally, I have discussed the various mediums through which wayfinding systems are implemented.

Finally, based on past and present trends, I speculate on the future of wayfinding system design and identify emerging trends. From both a technological and medium perspective, physical wayfinding systems are unlikely to disappear with the widespread adoption of digital devices and applications. Instead, they are expected to evolve into diverse media, carriers, and presentations. Regarding content development, design is increasingly emphasising the effectiveness of information display and communication.

Information design is moving through a trend from simplicity to complexity and back to simplicity, with this simplicity embodying modern minimalism. Standardisation and consistency are becoming key trends, reflecting the importance of branding in wayfinding systems. Furthermore, the integration of emotion and culture into wayfinding systems is one of the current trends, and there is reason to believe this will continue into the future.

In summary, this chapter provides the historical context necessary for understanding the development and evolution of wayfinding system design, and reveals key design strategies and principles for contemporary wayfinding systems. By reviewing the development of related disciplines and combining this with current design practices, the chapter speculates on the future trends and directions of wayfinding system design, thereby establishing a foundation for the design framework proposed in this thesis.

Chapter 4. Methodology

This chapter aims to outline the research strategy employed in this thesis, including the construction of the methodological framework and paradigm used in the study, as well as the data collection and analysis methods. The chapter is organised into the following sections:

Section 4.1 describes interpretivism as a research philosophy and qualitative research as the chosen research approach. Section 4.2 explains the three strategies employed in this research: backcasting, a method based on decoding Kevin Lynch's theory, and the case study approach. Section 4.3 introduces the research location, Manchester city centre, and outlines the reasons for selecting this site as the research sample. Section 4.4 details the specific research methodologies used to collect data for this thesis: walking interviews and workshops. Section 4.5 addresses the research ethics and morality guiding this study. Section 4.6 describes the processes of data collection, transcription, and analysis. Finally, Section 4.7 provides a summary of the chapter.

4.1. Research Philosophy and Approach

Research should be underpinned by key philosophical assumptions that consider the nature of the study, the supporting evidence, and the methodology employed (Djamba & Neuman, 2002; Myers, 2013; Orlikowski & Baroudi, 1991). Interpretivism, rooted in anthropology (Ryan, 2018), is positioned as the opposite of positivism and is sometimes referred to as anti-positivism (Flick, 2013). As Ryan explains, interpretivism argues that

truth and knowledge are subjective, grounded in people's experiences and the cultural and historical contexts in which they interpret them.

As discussed in the literature review, knowledge from both external and internal sources forms the basis for people's wayfinding. In wayfinding, individuals subjectively interpret environmental information and form cognitive maps based on their personal cognition. These cognitive maps arise from individuals' knowledge of, and interaction with, their environment. When forming cognitive maps, individuals also develop experiences and perceptions of the city. Interpretivism supports the view that interactions within social and cultural contexts form the basis for people's understanding of reality and knowledge (Chowdhury, 2014). The commonalities within these cognitive maps integrate to shape people's impressions of the city, which result from their knowledge, experiences, emotions, and external stimuli arising from city-human interactions (Osóch & Czaplińska, 2019). Human wayfinding behaviours occur alongside these interactions, and interpretivism allows researchers to consider diverse factors, including behavioural aspects grounded in participants' experiences (Alharahsheh & Pius, 2020).

Interpretivism involves focusing on people's experiences, behaviours, and their subjective views and understandings of phenomena, which is why it is applied in this thesis. Cognitive maps reflect individuals' interpretation, understanding, and construction of information about their surroundings, and the city image emerges from the commonalities among these cognitive maps, forming a coherent understanding of the city. When this shared understanding is combined with individual perception and interpretation of the city and further integrated with culture to construct a wayfinding system design related to city identity, the design is grounded in experience and serves to enhance that experience. As Hammersley (2012) argues that people's experiences and

perspectives are more diverse, complex, and fascinating than commonly assumed, and documenting them is inherently valuable. The behaviours, interactions, and perspectives that people contribute during design activities lie at the core of the wayfinding system. These behaviours themselves constitute valuable data, and both the behaviours and the reasoning behind them provide important insights.

Interpretivism employs qualitative methods (Thanh & Thanh, 2015) to explore human experience in depth through qualitative design and methodology (Alharahsheh & Pius, 2020). Adopting an interpretive paradigm can provide a deeper understanding of specific contexts by collecting and interpreting qualitative data, leading to meaningful insights and conclusions (Saunders et al., 2012). Qualitative research aims to address issues related to understanding the dimensions of meaning and experience in human life and the social world, focusing on the subjective meanings of research participants (Fossey et al., 2002). It is primarily used to explore the meanings of social phenomena as experienced by individuals (Malterud, 2001).

Positivism and quantitative approaches are also commonly employed in wayfinding studies. For example, Vilar et al. (2014) tested the effect of different signage systems on navigation tasks by varying the type of signage (horizontal or vertical). Cliburn and Rilea (2008) examined the importance of signage for wayfinding by controlling the number of signs within a virtual environment. Xie et al. (2007) studied how viewing angles affect the readability of signage. The authors proposed a theoretical model and experimentally tested it by controlling for different angles. They showed that the maximum viewing distance of signage depends on the viewing angle and decreases non-linearly as the viewing angle increases. Von Stulpnagel et al. (2014) explored the role of individual landmark placement in spatial learning. By having participants place landmarks around a virtual building, the study investigated how people develop spatial

cognition and form mental maps in virtual environments. The results of the study revealed that although participants placed landmarks independently, their placements showed strong consistency, and the act of placing landmarks may negatively impact mental maps. It can thus be seen that placing the study in a laboratory environment to control variables is justified.

However, positivism, when applied to this study, overlooks people's interpretations, experiences, and behaviours concerning urban environmental information and wayfinding system design concepts, which are the central focus of this research. Especially in the field of design, people's experiences and perceptions often influence how they interpret information in their environment and how they interact with it. The positivist research method, with its emphasis on variable control and quantitative analysis, is not well-suited for this study. In contrast, the interpretivist approach aims to understand the meaning behind phenomena, rather than simply quantifying their impact. Qualitative research provides an ideal tool for this kind of exploration, as it can capture participants' individual experiences and emotional responses, as well as how they interpret and interact with the urban environment. Therefore, interpretivism is a more appropriate philosophical approach for this study, and qualitative research is the most suitable research method.

4.2. Research Strategies

4.2.1. Backcasting

For most of human history, people have supported the wayfinding process by providing information. Over this long period of development, the wayfinding system has evolved

into an integrated and complex field with multiple roles, including communicating environmental information, enhancing accessibility and clarity, supporting sustainable urban development, improving the city's image, and enriching people's experiences within the city. In such a complex field, establishing a clear vision for the future is crucial for developing an effective wayfinding system design approach. Furthermore, when facing complex problems where current trends contribute to the issues, backcasting proves to be a highly effective research method (Holmberg & Robert, 2000).

Backcasting is a planning method first proposed by Robinson (1990). Today, backcasting is frequently used as a research method in urban studies related to sustainability (Bibri, 2020). It begins by defining an ideal future, then links this future to the present, exploring the ways, methods, and steps necessary to achieve that envisioned future. As Dreborg (1996, cited in Bibri, 2020) suggests, backcasting is suitable when the study's scope is sufficiently broad and the timeframe long enough to allow for conscious and diverse choices and directions of development. The purpose of backcasting is not to predict the future but to focus on possible solutions to current and forthcoming problems to achieve the desired future (Sisto et al., 2022).

In both the past and present, designers and non-designers have collaborated to create ways of understanding and shaping the future (Sanders & Stappers, 2008). It is important to note that backcasting, as a research method, complements design. Design is a goal-oriented process aimed at solving problems, meeting needs, improving situations, or creating something new and valuable (Friedman, 2003). Design provides the tools and knowledge to generate and test future scenarios, while backcasting offers a framework within which design operates. Backcasting enables research to start from the analysis of past wayfinding systems, identify trends and development needs, and

speculate on future directions, thereby offering a comprehensive perspective for this study. The design process is then guided by this future vision framework, delivering solutions and insights to address forthcoming trends and enabling iterative reflection.

In design, the creative conceptualisation process always involves a research phase, which includes searching for examples from the past. Designers look to previous design challenges, resources, or precedents with an interdisciplinary perspective. This reflection on past paradigms helps form a design ethic that respects both the past and the future (Cooper, 2024). Recording and analysing the past enables us to look forward, while looking to the future allows us to assess the complex relationship between the future and the present in making decisions. This future does not imply predicting what will happen but envisions a combination of informed speculation and imaginative critical design—a scheme and strategy for how wayfinding systems should be designed. Backcasting is an effective research method for exploring the possibility of achieving this goal. Based on this backcasting approach, Cooper (2024, p. 174) proposes 'Pendulum Futuring,' where designers explore forward and backward over an equal period, creating a non-linear back-and-forth swing to examine future history from the designer's perspective. Timescapes created through this method make precedents and possible consequences visible, using the study of precedents and contexts to help outline potential futures. This approach is necessary for wayfinding system design. Studying the history of wayfinding systems helps construct potential futures and, most importantly, guides the direction of future research in this field.

As stated in the literature review, studying the past of the wayfinding system is crucial because it provides valuable insight into its development and evolution. This analysis of historical wayfinding systems helps inform speculation about future directions. Particularly for wayfinding system design, the scope can be more specific, yet there is a

lack of relevant theories clearly outlining the essential elements it should encompass. As Höjer and Mattsson (2000) suggest, when exploring solutions to social problems, the focus tends to be on envisioning the ideal future and the pathways to achieve it, which requires analysing the changes needed, the decisions involved, and the associated constraints and hidden conditions. Backcasting offers a means to explore the implications of different developmental trajectories and the underlying values guiding them (Robinson, 1988).

Considering the extraordinary complexity of the field and the multiple subjects involved, backcasting provides this thesis with a comprehensive view by looking back, analysing the present to understand trends in wayfinding system design, and exploring its potential future directions. Extracting a clear future from a complex past and present is a difficult task, but backcasting offers this thesis a method to explore a viable framework for the future. In this thesis, the backcasting method is employed to analyse past and current wayfinding system designs, with the aim of understanding and tracing their development trends. Although this thesis does not present an ideal vision of the future, backcasting, through reviewing the past and analysing the present, allows me to explore how future needs can be met through improved design. While the proposed future trends cannot be the only possibility, and the framework provided by this thesis is not the only way forward, it is a feasible option that has been proposed after thoughtful and systematic analysis. By analysing historical experience, we can identify elements of wayfinding system design that have worked and use these insights to speculate on future improvements. Historical trends and patterns can guide the construction of future designs: linking the past to the present and extending this into the future ensures that the design evolves in a coherent manner. In other words, by reviewing and analysing existing wayfinding system designs, backcasting as a methodology establishes a perspective for this thesis to speculate on the patterns and trends of their development,

and based on this perspective, provides a framework for wayfinding system design that can be followed in the future.

4.2.2. Kevin Lynch's Approach

Kevin Lynch's contribution to wayfinding extends beyond defining the term, his concepts of legibility and imageability, and his identification of the five elements of urban form. Most importantly, Lynch developed a framework that links wayfinding to people's perception and understanding of cities.

Lynch's theory and methodology provide the theoretical foundation and methodological guidance for this thesis. He offers a framework for forming individuals' overall impressions of a city by summarising the commonalities found in individual cognitive maps. Cognitive mapping is a research method that captures and reflects the interplay between places and social relationships. Lynch developed cognitive mapping tools to represent how people perceive space, places, and the organisation of city components into coherent patterns, which he terms the legibility of cities (Powell, 2010). Furthermore, Lynch created an empirical approach to reveal the mental images of spatial environments formed during perception (Zmudzinska-Nowak, 2003).

Specifically, Lynch's methodology for studying city impressions involved an in-depth case study of three cities (Boston, Jersey City, and Los Angeles) and interviews with their residents. During these interviews, participants were asked about their memories of city features, to describe multiple trips through the city, and to map their perceptions of it. In addition, Lynch developed a method inviting participants to sort and identify photographs of urban streetscapes and to reposition them according to their actual

locations. He also conducted fieldwork where pedestrians were asked for directions to six selected destinations in Boston, randomly approaching four or five people on the street for their wayfinding responses. This on-site analysis was later simplified into a process where a trained observer walks through the city and draws a cognitive map based on urban impressions. Lynch's research methodology provides a framework for exploring the relationship between people and their environment and for constructing and shaping mental maps.

Most importantly, as discussed in subsection 2.2.1, cognitive maps are not literal maps but mental representations. Lynch's approach offers a means of externalising these mental representations through mapping to illustrate the relationship between space, objects, and people. It also enables an exploration of how spatial and environmental information influences wayfinding behaviour, and simultaneously, how such behaviour affects people's understanding and experience of the city, thereby shaping its image. Therefore, applying Lynch's theory as an analytical framework and utilising the mapping tools developed from his research to gather individual feedback on urban spatial and environmental information — to identify common cognitive patterns that contribute to the city's image — is feasible. This forms a solid methodological foundation for wayfinding system design.

4.2.3. Case Study

The research strategy of this thesis also emphasises the use of a case study approach. While many previous wayfinding studies have relied on virtual wayfinding in laboratory settings—such as those by Lawton (1996), Rauba and Egenhofer (1998), Murray et al.(2000), Haque et al. (2007), Wiener et al.(2009), Vilar et al. (2014), and Ruddle and Lessels (2006) —this thesis focuses on individuals' perception and experience within

the actual city environment rather than the underlying mechanisms of wayfinding. Given the impracticality of selecting multiple cities for this research, it was necessary to opt for a real-life urban setting, making a case study the most suitable research method.

Yin (2009) defines a case study as an empirical research method used to investigate contemporary phenomena and recommends selecting a representative or typical case. Gerring (2004) describes a case study as an intensive examination of a single unit aimed at understanding a broader class of similar units. Single case studies can provide nuanced and empirically rich descriptions of specific phenomena (Willis, 2014). In other words, case studies enable an in-depth exploration of a particular object, helping to better understand complex contexts and situations. Furthermore, case studies allow researchers to focus on one object when the scope includes numerous possibilities, making it feasible to select just one city out of countless worldwide.

Case studies are widely used in the social sciences, particularly in practice-oriented research. Although often regarded as qualitative, case studies may also incorporate quantitative elements (Starman, 2013). Starman further highlights that case studies focus on development and specific events occurring within a particular context. In the design discipline, case studies are a common research strategy. For example, Simeone et al. (2018) employed a case study of Harvard University's metal LAB to explore opportunities for academic entrepreneurship through art and design as communication mechanisms. Fass (2014) used interpretive design to provide qualitative depth to quantitative data, while Elsden (2017) applied bibliographic informatics. Some scholars, such as George and Bennett (2005), criticize case studies for potential selection bias arising from researchers' subjective choices influenced by familiarity with the case. However, it is important to note that leveraging prior knowledge in case studies can

strengthen research programs, as this foundation facilitates more rigorous theory testing (Starman, 2013).

Case studies are also a frequently used research method in many urban studies. For example, Poplin's (2012) study contributes to public participation in urban planning. Pham et al.'s (2011) study on urban space and urban remote sensing growth. Cheng and Masser's (2003) study on urban growth patterns. Cetin's (2019) study the impact of urban planning on urban form. All these studies employ a methodology that involves selecting a specific city as a case study and research site. For urban designers, city planners, and researchers in this field, the city serves as a vast laboratory or research arena. The case study approach allows for detailed and in-depth research on a specific city while also enabling the development of a transferable framework applicable to other cities. Additionally, a case study permits the observation and understanding of how people interact with environmental information in practice, providing a solid foundation for real-world wayfinding research. Therefore, choosing a case study as the research methodology and selecting Manchester as the sample for this study is feasible. To provide a clearer overview, all types of data collected in Manchester city centre, along with the various research methods employed, are listed in the table below (Table 3) and will be discussed in detail in subsection 4.4. The rationale for selecting Manchester will be explained in the following subsection.

Table 3 Data collection and methods overview.

Data Collection Method	Data Volume	Data Type	Description
Walking Interviews (Qualitative Data)	13 interviews, 17 participants	Videos and audios records of walking interview	With the exception of a few special walking interviews discussed in subsection 5.1.1, all interviews were audio-recorded, and the street scenes were video-recorded.
		Transcripts of walking interviews	The interview was transcribed into a manuscript.
		Hand-painted Map by participants	Participants created hand-drawn maps based on the walking interview process.
		Route recording maps as observation data	After each walking interview, I mapped the route and labelled key information along the way, confirmed by the video recordings
Workshops (Qualitative Data)	3 workshops, 32 participants	Information extracted from street view photographs and panoramic photographs	Participants extracted relevant information from street view and panoramic photographs that they deemed helpful for wayfinding.
		Divided districts	Participants divided the Manchester city centre into districts and named/described them.

	Identified routes and decision points	Participants planned the routes and identified key decision points.
	Design works and methods	Participants developed a wayfinding system design for the Manchester city centre and provided detailed descriptions of their design.

4.3. Research Site: Manchester City Centre

The study was conducted in Manchester city centre, with the approximate extent shown in Figure 7. Manchester city centre is variously defined, either as the urban area within the inner ring or the entire area enclosed by the Manchester ring road. According to the *Manchester City Centre Office Market Report*, the city centre boundaries lie within a circle formed by Great Ancoats Street, A6042 Trinity Way, and A57 Mancunian Way (GVA Grimley, 2008). In the figure, the red star symbols indicate the destinations involved in the wayfinding experiment during the study. The red dotted line frames the approximate study area when all the destinations are connected. In the actual study, participants were not limited to this range of destinations due to their differing choices when getting lost and wayfinding, so the blue dotted line shows the approximate coverage of the activities undertaken during the walking interviews. In the workshops, as the study scope was not restricted, participants worked within a broader area, roughly framed by the green dotted line in the figure. The design and research processes for the walking interviews and workshops will be discussed in more detail in the following subsection. All areas indicated in the figure are approximate.

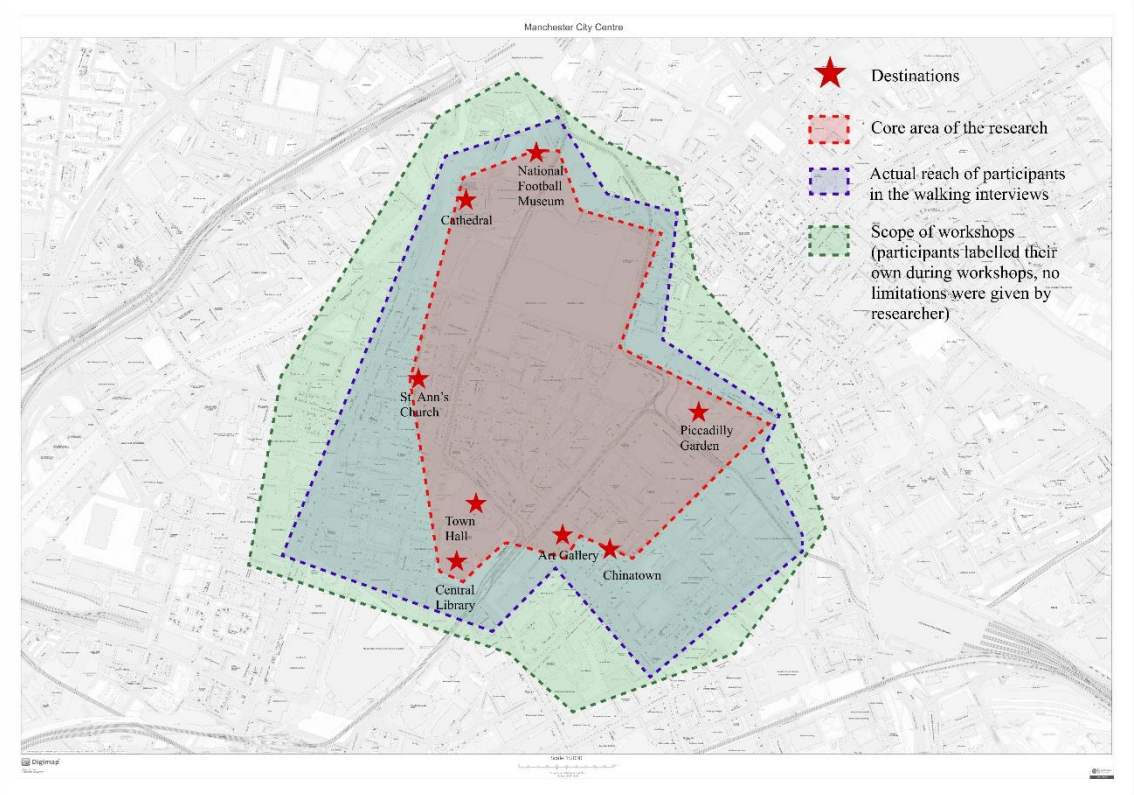

Figure 7 Approximate research area in Manchester city centre. Base map downloaded from Digimap (https://digimap.edina.ac.uk/). Drawn by the author.

4.3.1. Why Manchester?

Since the late 19th century, Manchester's identity has been that of an industrial city built around innovation, creativity, and commerce (Kellie, 2014). From the mid-20th century onwards, the city has sought to reshape its identity and cityscape. Kellie highlights the preservation, development, and reinvention of heritage and historic buildings in Manchester's city centre, arguing that Manchester is characterised by a cityscape of old and new buildings. The city centre retains a diverse range of heritage and historic buildings with distinctive characteristics, including recognisable industrial landmarks such as the Royal Exchange Theatre, the Museum of Science and Industry, municipal buildings, alongside modern development projects.

Manchester was chosen for several reasons. It is one of the UK's cities with the strongest sense of identity and culture. Contemporary Manchester has emerged from industrial decline and undergone significant transformation, with places grounded in cultural investment and creative assets (A. Miles, 2010). Miles also points out that Manchester's current cultural fabric comprises various institutions that shape people's elective belonging—the process by which individuals form emotional and symbolic connections to specific cultural and geographical environments through active choice. Therefore, cultural structures and districts hold great significance in contemporary Manchester, both in terms of the city's image and identity.

A BBC survey found that Manchester is considered England's second most important city after London (BBC, 2007). The influential cultural scene enhances Manchester's psychological importance in the nation's minds. While London is undoubtedly renowned and equally suitable for research, practical constraints such as distance make frequent visits to the capital challenging for me. In contrast, Manchester's accessibility, being just an hour's drive from my city of residence, facilitates regular visits and thus makes it an ideal research site.

Liverpool was initially considered as one of the research sites, alongside Edinburgh. However, Edinburgh's considerable distance from my place of residence made it difficult to visit regularly. Liverpool was eventually excluded due to the large distances between its cultural districts. Since my research is closely linked to people, accessibility of the locations for participants was a critical consideration. If the cultural districts were close to each other or even visible from one another, the study would not genuinely reflect wayfinding. Conversely, if the distances between locations are too great, participants may become fatigued, which could diminish their motivation and

willingness to continue. Some participants might even withdraw halfway through, seriously compromising the validity and reliability of the data collected.

Manchester city centre not only contains clearly identifiable cultural districts, but importantly, these districts are all within a fifteen-minute walking distance of each other (Figure 8). The figure illustrates the walking times between these cultural districts. All times are based on measurements from Google Maps and include various routes connecting the locations (the straight lines in the figure represent walking times along road routes). To verify these estimates, I conducted multiple visits to Manchester city centre and compared the estimated times with my actual walks, confirming their reliability. Among the cultural districts, the Central Library and the National Football Museum are the furthest apart, with the shorter routes taking approximately 13 minutes to walk. The only exception is a longer route between the National Football Museum and Central Library, which takes about 18 minutes.

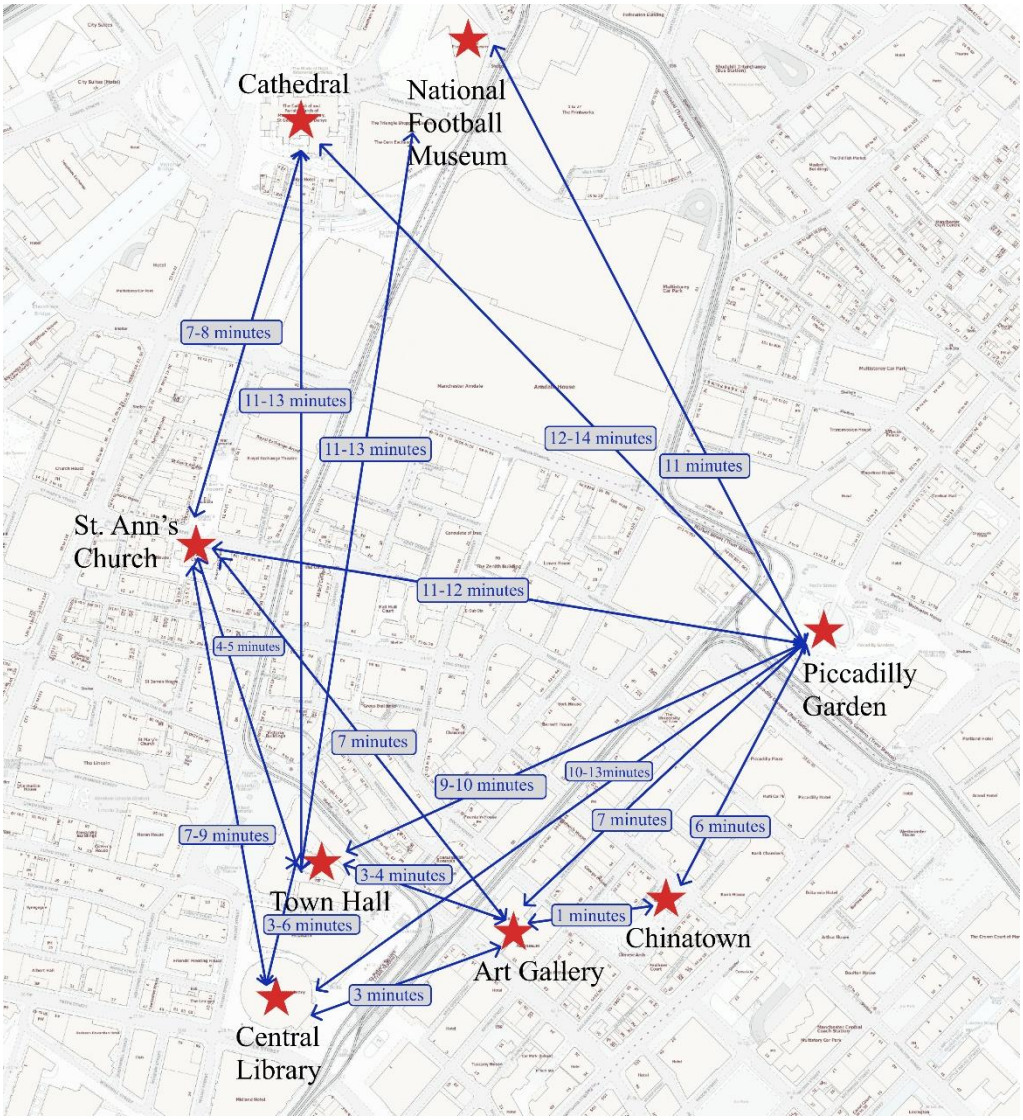

Figure 8 Walking time required for Manchester city centre walks between various cultural districts. Map downloaded from Digimap (OS map). Walking time data from Google Maps estimates. Drawn by the author.

In contrast, Liverpool's cultural districts are generally more dispersed. According to the Liverpool World Heritage City website (https://www.liverpoolworldheritage.com/), Liverpool's key heritage and cultural zones include several areas, namely the Pier Head, Albert Dock Conservation Area, Stanley Dock Conservation Area, Commercial District, Cultural Quarter, Merchant's Quarter, and Buffer Zone. Due to its distance from the other areas, the Stanley Dock Conservation Area was excluded from consideration. Although exact distances between these cultural zones are not specified, Liverpool's

cultural districts are widely spread, resulting in relatively long walking times, as shown in Figure 9. One possible approach would be to start in one cultural district and follow a circular route passing through all the locations; however, I was reluctant to restrict the participants' decision-making range during the wayfinding experiment. Additionally, when wayfinding in a city, it is crucial to allow for the possibility that participants may get lost, take longer routes, and spend more time navigating. After several visits to Liverpool to test these routes, my experience indicates that even walking a circular route can take at least an hour and thirty minutes, which is already a demanding journey.

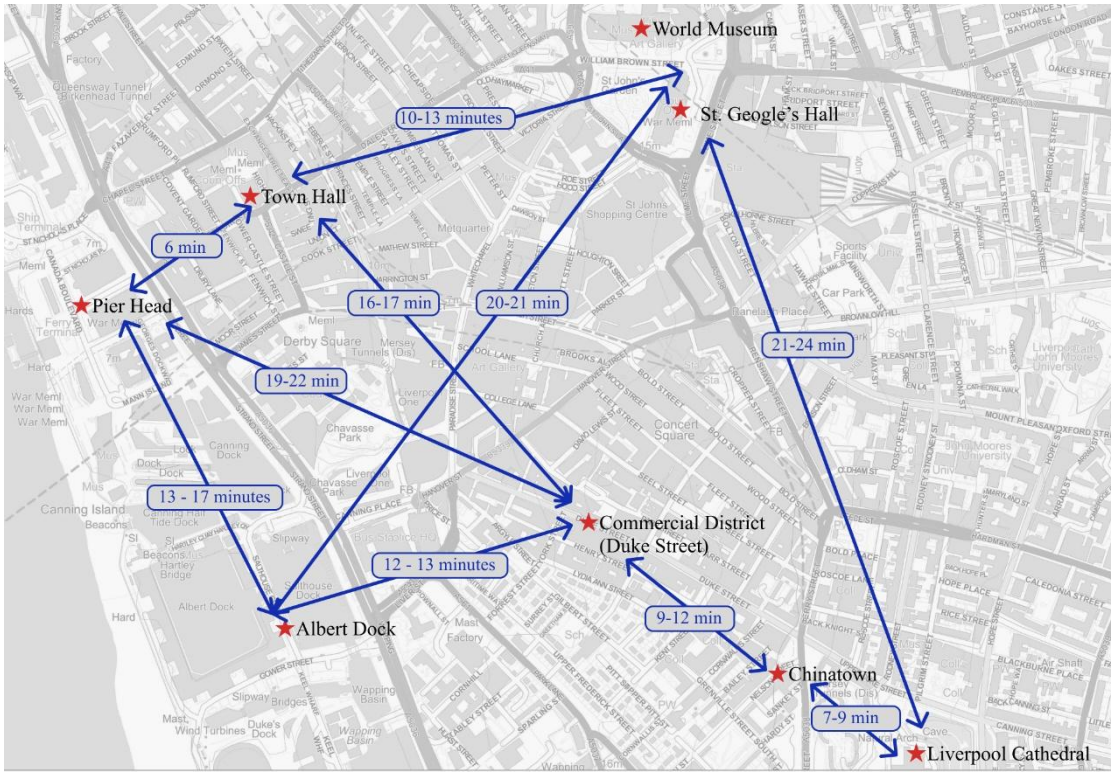

Figure 9 Walking time required for Liverpool city centre walks between various cultural districts. Map downloaded from Digimap (OS map). Walking time data from Google Maps estimates. Drawn by the author.

4.3.2. Selected Cultural Districts

Wayfinding is the process of navigating through space from a starting point to a destination, making the selection of appropriate destinations crucial for this research, especially for the wayfinding experiments conducted in the city. Manchester has numerous representative cultural districts but determining which to include in the study was a key consideration. Ultimately, three sources of data were collected and referenced to identify the destinations for the wayfinding experiments during the research process:

1. Cultural Gems (https://cultural-gems.jrc.ec.europa.eu/) and the Cultural and Creative Cities Monitor (CCCM, https://composite-indicators.jrc.ec.europa.eu/cultural-creative-cities-monitor) serve as valuable resources for understanding Europe's cultural and creative landscape. Cultural Gems, developed by the European Commission's Joint Research Centre and launched in 2018, is an open dataset aggregating contributions from cities, universities, and public and private organisations across Europe, providing comprehensive information on over one million cultural sites. Integrated with OpenStreetMap, it offers a detailed repository of cultural data. The CCCM functions as a tool to evaluate and compare European cities through both qualitative and quantitative data, aimed at informing policymaking related to culture and creativity. Both datasets are based on extensive data collection, ensuring their reliability. Through communication with the Cultural Gems team, I obtained access to the Manchester data package, which I imported into ArcGIS to generate a map of cultural sites in Manchester. Permission to cite Cultural Gems in this thesis was granted in accordance with the website's data privacy agreement.

2. Related books, literature, and reports have also been consulted. For example, Kellie (2014) explores the development and evolution of Manchester's cityscape. A book *Culture in Manchester Institutions and Urban Change Since 1850* that edited by Perreault (2010) exploring institutional and urban change in Manchester since 1850 contains various authors' articles on Manchester's urban and cultural institutions. In addition, several sources are from Manchester City Council's web pages, such as City Centre regeneration areas (Manchester City Council, n.d.). Manchester City Council's latest *Annual Culture Report* (2024) appeared at the time of the paper's writing when the data collection was complete, but the report further corroborates that these destination choices are well-founded.

3. Manchester's official tourism website, Visit Manchester (https://www.visitmanchester.com/), along with other unofficial tourism websites, were also consulted. Although this thesis does not specifically focus on tourism, tourism websites serve as important platforms through which a city presents itself, and thus reflect the city's image. For example, the official Visit Manchester website previously described the city on its homepage as 'The original modern city.' However, this phrase was removed from the homepage on the current version of the website (2024).

The CCCM evaluates 24 indicators across nine dimensions, reflecting three key aspects of a city's cultural, social, and economic vibrancy. Within the cultural vibrancy dimension, the CCCM further divides culture into two sub-dimensions: cultural venues and facilities, and cultural participation and engagement, encompassing a total of nine indicators. The indicators under cultural venues and facilities include sights and landmarks, museums and art galleries, cinemas, concert and music halls, and theatres.

The remaining four indicators focus on cultural participation and engagement, such as tourist overnight stays, museum visitors, cinema attendance, and satisfaction with cultural facilities. Savage and Wolff (2010) suggest that to understand Manchester's cultural history and evolution, culture can be broadly defined to include fine art institutions (such as galleries, orchestras, museums), while also considering other forms such as people's theatres, societies, and clubs. In selecting specific research sites as destinations, I used these indicators as a reference and identified relevant sites within these categories.

Ultimately, the chosen research sites included Piccadilly Gardens, Chinatown, the Art Gallery, St Ann's Church, the Central Library, the Guildhall, Manchester Cathedral, and the National Football Museum.

4.4. Research Methods

To provide valuable answers to the research questions, two research methods were employed: walking interviews and workshops. Walking interviews enabled participants to engage directly with natural urban environments, offering insights into their cognitive processes, decision-making strategies, and the environmental information they relied on during wayfinding. Workshops facilitated collaborative design, integrating diverse perspectives and allowing participants to select and combine their perceptions, awareness, and understanding of the urban environment into the design process, thereby generating insights and ideas across multiple dimensions of wayfinding system design. Data collection was divided into three main sections, involving a total of fifty-one participants. These research methods were as follows:

- **Walking interviews:** Thirteen walking interviews were conducted with seventeen participants. Of these, two were local to Manchester, three were from other parts of the UK, and the remaining participants came from overseas, including China, Pakistan, and India.

- **Workshops:** Three workshops were held, involving thirty-two participants. Among these, nine were from the UK, while twenty-three were from overseas countries including China, Pakistan, India, Russia, Japan, Ukraine, Poland, Peru, Bangladesh, Thailand, and Turkey.

- **Framework Development:** Following analysis and interpretation of the walking interviews and workshop results, a framework for wayfinding system design was developed. To further validate its effectiveness, testing was conducted in the Mill Race area of Lancaster, UK, with two participants taking part: one with a background in design and another designer with prior experience in wayfinding system design.

4.4.1. Participants Recruitment

Given the qualitative nature of this research, various factors influenced both the research process and outcomes. These include the phrasing of questions, participants' emotions and body language, the researcher's personal interests, as well as participants' social experiences and socio-cultural backgrounds. Additionally, external conditions such as the urban environment, weather, and traffic also had an impact, particularly during the walking interviews. In the collaborative design workshops, interaction and communication among participants were fundamental components of the study. As

Hammersley (2012) points out, data and its interpretation are inevitably shaped by the social and personal characteristics of those involved; while these influences cannot be eliminated, they can provide valuable insights despite the risk of introducing bias or errors.

Participants were recruited using a snowball sampling approach, utilising online platforms such as Facebook and email, alongside physical posters.

The recruitment process targeted three distinct participant groups, aligned with the study's focus on exploring individuals' wayfinding behaviours and their perceptions of the city and its culture:

- Individuals from overseas, representing diverse cultural backgrounds different from those of the UK.
- UK residents who are non-local to Manchester and have not lived or worked in the city for a significant period.
- Residents of Manchester, referred to here as Manchester natives.

4.4.2. Walking Interviews

Walking interviews are a suitable research method for exploring people's wayfinding behaviour in urban environments. They represent a distinctive qualitative approach that investigates the relationships between people and places, allowing for the collection of more site-specific and context-rich data (J. Evans & Jones, 2011). Sheller and Urry (2006) propose the emergence of a new mobilities paradigm, which highlights cities as dynamic environments where people, objects, and information are continuously on the move. This paradigm underscores the interconnectedness of places, rejecting the idea of

cities as isolated silos. Moreover, unlike traditional research approaches that treat places as separate from the people who move through them, the mobilities paradigm views places as dynamic processes shaped through interaction with their visitors. In essence, it stresses the significance of the connections between people and places, between places themselves, and the interplay among these elements.

A research perspective emphasizing mobility and dynamism is crucial for understanding wayfinding behaviour in urban settings. Passini (1981) argues that wayfinding can be misunderstood if viewed merely as an orientation problem that stresses a static relationship with space. Instead, wayfinding is a dynamic activity within the city, and walking interviews represent a research methodology well suited to capturing this dynamism. The use of dynamic and mobile research methods is increasing (J. R. Hein et al., 2008) , with social scientists and geographers adopting approaches where researchers walk alongside participants. Examples include Anderson's (2004) study on personal life and knowledge within geographical contexts, Carpiano's (2009) investigation of the relationship between local communities and health, Kusenbach's (2003) ethnographic fieldwork on urban communities, and Reed's (2002) study in London exploring how people construct the personality of the city.

Compared to traditional interviews, walking in the city means that the participants and the researchers are more exposed to multi-sensory stimuli from their surroundings (Adams & Guy, 2007) rather than being enclosed in a selective environment, which means this method brings immediacy and kinaesthetic rhythm to the research (Middleton, 2009). Research has shown that one of the main advantages of walking interviews is that the researcher can understand people's attitudes and knowledge of their surroundings (J. Evans & Jones, 2011). According to Vergunst and Ingold's (2008) comments, walking with interviewees facilitates a connection with the environment and

a better understanding of the person's understanding of the environment, for example, how the routes people walk create places. Teff-Seker et al. (2022) state that walking interviews allow participants to be closer to the environment and more locally sensitive, mainly by providing insights and constructive experiences for the participants themselves. A critical perspective is that when conducting research using walking interviews, participants can interact directly with environmental information due to the placement of the research in a natural urban environment, which helps to reveal many subconscious or intuitive navigational decisions. In summary, walking interviews allowed me to gain insights into people's understanding of information within the environment, that is, people's knowledge of the external. Such insights provide information about the environment that makes up people's cognitive maps and insights about the cognitive maps that people form.

In order to gain a deeper understanding of people's perceptions of the city and their interactions with the city during the wayfinding process, the walking interview was conducted in the form of a semi-structured interview. Semi-structured interviews are the most commonly used interview method in qualitative research (Kallio et al., 2016), allowing researchers to better understand the unique perspectives of the participants (Adeoye-Olatunde & Olenik, 2021). Semi-structured interviews provide greater flexibility for both the researcher and the participant than traditional methods such as structured interviews, questionnaires, or surveys (A.Smith et al., 1995). Semi-structured interviews offer a wide range of possibilities to ensure that the discussion focuses on the specific topic of the phenomenon under study; in addition, they can be combined with other methods such as quantitative surveys, participant observation, and so on (Galletta & Cross, 2013). It can be argued that semi-structured interviews are particularly helpful in capturing the dynamic responses of participants in the midst of the wayfinding process and can help me to dig deeper into the immediate responses of participants to the urban environment.

Walking interviews may provide a more dynamic and immediate perspective than the approach adopted by Lynch (1960), whose focus was on obtaining public impressions of the city, with wayfinding as a vehicle, or rather, a way to help people recall their impressions of the city. In other words, Lynch's focus is not on wayfinding but on the impressions of the city, which in turn leads to opinions on city building and planning. In contrast, my research focuses on wayfinding, and the city image is the basis for generating the design of the wayfinding system. It can be said that the difference in research objectives led to the fact that my research methodology, although very related to Lynch's, was different from Lynch's, which used structured office interviews, asked participants to draw maps, and relied mainly on recall. In comparison, the walking interview was a dynamic, participatory cognitive process. The walking interview is a multi-sensory experience that includes sight, smell, hearing, and spatial perception. Lynch also asked people to look around the city, recording elements and drawing cognitive maps to test people's grasp of the city's overall structure. However, this method is primarily designed to validate the structure and framework of the city. Participants can provide real-time feedback by observing and feeling the streetscape and the dynamics of the city. Participants may have received less guidance during the walking interviews, and the non-interventionist approach allowed participants to respond instantly to the current urban environment. This research methodology allowed me to comprehensively understand the spatial elements that participants perceived and used during their walks. Based on my research questions and problem, these elements need to be further externalised and visualised to become a framework for the wayfinding system design, hence adopting the workshop as an alternative research methodology. I will then explain in detail how the workshop was designed and practised.

Evans and Jones (2011) also summarised the typology of walking interviews, suggesting that walking interviews comprise three types: the researcher setting the route, without setting the route, and the respondent deciding on the route. Kinney (2017) summarised the walking interviews in its various forms, including the docent method developed by Chang (2017, cited in Kinney, 2017) in his study of the link between place and health, the go-along walking interview which consists of a combination of participation and observation, participatory walking interview, and Bimbling, which considers only the content of the interview regardless of the route and objectives.

This thesis concerns people's wayfinding behaviour, which is a purposeful activity of traversing space. As stated by Wiener et al. (2009), directed wayfinding is the process by which a navigator approaches one or more specified destinations. Wayfinding behaviours involve knowledge of paths to destinations only when such destinations are defined. Therefore, a destination was formulated for the walking interviews, which are the cultural districts proposed in subsection 4.3.2. Participants were able to provide real-time feedback by observing the streetscape, sensing the dynamic changes, and experiencing the evolving environment of the city. Destinations were set by the authour and routing was decided by participants. Participants received minimal guidance during the walking interviews, and the non-interventionist approach enabled them to respond spontaneously to the current urban environment. This research methodology provided a comprehensive understanding of the spatial elements that participants perceived and utilized during their walks.

In contrast to walking interviews, which are traditionally presented in the literature, observations of participants' behaviour during wayfinding formed another aspect of this study that complemented the textual and verbal communication data. Using recorded

videos and observations collected during the walking interviews, I created a series of road maps with labelled information to document these wayfinding processes. Throughout the study, I consciously avoided interfering with participants' behaviour. My role was purely that of an observer and recorder, without guiding participant decision-making. The participants independently made decisions regarding routes, directions, and reference information retrieval. Whilst some researchers (Roller, 2015; Spano, 2005) have expressed concerns about the possible negative impact of the observer effect on studies, it is important to note that observation was not the primary methodology of this study but only a complementary part of the walking interviews. Monahan and Fisher (2010) note that while participants may change their behaviour as a result of being aware of observation, this also indicates that they are attempting to share their views on what they feel is relevant to the study, and this is where the study's value lies. The process and design of the study will be discussed in more detail in Chapter 5.

Walking interviews, as a research methodology, provide data about the environmental information involved in the wayfinding process and how people use this information to form cognitive maps. However, it is critical to find ways to incorporate this data into the design of the wayfinding system to create a framework that will ultimately guide its design. Therefore, workshops were also employed as a research method to explore the design methods and strategies of wayfinding systems. I will explain this next.

4.4.3. Workshops

In contrast to science, design is a practical discipline (Cross, 2001). Cross states that design, as a discipline, can be researched on its own terms and within its own culturally rigorous framework, seeking to develop field-independent design theories and research methods. Design is a goal-oriented process aiming to solve problems, improve

situations, or create something new (D'Ippolito, 2012). D'Ippolito also notes that the concept of design as an enabler of potential innovation depends on the design's motivation and the type of knowledge on which it relies. The type of knowledge design depends on is crucial. In the case of wayfinding system design, this includes knowledge of environmental information and cognitive maps shared by people, as well as knowledge of subjective expressions such as graphic and information design. Therefore, the focus is not only on how to express these elements but also on what to express. This area centres on user experience, which is becoming increasingly important in current development trends, making it critical to ensure the communication and presentation of the information users need. Hence, involving people beyond designers is necessary to provide the user's perspective. Workshops with multiple participants are an effective research method.

Workshops as a research method aim to generate valid data through future-oriented processes such as organisational change and design (Ørngreen & Levinsen, 2017). Workshops focus not only on the present but also explore future possibilities through collaboration and co-creation, and they can be effectively combined with the backcasting method. For example, Axelsson et al.(2020) u used workshops as a research methodology to assess the progress of sustainable transport infrastructure projects and to facilitate interdisciplinary research collaboration. Similarly, Bertella et al. (2021) revealed a methodological framework for designing workshops targeting sustainable development in tourism. When used as a research methodology, workshops enable the collection and generation of reliable and valid data within a particular field (Ørngreen & Levinsen, 2017). This methodology has also been applied in wayfinding system design. For instance, C.-H. Chen et al.(2012) and others have used workshops in design education to guide students in creating wayfinding design works and to provide a framework.

Design workshops can promote design research as an object of social research, as a design tool, and as a means of reflection and practice for designers (Rosner et al., 2016). The design of the workshop is essential and directly affects whether the data generated can be valuable in answering the research questions. In this thesis, two theories provide the framework for the workshop's design: research through design (RTD) and participatory design.

RTD is an approach to research that generates knowledge through design practice, utilising the unique insights gained to better understand the complex and future-oriented nature of the design field. This approach was initially proposed by Frayling (1993), who noted that researchers can learn about aspects of human experience by designing artefacts. Cross (1999, p. 2) suggests that design is a discipline in its own right and divides design research into three broad categories based on people, processes and products: design epistemology (the study of cognitive approaches to design), design praxeology (the study of design practices and processes), and design phenomenology (the study of the form and construction of artefacts). Later, Findeli (2004, cited in Godin & Zahedi, 2014) redefined these three forms of design research, with RTD defined as research closely linked to the actual design, redefining the design aspect of creation as research — an approach that creates new products and experiments with new materials and processes. Stappers and Giaccardi (2017) state that RTD refers to design activities that play a formative role in knowledge generation and include the development of prototypes (or artefacts), which may be mistaken for products. They also highlight that design activities are where insights and ideas are generated, with a focus on the design activities used in knowledge production. This theoretical framework allows design to be used as a research method, emphasising the importance of insights, knowledge, and prototypes (or artefacts) generated during design activities. Therefore, RTD can provide

a framework for the research methodology of workshops to support the generation of new insights and knowledge about design within workshops. These insights and knowledge further contribute to and enhance the design framework of the wayfinding system as a prototype.

RTD can be used to explore the design of wayfinding systems to generate new knowledge, including design methods, principles, design behaviours, and artefacts that support design. It allows researchers to integrate design as a core part of their research, playing a central role in the knowledge generation process. RTD creates opportunities for interactions between people and products, realised through design. Although there remain criticisms, controversies, and discussions around RTD, as Zimmerman et al.(2007) note, there is still no universally agreed research model for designers beyond developing and evaluating new design methods. The core focus of RTD is design practice (Godin & Zahedi, 2014). It introduces practice as a research component and enables the translation of practical outcomes into new research knowledge.

Additionally, utilising design thinking in workshops is essential. Although this term often describes designers' impact on problem-solving, it is rarely explicitly defined (Zimmerman et al., 2007)). As Bertella et al. (2021) state, design thinking is closely associated with innovation in workshops because it develops creative solutions to complex problems through an iterative process. Design thinking introduces diverse ideas and solutions into wayfinding system design workshops, refining knowledge through iteration and reflection. However, as noted in the summary of Section 3.3, the future trend of wayfinding system design increasingly focuses on the user experience rather than solely on the designer's perspective. Therefore, incorporating the framework of participatory design is also essential.

Participatory design is a research methodology that treats users as partners, complementing user-centred approaches. Concepts such as co-creation and co-design have gained traction in this field (Sanders & Stappers, 2008). Participatory design involves not only research but also the production of artefacts, systems, organisations, and practical or tacit knowledge (Spinuzzi, 2005). Spinuzzi highlights that participatory design empowers designers with an enabler's role, ceding decision-making power to users. It emphasises co-research and co-design, with designers (or researchers) making decisions collaboratively with participants throughout the iterative process.

Participatory research helps narrow the gap between researchers and participants by involving key stakeholders in research design and implementation (Fossey et al., 2002). The core of participatory design is including the target audience in the design process, allowing them to contribute ideas, insights, and knowledge, and collaboratively generate new knowledge iteratively. Workshops are a prevalent method in participatory research. For example, Van Berkel and Verburg (2012) combined participatory research and workshops to study the impact of land use changes on landscape ecological services, incorporating backcasting as a method. Muller and Druin (2002) employed participatory research to explore the concept of third space in human-computer interaction (HCI) design.

Overall, RTD and participatory design provide the theoretical foundation and framework for using workshops as a research methodology. RTD offers a structure for generating knowledge through design practice, enabling workshops to produce design outcomes and derive knowledge from them. Participatory design, meanwhile, positions workshops as collaborative platforms where designers, researchers, and participants jointly explore ideas, facilitating the generation of valuable insights through their interaction.

4.4.3.1. Designing Workshops

Design, like art, is often viewed as a visual discipline and is therefore examined using various visual methods (Boradkar & Dhadphale, 2020). As D'Ippolito (2012) highlights, the knowledge underpinning design is of particular importance. The literature review and analysis of design examples in Chapters 2 and 3 reveal that the knowledge needed for wayfinding can be categorised into two main aspects: external environmental information and internal cognitive maps. Accordingly, the workshop design was oriented around these two aspects. Participants were provided with a comprehensive, step-by-step guide. The workshop process was structured into two primary phases: searching for external information and constructing a cognitive map of the city to develop a distinctive city image. Within the participatory and co-design workshop context, it is the researcher's responsibility to collaborate with participants and introduce relevant domain theory in an accessible and manageable way (Sanders & Stappers, 2008). Therefore, providing participants with a clear and approachable introduction to the theoretical field of wayfinding was essential.

Accordingly, to ensure participants were willing and motivated to engage, I drew on the model of serious games to structure the workshop flow, thereby enhancing enjoyment within the theoretical framework. This was particularly important given the workshops involved specific terminology and concepts. The term *serious games* refers to the design of games intended for purposes beyond entertainment (Deterding et al., 2011; Gloria et al., 2014) , primarily for learning (Din et al., 2023). The use of serious games in urban research contexts is not uncommon. For example, Poplin (2012) describes employing serious games to facilitate public participation in urban planning, citing the example of

NextCampus, a game developed for this purpose. Similarly, Goli et al. (2022) present a serious game framework applied to architectural design education.

Furthermore, serious games have been employed in projects related to art and design. For instance, Gintere et al. (2024) present the InGame project, which investigates users' perceptions of immersive art experiences. Games can facilitate an alternative form of discussion that is more open, participatory, and potentially more enjoyable (Gordon & Baldwin-Philippi, 2014). Research using game-based methods shows that such approaches stimulate greater interest and enjoyment and are generally perceived as more engaging (Connolly et al., 2012). Incorporating serious games into workshop design has been shown to enhance participant motivation, integration, enjoyment, and engagement. The structured yet flexible environment provided by these games encourages collaboration and interaction among participants.

As stated by Ørngreen and Levinsen (2017), although researchers have access to various powerful devices for recording workshops, recording workshops from start to finish is not straightforward. Consequently, when workshops are used as a research methodology, researchers typically opt for immersive and collaborative environments and remain proactive in facilitating the process. To facilitate this process proactively, it is of the utmost importance to establish clear objectives for the workshops. According to Sufi et al. (2018), practical goal setting represents a fundamental guideline for a successful and impactful workshop. Establishing the workshop's objectives, which encompass both the overall objectives, and the sub-objectives is paramount. Consequently, the overarching goal is presented in this step and is described as follows: 'We will explore how to navigate through spaces and design a wayfinding system to encourage people to explore the city, rather than relying on Google Maps and their phones for directions'.

Non-professionals and non-designers participate in the workshops, so the descriptions provided may initially seem abstract to them in practice. Such participants may ask questions like, ‘What is a wayfinding system? What should I design? What are my design options? I’m not a professional, where do I start?’ Therefore, the workshop objectives are gradually clarified during the implementation process. Each stage has a clear and distinct goal, and as the workshops progress, these goals become more concrete and practical. The workshop objectives are achieved through a series of steps designed to give participants experiences that enhance their ability to express themselves at all levels throughout the workshop (Sanders & Stappers, 2008). These steps were carefully crafted to engage participants effectively. In the following section, I will describe the specific design and main steps of the workshop.

4.4.3.2. Part 1: Introduction

The objective of this section was to construct an overall perception of the workshop for the participants, including the purpose of the workshop and some related basic concepts. This part introduces fundamental concepts and terminology, including wayfinding and wayfinding systems. Examples of design elements commonly found in wayfinding systems, such as landmarks, signage, maps, directional signs, and environmental information design, are also presented in this part.

Explaining the terms is intended to enable participants to construct an idea of what the workshop will be about, so that they know what to expect, what they might produce, and how they might contribute. Explanations were not done in a highly professional or overly concise manner. Overly obscure concepts and excessive jargon could have

demotivated participants. Therefore, explanations were provided in a more accessible and concrete way.

Pre-preparation was also essential in this session, including explaining to the participants how the data would be recorded and retained, emphasising privacy protection, inviting them to read the PIS, and signing the consent forms.

Another critical step was the grouping of participants. Grouping participants is a common way of organising workshops. Chambers (2002) suggests that four or at most five people are appropriate for group work and notes that one or two may be excluded or marginalised even with five people. The study by Puccio et al. (2020) used a four to five person group size. It examined the role of creative problem solving, particularly creativity training, on group idea generation and solution creativity. Puccio et al.'s study does not directly discuss the rationale for choosing this size. However, it is a reasonable choice based on promoting group creativity and collaboration within the research design. Wheelan (2009) explored the impact of group size on development and productivity, with her study suggesting that groups of three to six people performed more efficiently, with sizes of three to four performing better than sizes of five to six, and sizes of seven or more potentially leading to a reduction in cohesion and quality of communication. Therefore, in the end, I aimed to maintain the group size of workshops at four people as the ideal size. However, workshops may have uncontrolled exceptional circumstances, so a group size of three to five people is also reasonable. Subsequent practice proved that this was a reasonable group size. In practice, most groups consisted of four participants, with two exceptions: a group of five in Workshop 2 and a group of three in Workshop 3, due to a participant withdrawing at short notice.

An icebreaker is often considered a participatory activity (Chlup & Collins, 2010). The purpose of setting up an icebreaker in a workshop is to allow participants to relax and open the conversation appropriately. The Icebreaker began with open questions. It should be noted that icebreakers had good results in later pilots of the practice. However, balancing time, effort, and cost is essential in designing workshops (Sufi et al., 2018). Too much time may sap the energy of the participants. As a result, the session was cancelled during the actual running of the workshops. Nonetheless, keeping this session in reserve for the smooth running of the workshops is helpful when time permits.

4.4.3.3. Part 2: Group Mapping

This phase was the most critical part of the workshop and aimed to externalise the process of using external information and forming impressions of the city. Mapping is recognised as one of the activities and steps of an appropriate workshop (Chambers, 2002) and fits well with the research area of wayfinding and wayfinding systems in cities. Group Mapping allows participants to interactively work together on a map to express their perceptions of the environment. Mapping is a critical and reflective practice that helps to reveal and explain complex social, cultural and spatial phenomena, which helps researchers explore the relationship between theory and practice in the field of design and reflect on it (T. Allen & Queen, 2015). They also note that incorporating critical mapping methods into the research process can help researchers create new tools and methods to understand complex problems and drive innovation. Thus, mapping can help participants express their understanding and perception of the city and integrate it with the spatial layout.

At the same time, mapping is also a form of place-making, with anthropologically constructed maps contributing to understanding and constructing place; maps and people are mutually constitutive, involving social and cultural knowledge of place (Hyler, 2013). Maps as vehicles are snapshots of the natural world and collections of signs and tools for expressing and organising semiotic information (Cosgrove, 2008). This phase is of the utmost importance, as it aims to externalise the process by which people use external information and form impressions of the city. As Corner (2011) posits, mapping is a cultural project that creates and constructs the world while curating measurements and depictions of the world and, most importantly, what is mapped in the process. Mapping is an open-ended collaboration in which the mapper's various discovery and creation behaviours support the production of contextual knowledge (Tang & d'Auria, 2023). Despite the wide range of technical mapping abilities, Ingold (2000) argues that mapping is a wayfinding and story-building activity. Furthermore, he posits that these practices are part of the personal knowledge used to build specific stories and convey information. Mapping is a valuable multi-sensory research methodology, as it enables the exploration of the relationship between place, lived experience and community (Hughes, 2012). This collaborative and interactive mapping activity helped the participants to visualise the ideas and insights they wanted to express, combined with an understanding of the city and space, to build a foundation for their wayfinding system design and simultaneously reveal their perceptions and understanding of the environment. Therefore, this method is a way to help the participants construct an image of the city, even though they may not understand the concept.

In contrast to Lynch's research methodology, the workshop emphasised interaction and co-creation between participants and the knowledge stimulated in the process. This difference stems from the differing purposes of the research. In addition to interviews, mental maps, and observation, Lynch's (1960) methodology relies on people's

memories. It is fair to say that technological advances have given me more opportunities to develop my approach. As such, my workshops offer a variety of cognitive tools, including photographs, panoramas, videos, and street views provided by online maps, such as Google Earth. In contrast to Lynch's approach, participants in my workshops adopt multiple identities, providing insights and knowledge about the creation, design, and integration of spatial information. This shift transforms their role from passive data providers to active creators. The workshop served as a site for creative experimentation. In addition, the interaction and group collaboration between participants was highlighted.

4.4.3.4. Part 3: Wayfinding System Construction

This component was designed to ask participants to organise and construct a wayfinding system using props based on Group Mapping, with the primary aim being to integrate information from the previous stage and generate creative knowledge and insights. Visual research methods primarily informed this stage, where visual material generates evidence to explore the research question (Rose, 2014). Creating visual images as part of research is increasingly used by researchers and research teams, as well as in collaboration with and by participants (Rose, 2022). For example, Daniels (2002) uses photography and other visual research methods to document the life stories of South African women in order to advance their emancipation and development. O'Connor (2007) analyses children's texts and drawings to reveal how globalisation and local culture influence children's gender representations.

Visual research methods allow for utilising and interpreting images and creating knowledge using images and methods (Glaw et al., 2017). Visual images can reveal the inner mechanisms hidden within everyday experiences and ordinary things (Knowles &

Sweetman, 2004). Visual images can also serve as cultural icons, highlighting the values and expectations of individuals and groups and bringing depth to the topics discussed (Liebenberg, 2009). With the aid of cognitive tools, participants' design thinking, logic, insights and knowledge can be visualised and fleshed out in a process that is purposefully responsive to production and design. The research was able to derive rich qualitative data from the images and models created by the participants to create valuable answers to the research questions. This section created a range of cognitive tools to assist participants in making images, which will be discussed in more detail in subsection 5.2.3.

4.4.3.5. Part 4: Sharing and Discussion.

This part is the concluding phase of the workshop, during which participants present their mapping of ideas. This is the final part of the workshop, where participants share and present their results. Sharing is an integral part of workshops (Chambers, 2002). In this step, participants were invited to explain the wayfinding system they produced and why they did it. This step allowed me to elicit subjective explanations from the participants that would reflect their design thinking and to reflect with them. Another part of this stage was to ask the participants what they thought about the workshops themselves so that I could continually improve them.

4.4.3.6. Artefacts as a Toolkit for Workshop

Wikström (2018) states that the creation of external cognitive tools (e.g. maps, sketches, diagrams) is important to compensate for the limitations of human memory and information processing due to the fact that visual representations take the pressure off of

memory and externalise it. Visual materials created by researchers often allow for better control of the data collection process and ideally involve more reflection (Pauwels, 2020). The participatory design extensively uses visual tools and techniques, such as photographs, drawings, and other materials, to create maps to visualise users' current and potential future experiences (Boradkar & Dhadphale, 2020). Therefore, it was important to create cognitive tools for the participants, which directly affected the outcome of the workshop.

In the workshops, the props can be broadly classified into two categories: visual materials depicting the streetscape, and design aid tools. These two components serve distinct purposes. In the design of the wayfinding system, the primary objective was to consistently provide participants with a visual representation of the streetscape. Ware's (2008) research indicates that the human brain processes visual information one to three times per second. Throughout this cognitive process, individuals continually reflect upon and assign meaning to what they observe. Visual materials, including printed photographs, digital videos, photographs, panoramas, and maps, play a compensatory role, addressing the limitations of personal experience, memory, and information processing. These visual materials provided participants with information and a basis for stimulating their past experiences and memories. Images such as photographs are considered particularly valuable in urban studies because they capture the sensory richness of urban environments and convey a sense of urban places, spaces and landscapes, especially those gestures that are visible in some way (Rose, 2022). Without the use of these visuals, it would not have been possible to conceptualise Manchester in a small space, making the workshop challenging without visual aids.

A toolkit has been developed (see Appendix for details), which consists of a set of cards and accompanying artefacts. The artefacts include a card stand, a districting board, an

A0-sized map, and a collection of numbered street view photos and panoramic images. Cards as research aids are not uncommon in design research. For example, IDEO Method Cards are a design tool designed to explore new methods and help develop your own (Peters et al., 2021). Lucero and Arrasvuori (2010) used the PLEX cards in workshops to introduce a playful experience in design, stimulate creativity, and facilitate the exchange of ideas during the design process. Deng et al. (2014, p. introduction) designed a card set named Tango to support designers in acquiring tangible learning about design. Cards can aid the design process and conveniently provide information, methods or promising practices (Roy & Warren, 2019). Also, cards can facilitate fun and collaborative design activities (Wetzel et al., 2017). Mavros et al. (2022) designed two sets of cards, the *Spatial Cognition Thinking Cards* and the *Architecture Design Strategies Cards* (p. 120), for use by architects and designers. These cards are intended to help architects and designers think about users, establish user-centred thinking, and create a common vocabulary between architecture and spatial cognition. The results of the study show that this set of cards can effectively integrate academic research into the design process. Cards, as a supportive tool, establish a design framework that can be understood and easily accessible, facilitating communication and expression among participants during workshops.

There are a total of 48 designed and semi-finished cards, encompassing preparation cards, introduction cards, character cards, task cards, location cards, and method cards. These cards serve as tools at different stages of the workshop, aiding participants in both design and discussion. Additionally, an instruction card detailing how to use the deck is included. As I used icons from the website Flaticon (https://www.flaticon.com/) in designing the cards, I created an additional attribution card to acknowledge all the icons, in compliance with the website's requirements.

The Introduction phase incorporates two types of cards: the Preparation cards and the Introduction cards. These cards outline the aims, objectives, main processes, and steps of the workshop, offering a concise overview of the entire session. They also introduce key concepts and terms such as wayfinding and wayfinding system.

The Group Mapping phase includes four types of cards: Character cards, Location cards, Task cards, and DIY cards. Character cards include two role types: guide and visitor. Each card contains guiding questions, fostering participant engagement and immersion in the workshop. The assignment is flexible, allowing for one role per person or one role per group. Location cards are designed for a session focused on identifying the top six most attractive and unique places in the city. These are semi-finished cards, allowing participants to contribute content. Task cards are designed to correspond with different roles and include various missions aligned with each stage of the workshop.

The Wayfinding System Construction phase encompasses Method cards and DIY cards. Method cards provide simple guidance for the final design and construction of the wayfinding system by introducing various methods and perspectives.

DIY cards in these two stages are semi-finished, supporting participants in adding their own information. These cards complement the other types, recognising that wayfinding is a complex subject, and a single set of cards may not encompass all the information participants wish to include.

The utilisation of Marker cards applies to both the Group Mapping and Wayfinding System Construction phases. Marker cards encompass various wayfinding elements found in the city, including landmarks, architecture, squares, stores, artefacts, heritage

sites, theatres, greenery, public spaces, paths, unique places, and more. Additionally, decision points, special places, and other relevant features are included. These cards serve essential functions such as categorising information and defining districts within the city. There is no prescribed limit to the number of cards that can be labelled. Participants are usually instructed to stand them up in card holders and place them strategically on the map. To enhance flexibility, I also introduced semi-finished cards in this section. These cards allow participants to seamlessly add any additional information they wish to incorporate into the evolving wayfinding system.

Complementing the cards, a districting board was designed to align with the numbers on the photographs and maps. Participants have the option to either fill in the blanks with corresponding numbers or directly affix street photos onto the designated spaces. This tool facilitates a more hands-on and interactive approach to incorporating visual elements into the workshop process.

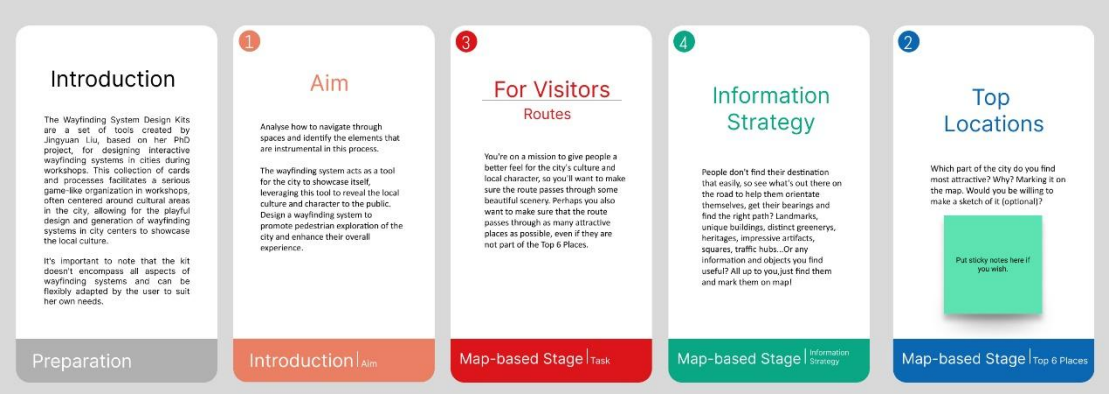

Figure 10 Part of the cards used in the workshops. Designed by the author.

Overall, this is a toolkit of cards and their associated components (including maps, sticky notes, pen and paper, distinguishing boards, and cardholders) to support the

workshop from start to finish and to serve as an essential cognitive tool to aid in the cognitive processes and design activities during the workshops.

4.5. Research Ethics

The research project obtained ethical clearance from Lancaster University. In all phases of the research, every participant received a Participant Information Sheet (PIS) and was given sufficient time to consider whether to participate. Participants provided voluntary consent by signing a consent form. They were informed of their right to ask questions and could withdraw from the study at any time, with their data being removed upon request.

The walking interviews involved taking the participants for a walk in Manchester city centre, so safety became paramount. Although the workshops took place indoors, I still felt it was my duty to ensure that my participants did not suffer any harm or loss while participating in the study. Therefore, I always reminded my participants to prioritise their safety during all walking interviews. All walking interviews were conducted by me and the participant together. Throughout the process, I remained beside the participants, observing the surrounding traffic conditions to ensure both my own safety and theirs. In exceptional situations—such as crossing roads, junctions, or areas with traffic congestion—I would remind participants to pay attention to safety, observe the traffic, and guide them when necessary, including stopping them from crossing when vehicles were approaching.

Ensuring the anonymity of the participants is crucial. All walking interviews were audio- and video-recorded to document the situations and dialogues. To prioritise

anonymity and protect participants' privacy, no personal information, including faces or other identifying features, was recorded in any of the videos or audio files. During the walking interviews, I ensured that the camera was focused on the street ahead, capturing the streetscape rather than the participants. All workshops were audio-recorded in their entirety to document decision-making, design behaviours, and interactions between participants during the engagement process. The workshops were not video-recorded. The results of the workshops were photographed and preserved. None of the participants appeared in these photographs. As a precaution, I manually checked all the photos and videos to ensure that any personal information had been deleted or blurred. These audio and video recording procedures were clearly communicated to participants and stated in the PIS to ensure that participants were fully informed and had given their agreement.

The walking interviews took place in Manchester city centre, and some participants had to travel to the venue. Considering that they should be fairly compensated for their time and effort, these participants were reimbursed for the cost of train tickets and lunch. As the workshops spanned 2–3 hours, I felt it was important to thank participants for their time; therefore, some were given an Amazon voucher worth £15. All incentives were approved by the Lancaster University Ethics Committee.

4.6. Data Analysis

4.6.1. Transcription and Extraction of Data

The research data mainly consisted of audio and video recordings, design outcomes, and some initial artefacts. Maintaining transparency and impartiality in the research process was crucial, particularly in handling and transcribing the data.

Due to the extensive volume of textual data, I personally transcribed a portion of it, while the remainder was transcribed by professional transcribers following approval from the Ethics Committee at Lancaster University. These transcriptionists signed confidentiality agreements to ensure data security. Subsequently, the transcribed data underwent meticulous review, proofreading, and supplementation by me to enhance comprehension and accuracy.

Despite my efforts to transcribe all studies with as much detail and accuracy as possible, it is important to acknowledge that no transcription system can provide a completely accurate and exhaustive account of the original events. All transcription involves selectivity and carries the risk of bias. However, researchers can mitigate this risk through rational judgement and careful selection of data (Kowal & O'Connell, 2014).

The transcription of textual data involves a combination of verbatim transcription and research notation, which is considered essential for ensuring the reliability, validity, and accuracy of qualitative data collection (Halcomb & Davidson, 2006; Kowal & O'Connell, 2014; MacLean et al., 2004). It is important to capture people's pauses, laughter, and physical behaviours during transcription, particularly since part of my

research focuses on people's wayfinding behaviour. Recording these paralinguistic phenomena and suprasegmental characteristics helps to better understand individuals' thoughts and attitudes, as explained by Schmidt and Wörner (2022, p. 567):

> *Linguistic behaviour on different linguistic levels. It is usually not sufficient to simply record the syntactic and lexical properties of speech, because paralinguistic phenomena (like laughing or pauses) and suprasegmental characteristics (like intonation or voice quality) may play an equally important role in the analysis. The data structure must therefore also be able to accommodate and distinguish descriptions on different linguistic levels.*

Transcribing data from design works, including photographs, images, and artefacts, presents unique challenges compared to text. One significant challenge is determining the appropriate visual language to transcribe the data in a meaningful way for analysis. Visual data pose greater challenges because they require more time for transcription, and there is less established guidance on how to transcribe visual material (Bailey, 2008). Using images as data is uncommon in social science research, and methods for coding and analysing photographs are not typically covered in qualitative or quantitative research training (Chapman et al., 2017). Therefore, transcribing images, photographs, design outcomes, and artefacts presents specific difficulties.

Owing to the nature of the study, it was imperative to integrate the data with the corresponding locations. Many conversations occurred in specific areas, particularly during walking interviews. For instance, participants often pointed to a building and referred to it as 'that building' or 'the building,' or sometimes even as 'that one' or 'this one.' While such descriptions may seem vague in textual form, they convey significant

information about the location. Therefore, while transcribing the text, I marked where the dialogue occurred.

At the workshops, all designs and artifacts were photographed and saved. Subsequently, I imported all the information into Figma, a design software, for transcription. This transcription was faithfully rendered in the original state of the work, including all the information used by the participants in the workshops, along with their notes and artifacts, which were marked on the map in their respective locations. While I have applied colour to certain elements (such as districts), these colours were not determined by the participants during the workshops (Figure 11).

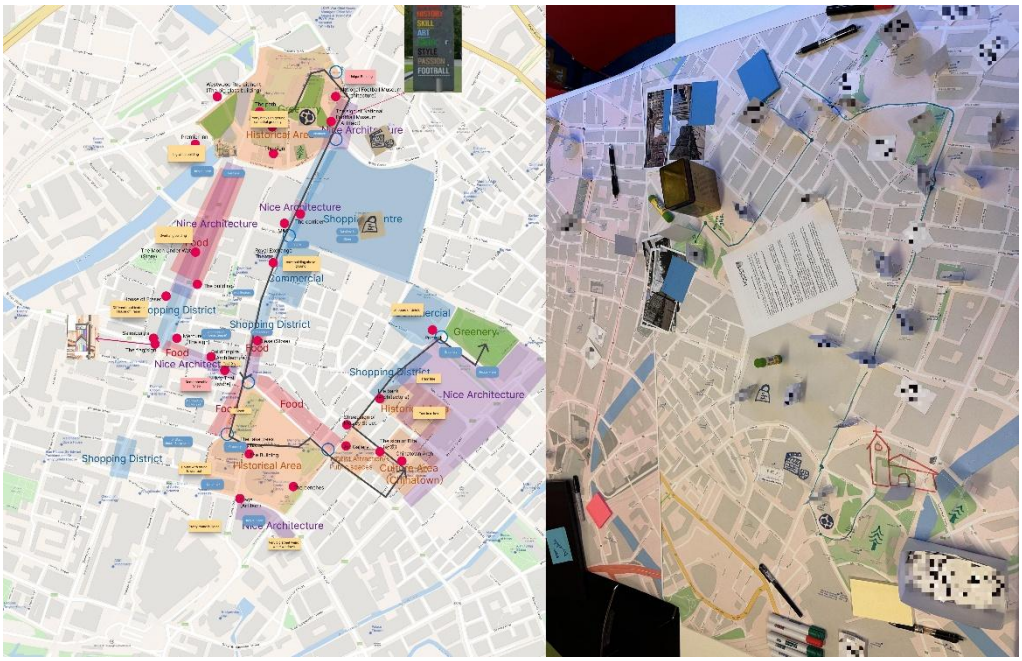

Figure 11. This figure shows an example of the transcription results of the workshop data. The photo on the right was taken during the workshop, and the transcription results are shown on the left. Photo and drawn by author.

4.6.2. Coding and Analysing Data

Content analysis is regarded as the most suitable method of analysis for this study. It involves systematically describing the meaning of qualitative data by allocating contiguous portions of the material to a coding frame, which forms the core of the content analysis process (Mayring, 2000; Schreier, 2012). Content analysis is a highly flexible research methodology that employs various analytical techniques to generate and contextualise research findings (White & Marsh, 2006). Content analysis can help researchers understand specific phenomena by explaining processes and providing structure to large amounts of textual data (Kleinheksel et al., 2020). Thus, content analysis allows me to understand people's wayfinding behaviours, design thinking, insights and knowledge about wayfinding and wayfinding systems based on the data.

In addition, Kleinheksel et al. (2020) state that content analysis also offers the possibility of helping researchers analyse both explicit and latent data content. Analysis of explicit content involves elements present on the surface of the text, which may include the ideas and insights that people share with me during walking interviews, the work they produce during workshops, and the interpretations associated with that work. On the other hand, analysis of latent content uses mental schemas, theories and lenses to interpret and make sense of the data, emphasising the importance of the researcher working with the text to create meaning. Content analysis for latent content allows me to understand the wayfinding behaviours, decisions behind the textual data, and the design thinking presented in the design work. More importantly, content analysis of latent content enables me to study and understand how participants constructed their internal representations through external features in the urban environment. Furthermore, content analysis can be used with various data sources, including textual

data, visual data (such as photos and videos), and audio data (Stemler, 2015), which fits well with my research.

The first step in analysing the data and developing a coding system involved thoroughly reading and familiarising myself with all the materials. During my initial examination of the data, I noticed that in the walking interviews section, the participants' cultural backgrounds had a relatively minimal impact on the outcomes. Some participants exhibited multiple identities. For instance, one participant was Chinese but had resided in the UK for over six years, suggesting a blend of cultural backgrounds. Additionally, with the widespread access to the internet in recent years, many individuals have had the opportunity to learn about various cultures worldwide. In the case of the workshops, the influence of cultural background on the outcomes was almost negligible. Although I considered cultural backgrounds when grouping participants into categories such as overseas groups and local UK groups, the overseas groups could encompass individuals from diverse countries, each representing distinct cultural backgrounds. It is not practical to group participants according to nationality. Moreover, categorising participants solely based on their country of origin may not accurately capture their cultural diversity. For example, within China, there are significant variations in traditional customs between regions such as the north and the south. Due to these complexities, I opted to focus primarily on identifying themes present in the data, rather than attempting to segregate contributions based on individual cultural backgrounds.

Most themes, which means units of meaning, emerged naturally from the material rather than being predetermined. All coding was performed manually, as attempts at automated coding or text mining using software such as NVivo yielded ambiguous results. Subsequently, a code system was devised to analyse the data (Figure 12). Text data were coded and analysed separately using NVivo.

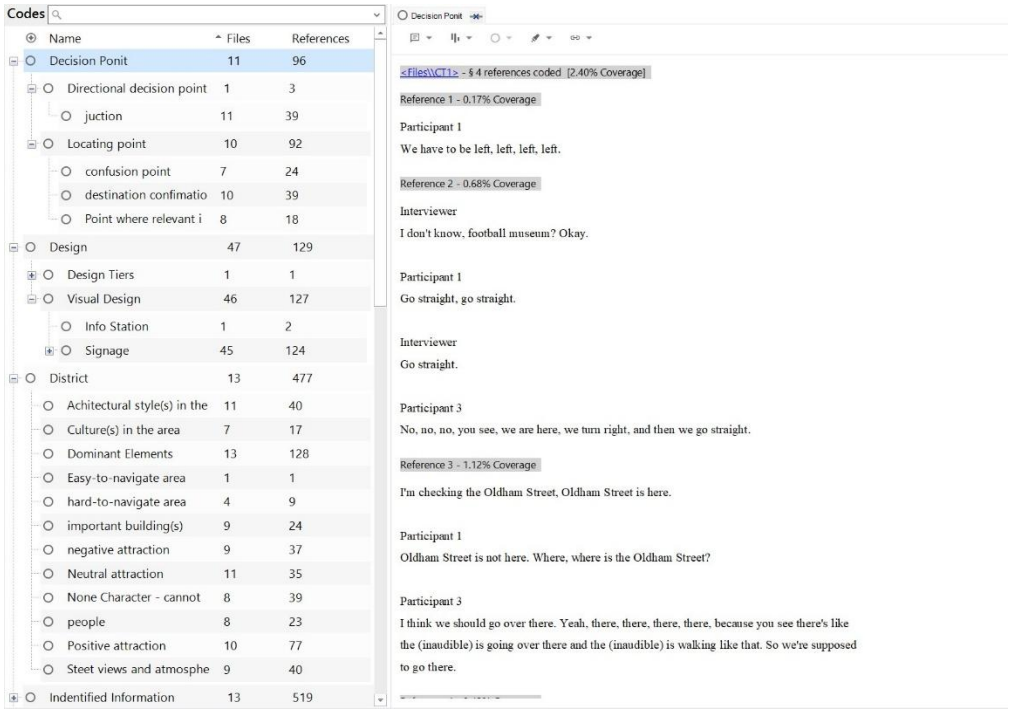

Figure 12 Coding example of content analysis using NVivo.

As the research area of this study is wayfinding, additional attention needs to be paid to the connections that people establish with the urban environment during the wayfinding process, as well as the cognitive maps and city images that result from these connections. Therefore, after analysing the data, I developed a series of preliminary sketches to visualise the perceptions and understandings of urban space that people build during the wayfinding process (Figure 13).

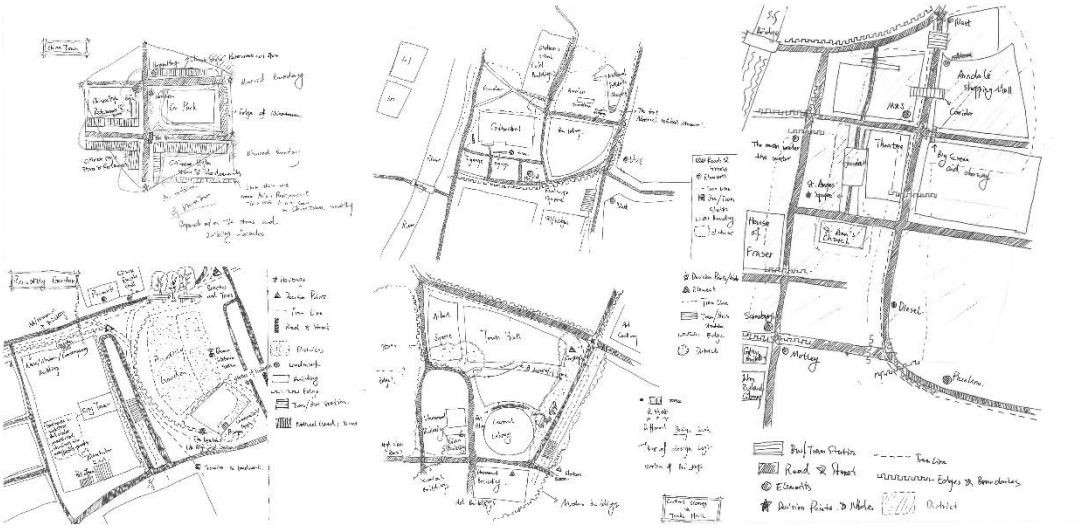

Figure 13 Sketches based on data, drawn by the author.

These sketches were drawn by hand on paper and served as a means of analysing the underlying content of the data. In making these sketches, the questions I pondered and distilled from the data included: What information in the environment is meaningful and has commonality to wayfinding? What districts are formed in people's perceptions? How are the extent and boundaries of districts defined? What are the locations where people are generally willing to make decisions? Which roads are vital, and which are of secondary importance? Which locations are more attractive? What are the hidden wayfinding strategies behind these decisions, opinions, and insights? Moreover, how are perceptions of the city shaped? These sketches, followed by further analysis and data extraction, ultimately developed into Manchester's image, which is explained and discussed in detail in Chapter 7.

4.7. Summary

Overall, the methodology of this thesis is guided by interpretivism with a qualitative approach. To provide valuable answers to the research questions, the study developed three strategies: backcasting, Lynch's methods, and a case study.

Backcasting created a comprehensive perspective to analyse the past and present of the wayfinding system in order to form a vision for the future. Lynch's methods provided an essential theoretical underpinning for the study by offering a framework for exploring the relationship between people and the environment to construct cognitive maps and, hence, a city image. The case study offers an in-depth research approach to complex, contextualised research, collecting data within a real-world environment, providing rich contextual support for understanding the actions and perceptions of participants, and making the research informative at a practical level.

Specifically, two methods were used to collect data: walking interviews and workshops. Walking interviews provided participants with a dynamic experience in a real-world setting, allowing their perceptions and behaviours to be captured in a natural state and offering real insights into the characteristics of the external environment. Through participatory design and Research Through Design (RTD), workshops built a platform for interactive creation, where researchers collaborated with designers and non-designers to generate practical design knowledge and insights for the wayfinding system.

Content analysis provided a guiding methodology for the data analysis of this thesis, allowing me to examine not only the explicit behaviours and language of the

participants but also to explore the invisible and latent content. The creation of cognitive maps based on Lynch's theory also explains the cognitive patterns people develop in the city and the shaping of the city's image. These cognitive maps reveal how participants spatially orient themselves using elements such as landmarks, paths, and nodes during navigation. They also reflect their subjective perceptions and emotional connections to urban space. Through Lynch's framework, content analysis helped to identify and explain the commonalities and differences in the cognitive maps formed by participants in the urban environment, which provided visual references for understanding wayfinding behaviour. Drawing cognitive maps and thus integrating them into an urban image is likewise a process of translating the complexity of people's perceptions, experiences, and knowledge into a visualisation tool.

In summary, this thesis deeply explores the past, present, and future of wayfinding systems through a systematic qualitative approach, incorporating backcasting, Lynch's methodology, and case studies. Specifically, within the framework of these research philosophies, approaches and strategies, two research methods—walking interviews and workshops—were used to collect data, and the data were analysed in depth using content analysis to answer the research questions.

Chapter 5. Research Process and Data Collection

This chapter describes the specific data collection process employed in this study through the methods discussed in chapter 4 and outlines the key content of the collected data. The research methods used to collect the data included walking interviews and workshops. In addition, two experiments modelled on the workshop format were held to validate the results obtained from the data analysis. These two experiments cannot be considered workshops in the true sense, as only one person participated in each. However, the process was designed according to the workshop structure.

This chapter is divided into three parts. The first part describes the data collection process of the walking interviews, detailing the execution, procedures, and methods used, as well as how participants navigated the city. The second section outlines the core steps of the workshops, the iterative process, and the design knowledge that emerged. The core steps, iterative process, and toolkit developed during the iterations were utilised in the workshops. The final section describes the two experiments conducted to validate the results and summarises the data collected from these experiments.

The backgrounds of participants are shown in the table below (Table 4). One clarification is necessary: among all the workshop participants, only one person was originally from Manchester. As the workshops were group-based, this participant worked alongside other local UK participants. The participants from overseas included individuals from China, Pakistan, India, Russia, Japan, Ukraine, Poland, Peru, Bangladesh, Thailand, and Turkey.

Table 4 Cultural background of participants.

Research	Manchester Participants	Non-Manchester UK Participants	Overseas Participants	Total Number
Walking Interviews	2	2	13	17
Workshop 1	0	0	8	8
Workshop 2	1	4	8	13
Workshop 3	0	4	7	11
Test Experiment 1	0	0	1	1
Test Experiment 2	0	0	1	1

5.1. Walking Interviews: Exploring the Wayfinding in the Real World

The walking interview was conducted in Manchester city centre. To understand the wayfinding behaviour of the participants, the researcher could not develop routes in advance. Therefore, throughout the walking interviews, I defined only a few purposes of the journey: a few locations that needed to be found in the city. These destinations include Piccadilly Gardens, Chinatown, Art Gallery, Central Library, Town Hall, St. Ann's Church, Manchester Cathedral and National Football Museum. Considering the limited length of the study and the fact that participants would be tired, five or six of these destinations were sought for each walking interview.

5.1.1. Process of Walking Interviews

Thirteen walking interviews were conducted between June 2023 and November 2023, consisting of one three-person interview, two two-person interviews, and ten one-on-one interviews. These walking interviews were conducted with: (1) participants local to Manchester (2 participants); (2) participants from the UK who had not visited Manchester or had only visited a few times (2 participants); and (3) participants from overseas (13 participants), who were from China, Pakistan, and India. The destinations that participants were asked to find during the walking interviews are listed in the table below.

Table 5 Number of participants in each walking interview and the destinations they passed through.

Walking Interview Number	Number of Participants	Destinations
1	1	Chinatown, Art Gallery, Manchester Cathedral, Central Library, Manchester Cathedral, National Football Museum
2	2	Piccadilly Gardens, Chinatown, Art Gallery, Manchester Cathedral, Town Hall, Manchester Cathedral, National Football Museum
3	1	Piccadilly Gardens, Chinatown, Art Gallery, Manchester Cathedral, Town Hall, Manchester Cathedral, National Football Museum
4	3	Piccadilly Gardens, Chinatown, Art Gallery, Manchester Cathedral, Town Hall, Manchester Cathedral, National Football Museum

5	1	Piccadilly Gardens, Chinatown, Art Gallery, Manchester Cathedral, Town Hall, Manchester Cathedral, National Football Museum
6	2	Piccadilly Gardens, Chinatown, Art Gallery, Manchester Cathedral, Town Hall, Manchester Cathedral, National Football Museum
7	1	Piccadilly Gardens, Chinatown, Art Gallery, Manchester Cathedral, Town Hall, Manchester Cathedral, National Football Museum
8	1	Piccadilly Gardens, Chinatown, Art Gallery, Manchester Cathedral, Town Hall, Manchester Cathedral, National Football Museum
9	1	Piccadilly Gardens, Chinatown, Art Gallery, Manchester Cathedral, Town Hall, Manchester Cathedral, National Football Museum
10	1	Piccadilly Gardens, Chinatown, Art Gallery, Manchester Cathedral, Town Hall, Manchester Cathedral, National Football Museum
11	1	Piccadilly Gardens, Chinatown, Art Gallery, Manchester Cathedral, Town Hall, Manchester Cathedral, National Football Museum
12	1	Piccadilly Gardens, Chinatown, Art Gallery, Manchester Cathedral, Central Library, St. Ann's Church, Manchester Cathedral, National Football Museum
13	1	Piccadilly Gardens, Chinatown, Art Gallery, Manchester Cathedral, Central Library, St. Ann's Church, Manchester Cathedral, National Football Museum

At the beginning of the walking interviews, each participant was provided with a map of Manchester city centre, on which the destinations were marked. This map was changed

after the first four walking interviews. Specific details about the maps are provided in subsection 6.1.1. Participants were also provided with a table listing all of the questions (see Appendix). During the walking interviews, participants were asked to refrain from using electronic navigation such as Google Maps. Participants were free to choose their routes and the order in which they arrived at their destinations. The wayfinding tasks required participants to find and reach all destinations but did not require them to return to the starting location. One walking interview began at Manchester Oxford Road station, as the participant arrived in Manchester by train from Lancaster with me. The remaining twelve walking interviews started at Piccadilly Gardens.

The walking interview process is divided into stages based on destinations, with the stages defined as the travelling process between two destinations. The questions were repeated at each stage to ensure that participants could provide feedback on the same topics and offer their perceptions of the surroundings at different locations. Specifically, the questions included:

- What in your surroundings impressed you?
- Are there any landmarks around you?
- What and where make you decide to turn/continue straight ahead?
- Do you think find this place attractive? Why?
- How do you tell you have arrived at the destination?

Since the interviews were conducted in a semi-structured manner, these five questions served as guiding questions. In practice, participants' responses were not limited to these questions; they also included further discussion and follow-up questions that I posed in response to the participants' answers.

Although walking interviews typically require the researcher and participant to walk together in the city, in the initial stages of the study, I was still in the exploratory phase of the research methodology. Initially, I thought my research method differed from the traditional walking interview, so I named it ‘city trip.’ However, after a few trials, I realised that this method aligns with the walking interview. In the early stage of the research, I tested a version of the walk without accompanying participants, allowing them to navigate independently. This approach offered some insights but was eventually abandoned due to its lack of interactivity and dynamic feedback.

During the three multi-person walking interviews, several important issues were identified. Firstly, some participants became disengaged from wayfinding when accompanied by their peers, preferring to listen to and rely on their peers, which resulted in a lack of independent feedback during the interviews. Secondly, there were instances when participants disagreed on wayfinding decisions at certain locations, such as whether to turn left or continue straight at the same intersection. As the researcher, it was not possible for me to effectively follow each participant simultaneously, resulting in some participants having to compromise. It should be noted that the early multi-person interviews provided valuable feedback, including observations of group interactions and decision-making disagreements, but these issues led me to adjust the methodology to ensure that subsequent data would focus on individual wayfinding behaviours.

During the interviews, as the researcher, I tried to avoid intervening in participants' decisions and behaviours to ensure the naturalness of the data. However, in practice, there were situations where participants were unable to find their destination despite repeated efforts, becoming lost, anxious and fatigued. To ensure that the interviews proceeded smoothly and that the participants did not become frustrated or lose interest

for too long, I had to provide prompts at those moments. The prompts were simply to help participants continue with the task, without influencing their judgment or choices. For example, one participant mistakenly identified the Central Library as the Art Gallery and became lost, in which case I had to remind them that the building was not the Art Gallery.

At the end of the walking interview, after arriving at the final destination, participants were invited to answer two questions reflecting on their experience and observations during the walk, which helped me gain a deeper understanding of their views and perceptions of the city. Specifically, the two questions were:

- Please describe your cultural experience during the trip.
- Please record the changes in the street views throughout the trip.

All participants answered these questions verbally, except for the one who filled out the form. When answering the questions, participants were typically at the final destination, rather than indoors, in order to maintain their perception and connection to the external environment.

Afterwards, participants were invited to draw a map of this trip, trying to capture the route they had taken, the landmarks they had passed, and any objects and street scenes they remembered or were impressed by along the way. A portion of the participants used an iPad and stylus to complete the maps on Goodnotes, a software application, while another portion used pen and paper. In the first few interviews, participants who used iPads generally provided less information, which prompted me to reflect on whether these tools were unsuitable. As a result, in later interviews, I asked participants to use pen and paper instead. This subjective mapping from the participants is expressive

(Lyon, 2020) and intuitively reflects their recollection of the entire process. Participants were told that the map did not have to be very precise, nor did it correspond to the directions.

Figure 14 With a participant in Manchester during a walking interview, photographed by another participant.

The walking interviews were recorded in both audio and video formats, using my cell phone as the recording device. The reason I did not use more professional recording equipment was that I believed my cell phone was entirely sufficient for my research needs. In addition, I documented the route maps of all the walking interviews by

drawing maps and taking notes, labelling information such as the references identified by the participants, the locations where decisions took place, the participants' perceptions of the area, and their identification of boundaries. These road maps were drawn immediately after the walking interviews and later re-verified against the video recordings. At the same time, the process of drawing the roadmap also serves as a part of the data analysis process.

Three of the walking interviews differed from the others. In one case, there was only an audio recording and no video recording, but the route map, which was drawn and verified collaboratively with the participants immediately after the walking interview, and the information on it were checked with them. In another case, the video recording was deleted at the participants' request after the road map had been drawn. In the third case, only the video recording was preserved, and the audio recording was lost due to a malfunction of the recording equipment during the walking interview. However, the video recordings, the participant's hand-drawn map, and the road map I created based on my observations of the wayfinding process were all preserved, so I did not exclude this participant's data.

The text portions of all walking interviews were transcribed, and the transcriptions were then analysed using NVivo. All paper hand-drawn maps were scanned into the computer, and all digital hand-drawn maps were saved.

Based on these walking interviews, I was able to gain insights into the references participants used during the wayfinding process, their real-time interactions with the city, the decisions they made during the wayfinding process, and their perceptions of the

city. Several key findings emerged from the study, and in the following section, I will summarize the data obtained from the walking interviews.

5.1.2. Results of the Walking Interviews

Several findings emerged from the walking interviews, most notably regarding the objects in the city that participants used as references during wayfinding. Participants also provided their ratings of the city. Some areas were identified during the wayfinding process based on various factors, and some boundaries were noted by the participants. Finally, participants demonstrated certain wayfinding strategies and preferences.

Objects as Wayfinding References

The references identified by participants during the wayfinding process were varied, ranging from prominent landmarks to everyday elements in the streetscape. Specifically, these references included buildings such as Manchester Cathedral and the Art Gallery, stores like Primark, artifacts such as flags, billboards, and banners, words such as those on the buildings of the National Football Museum, heritage elements like statues, and various other elements, such as Chinese characters. The figure below provides a visual overview of this information. It should be noted that this word cloud was not generated using specialized analytical software and is therefore intended only as a visual representation of the data, not as an analysis.

Figure 15 Word cloud of objects used as reference information. Generated using WPS Office software rather than specialised data analysis software, and intended only as a visual overview of the data.

Perceptions of the City

Participants' perceptions of the city presented a wide range of perspectives, covering positive, negative, and neutral views. These perceptions focused on the attractiveness of certain locations or areas in the city. Participants had different perspectives on different locations or areas. There were times when the same locations or areas were rated differently.

Some places were perceived as highly attractive areas, and participants usually expressed bluntly that these places were attractive. For example, when I asked participants if they thought this place was attractive, they would answer ‘yes’ directly. In addition, they would usually bluntly say ‘that area is very beautiful,’ ‘I like this Gallery crossing, nice plants,’ or ‘Yeah, attractive. I like that building; it is very nice.’ Some areas were rated as relatively attractive, for example, one participant near the Arndale Shopping Mall said, ‘Yes, kind of attractive, but not that much.’ Some participants would find some parts of an area or parts of an area attractive. For example,

one participant said, ‘Yes. Some of the buildings are.’ This comment was also common in Chinatown, where several participants indicated that the food was attractive.

Most of the neutral comments were descriptive. Participants generally described the area in various ways, such as the streetscape, the buildings, and the people on the street. For example, one participant said: ‘I would say it’s more diverse than Lancaster here, like these people from different nationalities here. In Lancaster, it is mostly a limited set of people that you see walking on the street.’ Another participant said after the walking interviews: ‘All these stores, all these different stores that are like, I guess, based off of media, fast fashion, those stores are coming in. So that's kind of... I feel like, at least the way that I'm seeing it, there's just so little of those historical buildings, like churches.’

Some participants expressed negative comments about areas and locations in the city, often stating bluntly, ‘I don't like it here.’ For example, one participant described the stretch from Piccadilly Gardens to Chinatown: ‘I didn't really like the section from garden to Chinatown. I think there is nothing in the middle, it's boring and then it's a bit low. There's only The Bank in the middle which I just saw, and nothing else to see.’ Another participant told me at the transport interchange next to Piccadilly Gardens: ‘I think the main street of a commercial area would be more attractive. Here, it is just a place like a transport hub, dirty and unattractive.’

When people viewed Manchester as a whole, most tended to see the city as a combination of the old and the new, with both new and old buildings being retained. For example, one participant said:

Compared to the other areas, especially here in Manchester, at least Manchester Piccadilly, I'm seeing a lot of different buildings just put together, like, again, in the same environment. Because you're seeing retail stores, historical buildings, and then you've got things like train stations, just like all together, all in one place.

Districts and edges in Wayfinding

People find areas in the city that they recognise in a variety of ways. For example, Chinatown was often seen as an area rather than a single location, and the area around the Arndale Shopping Mall was frequently recognised as a place associated with business and shopping. Additionally, many participants identified certain areas as commercial zones. For instance, one participant walking down Portland Street said, 'just like commercial a bit, and those are the shops and restaurants. So, I suppose this… some over there as well.' The vicinity of Piccadilly Gardens was perceived by one participant as an area similar to the town centre.

Some boundaries were also identified during the wayfinding process. Some were clearer, such as Cateaton Street near Manchester Cathedral, where some participants felt that the buildings on either side of the road belonged to two different eras. The same was true of Mosley Street, where one participant said, 'Half of the front of it is all modern architecture, and then half of it is more... more... How do you describe it? It's just more... Half of them are classical buildings.' There were also blurred boundaries, such as where Deansgate and Cateaton are nearing their junction, where participants felt they were moving away from the business district. The Royal Exchange Theatre neighbourhood was perceived by some participants as the point where they were about to enter the commercial area.

Wayfinding Strategies and Preferences

During the wayfinding process, participants demonstrated various methods. People typically attempted to match real-world information with the map. For example, before the map used in the walking interviews was changed, no participants relied on street names as reference points for locating places. However, after the map was updated, most participants began using street names. Some participants showed preconceived notions about the destination and used these to guide their wayfinding. For instance, one participant believed that Chinatown should not be located in an area with a very modern style. Participants also paid attention to the shapes on the map; for example, Central Library, which is circular both in reality and on the map, was easy to identify. One participant adopted a slightly different strategy, using the map's scale to calculate distances.

Participants also displayed certain preferences and tendencies in their wayfinding choices. For example, two participants, standing at the intersection of Mosley Street and Nicholas Street, saw the word 'Bifa' and assumed that direction would lead to Chinatown. However, they chose not to turn and instead continued straight. When I asked them about this decision, one participant said, 'I think it depends on the street view, because you can already see the end of the way, which is the side of an art museum. There's nothing left. But this side feels like there's something fresher, fresh people and things and stuff.' Another participant, when travelling towards the National Football Museum and Manchester Cathedral, chose Deansgate over Cross Street, explaining that the scenery along the former was more attractive. These participants demonstrated a preference for aesthetics and scenery, as stated by Golledge (1995), who argued that in real-world environments, people tend to choose routes with better scenery. Reducing wayfinding complexity and avoiding unnecessary turns are common strategies in wayfinding (R. C. Dalton, 2003), and some participants demonstrated more

practical wayfinding strategies. Some participants believed that main roads made it easier to orient themselves, while smaller streets led to confusion. Others preferred to walk in straight lines and avoid turning to reduce the risk of getting lost.

5.2. Workshops: Exploring the Design for Wayfinding System

Design thinking is based on experimentation, where designers create, process information, and make decisions through design and experimentation in creative problem-solving initiatives (Magistretti et al., 2022). I organised a series of workshops as the primary research method. Workshops are places where design thinking is enacted, providing a practical platform for participants to engage in design activities that aim to generate new designs through an iterative process of reflection and innovation. The aim is to generate new designs through an iterative reflection, innovation and evaluation process.

Knowledge emerges slowly during the workshop process, and the design of the workshops is an iterative process that is constantly being reflected upon, developed, and refined in practice. Whilst graphic design and icon design are essential means of design expression, it is more important to explore how people creatively generate new knowledge and insights through interaction and collaboration. Active intervention by allowing participants to produce and interpret their own visual materials can democratise the research space (Mitchell, 2005, cited in Hughes, 2012). As highlighted by Streule (2020), in live co-analysis sessions, dialogue allows for integrating knowledge from different fields into a shared framework.

It is, therefore, necessary to create an environment for participants that is conducive to dialogue and co-participatory design. As discussed in Chapter 4, the workshops were

designed using RTD and participatory design as a framework. Although I adopted participatory design as my guiding framework, the researcher must sensibly organise the participants' engagement in the research process to obtain valuable answers to the research questions.

In addition, not only do workshops as a research method provide a platform for generating new knowledge and insights, but their design is also one of the research outcomes of this thesis. Through the iteration, reflection and improvement of the workshops in practice, the process design of the workshops and the artefacts that play an essential role in them can be applied and expanded in future design practice and research. At the same time, the outputs generated from the workshops can become a proven process and accompanying toolkit that can be used as a framework for design in the same and similar fields in order to provide designers and non-designers, as participants, with a medium for design and expression, and to help them, especially the non-designers, transform their own experiences, knowledge and insights into design expression. Therefore, this section elaborates on the iterative development and refinement of the workshops. Additionally, the auxiliary tools used in the workshops are also described in this section.

The outline followed by all workshops was fixed, and they adhered to the same set of processes. Each workshop followed a linear structure, while the design of the workshops was iterative. The results and reflections from the workshops continued to influence me, prompting revisions and ongoing efforts to refine the process and design details. Three formal workshops were held with 8, 13 and 11 participants. Before these three formal workshops, two pilots were organised to test the workshops' process, steps, and materials. I name the two pilots, Pilot 1 and Pilot 2, and the three formal

workshops, Workshop 1, Workshop 2, and Workshop 3, to describe them in the following.

5.2.1. Experiences Gained from the Pilot Studies

Prior to the formal collection of data, two pilots were conducted to test the steps of the workshops and to evaluate the materials and methods in order to run smoothly in the formal study. The data from the pilot study was not collected or used. Only problems in the process and suggestions for improvement were recorded. In the pilots, three problems were identified: the first was that the original process was too time-consuming, the second was that the earliest design of LEGO bricks did not have the desired effect, and the third was how to make people use streetscape sensibly as a reference within the laboratory environment.

The earliest Pilot 1 was a classroom design activity, with six students from Lancaster University taking part in this pilot. The wayfinding system design undertaken in Pilot 1 was not about Manchester city centre but was based on Lancaster University campus. This pilot demonstrated the importance of the environment for the workshop. As the pilot took place on campus, the students had the opportunity to walk around the campus to gain information about the environment. Feedback indicated that this step was critical.

Pilot 2 was a complete workshop, exactly as I had envisaged and outlined it, but it took a very long time, which was three and a half hours. In the icebreaker session in Pilot 2, I set up two questions that included asking participants to talk about their past experiences of getting lost, as well as talking about the difficulties they had encountered

in their past wayfinding. The participants proactively shared their personal narratives, thereby achieving the desired outcome of fostering a convivial and open-ended discourse. However, this initial session proved to be quite time-consuming. Consequently, it may be advisable to implement an icebreaker only when circumstances allow, given that it is not an indispensable component of the programme. Ultimately, the session was regrettably cancelled due to time constraints during the formal workshops.

Group mapping is one of the core stages of the workshop. To be better understood by the participants, this section was divided into four sub-steps: information strategy, location strategy, categorising the city and route planning. In the information strategy step, participants identified objects that stood out in the streetscape and that they thought might serve as references for wayfinding and marked them on the map. In this step, the information was also coded and categorised. There were no restrictions on the identified information, and I emphasised that any object could be marked in this step. The location strategy allowed participants to identify essential locations in the wayfinding process, which mainly consisted of decision points and identifying the location of the destination. Classifying the city was the step in making the city legible. This step allowed participants to create a macro view to help them effectively organise and communicate spatial information. The final step of developing routes allowed participants to plan clear routes, providing a simulated view of wayfinding. Realistic wayfinding can occur anywhere, and users may travel through any route. Therefore, this component is flexible, and participants can plan as many paths as they wish to organise the information on the path.

However, if participants were required to complete workshops on Manchester City centre as a location, a primary concern would be that they were able to see a street view of the place, as it would be impossible for them to imagine it. An impossible thing to do

will be to bring Manchester City centre into a room, even if only as a model. From its inception as an academic discipline, geography has used visual imagery as a research tool, including photographs, maps and diagrams (Dodge et al., 2011). Therefore, streetscape images and videos became my primary options. Initially, I provided a video of a street scene I had recorded in Manchester. However, in practice, participants still encountered difficulties: firstly, it was difficult for them to locate the street scene based on the video, and they would thus waste a lot of time trying to find the location of certain objects on the map; secondly, they had to repeatedly pull the progress bar to go back to a certain point in the video to confirm the street scene. In the end, they had to use applications and online resources such as Google Maps and Google Earth to complete the workshop.

In the phase construction of the wayfinding system, there was a wayfinding system designed using LEGO® blocks. It is not uncommon for LEGO blocks to be used in urban design and planning. For example, researchers from MIT developed CityScope (Hadhrawi & Larson, 2016, p. 106), a dynamic city model that combines physical LEGO blocks and digital projections. Tewdwr-Jones and Wilson (2022) developed a LEGO block-based game for use in urban planning, among methods that promote collaboration, creativity, and participation. Therefore, initially, I thought that LEGO blocks, as a visualisation and modelling tool, would allow people to freely form their own creations and might provide some basic shapes to facilitate the expression of their creativity. However, in practice, it was found that LEGO blocks were more like toys than tools for wayfinding system design. Feedback suggests that LEGOs are fun to build but are more suited as a game than a design tool. This may be since in a wayfinding system, one may prefer to create pictograms that are more graphic in nature, whereas LEGOs do not fulfil this requirement, they do not fit as well with the wayfinding system, and they do not express some graphic design forms. As a result, this session was eventually cancelled in the official workshops.

Following the completion of the two pilot studies, three formal workshops were conducted. Building on the insights from the pilots, the duration of the workshop must be shortened, and an easier-to-use reference should be constructed during the process. Next, I will detail the process of these three formal workshops, the tools used, and the results obtained. The experience gained from the two pilot studies prompted me to refine the workshop process in detail. Next, I will describe the process of the three formal workshops, the tools used, and the results obtained.

5.2.2. Workshop 1

Workshop 1 was conducted in October 2023, with eight participants from overseas. They were divided into two groups of four. For this workshop, the video presentation was replaced with photographs, as it was recognised that the viewing of videos would offer limited experience, and that direct visual stimulation and memory retention would be more effective. Photographs have the capacity to evoke feelings, memories and information (Glaw et al., 2017). This approach also saved time, as participants did not have to repeatedly review videos to match locations with the map.

Therefore, the tools I prepared for this workshop included photographs of cultural areas in Manchester city centre, place-marking cards, a large A0 map, as well as card stands, multicoloured pens, sticky notes, and other tools. Photographs of various locations in Manchester were placed on card holders, allowing participants to position them on the map. Additionally, I provided electronic devices for participants to refer to Street View and use applications such as Google Maps and Google Earth. The devices included

iPads and laptops. Participants were also allowed to use their own devices to access online street maps and other relevant information.

I introduced more props for the participants to use in constructing the wayfinding system design, including cards with various symbols, sticky notes, semi-finished card street signs that could be painted and altered by the participants, and card stands. The cards used for marking included various types of information, such as landmarks, stores, greenery, decision points, heritage, and so on. Additionally, there were semi-finished cards that participants could modify and customise with their own content. Together, these props form a deck of cards, which were later designed to aid in the workshop. This deck was in its early stages of development during Workshop 1.

These additions were aimed at making the workshop more engaging and accessible to participants. I also experimented with having participants take on role cards to play different roles, such as visitor and guide, and designed different tasks for each character at each step. It is not uncommon for role play (sometimes written as roleplaying) to be used in research, especially among studies framed as serious games. For example, Rumore et al. (2016) used multi-stakeholder negotiation RPS, a serious game model, to assign different roles to different participants for decision-making. Wulandari et al. (2019) Use roleplay applications in education to improve students' speaking skills. By playing roles, the participants' cognition can be promoted (Winardy & Septiana, 2023). The roles for the workshops were designed to increase the motivation and engagement of the participants and to provide multiple perspectives. The different personas had slightly different tasks at each stage to help participants move through the steps with different questions.

The ice-breaker session was omitted in this workshop. I began by introducing the workshop to the participants using the prepared slides, which included the workshop objectives, basic concepts (e.g., the concepts of wayfinding and wayfinding systems and their components), and detailed guidelines for each step, particularly the group mapping and wayfinding system construction sessions.

Subsequently, one activity involved inviting participants to select six locations from the provided photographs that they would most like to visit or take their friends to, using these six locations as destinations and a foundation for their design.

Group mapping, as described in 4.4.3.3, consists of four sub-steps: information strategy, location strategy, categorising the city, and route planning. These steps are designed to help participants identify and label the city's information, forming the foundation for the design. Each session is presented in the slides with a detailed step-by-step guide, along with examples. To save time, I tried to combine the four steps in the Group Mapping section into one step. Although this reduced the workshop's duration from three and a half hours to one hour and thirty-five minutes, it became evident that the guidelines in the Group Mapping section needed to be more explicit to prevent participant confusion as they navigated through the process. Participants also required more street images in this section.

Wayfinding system construction is a design session aimed at allowing participants to develop their own designs based on the information in the city. The goal of the workshop is not to create aesthetically pleasing designs, but rather to understand the participants' approach, methodology, logic, and creativity in design. In Workshop 1, I did not provide guidance or examples for this session, but instead gave some hints, such

as suggesting they use card holders to support blank cards and markers to add information to the map. As a result, the participants appeared somewhat confused and overwhelmed. However, they ultimately produced some good design solutions.

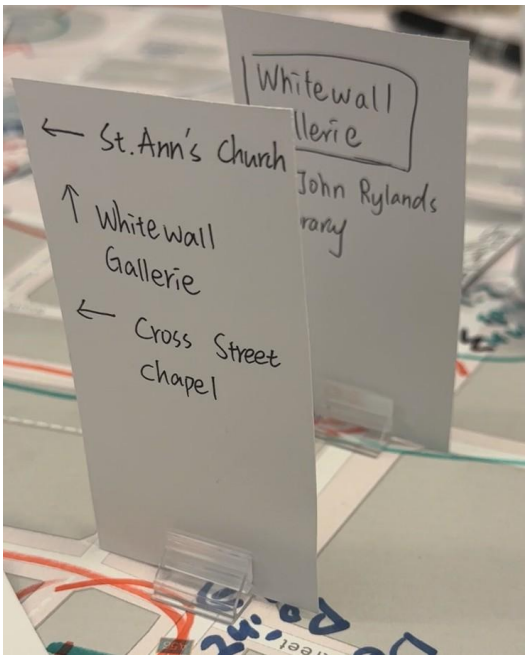

Figure 16 Example of a card supported by a card holder as part of the design content.

At the end of the workshop, participants were invited to share the designs they had created. This step provided them with an opportunity to articulate their design thinking and explain in detail what they had done.

Figure 17 Participants with the author during the workshop, photographed by one of the participants.

The workshop process was audio-recorded, and all outcomes were photo-documented. Although the workshop was audio-recorded, I found that the recordings were unclear, noisy, and difficult to distinguish between participants and their respective groups during transcription. As Ørngreen and Levinsen (2017) noted, recording the entire workshop was challenging. Consequently, although the audio recordings were transcribed, they were only used as a reference and were not included in the data analysis due to their low quality.

I gained learning from this formal workshop. The first concerns the duration: two to two and a half hours is reasonable, but it is best to keep it under two hours. Secondly, regarding the materials provided, more photos, especially street photos, should be included to help participants better understand the street scene. Additionally, participants should be provided with relevant examples at each step of the workshop. While the role cards received positive feedback and offered participants a design perspective, I observed that, in practice, participants sometimes forgot their roles and tasks. Therefore, the role cards needed to be closely aligned with the tasks, which risked

prolonging the workshop and exhausting the participants. As a result, I decided not to use them in the two subsequent formal workshops.

5.2.3. Workshop 2

Workshop 2 took place in October 2023 and was attended by four local participants from the UK, one participant from Manchester, and eight overseas participants, totalling 13 participants. These 13 participants were divided into three groups: two groups of four overseas participants and one group of five local UK participants. The participant from Manchester was merged into the UK local group due to the small number of local participants.

The process of Workshop 2 was largely the same as Workshop 1, with some differences in details. Therefore, this subsection will focus on describing the changes in detail.

For the Workshop 2, the option to select six locations as destinations was removed. I restricted the locations to Piccadilly Gardens, Manchester Art Gallery, Chinatown, Town Hall, Manchester Cathedral, and the National Football Museum to facilitate better comparisons with the walking interviews. Simultaneously, I provided a route map as a reference (though not a limitation), which included several routes participants had taken during the walking interviews.

In Workshop 2, additional tools were introduced. Based on the experience gained from Workshop 1, the deck of cards was refined and essentially completed. To provide participants with a better understanding of the streetscape, I added more photographs of

the streetscape. These photographs were printed as closely as possible to their respective locations on the map. Additionally, panoramic photographs of key intersections were provided for reference, and participants were given electronic devices, primarily laptops, on which these panoramas were stored. The panoramas were coded to correspond with the maps, allowing participants to view the street scenes directly and quickly identify their approximate locations. It should be noted that these street photos provided participants with a more intuitive experience of the streetscape, resulting in outcomes in Workshop 2 and Workshop 3 that differed somewhat from those in Workshop 1, which I will describe in the subsection 5.2.5.

Based on the experience gained from Workshop 1, the group mapping session was divided into three sub-sessions in Workshop 2. Each sub-session provided detailed instructions and examples for participants' reference. Specifically, the three sub-sessions were as follows:

- Defining routes and decision points: In this session, participants were invited to create at least one route connecting all the destinations. They were then asked to identify locations along the route where people would need to make decisions about turning or going straight. These decision points were marked on the map.

- Extracting information: Participants were invited to circle useful references on the Street View photographs and mark them on the map. These references could include any objects, and participants could categorise them, such as ‘landmark,’ ‘heritage,’ or ‘architecture’ and so on. The participants were provided with marker cards to use for this purpose and were encouraged to create their own categories if they wished.

- Drawing districts: Participants were invited to categorise the street photos and provide the rationale for their categorisation. The photos were grouped based on the participants' interpretation of the streetscape rather than the geographic location of the areas depicted. As a result, many photos from different locations were categorised together. Participants recorded the criteria for categorisation, such as ‘commercial area’ or ‘recreational area.’ They were then able to document their categorisation criteria both on the website and on their own devices. Additionally, participants could mark areas directly on the map and provide their own reasoning for the categorisation.

As a result of the experience gained in Workshop 1, the group mapping session was again split into four sub-sessions in Workshop 2. Detailed instructions and examples were provided in each sub-session for participants to use as reference. Participants were invited to circle the references they found useful on the street view photos and to mark them on the map. Afterwards, participants were invited to categorise the street photos and provide the basis for their categorisation. The categorised photographs were stacked on top of each other, and a sticky note was used to indicate the categorisation.

Figure 18 Example of extracting information and drawing districts in Workshop 2, created by the participants. Street view photos downloaded from Google Maps.

In the wayfinding system construction session, I provided specific instructions, which were embodied in the slides and made available to the participants as cards. These methods included:

- Establishing wayfinding systems at decision points.
- Setting up wayfinding systems near the destination.
- Creating wayfinding systems along the route.
- Developing wayfinding systems for district guidance.
- Designing any additional wayfinding systems that participants found beneficial.

It should be clarified that these methods were intended as references and suggestions, not restrictions. I encouraged participants to come up with creative ideas and develop their designs without being limited by the scope I provided. As a result, many additional ideas emerged. I was pleased to see that the participants were highly engaged and thoroughly enjoyed the workshop, and I received much positive feedback from them.

5.2.4. Workshop 3

Workshop 3 took place in November 2023 and was attended by four participants from the UK and seven from overseas, totalling eleven participants. The workshop was originally intended for twelve participants, but one participant was unable to attend due to unforeseen circumstances. The eleven attendees were divided into three groups: one group of four local UK participants, one group of four overseas participants, and one group of three overseas participants.

The process for Workshop 3 followed the same structure as Workshop 2, with only a few differences in the details. Therefore, this section will omit the process description and focus on the details of the changes.

In this workshop, the deck of cards was completed as a tool. Additionally, I provided participants with an expanded set of street photos for reference, each systematically numbered (Figure 19). These numbers were also incorporated onto a large map, enabling participants to swiftly and accurately locate the positions of the photos. Additionally, I provided panoramic photographs of key intersections (essentially decision points where participants often had to make choices during the walking interviews), numbered them in another colour, and stored them on the computers provided to the participants. These photos played an active role in the workshops. The photographs provided participants with cues to help them explore, recognise and perceive information in the environment. It can be argued that through these photographs and panoramas, as well as the coding system I devised, the participants were able to map the streetscape to its location and were able to quickly learn about the

environment at that location. This combination of photographs, street photographs, and numbering simulates, the visual environment of a person largely placed in a real street scene.

Figure 19 Encoded map used in a workshop, with photographs and panoramas. Blue numbers indicate photos corresponding to numbers in the bottom right corner; red images are panoramas. Panoramic photographs were saved on workshop computers with file titles matching map numbers and can be viewed in 360 degrees. Map downloaded from Digimap; notes and numbers added by the author. All photos and panoramas downloaded from Google Maps.

With the addition of the numbering system, districts could be identified by assigning numbers to the photographs. As a result, a form called the 'distinguishing board' was introduced, allowing participants to fill in the photo numbers to identify areas in the city. All materials used in the workshop can be found in Appendix.

Overall, while all two pilots and three workshops were developed on the same theoretical framework and shared the same guiding outline, their details were continually adjusted and refined during the iterative process, as outlined in the Table 6 below.

Table 6 Iterative process of pilots and workshops.

	Duration	Detail Adjustments	Props and Tools
Pilot 1	About 3 hours.	Based on Lancaster University campus. A walk part on campus.	LEGO bricks. Sticky notes and pens. Large size map.
Pilot 2	About 3 hours and 20 minutes	Completely followed the outline.	LEGO bricks. Sticky notes and pens. Large size map.
Workshop 1	About 1 hour and 35 minutes	Removed the Icebreaker. Combined the steps in Group Mapping into one.	Added pictures of locations. Added card props. Added character cards. Removed LEGO bricks.
Workshop 2	About 2 hours	Added preset locations (start points and destinations). Reorganized Group Mapping into four steps. Added categorized street images in the Drawing Areas.	Added more pictures of street view. Removed character cards.
Workshop 3	About 2hours and a half	To enhance clarity and reference, numerical identifiers were incorporated onto both maps and street photos.	Districting boards were introduced as new tools, complementing the existing set, and role cards were reinstated,

expanding the cards and tools into a comprehensive kit.

Overall, the iterative nature of the workshops allowed for continuous refinement of the process and tools, ensuring that participants' input significantly shaped the outcomes. In the following section, I will present the findings derived from these workshops, highlighting the key results and design knowledge that emerged.

5.2.5. Results from workshops

Some results emerged from the workshops. Participants extracted various types of information and references from street view photos, which they used as reference points for wayfinding. Several areas within the city were identified, along with key decision points. Additionally, design schemes and design thinking emerged throughout the workshops. The workshop process was audio-recorded, and all outcomes were photographed. The workshops' process was audio-recorded, and all outcomes were photo-documented. Although the workshops were audio-recorded, I found that the recordings were unclear, noisy, and difficult to distinguish between participants and their respective groups during transcription. As Ørngreen and Levinsen (2017) noted, recording the entire workshop was challenging. Consequently, although the audio recordings were transcribed, they were only used as a reference and were not included in the data analysis due to their low quality.

Extracted information

The information extracted from the street view photos during the workshops is diverse, encompassing both prominent landmarks and smaller artifacts. Specifically, these references and pieces of information include landmarks such as the Town Hall, Cathedral, and Art Gallery; notable streets such as tram tracks; artifacts like the benches in St. Peter's Square; shops such as Primark and Diesel; and heritage elements, including the Chinatown Arch and Cenotaph. The figure below presents a word cloud visualising the information extracted from the workshops. However, it should be clarified that this word cloud was not generated using professional analysis software and is intended solely as a visual representation of the data.

Figure 20 Word cloud of the references and information extracted by participants in the workshops. Created using WPS Office software by the author. This word cloud is intended as a visual representation of the data rather than an analysis, as WPS Office is not analysis software.

Districts in the city

In the workshop, some areas were identified, with various criteria used for defining them. In Workshop 1, the identified areas were more macroscopic. For example, a large

area encompassing the Arndale Shopping Mall, Selfridges, Cross Street, and Deansgate was considered a commercial area; the area including Albert Square, Town Hall, Central Library, St. Peter's Square, and some surrounding buildings was recognised as the city centre; and Chinatown and the Art Gallery were perceived as a whole area, labelled as a 'Cultural Area.'

In Workshops 2 and 3, more areas were identified, which were smaller, more scattered, and had many overlapping regions. For example, the large station near Piccadilly Gardens, St. Peter Square, and Exchange Square next to the Arndale Shopping Mall were each considered three small areas, marked as 'transportation buses.' An area centred mainly on Mosley Street was identified as 'office space'; an area centred on the Arndale Shopping Mall, including Cross Street and part of Market Street, was labelled as 'Commercial shops'; Deansgate is often regarded as a business district and is typically labelled as 'Business Centre,' 'Commercial spaces,' 'Shopping District,' and 'Shopping street (Shopping/hair/salon),' among others. On this street, there are areas labelled as 'Food,' 'Nice Architecture,' 'Salon,' 'Clothes Shopping,' etc., which overlap with the business district. Similarly, Cross Street is labelled as 'market,' 'commercial,' and 'shopping district,' with areas labelled as 'Food' and 'Nice Architecture' also overlapping with the commercial area.

Decision points

In the workshops, several decision points were highlighted, most of which were intersections. For example, the intersection of Mosley Street and Parker Street, located near Piccadilly Gardens, was frequently marked; at the other end of Parker Street, the junction with Portland Street was also often marked. The intersection at the southwest corner of the Art Gallery, at the junction of Mosley Street and Princess Street, is considered to be very important. The two intersections at the junctions of John Dalton

Street and Cross Street, and Deansgate, are also often highlighted. There are fewer potential decision points along a straight line, but the intersection of Market Street and Cross Street, as well as the junction of Deansgate and Cateaton Street, are examples.

Design solutions and ideas

The participants proposed several design concepts for Manchester city centre, including graphic designs that mainly took two forms. The first was based on the external contours and prominent features of real objects, such as the pillars of the Art Gallery, which were emphasised. The second form was symbolic, such as the Chinese flag, which one participant designed as an icon for Chinatown, and a football design created by another participant for the National Football Museum.

Signage, as an information display medium, appeared most frequently in the design proposals, with a variety of ideas emerging. The information presented on signage was diverse and mainly included the use of arrow graphics to indicate directions, placement of maps, indication of location names, estimated time (including walking and cycling) and distance to locations, 'you are here' markers, and area names.

Signage is mostly placed at intersections. One participant explained: 'It roughly points you in the right direction. I think roads, especially at turns, should be clearly marked. When you reach a turning point, you need to know if you should continue straight or take a turn.' Another participant said: 'To have as few turns as possible and to signify every turn with a special sign. And everywhere it is very useful to have like signs that lead you to the landmark you want to see.' Participants also used different colours to distinguish between different areas and created signage at the entrance. For example, one group of participants created a signage divided into two parts, the upper part of

which was labelled ‘district name’ and the lower part of which was labelled ‘everything in the district,’ with an explanation written next to it: ‘At each district place signs that list all important areas and buildings inside the district.’

In addition, participants also provided ideas for signage in various forms. For example, one design was placed at the entrance of a building or location, which the participant described as: ‘Visual signs on the pavement that would lead from like a bus stop or something similar to the entrance of the important building or place. Can use fluorescent paint and the signs will reflect the light at night.’ One group of participants designed an information station and wrote: ‘Info points with people working there that can give directions and etc.’ Another participant proposed the idea of digital signage, describing it as follows: ‘There should be a digital board. There will be an option for buttons or write the names of the place or also you can select the images. So, when you will do that it will give you the direction to reach the destination point from your current location.’

5.3. Tow Test Experiments

The research findings of this thesis were derived from the analysis of data collected through walking interviews and workshops. These findings include a design framework based on four elements (points, lines, planes, and timing, see Chapter 8), as well as a set of cards that complement the framework (see 8.4 for details). To further validate the application of the results, particularly in other cities, two experiments were conducted in Lancaster, UK. The experiments took place in the Mill Race area of Lancaster, a relatively small area that can be walked around in approximately 20 minutes. This area was selected due to its combination of cultural sites, prominent landmarks, and heritage.

Two participants from China took part in the two experiments. The process of these experiments was designed based on the outline of the workshop, although only one participant took part at a time, meaning they cannot be regarded as real workshops. The materials used in the experiments included a map of the Lancaster Mill Race area (Figure 21) and the cards I designed (to be discussed in detail in Chapter 8). The Mill Race area (outlined by the black line) is part of a cultural programme, *Mill Race: Flow of Change*, conducted by Lancaster City Council, Lancaster Arts (a part of Lancaster University), and the National Portfolio of Arts Council England.

Figure 21 Research area of Lancaster Mill Race.Basemap is downloaded form Digimap, and the area scope comes form the project Mill Race: Flow of Change (https://storymaps.arcgis.com/stories/99472716985e4b1787220f1665c0be05).

5.3.1. Experiment 1

The first test was conducted in June and August 2024, with the participation of a participant from China. The participant was provided with a set of physical cards and a map of the Mill Race area at the beginning of the test. The test consisted of three parts, with the first part focused on interpreting the area, the second part on analysis and design, and the third part on redesigning.

The first part involved a walk around the Mill Race area. I accompanied the participant from the three-way intersection of Damside Street and North Road and walked around the area once. Prior to the walk, I introduced the participant to the concept of the four elements and explained the objectives of the walk. Based on my background research on the area, the participant was tasked with identifying the following destinations during the walk: St John the Evangelist's Church, Factory, King's Community Church, Sugar House, and Grand Theatre.

During the walk, the participant was asked to mark four corresponding elements on the map to construct an image of the area for the design. As instructed, the participant marked the reference points used during the wayfinding process (points), recorded the route we walked, particularly the special routes (lines), identified possible areas (planes), and recorded the time and location where this information was observed (timing). At the same time, the participant also marked locations of objects they found attractive and interesting.

After the walk, the experiment moved to the second part, which was conducted indoors. The participant performed a preliminary design based on the steps outlined on the card

and the map on which they had just marked the information. At this stage, my primary objective was to test the feasibility of the card, ensuring it was understandable and usable to the participant. Based on the results of the experiment, I aimed to further improve the set of cards.

The final phase took place after the cards had been improved. Two months after completing the previous two phases, I invited the participant to redesign the area. This phase was conducted online using Figma, a software platform that allows collaborative design on a shared drawing board. During this phase, the participant was asked to design based on their memories of the walk and street view images from Google Maps. This part followed the order of the cards. Since the information collection and initial mapping of the area had already been completed during the previous walks, the participants analysed the area to determine the needs of each location and route. This included identifying what could be seen from different directions, what was missing along certain stretches of road, and which places were relatively difficult to navigate. The design was then carried out according to the design part of the cards.

5.3.2. Experiment 2

The second experiment was conducted in a laboratory setting in June 2024, following a similar process to the first, but only the first two parts were carried out, without the third. A participant from China, with a background in graphic design and experience in designing wayfinding systems, took part in this experiment.

In this experiment, the participant mainly relied on online street view maps and panoramic maps to become familiar with the area. This part could be considered an

‘online walk.’ The online method was chosen because my research method included both indoor and outdoor components. The walking interviews took place in the centre of Manchester, where participants had access to the real streetscape, while the workshops were conducted in a laboratory setting, where participants relied on street maps. The two different experimental settings aimed to explore whether the cards could be used in the same or similar ways in both settings.

5.3.3. Result from Experiments

Participants identified landmarks and wayfinding references in the Mill Race area. These references covered a wide range of objects, from large landmarks to small artefacts. Some references were identified as landmarks, such as St John the Evangelist's Church and the Grand Theatre; others were identified as open spaces or squares, such as the two car parks on North Road and St Leonard's Gate. Some shops, such as Yellow Lets, were also identified. The junction formed by the intersection of North Road, Cable Street, and Parliament Street was considered a very important reference. There were also smaller artefacts, such as the poster at the Grand Theatre and the St. Nick's logo attached to the facade of the building.

Participants who walked around the city marked two particular roads, both uphill. The locations of the references were also indicated on the map. Participants also identified areas where wayfinding was particularly difficult, and information was lacking. For example, a section of North Road was considered hard to navigate. One participant said, ‘I think this area is really hard to find. Because the road is narrow, and the buildings are tall, blocking the view.’

Some areas were delineated. For example, North Road and Church Street were considered to be related to ‘Commercial’ and ‘Food.’ St John the Evangelist's Church and its surrounding area were designated as a separate area. Similarly, the Grand Theatre was marked as ‘Culture and Leisure.’ The two car parks were also identified as two distinct areas.

Several design proposals were made. Two junctions, namely the entrance to the footpath leading to Sugar House, were considered both difficult to find and lacking in information. As a result, participants in Experiment 1 proposed placing an information station at the junction on North Road to direct people to Sugar House, St John the Evangelist's Church, and the Grand Theatre. A map should be displayed at the junction of Church Street and Rosemary Lane, along with a ‘You Are Here’ sign. The entire length of Church Street and St Leonard's Gate should be colour-coded, using the same colour as the facade of the Grand Theatre, with graffiti in the same style designed for the junction leading to Sugar House. Additionally, signage should be placed in the difficult-to-navigate area on North Road, featuring a graphic design based on the outline of the church and indicating the distance to the church. Participants in Experiment 2 proposed a colour-coded design scheme that would unify the house numbers in the area into one colour and give them meaning. The participant described this idea as follows: ‘Like, the shop numbers, say, 78 on whatever street — the house numbers are all the same colours.’

Since the aim of the experiment was to test the cards, participants used them to create and design an impression map of the district according to the process outlined on the cards, with the results presented in visual form. The two images below show the maps marked by the participants and the transcribed results of the design solutions they created.

Figure 22 shows the results of the first experiment, while Figure 23 shows the results of the second experiment. As illustrated in the figure, the purple stars represent the destinations for wayfinding, the red dots denote references and information (points), and the blue dots indicate locations where references, information, or destinations can be seen (timing). The black lines with arrows represent routes (lines), and the red, yellow, and blue blocks indicate recognized areas (planes). The dark grey lines denote important roads, while the light grey lines represent secondary roads. The green area highlights the location of the design, and the purple rectangle indicates signage.

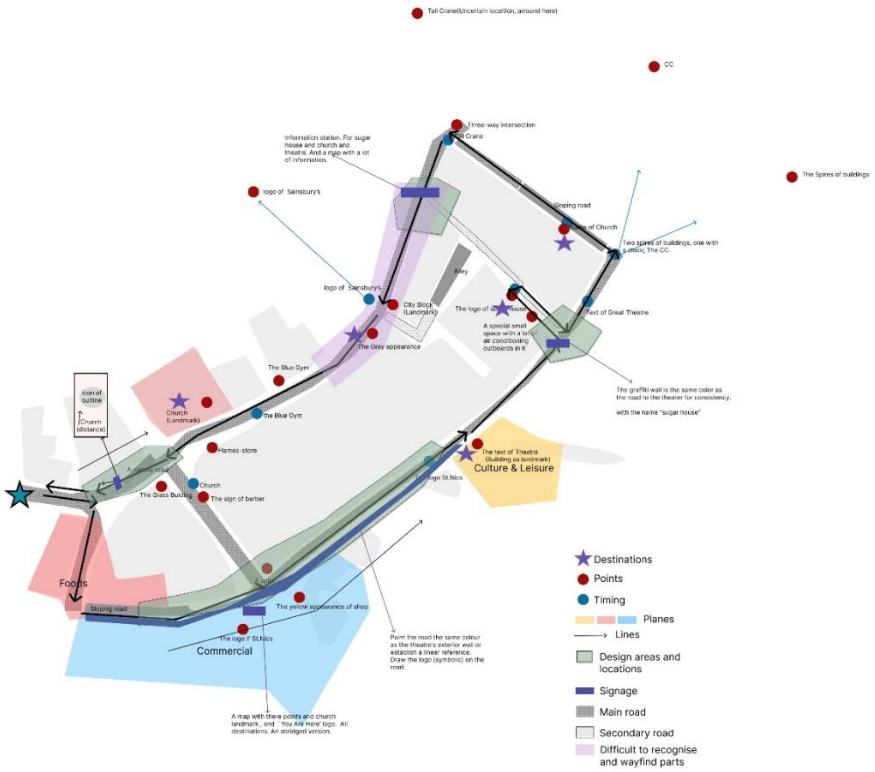

Figure 22 Visual transcription of the results of Experiment 1, transcribed by the author.

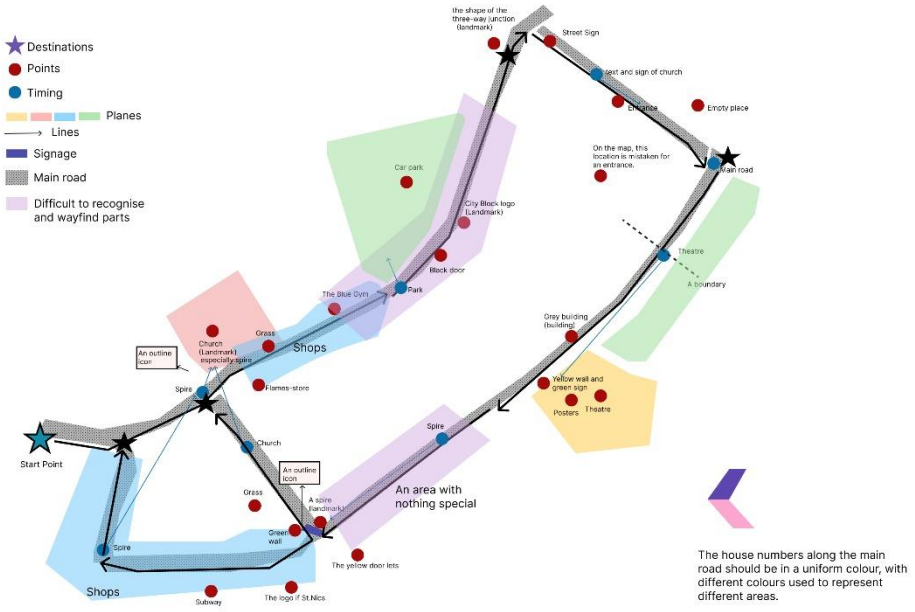

Figure 23 Visual transcription of the results of Experiment 2, transcribed by the author.

5.4. Summary

This chapter provides a detailed description of the walking interviews, workshops, and two trials, and summarises the data collected. In general, the results of the walking interviews, conducted in the city centre of Manchester, demonstrate the external environmental information used by participants when navigating real cities. This information is diverse, ranging from large landmarks to small artefacts. The areas and boundaries within the city are also recognisable. It reflects participants' understanding and perception of the city, revealing some of their wayfinding strategies and preferences. The results of the workshops show how people extract external environmental information from street view maps and incorporate this information into their designs. After extracting information, planning routes, identifying decision points, and dividing streets, participants created wayfinding system designs, generating

responsive design solutions and ideas. By synthesising the data from the walking interviews and workshops, the main outcome of this thesis—a deck of cards and a framework for designing wayfinding systems—was developed. To test the card set and framework, two trials were conducted in the Lancaster Mill Race area. The results reflect participants' encoding of the city using the cards, as well as the design methods and design solutions that emerged.

As demonstrated in this chapter, participants extracted a considerable amount of diverse reference information from the urban environment to support wayfinding, and in the process, formed their own understanding, perception, and feelings about the city. In the following chapter, I will further explore the external information people obtain from the urban environment during wayfinding, based on this data, and discuss the role and function these cues play in the wayfinding process.

Chapter 6. External Features: Information in the Urban Environment

Based on the collected data, this chapter explores the external features that support the wayfinding process in urban environments and influence people's perceptions of cities and spatial cognition. Additionally, it analyses the role of these features in wayfinding through the lens of Lynch's five-element theory, examining how they shape people's perceptions of urban spaces.

This chapter include three sections. In the first section, this chapter will explore the information people use as reference cues during wayfinding in urban environments. The information used as a wayfinding cue in urban environments mainly includes landmarks, buildings, artefacts (including texts, posters, advertising signs, big screens, flags), squares, heritage, roads, signs, and plants. This information came from the two parts of the data collection, primarily the information used by the participants in the walking interviews when conducting the wayfinding experiments. Secondly, the information from workshops that people highlighted from street photos, online maps and street panoramas has been included. The workshops aimed to co-design a wayfinding system for Manchester city centre, so the information that people highlighted in the workshops was also used for wayfinding. The results of analysing these two parts of the data together form the basis of the wayfinding system design. In this section, I will explain which cues people used to support their wayfinding and the wayfinding system design process. The second part will discuss how these external features are represented in wayfinding systems. This section will use Lynch's five-element theory as a foundation to explore how these external features are represented in mental representations and cognitive maps, how they support the wayfinding process, and compare them with Lynch's theory to highlight the differences in how these features

are understood in different research contexts. The third section will be the summary of this chapter.

The second section will discuss how these external features are represented in the wayfinding system. Based on Lynch's five-factor theory, this section will explore how these external features are represented in mental representations and cognitive maps, how they support the wayfinding process, and how they compare with Lynch's theory in order to clarify how these features differ across different research contexts.

Additionally, although at the very beginning, it made sense to group participants according to different cultural backgrounds, as participants from different cultural backgrounds may present different results, for example, in terms of their understanding of urban locations and cultures. The difference was reflected in later studies, where people were relatively more likely to notice factors related to their culture. For example, K Star, an audio-visual store in Manchester, primarily sells albums, posters, records, and other merchandise related to Korean pop singers and dancers. Undoubtedly, this is a typical shop with an Asian cultural flavour, and it was noticed by some Asian participants who passed by it. Even more interesting is that the Asian participants who took part in my study were Chinese rather than Korean, but they still showed great interest in the shop and were willing to stop and talk about it. However, they would not consider the shop a cue, nor would they perceive it as helpful in wayfinding.

However, throughout the study, the more influential factor in wayfinding was the participants' combined personal understanding of space, routes, and maps, as well as their familiarity with the city and its routes. What influenced the wayfinding process more than anything else was the ability to read maps, discern directions, estimate

distances, and recognise spatial information—abilities that varied between individuals. The landmarks or references identified by participants from different cultural backgrounds remained generally similar. In the walking interviews section, participants from the local area provided insights into the cultural background or historical significance of landmarks and historic buildings, sharing local stories in the process. However, the references, landmarks, and information they used for wayfinding were similar to those used by participants from overseas or from outside the city. Participants exhibited some preferences influenced by their cultural background, but based on my findings, this preference was not a determining factor affecting wayfinding, or even their overall impression of the city. Therefore, in this chapter, I will focus more on how environmental information affects people's wayfinding behaviour and how it contributes to constructing cognitive maps and city images, rather than on identifying participants' insights from different cultural backgrounds.

6.1. Information in Urban Environment

Space is an aspect of cognition, and the perception of recognisable features, whether artificial or geographic, is essential for unifying patterns of human activity in the environment (Correa de Jesus, 1994). Wayfinding not only depends on the presence of signages but also involves perception, spatial knowledge, information refinement, memory and problem-solving (Muhlhausen, 2006), which is based on the spatial knowledge and perceptual cues to arrive at the destinations (Hegarty et al., 2023). Therefore, extracting information from the environment as a reference is essential for wayfinding, especially in complex environments such as urban centres. Gathering environmental information has also long been a focus of attention in past research (Iftikhar et al., 2020). By integrating information collection, processing, spatial knowledge, route reassurance, and performance computation, people develop awareness

of their indoor and outdoor environments, supporting their wayfinding processes (Lövdén, 2005, cited in Iftikhar et al., 2020) .

The availability of environmentally relevant information is essential in the wayfinding decision-making process (Casakin et al., 2000). In the case of urban environments, there will always be information present, and provides clues to the wayfinding process. When this information is incorporated into the wayfinding system, people can use the help of the wayfinding system and the references in front of them to help them find their destination, orientate themselves and set their course.

When participants were in a real urban environment, they used information from the surrounding environment to help orientate themselves, calibrate directions, estimate distances, and make decisions. Participants in the lab extracted important visual cues from street view images, which were mainly used to build and design the wayfinding system. Together, these two components make up the place-based information in the urban environment of Manchester's city centre.

The results show that people recognise information from the environment as a reference to support the wayfinding process. These references and cues from the urban environment are objects that exist in physical form and serve as concrete visual indicators. Abstract concepts such as the ambience and atmosphere of streets also emerged, but were relatively less common. The impact of this information on the wayfinding process has two dimensions: the first is how it affects the process of finding one's way to a destination accurately; the second is how it influences one's understanding, interpretation, and perception of the city.

6.1.1. Maps

Maps are the one of the most basic, if not decisive, bases for wayfinding. During the study, many participants stated directly or indirectly that they would only have been able to find their way with a map. Maps present spatial information as a perspective of the observer's position and that location and orientation do not depend on the position of a particular observer, so the spatial relationships presented by maps are stable (Münzer et al., 2006).

Whatever purpose a map serves, it must represent reality (Bjerva & Sigurjónsson, 2017), and the better the information on the map matches reality, the easier the wayfinding task will be accomplished and the easier it will be to manage. The map must be integrated with the characteristics of the city, which could help users can match the information in real world and on maps. A map with more detailed information is not necessarily more helpful in wayfinding. The validity of a map is the result of selectivity, and it is essential to define the objectives of the map in order to select the necessary information (C. M. Hein & van Mil, 2020). In fact, during the research, participants showed a tendency to want specific information from the maps, such as the name of a building or information that facilitates the correspondence of an object to reality. For example, one participant told me, 'I tried to find the names of some of the buildings but couldn't find anything'.

Initially, to gain as much insight as possible into how participants would rely on information in the urban environment for wayfinding, participants were given an almost blank map to reference during the first few walking interviews (Figure 24). This map provided little to no information to the participants. As a result, the participants focused

more on the correspondence between environmental information and the map, particularly in terms of shape, location, and relative position.

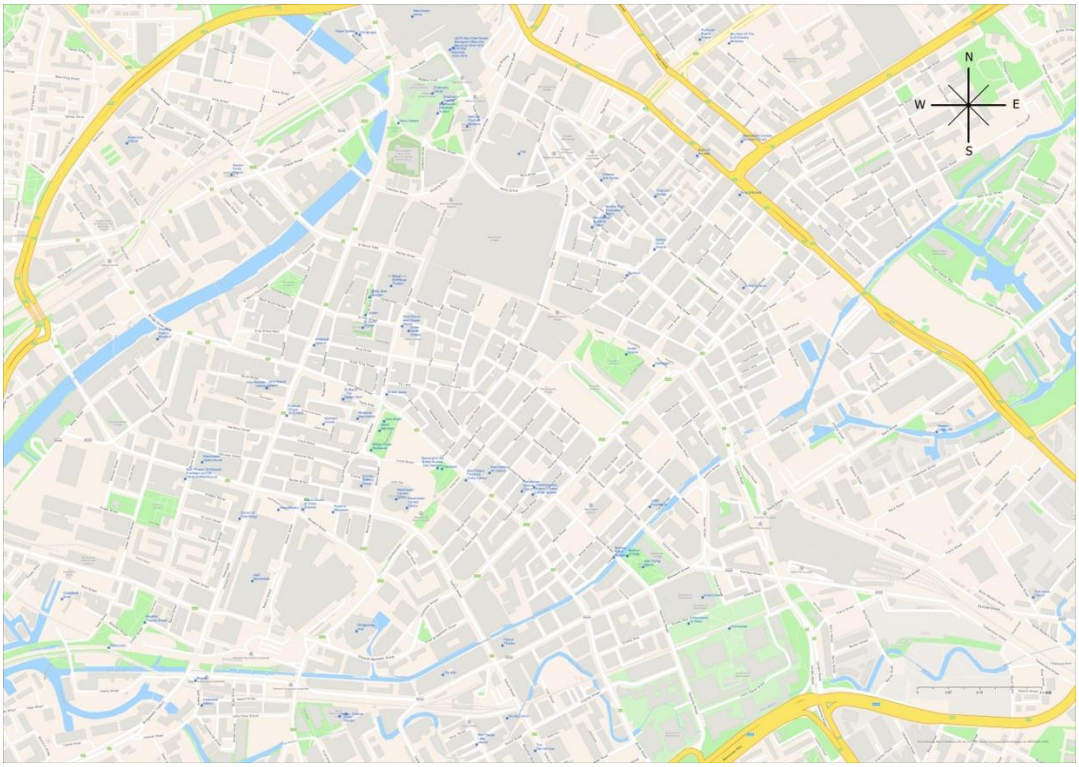

Figure 24 Blank maps initially used by participants in the walking interviews. Base map downloaded from Digimap (https://digimap.edina.ac.uk/). Blue fonts and dots imported from CCCM's cultural zone data using ArcGIS and labelled on the map, with additional directional markers added by the author.

When using this map, participants tended to seek additional information, including the names of prominent buildings and the labelling of essential places. The names of buildings that could be matched to reality were frequently mentioned by participants. A typical example is the House of Fraser building, which was considered a landmark by almost all participants who passed this large shopping centre. The building had the name 'House of Fraser' clearly displayed on its façade, and participants expressed a strong preference for having this name appear on the map as well. The House of Fraser shopping centre is a typical example. However, its name was not labelled on the map.

Some participants commented that it would have been easier to locate themselves if the name of the building had been included. The relatively blank and less informative maps highlighted certain information, such as the building footprints and road shapes corresponding to the real environment. However, they also increased the time participants spent on wayfinding and the number of times they became disoriented. As a result, I revised the map in subsequent walking interviews to make it more informative (Figure 25).

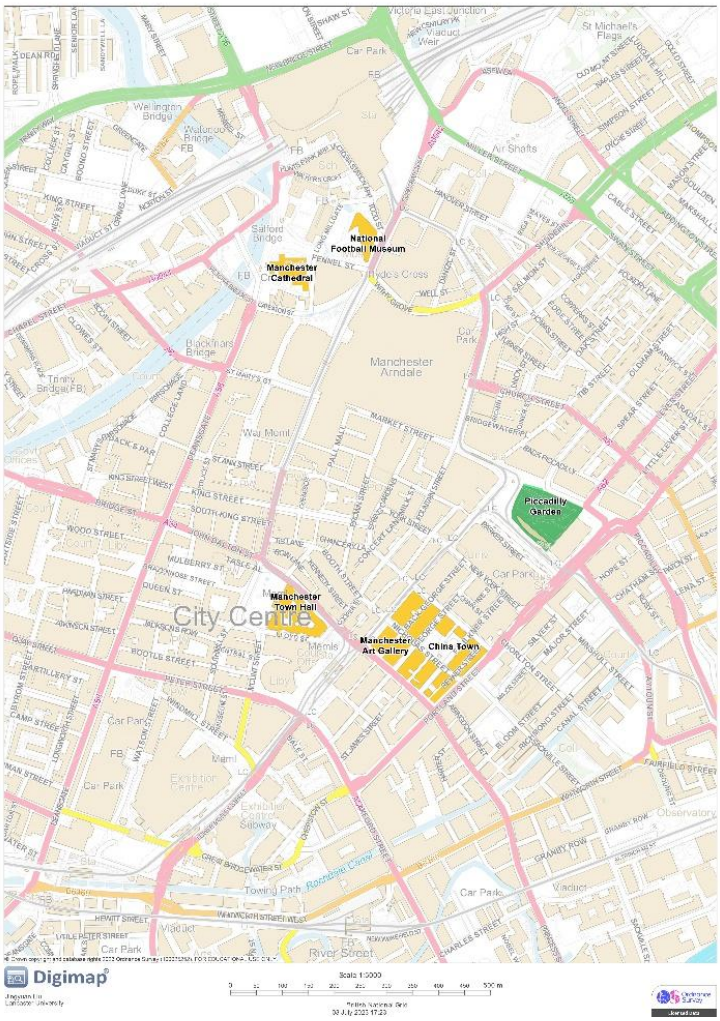

Figure 25 Second map used by participants in the walking interviews. Base map downloaded from Digimap (https://digimap.edina.ac.uk/), with destinations highlighted by the author using Photoshop.

In the second map, the destinations that participants were asked to find were highlighted, and more information appeared on the map, including the names of locations and streets. Interestingly, when using the previous map, participants never actively searched for street names in the city, as the street names were not shown. However, once the new map was introduced, with street names labelled, participants began to use them consistently as a reference, actively looking for street signs displaying those names. This phenomenon further illustrates the decisive influence of maps on wayfinding. Indeed, the references people look for are, to some extent, determined by the map.

Spatial information in maps may require cognitive fine-tuning to derive routes from them, and these fine tunings may involve mental rotation to align the map with the current view of the environment (Münzer et al., 2006). The absolute east, west, south, north and south directions were almost not used during the study. People preferred to focus on relative directions. This relative orientation consists of two types: the first is rotating the map's orientation to match one's face in the city, and the second is judging whether one should go straight, turn left, turn right, or make a U-turn based on one's surroundings. In general, subjects were more concerned with their position on the map and usually used the position corresponding to the information to make their judgements. For example, a subject judged his or her location by identifying the Town Hall and the Central Library (as opposed to a map) and then assumed that he or she was in the middle of these two buildings. Once the subject cannot map the information to reality, the subject is immediately disorientated.

A map is an essential reference for wayfinding. The primary function of maps, whether physical or digital, is to facilitate the correlation between the map and the corresponding geographical reality. The participants' attempts to find information on the maps further

support the need for their design, and the purposeful selection of information from the environment and its incorporation into the maps and design is an integral part of the wayfinding system.

6.1.2. Architecture and Heritage

Architecture is one of the most frequently mentioned elements and serves as an essential reference for all participants in the wayfinding process. How individuals utilise architectural features to facilitate their wayfinding varies. As an integral part of the city, architecture provides people with various cues to support the wayfinding process. In addition to the buildings themselves as objects and reference points, aspects such as the style and appearance of the building, its shape, and prominent features can individually influence wayfinding. A building that influences wayfinding must meet the condition of being visible from the road—meaning it must be located within the line of sight of a person walking along the street. At these moments, it can be stated that buildings that aid in wayfinding are easily recognisable and have visual prominence in the environment, which aligns with the definition of landmarks (Yesiltepe et al., 2021). Therefore, in these instances, they are essentially equivalent to landmarks. Furthermore, architecture is not independent of the context in which it is situated. However, it is often emphasised that objects that stand out from their environment are more likely to be wayfinding clues. As emphasised by Nurgandarum and Anjani (2020), it is essential to integrate architecture into the urban environment to enhance the city's legibility. However, buildings within cities not only function as landmarks but also influence people's wayfinding in other ways, as well as their perception of and interaction with the city, which will be discussed in section 6.2.

The *Oxford English Dictionary* defines heritage as ‘Characterized by or pertaining to the preservation or exploitation of local and national features of historical, cultural, or scenic interest, esp. as tourist attractions.’ Heritage, n 2023). Heritage refers to things of historical or cultural value that can be preserved and inherited, including objects such as artefacts, buildings, sites, and landscapes, as well as practices such as language, music, and memory (Harrison, 2010). United Nations Educational, Scientific and Cultural Organization (UNESCO) defines cultural heritage as follows (1972, p. 2):

monuments: architectural works, works of monumental sculpture and painting, elements or structures of an archaeological nature, inscriptions, cave dwellings and combinations of features, which are of outstanding universal value from the point of view of history, art or science.

groups of buildings: groups of separate or connected buildings which, because of their architecture, their homogeneity or their place in the landscape, are of outstanding universal value from the point of view of history, art or science.

sites: works of man or the combined works of nature and man, and areas including archaeological sites which are of outstanding universal value from the historical, aesthetic, ethnological or anthropological point of view.

Considering the scope of this thesis, here, heritage refers to cultural heritage in the city, which are objects of cultural and historical value, including but not limited to buildings, monuments, statues, archaeological sites, artefacts, districts, and other objects in the city that are considered as heritage by the participants. Given that the concepts of heritage and architecture are intertwined, they are addressed in this discussion. Notably, references to non-architectural heritage are less frequent than those about architecture, which may be attributed to the larger scale of the buildings in question.

Architecture and heritage are the references and cues for wayfinding, as well as the key elements that most influence people's experience and perception of the city. In the urban environment, architecture and heritage provide very visual cues. Cultural heritage, especially buildings and landmarks of historical and cultural significance gives the city a unique identity and atmosphere and influences the cognitive and emotional experience.

6.1.2.1. Architectural Appearance

Architectural appearance refers to participants' subjective understanding and description of the term, including the style and form of the building (such as modernist, classical style buildings), the building materials (such as masonry and glass), the colours (the overall tone of the building, such as white buildings, light buildings, dark buildings), and the features (certain very noticeable parts of the building, such as the top of the tower and the clock on top). For instance, buildings with large expanses of glass on the facade are usually considered more modern. In contrast, those constructed mainly of masonry and stone, decorated with relief carvings, floral motifs, and columns, are often considered older in style. The influence of architectural appearance on wayfinding is manifested in many ways. The visual presentation of architecture is crucial to the realisation and experience of built places (Elhagla et al., 2020). It is not only the famous and distinctive buildings but also the everyday architecture that shapes the city and, therefore, how one feels. For example, Ruscha (1966) took a series of street photographs of Sunsets Strip (Hollywood, Los Angeles, USA) from 1966 to 2010, capturing all the architectural features of every day along the street, and these images helped to build up people's perception of the city.

The impact of architectural appearance on wayfinding is manifested in many ways. Buildings are the basic units that make up the architecture of a city, and their roofs and facades play an essential role in creating the legibility and imageability of the city (Nurgandarum & Anjani, 2020). Generally, the appearance of a building determines whether the building stands out from its surroundings and becomes a wayfinding reference. Another critical factor is the size and height of the building.

There is some consensus on the correspondence between architectural style and appearance and their functions. In some cases, this manifested in an overriding judgement and understanding of architectural style and appearance, an assumption about the destination, and an attempt to justify this assumption in the wayfinding process. For example, some participants guessed the architectural style of the destination and used this for finding and identifying the destination. One participant said this when searching for the National Football Museum:

'If it is a museum and it's a football museum, then I think it should be a very modern building, so I am going to be looking for buildings with a lot of glass…'

Another participant made a similar point when looking for Manchester Cathedral:

'A building like the Cathedral would essentially be an older building, so I would have to go to the old town...'

Manchester Cathedral is a very typical case. All participants immediately identified the Cathedral as the destination when they saw it and gave similar reasons for thinking it

must be the Cathedral due to the style and appearance of the building, with most participants emphasizing that it was very typical of cathedral-style buildings and easily recognizable from the environment. In the most typical example, one participant saw a part of the Cathedral when they were still about 0.2 miles away from it and immediately explained it very clear: ‘Cathedrals are generally Gothic buildings, and this one is so typical that as soon as I saw it, I knew it had to be the Cathedral.’

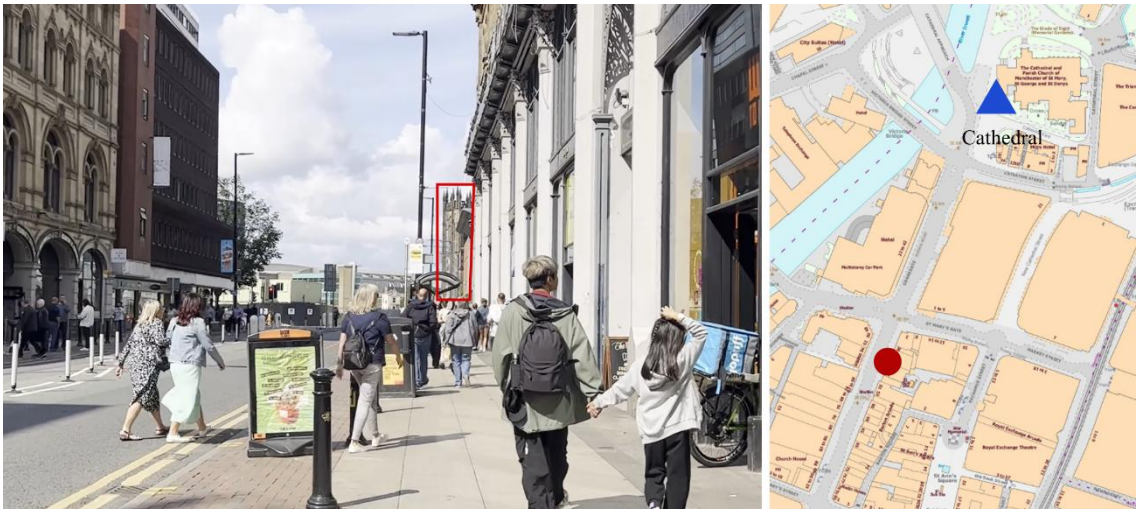

Figure 26 Figure 26 Location where participants placed the Cathedral. The photo on the left, taken by the author, highlights the Cathedral in red. The red dot on the right image shows participants' positions at the time, while the blue triangle indicates the Cathedral's location. Base map downloaded from Digimap..

Another example was the Art Gallery, where many participants thought that the style and appearance of the building must be that of an art gallery or museum, said one participant: ‘…because it seems like an old building, like either it’s an art gallery or a museum or something like that.’

In addition to individual buildings, clusters of buildings (such as buildings on a street and styles within an area) can also impact people's perceptions. Sometimes, people perceive buildings not individually but in terms of the style and appearance of a group of buildings. As Lynch (1960) emphasised, the overall style of a group of buildings contributes to the legibility of the urban environment. Nurgandarum and Anjani (2020) stated that legibility can be measured through the unity and harmony of the building facade. Unity refers to the continuity between the elements of the building facade, which means the consistency and continuity of features. Harmony is reflected in the architectural elements' proportions and the modules' orderliness. A typical example is Chinatown. The building facades of Chinatown have continuous and consistent Chinese signage, so it is easy to create a consistent impression. One participant explained this: '…you could get a Chinese restaurant sort of anywhere… The fact that there's so many of them suggest that it's like close by that.'

This perception of the style and appearance of the complex is also reflected in the speculation about the destination. One participant explained that when looking for Chinatown:

'I saw the red brick houses after Primark and thought to go in that direction. Because half of the buildings in front are modern and the other half are classical. I do not think Chinatown would be near modern buildings, so I chose to walk along the older buildings.'

However, it is interesting to note that this consistency posed a hindrance when participants needed to leave Chinatown, possibly because entrances and exits needed to be more evident despite the consistency of the building facades in Chinatown. People

can get lost amongst similar buildings because they are still determining the direction of entrances and exits.

This approach was sometimes helpful or successful in finding destinations, depending on whether the destination building was very well characterized and whether people's understanding of the destination matched its appearance. An example of this was a participant who thought that Town Hall should be modern and big, and who was unsurprisingly lost while searching for Town Hall based on this assumption.

In addition, because people have visions of destinations, there are sometimes cases of misidentification. A typical example is that almost all participants who took the Deansgate route mistook another building for the National Football Museum. One participant explained, 'Because the style of the building looks very, very much like the National Football Museum. It looks modern, and I think it looks very sport related.'

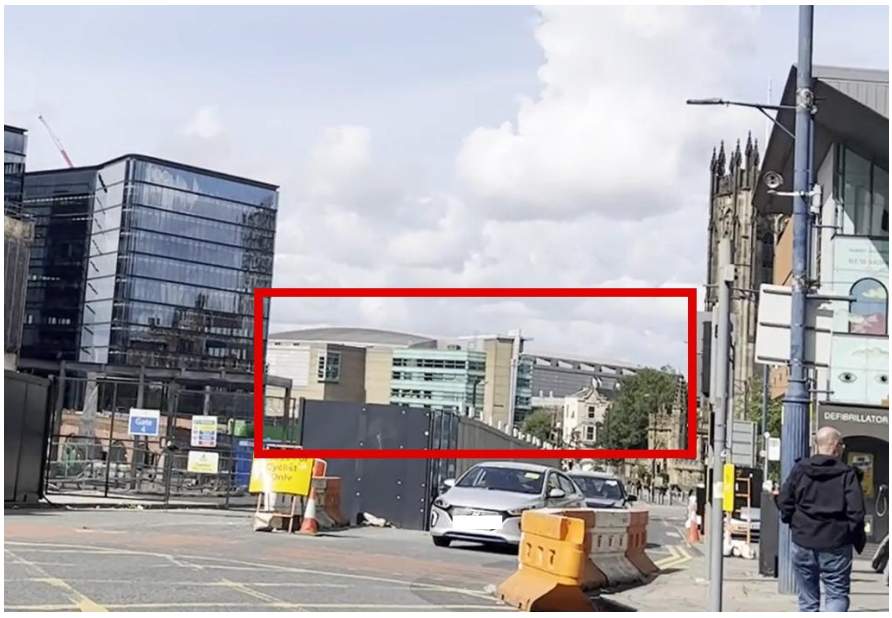

Figure 27 Building often mistaken for the National Football Museum, framed in red. Photo taken by the author.

The appearance of the buildings is also the element that most influences people's feelings and experience of the city. Most of the participants would emphasise that Manchester's style is a mixture of new and old buildings. One participant described it to me: 'So it's quite nice to see this old history, not just sort of worn down old buildings that you associate like it's not... I imagine Manchester to be like an industrial sort of... very old buildings' town. It's a bit worn down, but it was quite nice to see the different types of buildings at different periods, it's like the Tutor buildings, little house, different styles…I like seeing Chinatown because it was just different from everywhere else.'

Non-building heritage becomes cues and references in their entirety. In contrast, buildings were sometimes referenced for specific parts (such as decorations on the facades, tower tops, roofs, and columns) and sometimes as a whole. For example, some participants considered the pointed part of the roof of the National Football Museum to be an essential referent because it was noticeable from a great distance. In this respect, buildings as referents have their limitations. Buildings occupy a particular volume in the city, and they are large in scale for individuals. Participants may approach the front, side, or rear of a building, resulting in the reception of different information. For instance, one participant spent almost no time locating the Town Hall, whereas two other participants spent a considerable amount of time in the same area. Although the Town Hall was under renovation and its surface was almost entirely covered with white construction material—which added to the difficulty of identification—more importantly, these three participants approached the Town Hall from different directions. The first participant arrived at an area featuring a billboard with the text 'Our Town Hall'. Meanwhile, the other two participants came from different directions and did not encounter the same sign. Another example is the Art Gallery. On Mosley Street, the Art Gallery serves as an important landmark because the façade facing this street is

decorated with large columns, often perceived as typical features of an art gallery or museum. However, when viewed from Nicholas Street or George Street, individuals see the rear and sides of the building. The lack of distinguishing features on these facades makes the building less likely to serve as a landmark or reference point. At a particular time and place, the building may function as a prominent landmark, but it may lose that role from a different location or at a different moment. Thus, the role of architecture and heritage is not fixed but dynamic over time and space.

Figure 28 Left image shows the Art Gallery's facade facing Mosley Street, with large columns making it easily recognisable as the destination. Right image shows the facade facing Nicholas Street, which is harder to recognise due to the lack of distinctive features. Photographs taken by the author.

In some cases, architecture and heritage are seen in themselves and in their integration with their surroundings. Architecture influences how people see and feel about places (Elhagla et al., 2020). For example, the statue in St. Peter's Square is integrated with its neighbourhood and forms a whole, thus giving a very positive impression. The three buildings on the south side of the Central Library are also impressive because they are side by side and have the same style and harmonious colours. There were instances where architecture and heritage acted as representations and prominences of an area and

became people's primary impressions of the area. For example, two participants were very impressed with the John Rylands Library and the glass building beside it, indicating that this was 'the impression of the area and the street'. Based on the results of my research, it appears that it is a widespread phenomenon throughout my research that buildings, groups of buildings, and heritage serve as iconic features of certain regions, visually and psychologically symbolising people's impression of a certain one.

6.1.2.2. Shape of Buildings

The shape of building consists of two types: the visual shape of the building in the real world, and the graphical shape of the building as it is presented on the map. When the shape of the building in the real world and the shape on the map could be corresponded to, it positively helped participants' wayfinding. One participant almost always corresponds to the shape of the building in the real world and on the map during the wayfinding process to determine his or her location and find a suitable route. When choosing a route, this participant chose the more recognizable of two roads that appeared to be the same distance apart on the map (Figure 29), explaining:

'I judged the location based on the shape on the map. I chose to turn here (pointing to the intersection in front of the Central Library) because this road corresponds better. I was looking for buildings with particularly distinctive features. The buildings on the other road are similarly shaped on the map, and it is more challenging to recognize the location. However, the central library is round, so it is easier to match it to the map. This road is recognizable, but the buildings there are too similar.'

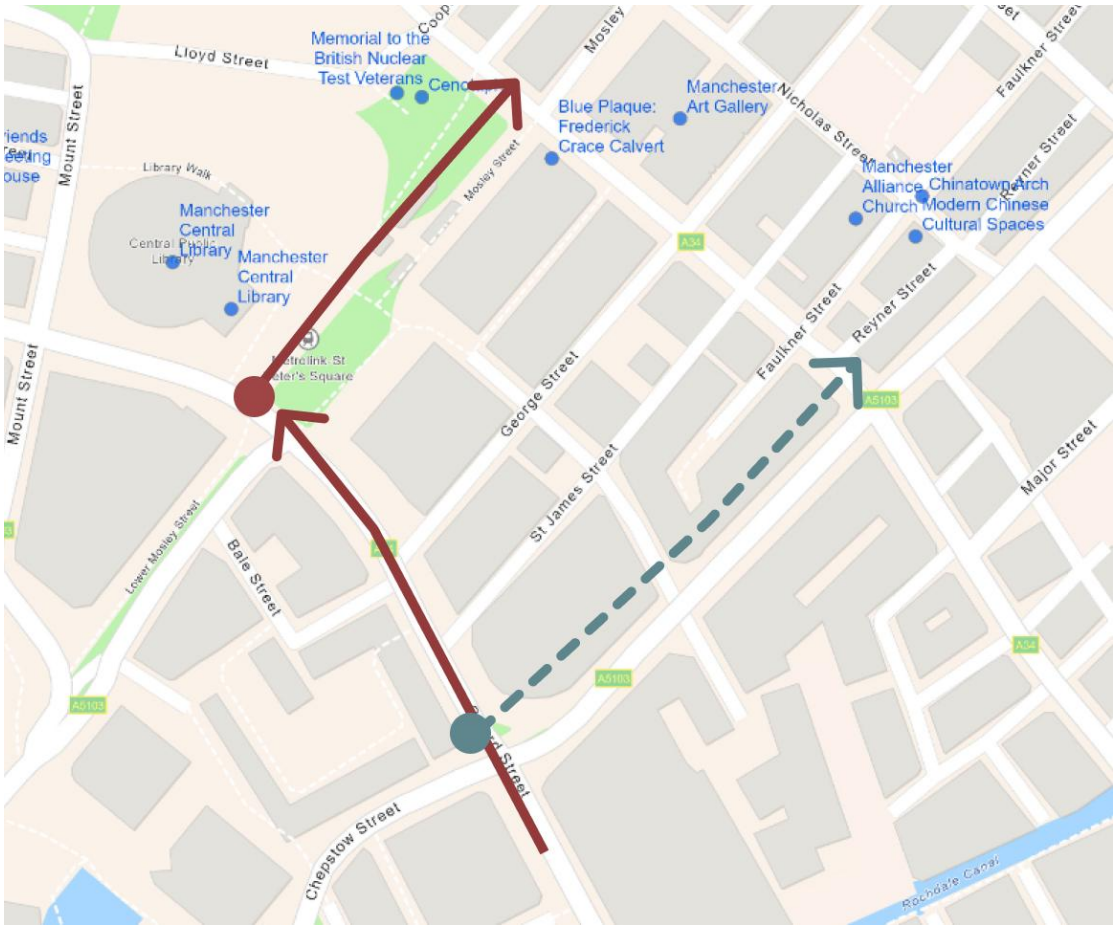

Figure 29 Locations where participants made their choices. Solid red line with arrows indicates the route taken, with the participant turning at the intersection marked by the red circle. Grey-blue dotted line indicates the route not taken, with the participant not turning at the intersection marked by the grey-blue circle. Base map downloaded from Digimap.

As shown in the figure, the library was easy to match to the map because of its circular shape on the map and the shape that can be seen in real world, which had a favourable effect on wayfinding. The participant also emphasised: 'The library is round and very clear on the map. Town Hall is a landmark mainly because it is a strange shape, big and with strange corners, which means it is unique.'

Another two participants also used the Central Library as a reference when locating themselves near Town Hall. When they were looking at the map, they quickly located

the Central Library and explained, ‘It is the most obvious because it is round, and it is round on the map.’ Therefore, buildings with unique shapes or features are more likely to be recognised and attract attention. If a building has a unique shape that corresponds to a shape on a map, that building will surely be helpful information for wayfinding.

6.1.2.3. Location and Density

The location of a building affects how participants make decisions during wayfinding in several ways, as well as judging whether they have reached their destination.

The location of the buildings themselves, as destinations, strongly influenced participants’ judgment of whether they had arrived. When two or more landmarks are positioned relative to each other and become a set of clues, their usefulness for wayfinding becomes more apparent, making the area more explicit in people’s mental maps. One participant noted the perception that Manchester Central Library and Town Hall have relative locations and would, therefore, be very recognizable. By locating one, one would be able to immediately locate the other and locate themselves more efficiently based on the location of the two buildings (Figure 30).

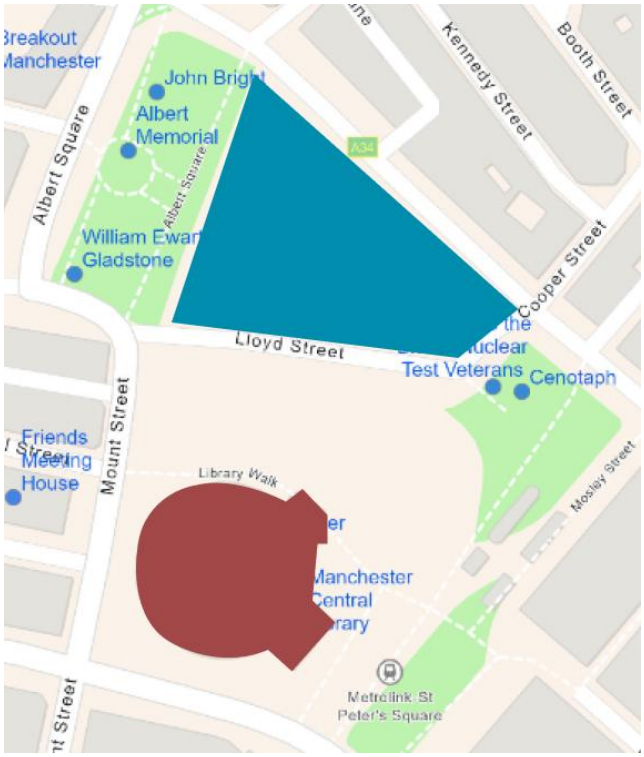

Figure 30 Relative positions of Central Library and Town Hall. Red circles indicate Central Library, and blue rectangles indicate Town Hall. Base map downloaded from Digimap.

Large or tall buildings are relatively more likely to be used as references, but if a building is so large or tall that it is outside one's field of vision, it will not function as a landmark. As a representative example, all participants passing through Deansgate recognised the House of Fraser as a landmark, whereas the Arndale shopping mall was rarely perceived as such during the walking interviews. It is often a part of Arndale that becomes a reference point, such as a large advertising screen, a billboard on the building, or one of the stores located within it.

Some buildings and heritage assets may hold the significance I mentioned in subsection 6.1.2.1, serving as symbols of their surroundings, but they may be of limited use for wayfinding due to their location. For example, the Arch in Chinatown was recognised by all as a significant heritage asset (some considered it a building), but it is located

within Chinatown and not visible from the main road outside. As a result, two participants commented, ‘I don’t recognise it is useful because I can’t see it from the main road outside.’ However, almost all participants recognised their arrival in Chinatown when they saw the arch. Thus, in effect, the arch helped people recognise their destination, which is its role in wayfinding.

This was also true in the workshops. Some participants circled buildings as references in certain photos, but in the street view photos taken closer to the same buildings, they did not circle them—or even realise that they were the same buildings.

The density of buildings affects to some extent the process of wayfinding and the senses of being in the city. If buildings are very dense and streets are narrow, it is easier to get lost because people’s view is limited, as in the case of Chinatown. In addition, people tend to perceive open places as better, while crowded places are usually rated more negatively.

6.1.3. Artefacts

Participants mentioned to varying degrees how helpful the artefacts were to them during the wayfinding process. In general, artefacts included billboards, street signs, text, graphics, and all other visual elements that appear during wayfinding. These visual elements influence people’s decisions in wayfinding because they convey messages from the surroundings.

The most intuitive and clear element is text. A prime example occurred during the search for Chinatown, where almost all participants determined whether they were close to Chinatown by judging whether Chinese characters appeared in their surroundings.

In this regard, one participant explained, ‘I think if I can see the Chinese characters and go in, then it must be Chinatown, but not necessarily the main entrance’, while another participant stated, ‘When I see Chinese characters, I judge that I am close to Chinatown.’

In another example, a participant guessed how to get to Chinatown on the road and said, ‘I should be able to see Chinese characters ahead,’ and made the correct wayfinding decision. When they saw the Chinese sign for George Street at the intersection, they decided to make a U-turn and enter Chinatown.

Text is also the most intuitive information to help participants confirm whether they have arrived at their destination. A typical example is the National Football Museum, which was immediately recognised as a destination by all participants due to the large ‘National Football Museum’ text on the external wall. The Manchester Cathedral, which has a billboard outside with the words ‘Welcome to Cathedral’, was an essential reference point. When searching for the Town Hall, many participants also identified the building by the text on the billboard outside.

Figure 31 Two images on the left show text on the National Football Museum, while the image on the right shows the word 'Cathedral' on signage. Photographs taken by the author.

The text itself is also a landmark, albeit a landmark with limitations. Sometimes, the text is part of the landmark, and certain words serve as features of the building that make the building a landmark. An example of text becoming a feature of a building and making the building a landmark is the two buildings in the Cathedral District. One participant said, 'I think what makes this section of the road a landmark is the building that says '100' on it. I do not know what building it is, but the '100' is really big and very visible'.

In addition, text that cannot be understood or read can also serve as landmarks. The most representative example of this was Chinatown, where although many participants could not read, use, or understand Chinese, they were cognisant of the writing or knew that it was in Chinese or an Asian language, and, based on the characters, judged whether they were approaching or arriving in Chinatown.

In addition to being a vehicle for words, billboards and signs are elements that influence people's wayfinding. People categorise billboards and other signs based on their

experiences and make further judgments about areas. An example is the billboards and posters outside the Manchester Art Gallery, where many participants judged that they had arrived at their destination because they saw the banners and billboards.

Another way in which billboards and signs influence how people find their way is by shaping their judgments about districts, especially regarding function. One participant explained his decision-making this way while searching for Chinatown:

'Looking the other way, I cannot see the billboards anymore, so I do not think that is a commercial area anymore. But Chinatown has a lot of stores, so it must be this way.'

Colours and materials in urban environments affect the identifiability of the environment, and their role as cultural and identifying factors becomes crucial, not only from an architectural point of view, but also from an urban perspective (Badami, 2022). Colours may have cultural meanings that create a particular impression of the city's image (Xu, 2019). Nguyen et al. (2020) point out that colour can enhance heritage value through collective identity, and as globalisation demands uniformity rather than diversity, colour can preserve region-specific characteristics. The influence of graphics and patterns is equally significant. Artefacts in a consistent style can even help shape regional styles. A more typical example is Chinatown. Chinese elements, such as red fences and Chinese-style pavilions, became references. Participants thought this looked very much like elements found in Chinatown. Participants from China had a deeper understanding of this, as the colour red is a typical and symbolic colour in Chinese culture. A participant from China explained:

'Because only Chinatown uses the colour red and write words on it, also use big characters on the billboards...and they are flat, unlike some local billboards that are embossed or hollowed out. There are also elements like, for example, Chinese knots, and for example, in London's Chinatown Town, there are lanterns...which are only found in Chinatown.'

Existing wayfinding systems (such as signage, street name signs; see Figure 32) were mentioned less frequently than the artefacts. Signage with street names was not mentioned at all as a cue or reference by any participant until the second map was activated. After the second map was activated, participants started to look for these street name signs because the street names were marked on the map. Such cues were used because the map provided them, rather than because they stood out from the surroundings or were noticeable in the city.

Figure 32 Part of the existing signage in Manchester city centre. Photo by the author.

Almost all participants did not believe that existing signage of street names could be landmarks or noticeable during a walk. Street signs labelled with street names are usually small and inconspicuous in Manchester, making them more likely to be overlooked. Manchester's existing wayfinding system does have some foundations, but there is still room for improvement in terms of providing effective wayfinding assistance, while greater improvements are needed in terms of helping to shape the city's image. This situation also emphasises, to some extent, the need for this study.

Artefacts are a part of the city that Lynch (1960) discusses relatively little. Lynch mentions door numbers (although they are numbers, their form in the city is that of artefacts), signs, and other objects. Although Lynch notes that a landmark can be a behemoth and 'a doorknob as well as a dome' (1960, p. 101), he focuses more on the significance of architectural categories as landmarks in the city, emphasising their qualities of standing out from the environment, which I will discuss in subsection 6.2.1. Regarding my findings, artefacts carry more significance in terms of wayfinding and city impressions. Although artefacts that stand out from their environment can play an essential role in wayfinding and leave a lasting impression, the significance of artefacts is not limited to this.

Artefacts can influence people's understanding of the function of buildings, groups of buildings, and neighbourhoods, as well as their perception of the impression of the area. For example, one participant told me that 'as long as there are huge screens, the place must feel like a business district'. Artefacts influence people's perceptions of the function of buildings, complexes, and areas. Sometimes, a single artefact changes people's perceptions of areas and places, and sometimes, coherent artefacts are clustered together and integrated into the environment to alter perceptions of a place. The

integration of artefacts into their environments is particularly evident in the study, especially in some distinctive cultural areas. Artefacts also often have a specific symbolic meaning and are integrated into the city's image.

6.1.4. Stores and Shops

Shops and stores are often an important reference point, but most shops are not considered landmarks. Generally, shops may be noticed for three qualities: shops with a very distinctive appearance, chain shops with a well-known brand name, and shops located within or attached to a unique building. Some shops may possess all these qualities.

A shop with a very distinctive appearance may have a large area on the building façade, or it may have very distinctive signage, windows, or related artefacts. For example, a shop named Diesel is often noted for its bright red windows. Chains with more recognisable brands are also often noted, with Primark, M&S, Boots, Sainsbury's, and other well-known UK chains mentioned, as well as the Post Office. Of these, chains considered landmarks usually take up more space and have more prominent billboards or windows. Smaller chains, on the other hand, usually do not draw attention to themselves. Primark, next to Piccadilly Gardens, was seen as a landmark by almost everyone, with one interviewee stating, 'It's so big and conspicuous that you cannot help but notice it'. Similarly, M&S was seen as a landmark by most participants, with one participant stating, 'M&S is a place I know very well'.

There are also small shops with a unique architectural appearance that are mentioned, such as a small shop on Cross Street called Mr Thomas's Chop House. In this category,

the line between the location as a reference to a building or as a shop is somewhat blurred.

Rather interestingly, whilst shops will be used as references to aid wayfinding, they are not usually rated very positively. Shops are seldom very distinct on people's cognitive maps, and they usually form vague, ill-defined commercial areas with little unique character. Such areas are generally viewed in a neutral and slightly negative light. It seems that most people see areas with a concentration of shops as less distinctive to the city itself, especially those with a high number of chain brands. Only two participants described the shops on King Street to me as seeming to have more of a local character, as there were 'not many chain stores.' Individual small shops do not represent or symbolise the impression of their surroundings; only the very large and massive shopping malls do, such as Arndale Shopping Mall and House of Fraser.

6.1.5. Paths and Traffic Hubs

Roads are often overlooked, even though people always walk on them. People usually focus on buildings and landmarks when walking, while the role of the road itself is often overlooked. However, the structure and layout of roads can profoundly affect wayfinding. Usually, distinctive paths that attract attention often serve as critical navigational clues. Another type of road that often draws attention is one with a more unique shape, like some curved roads.

In the city centre of Manchester, certain paths included tram tracks, bridges, and roads along the river. Participants were pleased to follow the tram tracks as they found them easily recognisable and different from ordinary roads. In addition, tram tracks were easy

to match to the map. One participant explained that 'it has a fixed track route.' Another participant's statement illustrates the role of the tram track shape in facilitating the process, and, describing the tram track at the junction of Parker Street and Mosley Street, stated that:

The track is really obvious here. On the map, it is in this kind of shape (curve shape). Look, there is an inclined bend here, obviously, right here, this position. So I knew that if I just followed the track this way, I'd be near Chinatown.

The layout and shape of the trails become important references if they can be easily matched to a map. Typical examples are the junction in front of Albert Square, and the curved road near Manchester Cathedral. Since the shape of the intersection or road is specific and the features are apparent, it is easy to match them with the map (Figure 33).

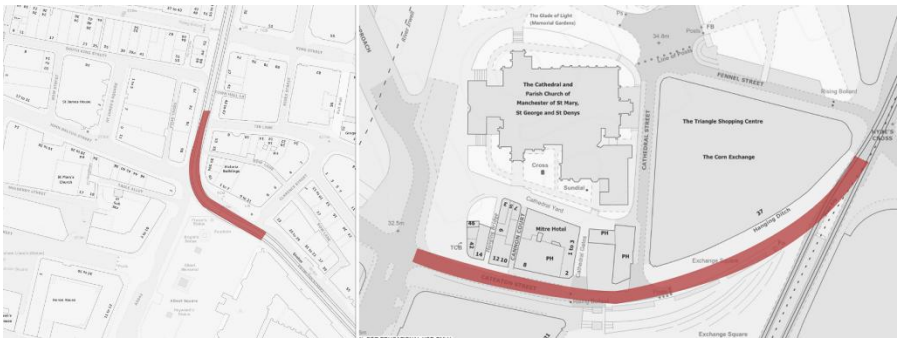

Figure 33 Roads with distinctive shapes in the following locations: John Dalton Street, Princess Street, in front of Albert Square, and the curved road near Manchester Cathedral. Base map downloaded from Digimap. Drawn by the author.

The width of the field of view affects wayfinding on streets, and it is usually less likely to get lost on streets with a wide field of view. Participants generally felt they would not get lost on wider roads and preferred main streets. It also depended on how much

information was in the field of view to aid wayfinding. The width of the street affects people's impression of the city to some extent, though this depends not only on the streets themselves, but on the entire streetscape. People's perceptions are subjective, and specific visual cues may be linked, albeit vaguely, to subjective impressions. For example, research by Quercia et al. (2014) suggests that green spaces and Victorian style are perceived as beautiful, while rubbish and broken windows are perceived as ugly. The streetscape along both sides of the street greatly affects people's feelings about the street.

Safety concerns were also mentioned by three female participants. One participant said at a location near Chinatown that she would not want to go through the narrow, dark paths because they seemed unsafe. Another participant said, 'I would only go on the trails if I had someone with me'.

Traffic hubs are essential references in the city and often influence people's impressions of the city. Two traffic hubs that attracted attention include the large bus and tram station next to Piccadilly Gardens, and the extensive tram station on St Peter's Square. This may be because these huge traffic hubs occupy a considerable area. They are not just stations but are also likely to represent the surrounding area and can be easily matched to a map. Traffic hubs were generally rated negatively, with most participants finding them busy and congested, making people reluctant to stay and wanting to get out of the area.

6.1.6. Squares, Greeneries and Spaces

Some squares, green spaces, and open spaces become helpful references for wayfinding, usually because they have a notable shape on the map. When the shapes of these places are highlighted on the map, they can become essential references.

These areas usually give a positive impression and are rated more positively. However, their ability to remain on individuals' cognitive maps usually depends on the presence or absence of representative and symbolic visual cues—especially landmarks—in their vicinity. For example, the large lawn area next to the National Football Museum was rated very positively, with almost all participants agreeing that it was beautiful. However, none of them perceived it to be independent of the museum.

6.1.7. Seasonal and Real-time Information

The real-time and seasonal information is dynamic and changing, but it is meaningful when viewed and influences people's impressions of places. The references that change with the seasons and time, as identified in the research, fall into three broad categories: plants, people, and activities.

Although the city always has greenery and plants, some plants may be seasonal—mainly flowers. Plants are seldom used as significant references unless they occupy a large area, or the individual plants stand out from the environment. Plants mainly influence people's impressions of the city. Typically, plants bring a favourable impression, especially flowers in bloom. However, plants rarely have a significant influence on people's mental maps.

People affect individuals' impressions of places in two main ways: the characteristics of the crowd and the density of the crowd. The characteristics of the crowd may be expressed in the occupations, economic situation, and even the dress of most of the people in an area. These characteristics of the crowd can affect people's understanding of the place; to be precise, people and places influence each other. For example, two participants told me on Quay Street that 'it is like a place for commuters to come to.' Another participant told me:

'I came up from, which is Manchester Piccadilly Station, I felt like it was very high class. Like people who work there tend to be, I felt like they were upper class professions. This seems to be an area where there's a lot of middle to upper class people.'

Also, socialisation or social support is an influence. One participant shared a story with me, saying:

'I'd just arrived at this intersection and was walking onto the railway tracks when a kind stranger pulled me back. I think I just barely avoided being hit by a tram...It's a very human city, so I love it.'

Another thing that can affect how people feel is the amount of foot traffic. Places with heavy foot traffic are usually unpopular, while places with moderate foot traffic are considered pleasant and cosy.

Another type of real-time information is the festivals in the city, especially the facilities set up for the festivals. These amenities often create a temporary landmark of sorts and impact people's perceptions and wayfinding experiences. To illustrate, one participant traversed St Anne's Square at a time when a multitude of diminutive, transient stalls densely populated it. The participant found this very impressive. Another participant passed by the grassy area in front of the National Football Museum, where a makeshift open-air pub left a lasting impression on the participant.

Overall, this seasonal and real-time information has more of an impact on how people feel about and experience the city, but not so much on wayfinding.

6.1.8. Mobility and Visibility

Mobility refers to movement and the willingness and ability to move, and establishes a relationship between people and space through physical changes (such as buildings), the use of space (such as work or living), and place attachment (such as identity, habits, and integration) in place-related decisions (Wegener, 2013). Today, mobility has been enhanced by the expansion of cities, making structures and environments more complex (Cheirchanteri, 2021). People's movement in the city, mainly walking, is not only a physical movement behaviour, but also has complex temporal and spatial dimensions, affecting people's understanding of the city and the construction of cognitive maps (Middleton, 2009). This is because moving through the city requires the integration of a sequence of views that change as one moves through the environment (Zomer et al., 2019). People see different objects and information at different times and locations, which in turn affects their wayfinding behaviour. Some information is therefore limited. For example, the Chinatown store named Bifa sign is an essential reference point, but it is only visible from a certain distance. As shown in the figure, the red dot in Figure A

represents the location of Bifa and the direction the sign faces. The sign is visible to pedestrians walking from the northeast to the southwest towards the intersection of Mosley Street and Nicholas Street, or from George Street, as indicated by the dark blue line in the figure. Conversely, the sign is not visible to pedestrians walking in the opposite direction, or from the southeast to the northwest along Nicholas Street, as shown by the dashed blue line in Figure A of Figure 34.

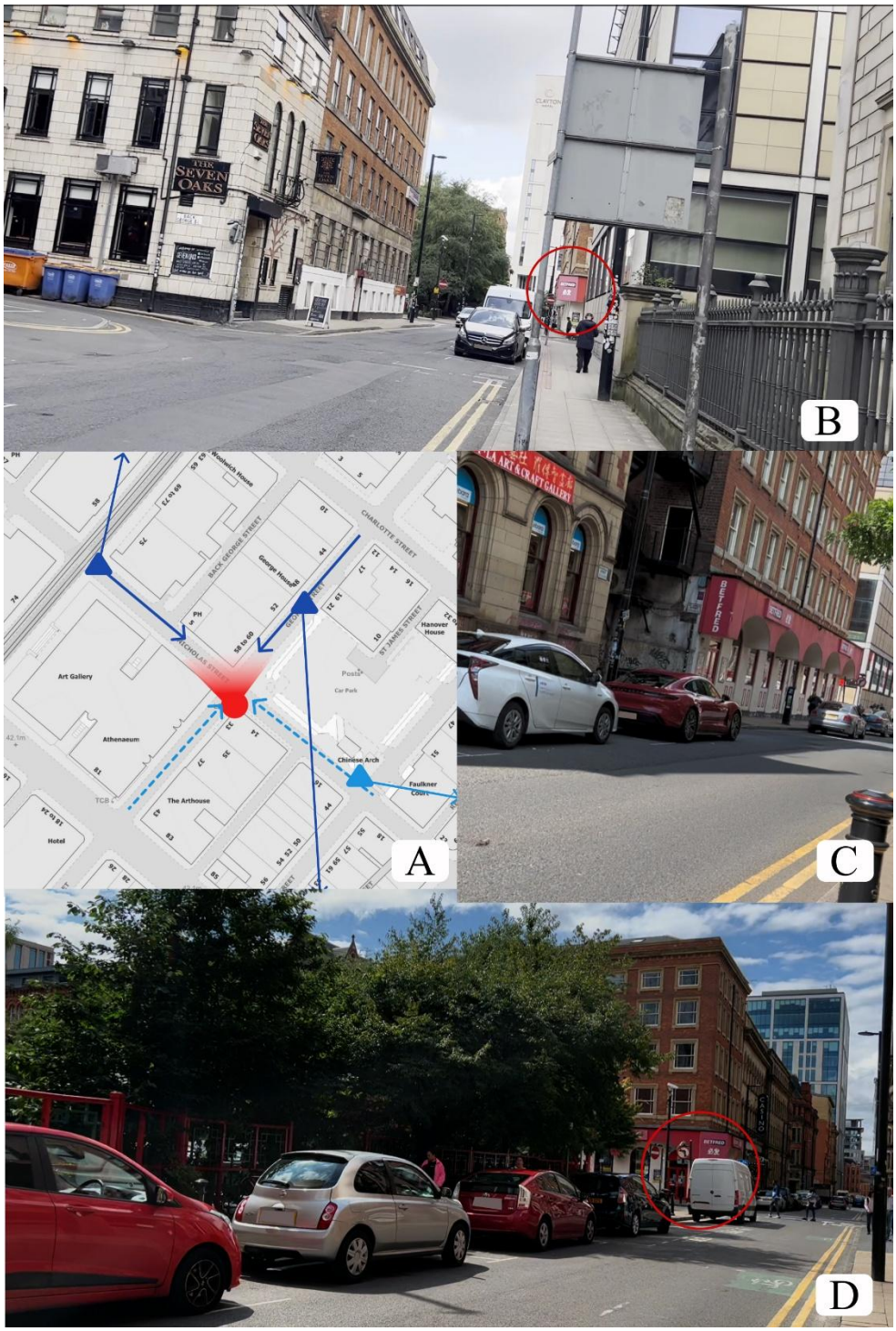

Figure 34 Visibility of the sign 'Bifa'. Figure A shows a schematic diagram of Bifa's visibility: visible when walking towards Chinatown along the road marked by the blue arrow; not visible along the route marked by the light blue dashed arrow. Figure B shows visibility when walking from Mosley Street towards Nicholas Street. Figure C shows lack of visibility in the opposite direction. Figure D shows visibility when walking from George Street. Photos taken by the author; base map for Figure A from Digimap.

Klinger et al. (2013) pointed out that the impact of space on mobility is mainly reflected in density. Density also significantly impacts wayfinding, mainly in cases where the streets are narrow and the buildings on both sides are tall. For example, one participant described it to me: ‘When the roads are narrow and tall buildings on both sides, I find it hard to find my way.’ Another factor that may influence wayfinding is the visibility of the street, or the visibility of information in the urban environment, which is essential in determining whether visual cues are effective for wayfinding. Visibility, sometimes referred to as visual access, is the extent to which different parts of the environment can be viewed from different perspectives, including the locations from which a wayfinder can observe their initial position, destination, and landmarks along the way (Omer & Goldblatt, 2007).

Another perspective on visibility is that the angle at which people see a reference object also affects the readability of the reference object, which in turn affects wayfinding. Xie et al. (2007) showed that the larger the angle of observation, the smaller the maximum readable distance of signage. Although Xie et al.'s research focused on indoor wayfinding, it still demonstrated that the visibility of signage is limited, which should also be the case in cities. On the other hand, there is related research in space syntax studies, where isovists are constructed from specific vantage points to assess the visible area on the surfaces of objects. Dalton et al. (2015) introduced the use of 3-D isovists to capture salient information and further explored how to analyse the visibility of object surfaces through isovists.

Visibility is a primary consideration for wayfinders and can help wayfinders avoid the negative consequences of being lost, including stress, frustration, and delay (Gath-Morad et al., 2021). Visibility can influence the quality of spatial knowledge acquired and the ability to construct a cognitive spatial representation of a given environment (D.

R. Montello, 2005). In other words, it concerns whether the streetscape is within a comfortable field of view for people walking daily. People extract features from the material in front of them, look for landmarks and topography, orientate themselves, and then look for the right direction—or what they perceive to be the right path.

6.2. The Representation of Information in Wayfinding

As I discussed in the previous subsection, when people are wayfinding in the city, there is much information in the urban environment that helps the wayfinding process and shapes their perception of the city. This information from the urban environment constitutes one of the wayfinding domain's foci, external features, while the other focus is internal representations (Vilar et al., 2014). After obtaining this information from the outside, people store, encode, acquire, recall and decode this spatial knowledge, also known as cognitive mapping (Ishikawa, 2016). Moreover, according to Lynch's classic research on cities (1960), he argued that this external information could be summarised into five elements: paths, edges, districts, nodes, and landmarks. These five elements help people understand and remember the city's structure and construct the city's image. Therefore, in this subsection, I will use Lynch's five elements as a framework to discuss how this information from the environment is represented in people's perceptions—that is, what roles they all play in the cognitive map.

6.2.1. Landmarks

Landmarks are an essential part of wayfinding and navigation. The relevant definition of the word landmark in the *Oxford English Dictionary* is 'An object in the landscape, which, by its conspicuousness, serves as a guide in the direction of one's course

(originally and esp. as a guide to sailors in navigation); hence, any conspicuous object which characterizes a neighbourhood or district' Landmark, n 2023). That is, it is a recognisable natural or artificial feature that is used for navigation and is a feature that stands out from the environment. Lynch (1960) defines a landmark as an external reference point the observer uses, an infinitely variable element of form. At the same time, he states that the concern for uniqueness and specificity trumps the concern for continuity. In fact, according to Lynch, the definition of a landmark is that any object can serve as a landmark. In Lynch's stated concept, the emphasis is on standing out from the environment rather than on what the object itself is as a landmark—whether it is a building or some other object—as he states (1960, p. 79): 'In another sense, subjects might single out landmarks for their cleanliness in a dirty city (the Christian Science buildings in Boston) or for their newness in an old city (the chapel on Arch Street). The Jersey City Medical Centre was as well known for its little lawn and flowers as for its great size.' Nonetheless, Lynch pays little attention to landmarks outside of buildings. His discussion of landmarks is primarily centred on architectural landmarks. This tendency may give the illusion that landmarks consist mainly of buildings, and that other objects in the city may have been neglected or disregarded to some extent.

However, in my research, unlike Lynch's theory, my hypothesis is that landmarks are only one part of the valuable information for wayfinding and people's perceptions of the city, which should be seen as two intersecting but not overlapping domains. Any objects or visual cues can be landmarks in real-world wayfinding tasks, including buildings, text, streets, natural landscapes, and artefacts. During my research, participants often found an object helpful in their wayfinding or noted that they could remember and use it as a wayfinding reference for various reasons. However, they did not think the object could be considered a landmark.

In Subsection 2.3.2, I discussed the definitions of landmarks by various authors after Lynch's definition. Typically, a landmark is defined as a prominent reference in the environment. Nevertheless, participants may have had some common-sense ambiguity about the term landmark. For example, I followed up with one participant on this issue, and the participant explained, 'I think a landmark should be relatively well-known.' People's understanding of architectural landmarks is closer to iconic buildings with historical or cultural value, which differ in design, scale, visual appeal, urban texture, or architectural style (Elhagla et al., 2020). The National Football Museum, Cathedral, Central Library, Town Hall, Royal Exchange Theatre, and John Rylands Library are typical examples. Objects of cultural and historical value are also considered landmarks—a point that Lynch's definition neglects.

Raubal and Winter (2002) argue that landmarks are visually attractive if they have specific visual characteristics (façade area, shape, colour, visibility, and other visual attributes) that contrast with their surroundings or stand out from their spatial location. Typical examples are buildings with extreme styles, such as the Art Gallery, historic buildings like the Cathedral, or unique buildings like the National Football Museum. These landmarks are considered landmarks because of their unique appearance and architectural style, but also because the style corresponds to the appearance of the building.

Many references are helpful for wayfinding and exist in people's understanding, but they are not considered landmarks. Participants extracted their distinguishing features and described them as 'house with round tower roof', 'cave building above around', 'overhang building', 'white building', and 'the big glass building', to name a few. Some buildings are even labelled directly on the map and described simply as 'the building'.

Landmarks are undoubtedly helpful for wayfinding. The utilisation of landmark location information can reduce decision-making errors (Lin et al., 2012). However, there are some objects that people consider landmarks but do not find meaningful for wayfinding. For instance, Queen Victoria's statue in Piccadilly Gardens and the arches inside Chinatown, as discussed in Subsection 6.1.2.3. However, after a comprehensive analysis and collation of the data, my hypothesis is that this is merely a superficial effect—these landmarks do not play a role in the wayfinding process. The role of such landmarks is to help people determine whether they have reached their destination.

According to Yesiltepe et al. (2019), landmarks are divided into two categories: global landmarks, which are visible from a distance, and local landmarks, which refer to nearby landmarks. Of these, global landmarks may be more like the concept of landmarks seen from multiple angles and distances, as described by Lynch. Anacta et al. (2017) state that local landmarks along routes and global landmarks that support orientation are both significant. However, my hypothesis is that global landmarks may only be useful if one can see an unobstructed path to the location. This may be because, in urban environments, despite seeing landmarks in the distance, they are still not helpful in finding an accessible path.

This different perception of landmarks is also reflected in the contrast between maps and reality, as maps provide people with a macro view. There is a slight difference between the landmarks people see when looking at a flat map and the landmarks they perceive in reality, unless the map specifically emphasises and accounts for this situation. An example of this difference is that during the workshop, all the groups labelled the massive building of the Arndale Shopping Mall as a landmark (Figure 35). However, during the walking interviews, participants always perceived parts such as the big screens, doorways, and corridors as more of a landmark than the building itself. One

walking interview participant thought Arndale was an essential landmark after he saw the writing on the building. However, they also said that without the text identifying the building, it becomes challenging to identify the building because ‘it is too tall for me’.

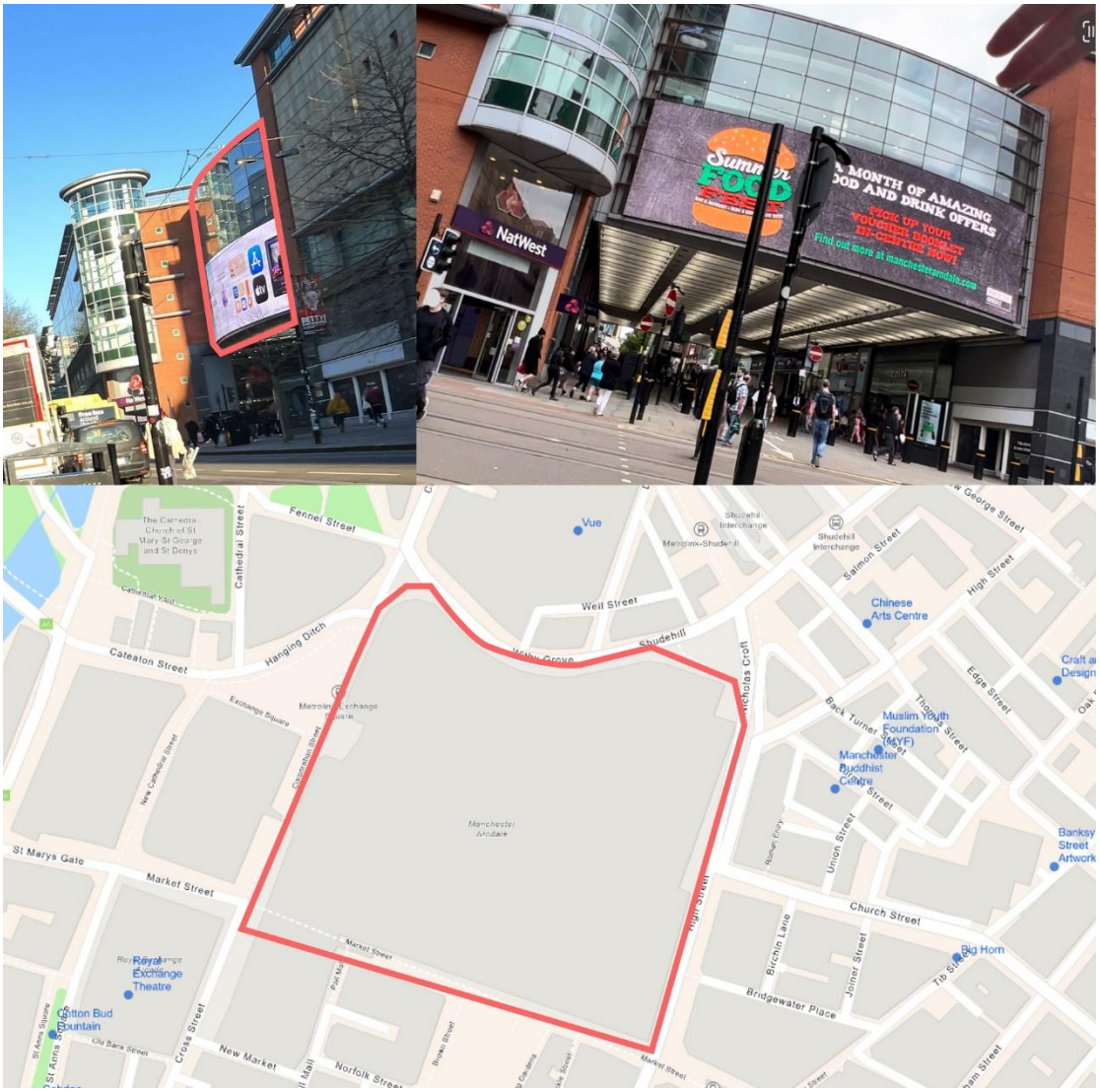

Figure 35 ifferent angles of the large screen on the Arndale Shopping Mall (above) and a graphic of the building on a map (below). Photos by the author. Base map image downloaded from Digimap.

Overall, the significance of landmarks in wayfinding consists of three types: helping people locate themselves, assisting in decision-making (such as whether to turn or go

straight), and enabling them to judge whether they have arrived at their destination. Landmarks that help people orientate themselves usually need to correspond to a map—unless they are already familiar with the place. Landmarks for making decisions are often visible at crucial decision points. Landmarks that help people determine whether they have reached their destination are often destinations themselves or have an undeniable connection to them.

As individual objects, landmarks shape people's perception of the city, but not all landmarks do so. For example, some people identify landmarks during the process of wayfinding but forget this information after completing the hand-drawn map at the end of the walking interview. Queen Victoria's statue in Piccadilly Gardens was also recognised as a landmark, but the garden, rather than the statue, made a stronger impression on people's perceptions. Strongly styled or significant landmarks become symbols and representations of the neighbourhood, influencing people's perceptions of the area, and are often found in architectural landmarks, as I have discussed in Subsection 6.1.2.

6.2.2. Paths and Nodes

Lynch similarly emphasises the importance of paths. According to my research, people may have a vague concept of paths, even though they always walk on them. Regarding the maps they drew, paths formed simple connecting lines between places in the participants' minds. Some people could only draw a straight or curved line connecting all the destinations. Some could remember impressive decision-making junctions and map the turning behaviour. Roads were conceptualised as lines connecting places, like modern underground maps. No one drew the maps with east, west, south, and north orientations—just as almost no one cared about east, west, or north during the

wayfinding process. People's impressions of roads are usually constructed from the streetscape on both sides of the road, unless the road itself has an impressive shape (such as a substantial curvature) or is remarkable in some other way (such as a tram track), as I discussed in Section 6.1.5. After the second map mentioned in Section 6.1.1 was activated, people began to use the street names as references for wayfinding. However, once the journey was over, they rarely managed to match the street names with the streets they had drawn. In workshops, street names were entirely ignored. In general, people preferred main roads to isolated side streets.

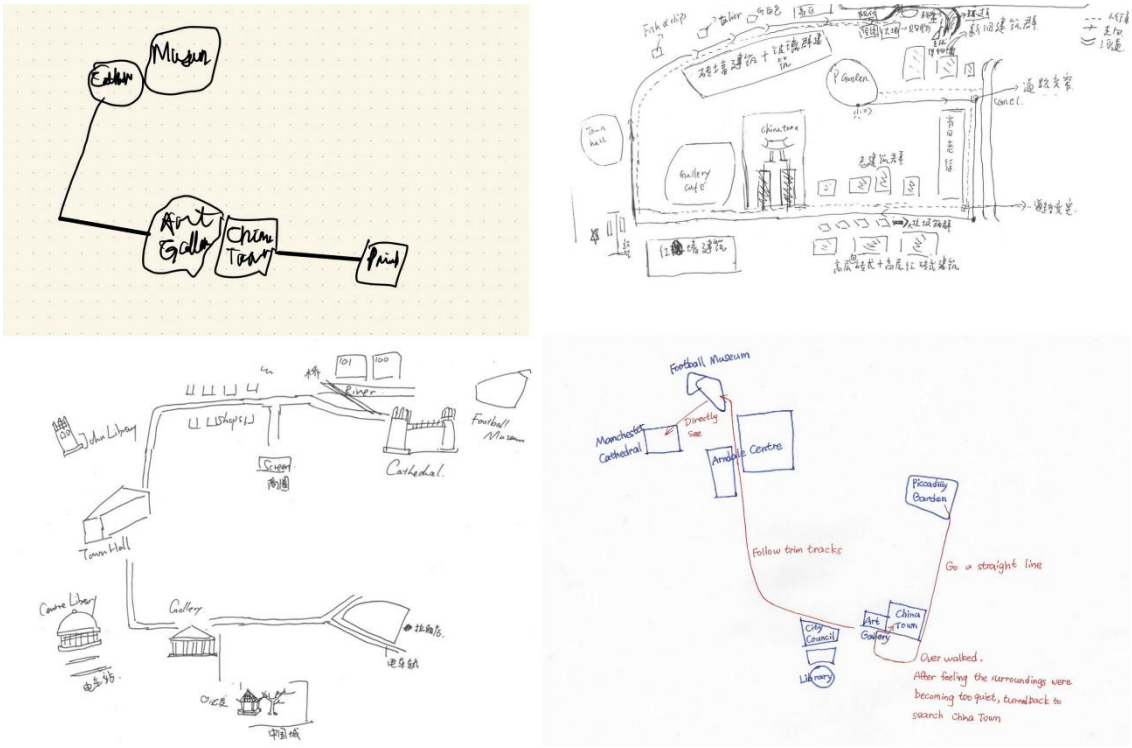

Figure 36 Examples of hand-drawn maps with varying levels of detail, drawn by participants.

In addition to the planned paths (streets, tramways, and bridges), there are potential routes in the city, which refer to routes other than the already planned ones. For example, a local Manchester participant took me through a route hidden between the Central Library and the adjacent building, which appeared to be part of the building.

There were also routes where people travelled through squares and open spaces. This coincides with Ingold's (2008) notion that people create a line when they walk—a trace of movement and a continuation of a way of life. Similarly, Smith and Walters (2018) point out that desire lines are people's own routes created outside of prescribed paths, which are a form of resistance to the spatial order imposed on them and a sign of social and historical activity. The authors also emphasise that desire lines are socially constructed, responding to people's choices based on efficiency and personal preference, and demonstrating the discrepancy between planned space and actual use. Burnett and Lloyd (2019) propose that desire lines show people's intentional and purposeful travelling directions, reflecting how people create their own routes through the environment to gain information about it. Bates (2017) states that desire lines are often understood as a sign of the failure of urban planners and landscape architects to predict and provide official roads in the right places. These potential routes reflect people's relationship with space and their environmental interaction.

Although Lynch (1960) mentions that paths also include routes that people might take, he focuses on clear, well-defined paths and on the grid structure that paths form. It is easier to impress people with paths that have distinctive features. In the case of my research, it is generally the paths with notable features that leave an impression—whether they are planned formal paths or potential routes such as desire lines. Overall, some main roads with special features form a more lasting impression, while others have relatively fewer memorable characteristics. Even though people walk on roads, they usually ignore their role in wayfinding and think of them simply as passages to move through. Nonetheless, if they are clearly and distinctly characterised, their place in wayfinding becomes dominant. Once there are continuous, followable road features that correspond to the map, participants usually ignore other cues and information, because the road forms a continuous reference.

A few junctions and three transport hubs discussed in Subsection 6.1.5 were essential nodes. Despite being a vital component of the city, several large transport hubs usually receive a more negative evaluation. As Bertolini (2008) suggested, stations are not only nodes but also places, serving as concentrations of multiple activities with high accessibility and traffic flow. Intersections are nodes and often crucial decision points for wayfinding (Brunyé et al., 2018). High traffic flow and accessibility mean crowds and congestion, usually making transport hubs look busy and cluttered.

As Xia et al. (2008) stated, during wayfinding, people divide routes into path segments, decision points, and landmarks located near the decision path segments. Decision points that are greater in scale (such as having a larger footprint) are also more memorable. Based on my research results, my hypothesis is that decision-making points at intersection-type locations on the edge of a region are typically memorable. For example, a decision point where people enter an area that feels different from the one they were in previously tends to leave a stronger impression. Typically, this change is primarily caused by the streetscape, which alters people's perception of the city. This brings us to a more latent and implicit type of decision point—namely, the entrances to an area. These entrances are usually vague, with only an approximate location or small extent, not necessarily a junction, and sometimes located along a straight path. However, decision points on a straight line are usually less memorable than those at a junction. This notion of decision points relates to the concept of region and its boundaries, which I will address in the next section.

6.2.3. Districts and Edges

Lynch (1960) argues that the physical characteristics that determine districts are texture, space, form, detail, symbol, building type, use, activity, inhabitants, degree of maintenance, and topography. Lynch's theory is also reflected in many existing maps, particularly tourist maps, which are happy to divide the city into several contiguous districts according to some criteria. However, during my research, it seemed that the districts in the wayfinding process were disjointed and that there were places that could not seem to be considered belonging to any district. This may be because Lynch's study is based on American cities, whereas mine is based on British cities. Research into the morphological representation of cities suggests that there are generally two types of structures that are very different in the appearance and layout of their constituent elements, with the *compact city* often seen as unique to historic European cities and the *sprawl* as typical of American cities (Dieleman & Wegener, 2004; Nguyen et al., 2020; Schwarz, 2010). American cities exhibit the dispersed, irregular agglomerations that characterise urban sprawl, dating back only to the eighteenth or nineteenth centuries, while British cities typically have more compact urban cores, building on their original heritage (Huang et al., 2007). This difference in urban form and history of urban development may have led to cities in the United States having more clearly defined areas and boundaries than those in the United Kingdom.

In contrast, Manchester's districts, as understood and perceived by individuals, are more likely to comprise a continuum of compact information that creates relatively fuzzy boundaries. In Manchester, there are relatively few clear boundaries, most of which remain blurred, and many areas of the city are not arranged block by block, but instead consist of multiple blocks overlapping each other. Some of the more clearly defined

areas include the business districts and Chinatown. For instance, one participant described this on Market Street:

'There are different kinds of coffee shops, clothing stores, every kind of malls, as well as the Arndale shopping mall is also here. It's a proper market area, like this sort of attractive area in the city, sort of, I would say that.'

Another participant in the same location described it this way:

'There are big screens here. There are advertisements everywhere. So usually, where there are big screens, it will be a mall.'

It is easy to see that people judge what kind of area they are in by the information they receive from their urban environment. The same is true of Chinatown, though it demonstrates a gradual layering. People usually first see a sign with Chinese characters in the distance, then spot some Chinese elements such as the pavilion, the red fence, and the many Chinese and Asian restaurants in the district and finally find the Arch of Chinatown. These elements related to Chinatown come together to make up the district. There is a hierarchy among these elements—the most significant being the Arch, followed by the others. I will deal with Chinatown and its boundaries in more detail in Section 7.2.

Some places had no character at all, and participants did not feel that they were walking within a definable district. One participant described an area near the Town Hall as:

'This area is hard to identify because new buildings are interspersed with old ones, and each is about the same size, except for Town Hall itself, which I find similar all around...The street view is similar, and I need to identify it.'

Describing the streetscape of John Dalton Street, another participant said that the area was quite ordinary and looked like other cities: 'There are a lot of small shops, but I cannot remember their names.' Another participant described Chancery Lane and Booth Street: ''I do not think it is different ... The roads are narrower here and were wider before, and there is no public transport here, but apart from that, it is not different.'

Figure 37 Street scene on John Dalton Street, a street generally considered unremarkable. Photographed by the author.

Manchester has a handful of clear boundaries, such as Cateaton Street, which is located on the south side of the Cathedral. This curved road is considered a dividing line, with modern buildings and shopping malls on one side and historic buildings on the other. Deansgate, located in the middle, is an obvious boundary when walking from Lloyds

Street to Hardman Street. One participant said, ‘The two sides of this road look like two different eras. I even feel like I am travelling through Time.’ Near St Peter’s Square, Lower Mosley Street forms a boundary. Two participants said, ‘The buildings across the street are classic, but the buildings on the other side look modern, and it feels like walking into a business district.’ However, these boundaries do not necessarily correspond to the edges of a district; they may be completely independent of a specific area, or they may mark the boundaries of more than one area. Clear boundaries are relatively rare, and most are vague, giving the impression that the edges of many areas overlap.

The impact of districts on wayfinding may be related to the nature of the destination. Districts are helpful when people have vague or general destinations. For example, if someone’s goal is to go shopping without specifying a particular shop, then districts are useful. When people have specific destinations, there is often a phenomenon where they form a mental image of the destination, imagine its category, and infer what kind of area it might be in. For example, when two participants were looking for the Town Hall, they thought the building should be relatively traditional or historic, so they avoided areas with many modern buildings. However, this kind of speculation is not always successful, as Manchester’s urban style often mixes old and new buildings. Edge, on the other hand, is a concept that has almost no presence in the wayfinding process. Although Lynch believes that clear areas and boundaries enhance the legibility of a city, fuzzy areas and boundaries may offer a more nuanced navigational and cultural experience. The cultural and historical heritage of British cities has influenced how people represent and perceive areas and edges, with relatively few functionally defined districts. Manchester reveals more historical layering and cultural complexity, which complicates the definition of edges and areas.

6.3. Summary

In this chapter, I analysed the information from the urban environment that plays a role in the wayfinding process and the design of a wayfinding system. This information includes buildings, heritage, artefacts, paths, traffic hubs, public spaces, shops, seasonal and real-time information, as well as mobility and visibility. Subsequently, using Lynch's five elements as a framework, I compare and analyse the role of this information in spatial representation and its impact on enhancing the clarity of urban space and urban identity. Although the use and identification of information varies from person to person, the commonalities are undeniable.

Architecture and heritage are the most influential factors for wayfinding and the impression of a city, derived from their appearance, shape, and location. In addition, artefacts often appear on the façades of buildings and are therefore sometimes perceived as part of a whole. Memorable streets tend to be remembered more easily. When streets contain consistent and map-corresponding cues, these cues become dominant in the wayfinding process. An analysis of mobility and visibility reveals the dynamic nature of wayfinding, where people encounter different information at different locations and times.

Manchester gives the overall impression of a city where old and new buildings are intertwined. Landmarks, wayfinding, and the information that shapes the impression of the city should be seen as an overlapping intersection. In addition to planned streets, some potential walking routes reveal people's mobility preferences and patterns of spatial use. There are many small areas in the city, most of which have blurred boundaries. This analysis shows that in Manchester, the cognitive representation of the

urban environment is not only related to physical features but is also closely influenced by social, cultural, and historical factors.

This information should be integrated into a cognitive map, and subsequently into a city image, in order to explore its specific manifestations, functions, and potential design applications within the wayfinding system. Therefore, in the next chapter, I will explain in detail how the image of Manchester city centre was formed.

Chapter 7. The Image of Manchester's City Centre

In the previous chapter, I discussed the information from the urban environment that people use to support their wayfinding process, as well as how this information influences people's perception of the city and its representation in cognitive maps. Urban image is the image formed in people's minds based on the characteristics of the city (Chan et al., 2021). Human spatial behaviour depends on individuals' cognitive maps of the spatial environment (Downs & Stea, 2011), and these cognitive maps can converge on the images. People's attitudes and behaviours towards a city largely depend on the image of that city (Gilboa et al., 2015; Khashim et al., 2017), which is based on the core and essential factors in the relationship between people and cities (Laaksonen et al., 2006). Therefore, creating an identifiable image can support the discussion of people's behaviour in space, as well as their attitudes, emotions, and perceptions towards the city. It also provides a foundation and visual framework for integrating environmental information into wayfinding system design.

This chapter aims to explore the image of Manchester city centre from a wayfinding perspective, examining how it is perceived by people. It is divided into two main parts. Firstly, Section 7.1 presents the overall image map of Manchester city centre. This image reveals people's general understanding of Manchester and the elements that make up the city image, including significant landmarks, paths, areas, boundaries, and decision points. Then, based on this overall map, Sections 7.2 to 7.6 discuss the image of each part of Manchester, including Piccadilly Gardens; Chinatown and the Art Gallery; the Central Library and Town Hall; Deansgate; Arndale Shopping Mall and surrounding commercial areas; and the Cathedral and National Football Museum. These

cultural districts—which also form the core context of this research—can help explain how the image of the city is uniquely shaped.

7.1. The Image of Manchester City Centre

The image map of Manchester city centre is based on analysing and integrating all the data, as shown in Figure 38. Despite some individual differences—such as those affected by subjective perception and individual wayfinding ability, which lead to variations in how different participants conceptualise certain locations—there are still identifiable commonalities. In addition, the differing concepts of the same area among participants also reveal another layer of Manchester's image: the overlapping nature of its areas and the ambiguity of its boundaries. It should be emphasised that this thesis focuses on wayfinding and wayfinding system design. Although the image of the city is an integral part of this process and one of the two foci of wayfinding, its purpose here is to provide a basis and visualisation for designing the wayfinding system. The image of Manchester presented in this chapter results from people's interaction with the city, specifically within the context of wayfinding activities. These results are derived from two perspectives: the perspective of the city's physical characteristics and the subjective experience gained during actual wayfinding in the urban environment, and the perspective of the conscious extraction, creation, and arrangement of information for the purpose of designing a wayfinding system. Therefore, these images reflect the information, experience, and mental representation of the urban environment that can be applied to wayfinding system design—but they may differ from traditional city-centric images based on generalised perception, such as those in Lynch's research.

Figure 38 Image of Manchester city centre. Drawn by the author.

As shown in the instructions in Figure 38, the red star shapes indicate key nodes and decision points. The dark blue dotted lines denote relatively well-defined edges in the city. The black triangles mark pieces of environmental information that participants used and found memorable, including both landmarks and non-landmark features of the urban environment.

Roads are represented using lines of different colours, textures, and widths. The dark grey lines usually signify main roads and arterial routes. Grey-textured lines, filled and outlined in dark grey, indicate secondary routes that are less commonly travelled. The blue dotted lines represent tram tracks, with particular emphasis on segments that serve as important references or have left a strong impression. In addition, the orange dotted lines show invisible lines in the city—routes that participants took outside the planned

road and street network. These potential paths highlight locations and areas where unofficial or informal routes are frequently found.

Areas are represented in two distinct ways: one by a blue gradient shape, outlined with a dashed line and marked by a blue circle at its centre, and the other by a red shape, also outlined with a dashed line. These two types reflect different approaches to area representation, derived from findings during the data analysis process. As discussed in Sections 6.1.2 and 6.2.3, some objects were found to influence their surrounding environment and were perceived as an integrated whole. As explained in Chapter 5, the methods and cognitive tools used in the workshops evolved over the course of the iterative process. The earliest workshops did not include street view photographs, which led participants to adopt a broader, more macro-level view of the city. In subsequent workshops, the inclusion of street-level imagery enabled participants to engage with the environment in a more grounded way, aligning their perceptions more closely with those derived from walking interviews. As a result, their understanding of areas shifted towards smaller, street-level spatial definitions. Therefore, both methods of representing areas are used in this figure to reflect the multiple spatial scales and diverse perceptions of urban space observed throughout the research.

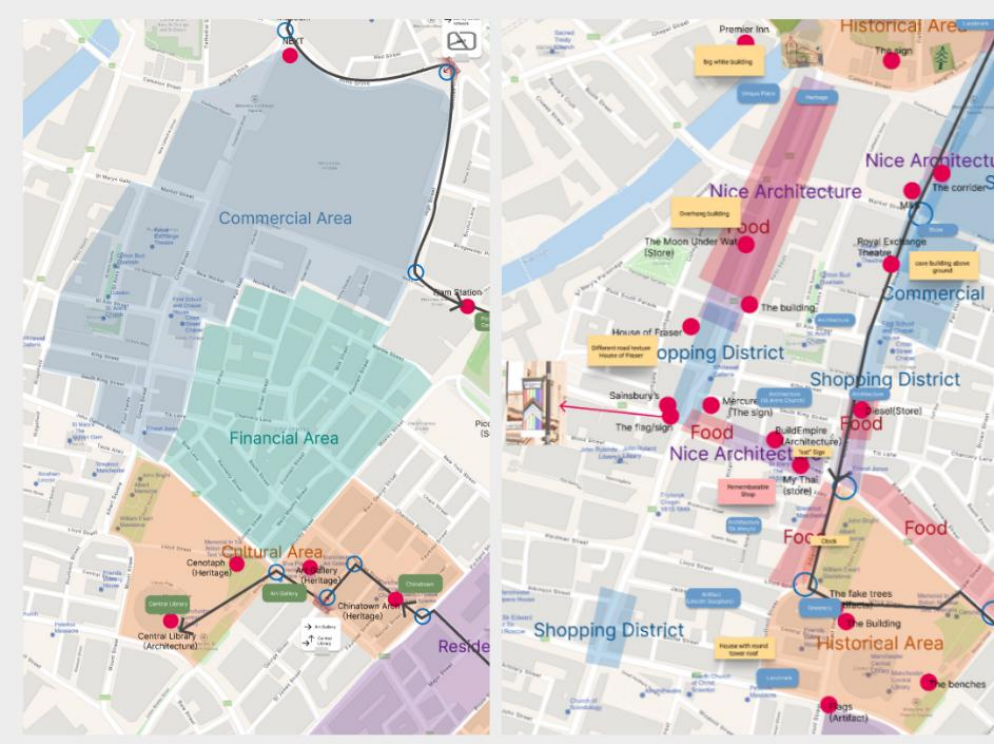

Figure 39 Example comparing data from different workshops. Left image from the first workshop presents a macroscopic perspective of district division. Right image from the second workshop shows that, due to the introduction of the street map along the street, the area appears fragmented along the street. Drawn by the author.

Next, to explore the urban image of Manchester city centre in more detail, I will break down and discuss the image area by area and analyse it.

7.2. Piccadilly Gardens

Piccadilly Gardens is the starting point for all trips. According to some tourist maps (visitmanchester.com, n.d.) and Manchester City Council information (*Piccadilly Gardens | City Centre Regeneration Areas | Manchester City Council*, n.d.), the more official area of Piccadilly Gardens should be the area bounded by Mosley Street on the

west, Parker Street on the south, Portland Street on the east, and Piccadilly Street on the north. This may be the more official scope and boundaries of the area.

The most distinctive impression of Piccadilly Gardens is that it functions as a major transport hub, featuring bus and tram stops, several intersecting tram tracks extending in multiple directions, a prominent long wall, rest areas with numerous trees and benches, and green spaces located behind the wall. Elements and visual cues that are meaningful for wayfinding or that influence people's spatial experience are distributed throughout this space (Figure 40).

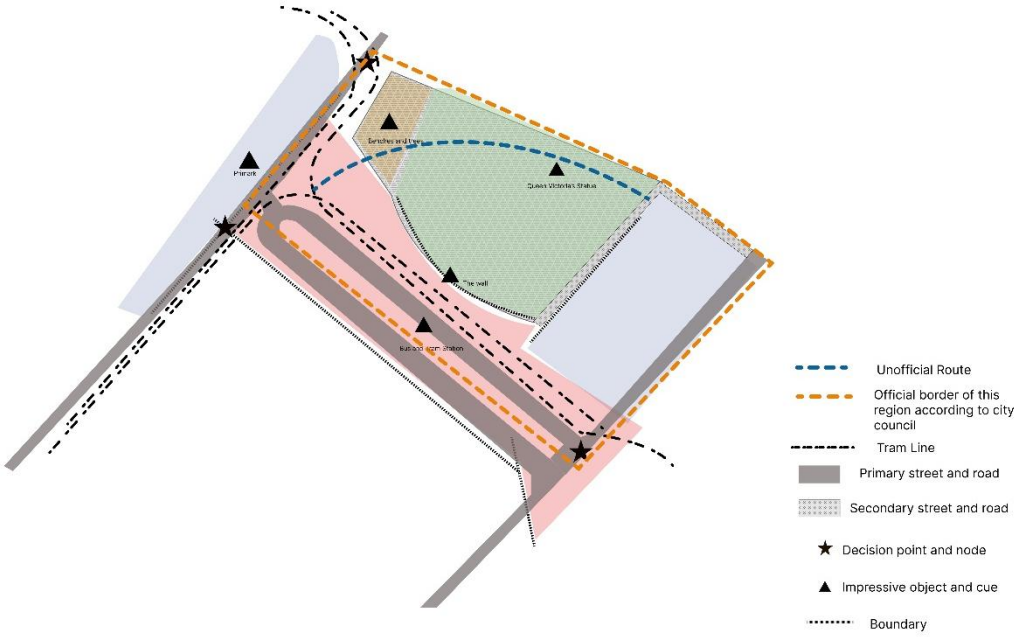

Figure 40 Image of Piccadilly Gardens, drawn by the author. Following the reorganisation of the data, the image has been updated and therefore may differ slightly from the previously published version.

As shown in the diagram, the yellow dotted line represents the official boundaries of the area, which I have derived from a tourist map and information from the Manchester

City Council. The blue dotted line represents potential routes outside the planned route, showing a general trajectory and where they are likely to occur. The black dotted line indicates some relatively clear boundaries. It is obvious that all participants clearly distinguished the park itself from the buildings and tram stops next to it, which they all perceived as different areas. Piccadilly Gardens was perceived as a green space, and the area next to it, consisting of trams, tram stops, bus stops, and roads, was understood to be a transportation hub. Participants had different experiences in different locations in this area. As shown, the green graphic represents Piccadilly Gardens—the area of Piccadilly Gardens given on almost all maps. The yellow area is the grove and the benches, which gave the area a somewhat cosier feel. Both areas give a more favourable impression. The red graphic represents the transport hub and is an area that is often described negatively. The areas represented by the blue graphic are different from the previous two, as many people do not know what these areas are and see them as very common—the type of street that could be found in any city. Some participants mainly considered these areas commercial or business districts but noted fewer features and impressions. In addition, the black triangles represent impressive local objects, while the stars indicate three important nodes and decision points for people in their wayfinding.

The long, curved wall is the clearest boundary, separating the garden from the adjacent transport hub. When people are on the southwest side of the wall, they usually see Parker Street, Mosley Street, and Portland Street, and they see traffic, stations, and people in a hurry. They therefore perceive the area as chaotic and congested. They disliked the area, and the responses were largely negative about whether it was attractive or impressive. The tram and bus stops on Parker Street are the main reason for this, primarily when the wall blocks people's view when they are located on the south side of the fence.

However, when participants are located on the north side of the wall and inside Piccadilly Gardens, the comments are relatively positive. Piccadilly Road to the east from the south side of the Garden, at the corner of Piccadilly and Portland Street, also received positive comments. All the groups in the workshops labelled this area as ‘Green Zone’, ‘Greenery’, and ‘Square as an area with landscape’. One group described the area as ‘where people sit and eat, music can occur, good for summer, and a place everyone goes to like the centre for tourists.’

Figure 41 Piccadilly Gardens, south side of the curved wall. Photo by the author.

When people stood on the southwest side of the wall, their description of the whole area was usually ‘crowded’, ‘chaotic’, ‘heavily trafficked’, and ‘too rushed’. One participant described the place as ‘a transport hub rather than a rest area for leisure’. Some were confused because even though the area was called Piccadilly Gardens, it did not look

like a garden. One participant described it as ‘I think it is definitely more sort of city field here than in the park.’ A local participant described it to me as ‘I saw a picture of Piccadilly Gardens used as a park. picture of Piccadilly Gardens used to look like, and it kind of like in Victorian times, and it used to be an actual garden with lots of plants.’ One participant, on the other hand, explained this to me seriously from the south side of the wall, where the green space was not visible:

‘Piccadilly Gardens is not an area for relaxation or leisure. It is a square used as a traffic hub. The main purpose of this area is to buffer and evacuate crowds and pedestrians. That is why the Garden was built as the way it is, because it just was not meant for relax and leisure.’

Figure 42 Traffic hub on the north side of the curved wall. Photo by the author.

The most significant reference of this area for wayfinding was the tram lines. Many participants used it as an ever-present reference. Almost everyone mentioned the positive effect of the tram track on wayfinding.

Figure 43 Tram tracks near Piccadilly Gardens. Photo by the author.

The curved wall was seen as an important reference in this area. However, when I revisited Manchester in 2024, the wall had been partially demolished and was being rebuilt. Interestingly, despite the partial demolition and reconstruction of the wall, which made it seem as if it no longer existed, people familiar with the area still described it as an important reference, making it a ‘ghost landmark.’ The same thing happened in my hometown. A large grocery shop in the town centre used to be one of the town’s most critical and prominent landmarks. Locals used to describe specific locations as ‘near the grocery shop’ or ‘a few hundred metres north of the grocery shop.’ The grocery store closed around the beginning of the 1990s, but the building remained in place. After that, the grocery shop became a ‘ghost landmark.’ In the thirty years since then, the building was first converted into a cinema, then into a supermarket, later into a shopping mall, and eventually into a complex of diverse shops. Even though the grocery shop ceased to

exist before I was born, local people, including my peers and I, still use past names as a reference and landmark to describe the location in everyday life. This phenomenon could be an interesting perspective on people's understanding and use of landmarks, although I have yet to research this direction in depth.

The store Primark situated in the northern region of Piccadilly Gardens was regarded as a prominent landmark within this vicinity. In the case of Primark, its status as a landmark is multifaceted. Some individuals perceived the store itself as a landmark due to its substantial size and conspicuousness, while others considered the prominent signage atop the building to be emblematic. Specifically, Primark serves as a landmark for various reasons, including its widespread brand recognition, extensive physical dimensions (occupying a significant portion of the building façade), and notable signage. Additionally, several smaller establishments, such as the Post Office, Popeyes, and Manchester Hotel, were identified by certain participants as noteworthy points of reference. However, these small stores solely served as memory aids and varied greatly based on individual perspectives.

Figure 44 Primark and the long curved wall. Photo by the author.

The grove and benches adjacent to the Garden were frequently mentioned, with some participants describing the grove as ‘not necessarily a prominent landmark, but it is highly memorable and serves as a convenient reference point.’ Despite Piccadilly Gardens being considered a transportation hub, the grove was perceived as ‘a space where individuals can unwind and take respite.’ One participant elaborated by stating, ‘I am impressed that there is like lots of benches for people to sit in, and there is like an area for people to stand where you’re like away from the trams... the trees and its concrete also make it easy to find out like where you are.’ This location was consistently identified during workshops. One group referred to it as ‘Street Forest’, while another characterised it as ‘social (area)’.

When situated on the southern side of the wall, the Queen Victoria Statue was regarded as a landmark or impressive sculpture. Some individuals expressed their desire to visit this site when they are tourists, but the statue is not helpful for wayfinding. In comparison, the statue of Wellington located at the corner appeared relatively less striking. It often goes unnoticed by passers-by, seemingly due to its lack of prominence within its surroundings.

The extensive tram and bus station positioned on Piccadilly Gardens' southern side also functions as a reference that represents a bustling transportation hub. However, people tend to perceive this area as a large transport hub, rather than distinguishing the station from the surrounding area. This transport interchange greatly influences the recognition of Piccadilly Gardens, as people tend to use its proximity-based description: 'the station is right next to the garden with all those tram tracks.' Nevertheless, one participant felt that this specific location could potentially complicate wayfinding efforts and lead to confusion in giving directions because: 'But I think, because there's so many trams going in different directions, it can be really confusing. Like, do I know if I'm like something here or on that side.'

Hardly anyone considers the City Tower a landmark. This is noteworthy, considering that the building possesses distinct characteristics that set it apart from its surroundings. Despite being passed by almost all participants, it appears that this tall structure did not receive significant attention. One possible explanation for this could be the difficulty in noticing the building's towering presence and large text unless intentionally looking upwards. Additionally, none of the workshop groups identified City Tower as a landmark or useful reference point, further suggesting that it may not fall within people's daily field of view, as depicted in the street views and panoramic photographs used during the workshops.

Piccadilly Gardens evidently plays a crucial role within Manchester city centre, with some individuals perceiving it to resemble the city centre itself. The area serves as an important transportation hub due to its high mobility levels. Three key junctions can be identified: the junction of Mosley Street and Parker Street, the junction of Parker Street and Portland Street, and the junction of Mosley Street and Market Street – collectively forming three vital nodes within this region.

7.3. Chinatown and Art Gallery

The area encompassing the Art Gallery and Chinatown exhibits a disorganised and challenging-to-navigate ambience in comparison to the vicinity surrounding Piccadilly Gardens. All references, whether pertaining to edifices, signage, artefacts, or landmarks, are unremarkable and relatively diminutive in scale. The densely packed small structures engender inconvenience and exacerbate wayfinding difficulties. Chinatown is regarded as an autonomous district independent of its environs. The Art Gallery building itself constitutes one of the most prominent landmarks within this locale; another significant landmark is represented by the Arch situated in Chinatown.

On Mosley Street, a prominent building is The Bank, also known as The Portico Library, which was recognised by several participants who passed by. A participant noticed the presence of The Bank of China on this street and inferred its significance as a potential reference point for Chinatown's proximity. Describing the route from Piccadilly Gardens to the Art Gallery, Mosley Street was characterised as unremarkable and typical; they described this street as 'one side consists of old buildings while the other side has modern buildings.' Participants did not perceive this street as possessing

any distinct characteristics or unique attributes. As one participant remarked, ‘I consider it quite common...a very usual place in city.’

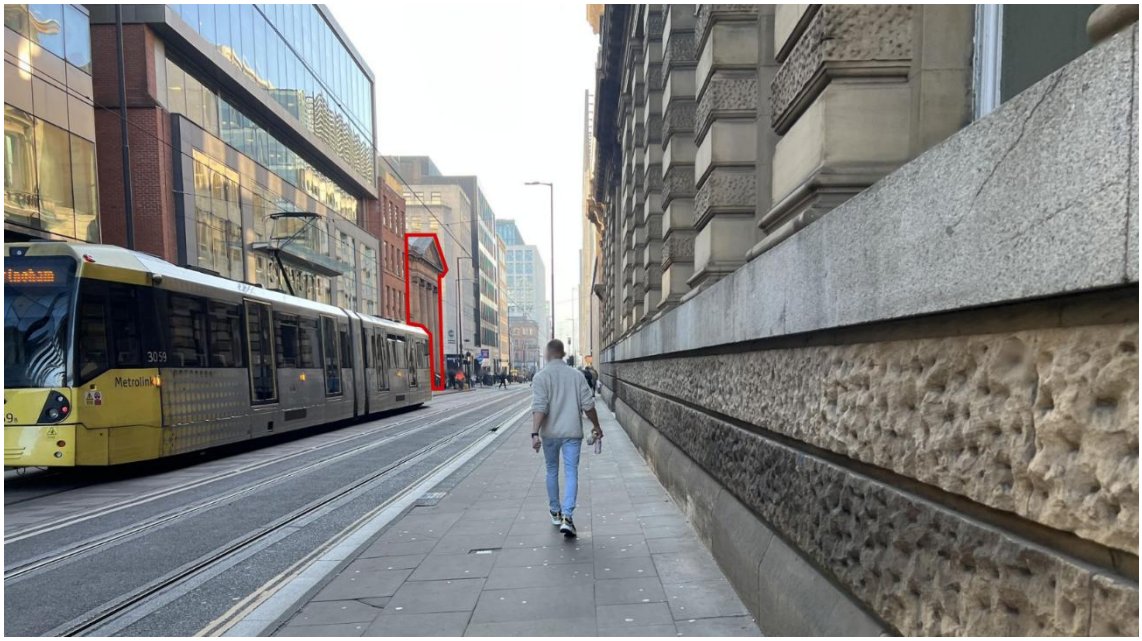

Figure 45 Street scene of Mosley Street, usually considered featureless. The red boxed area is The Bank, also known as The Portico Library. Photo by the author..

The Manchester One building is commonly regarded as a reference or a landmark along Portland Street. While some participants emphasised its conspicuous appearance, others focused on the prominent ‘Manchester One’ text adorning the building façade. The area encompassed by New York Street, George Street, Charlotte Street, and Portland Street was not deemed distinct enough to constitute a separate district.

Chinatown’s most notable feature is the Chinatown Arch, serving as the area’s prominent landmark. Although the centrally located car park occupies a considerable space, participants generally found it less impressive, often viewing it negatively. Some expressed confusion regarding its presence in Chinatown, considering it out of place. The Chinese pavilion adjacent to the car park, while a typical Chinese-style structure, is

seldom recognised as a landmark; instead, it is often perceived as a Chinese-themed element or cue. A notable reference point for many is a shop named Bifa across the street from the pavilion, primarily due to its expansive red signage and prominent Chinese characters '必发' (Bifa). Other frequently observed elements include Chinese architecture, Asian establishments, restaurants, supermarkets, prominent Chinese-style signage, calligraphy, Chinese motifs, and various red accents. Additionally, participants noted the significant presence of Asians in the area, further contributing to the cultural ambience of Chinatown.

Figure 46 'Bifa', the Chinese-style pavilion, and the Arch in Chinatown. Photo by the author.

Regardless of which route the participants chose and from which direction they entered Chinatown, they would invariably make the same judgement: when they saw Chinese-related elements, they knew they were almost in or near Chinatown. The Arch in Chinatown served as an unmistakable marker, leaving no doubt that they had arrived there.

The Chinese language often played a crucial role in their decision-making process, as I discussed with some examples in subsection 6.1.3. Many participants explained that when they saw the Chinese characters, they knew they were close to Chinatown.

Despite many participants not speaking or understanding Chinese, they could recognise the writing as Chinese. As one participant noted, ‘I have looked at the words, that’s got Chinese writing on it. Asian, I don’t know whether it’s Chinese, is it Chinese? So, I am guessing it is.’

Participants tended to perceive Chinatown more as an area or district than a specific location. While very few saw Chinatown as a location, during the wayfinding process, it was the Arch that they viewed as a location. Participants highlighted various elements, such as the abundance of Chinese restaurants. Individually, these elements may aid in identifying locations, but collectively, they contribute to Chinatown’s distinct identity as an area separate from the surrounding environment.

Figure 47 Variety of Chinese elements, including Chinese artefacts and Asian restaurants. Photo by the author.

Most participants regarded Chinatown positively because of its attractiveness and strong impression. Those from China often cited the appeal of the numerous Chinese restaurants, and two participants also expressed that they primarily visited for food purchases rather than for the neighbourhood or local architecture. Other participants noted the abundance of Chinese eateries and appreciated some aspects of Chinese-style architecture as a novel experience. However, they also acknowledged the visual clutter and disorganisation within Chinatown. Narrow streets cluttered with rubbish bins and tall buildings that restrict visibility contribute to the area's propensity for confusion and getting lost. Despite the Chinatown Arch's prominence as a landmark, its location is not easily visible from the main road outside, further complicating wayfinding. Chinatown and its environs emerged as the most challenging area for navigation in the study, with a

substantial number of participants experiencing varying degrees of difficulty finding their way within this district.

Another prominent feature is the smell in Chinatown. The dense concentration of Asian restaurants emanates a diverse range of food aromas, which some participants found particularly enticing, while one of them thought it was too pungent. Participants from China offered more detailed explanations and descriptions, with one noting, 'It's easy tell that Chinese restaurants sell completely different form local restaurants. The smell is stronger.'

The delineation of Chinatown's area and its boundaries varies depending on different perspectives. For instance, Google Maps and OpenStreetMap present divergent demarcations. In addition, some tourist maps also define the scope of Chinatown, such as the map from Manchester's official tourist website Visit Manchester (visit manchester.com, n.d.).

During the workshops, many participants depicted Chinatown as a distinct area, labelling it as either Chinatown or the Asian Cultural Area/District. Participants in the first workshop depicted areas resembling existing official maps, possibly due to fewer street and panoramic images provided for reference. In contrast, the latter two workshops yielded results more aligned with those observed during city trips.

To visually illustrate the boundaries of Chinatown as perceived by participants and other defined demarcations, I drew a comparative map of Chinatown's image (Figure 48). In this figure, the red dashed line represents the extent of Chinatown according to OpenStreetMap, while the blue dashed line delineates Chinatown's boundaries as

depicted on Google Maps. The green dotted line denotes the boundary derived from a map posted outside Manchester Oxford Road Station, which also corresponds to the boundaries and area of Chinatown as depicted on various tourist and attractiveness maps available online. Notably, the green dotted line aligns with the area outlined by participants in the first workshop. Furthermore, other map versions depict a more expansive area for Chinatown. To sum up, the maps provide a clear and consistent depiction of the Chinatown area, with streets serving as well-defined boundaries.

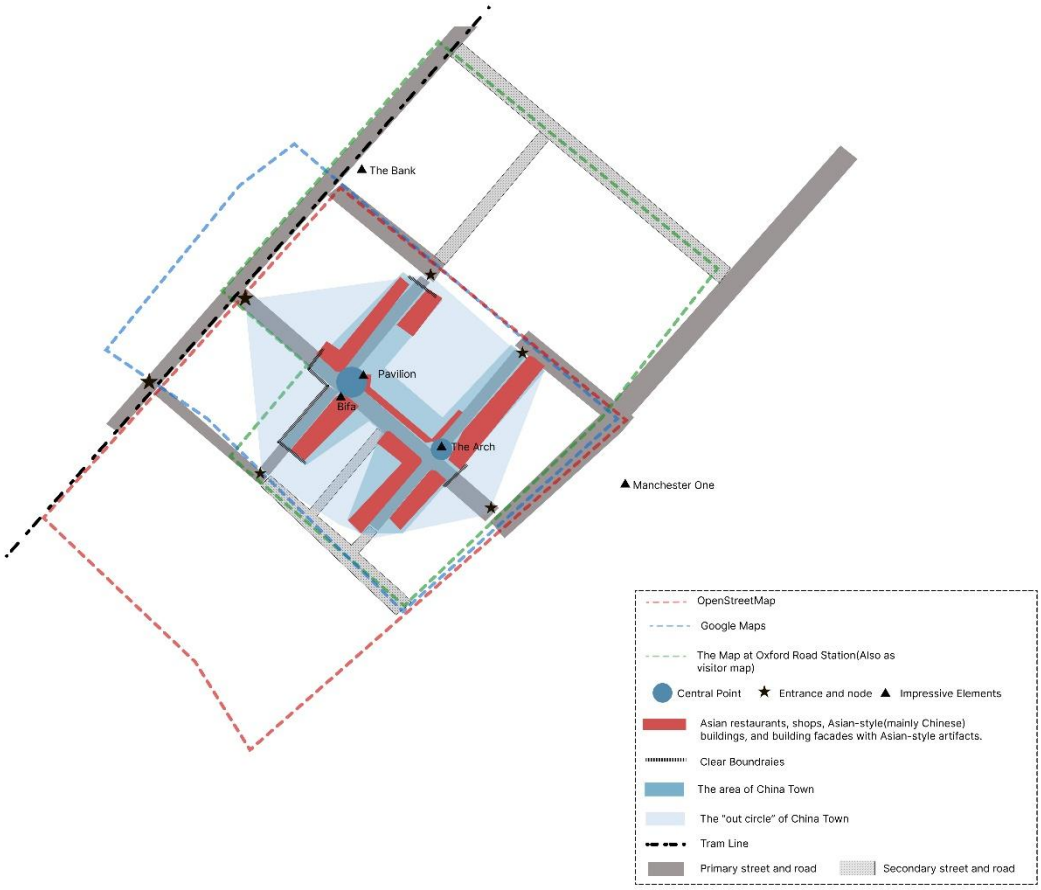

Figure 48 Image of Chinatown, drawn by the author. Following the reorganisation of the data, the image has been updated and therefore may differ slightly from the previously published version.

In the last two workshops and during all the city trips, a more nuanced understanding and idea of the boundaries and the range of the district of Chinatown emerged. The depiction was less defined and more irregular compared to the boundaries delineated by the aforementioned maps. The participants' field of vision played a significant role in shaping their perception of the area and its boundaries.

Chinatown resembles an onion-like image, with its core centred around the intersection of Faulkner and George Streets, where the Chinatown Arch stands as a prominent landmark as well as a symbol. Another crucial location is the junction of Nicholas Street and George Street, where notable references include the Bifa shop signage and the red pavilion. Overall, the Chinatown Arch, Bifa, and the pavilion constitute the two primary intersections and focal points within Chinatown, marked by dark blue circles on the map.

From these central points, Chinatown extends outward, characterised by various Asian, predominantly Chinese, elements and objects dispersed throughout the vicinity. These elements include Asian-style buildings, restaurants, shops, and decorative artefacts on building facades, represented by the red areas in the diagram. These sections are labelled as 'Chinese architecture, stores and cafes, cultural retail shops', reflecting the participants' observations during the workshops. Ultimately, these diverse elements converge to form an irregular polygon, which is depicted by the blue area in the diagram, representing the extent of Chinatown. In addition, the black dotted lines in the figure mark some relatively clear and distinct boundaries where participants expressed their determination of the range of Chinatown:

'I think we are here (means Chinatown), this is where it starts.'

'Through here, that is where we are...Straight here. Actually, this is Chinatown.'

'By the side of the street, there is the place (Chinatown).'

Beyond this area, another, more ambiguous 'outer circle' is delineated by connecting the entrances to Chinatown. This outer circle signifies proximity to Chinatown, but not yet being fully within its bounds. Illustrated as an irregular pattern in light blue on the map, this area consists of five nodes interconnected by lines, represented by the black star patterns in the picture. These five points serve as the entrances as well as nodes to Chinatown (Figure 49).

Figure 49 Visual line-of-sight study based on OS MasterMap data and OS Building Heights, drawn using ArcGIS Pro by the author. This map shows views from the five entry nodes of Chinatown, defined as locations where people can see

When individuals found themselves at these nodes, they typically assumed that elements associated with Chinatown were within their field of view. Commencing from the periphery of this area, some participants speculated that they had reached Chinatown

or were in close proximity to their destination. However, they continually used uncertain words such as ‘might be’, ‘maybe’, ‘probably’, and ‘seems’ in their descriptions, indicating that they were not confident in asserting that the location was indeed Chinatown.

Among the five nodes, three stand out as more prominent. The first node, located on Mosley Street at the northwest back wall of the Art Gallery, offers a clear view of the red sign of the Bifa shop. This signage catches the attention of all passersby, regardless of their proficiency in Chinese. The node on Faulkner Street provides a direct sightline to the Chinatown Arch, making it a distinct entrance point, while the node on Princess Street features a small sign identifying George Street in both Chinese and English. Although participants were uncertain whether this street was part of Chinatown or merely intersected with it, the presence of Chinese characters on the sign served as a significant indicator of Chinatown’s proximity.

The remaining two nodes are comparatively less straightforward, requiring individuals to pause and hesitate at these intersections. Despite initial uncertainty, people eventually discerned that these locations likely fell within the boundaries of Chinatown.

Chinatown essentially comprises a district formed by various scattered points converging together. These points encompass Asian restaurants, architectural features, Asian-style artefacts, and more. As these elements become less prominent, people’s perceptions of the area become increasingly ambiguous. Where these points densely cluster, individuals strongly identify the locale as Chinatown, perceiving it as an irregular area with blurred boundaries.

Contrastingly, the Art Gallery stands as a distinct structure within this vicinity. While some maps may include the Art Gallery within Chinatown's boundaries, none of the participants viewed it as an integral part of Chinatown. Instead, the building stands as a landmark, maintaining limited connections with its surroundings and preserving a standalone presence.

The architectural style of the building contributes significant impression to the Art Gallery's identity. Notably, its pillars are recognized as striking features. Participants expressed:

'This style of building is a gallery, or museum, at first glance. especially with these pillars...'

'I am not actually sure what this building is, but it looks like a museum or gallery.'

After that, the artefacts, including posters, flags, and text, help identify the Gallery with certainty. The entrance to the Art Gallery facing Mosley Street is easily recognisable, with the previously mentioned pillars on the façade of the building. On Princess Street, it is not easy to recognise the Art Gallery. From this direction, the building appears to have few features that stand out or distinguish it from its surroundings. Sometimes, temporary artefacts such as posters and banners appear in this direction, and whenever they do, identification becomes easier. On Nicholas Street and George Street, identifying the Art Gallery became utterly impossible for the visitors. No one on either street realised that the building next to them was the Art Gallery, except for a local participant who knew precisely where the Art Gallery was because they were very familiar with the city.

Figure 50 Façade of Manchester Art Gallery facing Mosley Street, with its pillars, is easily recognisable. Photo by the author.

In addition to the five nodes that serve as entrances to Chinatown, the most critical node in this area is the intersection where Mosley Street and Princess Street meet. This junction, with its open views and the tram tracks intersecting here, is one of the most present junctions in the area.

7.4. Central Library and Town Hall

A unique circumstance in this area was the ongoing renovation of the Town Hall throughout my research period. The renovation obscured many distinctive features of

the massive building with white construction materials, blurring its recognisable characteristics. However, this situation brought new ideas and perspectives to my research, prompting me to keep it and include it in my study.

Figure 51 Town Hall, which was under renovation during the research period, covered in white materials. Photo by the author.

The area presents a distinct landscape, encompassing landmarks such as the Town Hall, the Central Library, the Cenotaph on the corner, and the square surrounding it, Albert Square on the west side of the Town Hall, St. Peter's Square, and the tram tracks in this vicinity. The image presents a stark contrast to Chinatown. Unlike Chinatown, which is composed of scattered dots, this area comprises large blocks, with each site and building occupying a significant space. Consequently, the boundaries become more defined, with several clearly visible ones shown in the figure as black dashed lines. Notable boundaries include several streets, such as: the street from the junction with Mosley

Street up to Princess Street at the west end, which features distinct street scenes on either side; St. Peter's Square, perceived by pedestrians as an expansive and integral street, despite being a square; and the pedestrian path on the west side of Albert Square, where distinct rows of shops and the square can be identified.

Although the boundaries are evident, people's perceptions within the area appear fragmented and dispersed. The workshop participants annotated this area with labels such as historical buildings, local cultural areas, and government and education institutions. When entering this area in the real city, there is a tendency to further divide it into smaller, more numerous sub-areas rather than perceiving it as a cohesive whole. This may be attributed to each building and square within the neighbourhood occupying its own distinct large space. Additionally, other attention-grabbing elements are scattered throughout various locations and corners of the area, creating the impression of evenly distributed features. In essence, akin to the 'onion centre' of Chinatown, the area boasts several evenly distributed core points scattered throughout, giving rise to the perception of multiple focal points formed around the districts.

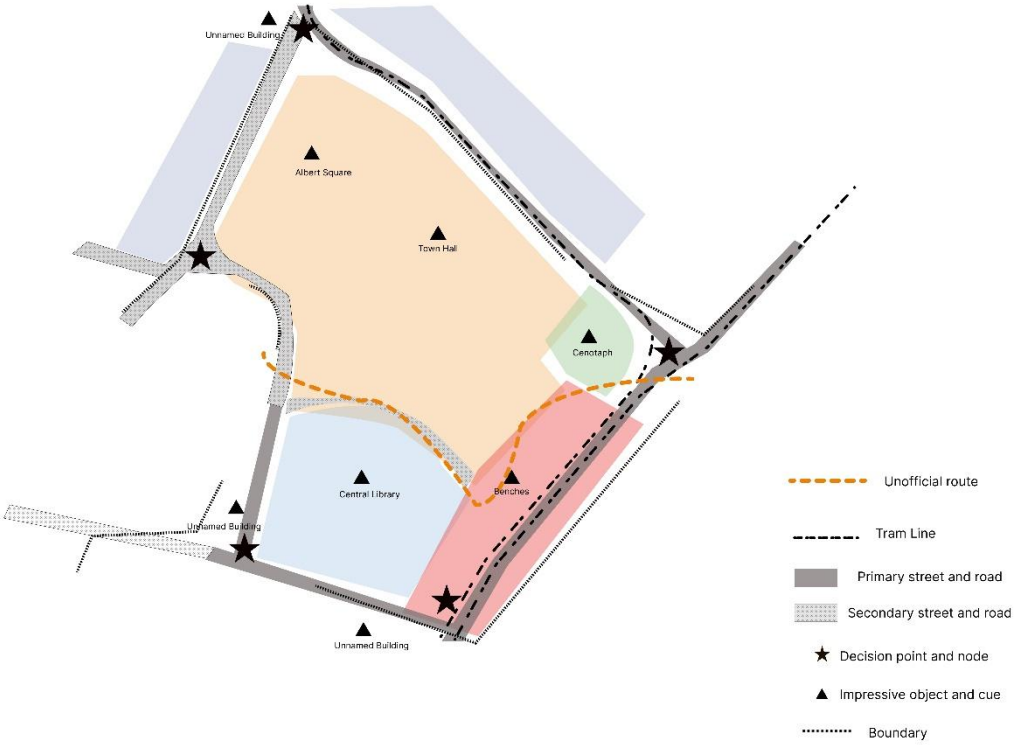

Figure 52 Image of Central Library and Town Hall, drawn by the author.

As shown in Figure 52, the broad dark grey lines represent the main arterial roads, while the light grey lines represent the secondary roads. The differently coloured blocks indicate the various smaller inner areas of the district. The star shapes indicate essential decision points, while the triangles represent impressive and wayfinding-relevant information about the area. The black dotted lines indicate the tram tracks, while the yellow dotted lines represent routes people might take outside the planned roads. This area contains many informal routes, and people often feel free to walk through the open spaces around the Cenotaph, St. Peter's Square, and the library.

Notable objects that leave an impression on people in this area include the Manchester Cenotaph on the corner, a bench in St. Peter's Square, and Albert Square. The Central Library and Town Hall are unequivocal landmarks. Additionally, several other notable

buildings are present in the area, though identifying them proved challenging. Participants could only describe them as ‘the building’, ‘the glass building’, ‘that one’, or ‘this one’. Finding the names of these buildings on maps posed difficulties. These structures typically drew attention due to their attractive or prominent architectural style, adorned facades, or intriguing decorations.

St. Peter’s Square boasts several noteworthy features, including the statue standing at the centre of the prominent street and the tram stop. Despite serving as a bustling traffic hub for trams, buses, and a transit station, feedback about this area was overwhelmingly positive. Its proximity to the Central Library contributes much to the beautiful landscaping, plantings, and open vistas. One participant expressed appreciation for the plaza’s harmony with the library and surrounding buildings. Near the Art Gallery, two participants articulated why this area felt more inviting, despite both being transport hubs:

‘... That area (means Piccadilly Gardens) feels more like a railway station to me and makes me just want to leave quickly. But it’s different here because there are a couple of benches by the tracks. And the building behind it has that kind of doorway-like decoration. That makes me think that I can sit here for a bit.’

Another participant added: ‘It has a very cultural feel to it. And that doorway gives it a very comfortable feeling.’

Figure 53 St Peter's Square and the small square with cenotaph. Photo by the author.

While locating the Central Library was straightforward due to its circular structure aligning with the map, finding the Town Hall proved challenging, with most participants needing assistance except for those familiar with the local area. However, much of this difficulty stemmed from the building being obscured by construction materials, resulting in its features being less noticeable. Despite ongoing renovation work and the fencing off of statues, Albert Square was perceived as a cohesive whole, with participants anticipating its eventual restoration. Overall, comments about this area were

positive, with people speculating and favouring what should have been a gorgeous area despite the Town Hall being obscured by building materials.

7.5. Deansgate, Arndale Shopping Mall and Commercial Areas

Deansgate, a prominent thoroughfare traversing almost the entire city centre, along with Cross Street, the Arndale Shopping Mall, and the array of shops and offices in proximity, forms a substantial portion of the city centre's business and financial hub. While some tourist maps categorize the area as a central retail district, such as the Manchester tourist attraction map, it is characterised by internal boundaries, distinguishing it from a uniform commercial or retail district. Although some tourist maps classify this area as a central retail district, its internal boundaries distinguish it from a unified commercial or retail district, as discussed in 7.1. In this subsection, the image of this area is shown in Figure 54. To make it more visually apparent, I have used a graphic to briefly outline the small areas on Deansgate and Cross Street that overlap, as shown in the red graphic. The figure uses black dotted lines to indicate tram tracks, triangles to indicate important information, and stars to indicate important nodes and decision points, as shown in the instruction in the lower right corner of the figure.

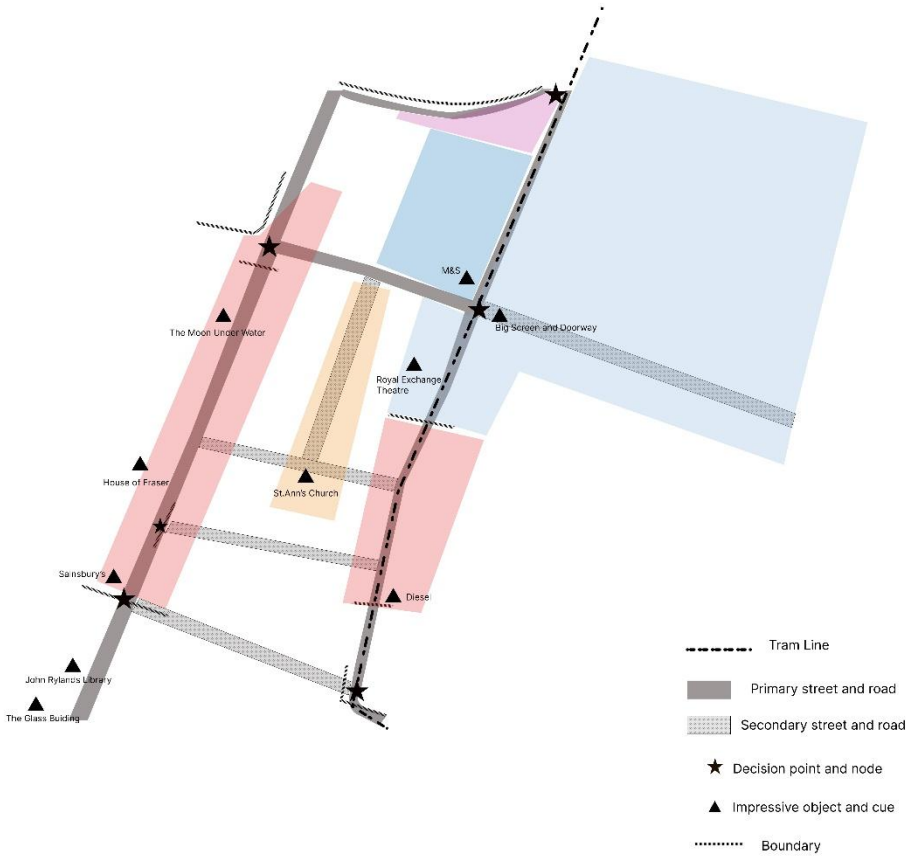

Figure 54 Image of Deansgate, Arndale Shopping Mall and the commercial centre, drawn by the author. Following the reorganisation of the data, the image has been updated and therefore may differ slightly from the previously published version.

There are fewer attention-grabbing locations on Cross Street. Starting at the southern end where it meets Princess Street, only one shop called Diesel repeatedly draws attention along the way due to its bright red windows and signage. For a long way north from Diesel, only a few objects or buildings are mentioned until one comes to the Royal Exchange Theatre, which many consider a landmark. After that, the Arndale Shopping Mall is impressive; it is so big that one cannot help but notice it, especially in the workshop section. However, when it comes to finding one's way around in reality, it is often part of the building that is on the façade that attracts attention rather than the building itself, which may be because the building's footprint is too large for people to see it in its entirety as they walk down the street. A common cause for concern in this

neighbourhood is M&S, a shop that most participants agree is a notable reference point. The massive display at the junction of Market Street and Cross Street was an essential reference. The doorway below the screen is also one of the locations that people pay special attention to.

St Ann's Church and St Ann's Square to the north of it are like small gardens tucked away in the middle of the city. Comparatively speaking, it is more challenging to spot and find because it is not close to either Deansgate or Cross Street. However, the area still received relatively positive reviews, with many participants thinking it had a beautiful view. Few participants passed through it, but those who did found it attractive. In one special case, when two participants passed through St Ann's Square during the festival, a temporary market was set up, and they discussed the market rather than the square itself.

This area has some relatively distinct and clear boundaries. Nowhere is this more apparent than on Cateaton Street, which is bounded on one side by the old buildings next to the cathedral and on the other side by Selfridges, a building with a glass façade on the whole side and huge text on it, as well as the square and fountain. One participant described it as '...It's an epochal road...lined with features from a completely different era.'

Along Deansgate, the John Rylands Library and the adjacent glass building typically command attention. The Sainsbury's at the junction of Deansgate and John Dalton Street serves as a prominent reference, partly due to its reputation as a supermarket chain and partly owing to its storefront. The House of Fraser stands out as a definitive landmark, frequently mentioned and identified during city trips and workshops. Further

north, The Moon Under the Water shop captures the interest of a few individuals, intriguingly not for its physical appearance but for the poetic allure of its name. Two participants from China engaged in a fascinating discussion with me about its translation into Chinese poetry. Beyond lies the cathedral, the adjacent river, and the bridge spanning it, which have consistently been noticed. Detailed exploration of the church and its surrounding neighbourhood will be addressed in the subsequent subsection to avoid digression here.

People still differentiate between areas within this large area because of the different elements, although this enormous area is more oriented towards a business area. Some parts of the area are considered to be more like office areas or financial streets, and these areas are also labelled in the workshops as office space, financial areas, working areas, and business areas. The basis for this classification is usually the number of shops in the neighbourhood and the overall feel of the streetscape, which means the elements on the street. Sometimes, it was because of types of shops or buildings; for example, one participant told me, ‘I think where there is a bank, it must be a busy neighbourhood for offices.’

Other areas were primarily considered commercial areas and were labelled as commercial areas, commercial shops, shopping centres, business centres, and shopping districts. Although the participants did not use the same words, they all meant the same thing. However, even when considered a sizeable commercial centre, there was still a tendency to think there could be a more detailed classification. For example, some participants considered Selfridges part of this business district, while others did not. One group of participants felt that the Selfridges side and the Arndale side represented different types of business districts, with the Selfridges side being more upscale. One participant at the junction of Deansgate and King Street described in detail how, using

this junction as a boundary, the eastern half of King Street is a street with local shops with an explanation: ‘They (means the shops) are not the big global brands like Zara or something. They are just small shops and feels like a place where the locals go. And, the House of Fraser is right at the junction, making it easy to find.’ On the other hand, the western half of King Street was not featured in this participant’s eyes. Several groups of participants delineated subdivisions such as food, salons, and clothes shopping, which resulted in a street where many of the zones became blurred and blended into each other, presenting different ways of dividing the zones based on different divisional criteria.

The tram tracks, which have been used as an essential reference point in previous zones, are less utilised as such in this area, although much of this is because the tram tracks only pass through Cross Street and do not turn. Straight journeys rarely require people to make decisions, so the role of reference could be more vital here.

It is easy to get lost once overly similar street scenes keep appearing. Although getting lost is relatively rare in this area, that is because people usually thought of the journey as going from Town Hall to Manchester Cathedral or the National Football Museum, so when they planned their routes, they assumed that going in a straight line would be refined so that they are less likely to get lost. This assumption was borne out. However, more similar streetscapes can cause confusion even on straight routes. On Deansgate and Cross Street, the point of confusion is not about needing help finding their way but about being unsure of their location and missing their destination. As soon as a decision needs to be made to change direction, for example, when people want to go to St Ann’s Church, more obvious confusion immediately arises. Whether on Deansgate or Cross Street, people need help distinguishing between King Street and St Ann Street. They see on the map that St Ann’s Church is in the inner part of the block, but they do not know

which junction to enter at and often spend a long time at the junction looking for the sign with the name of the street on it.

The area is confusing in a sense, and that confusion stems from the fact that people have many different and subjective ways and bases for dividing up areas, each of which makes sense. Therefore, this area is, in fact, one of those parts of the city that are very common, difficult to define, and have a less than evident character and identity. In other words, these are areas that lack clarity and legibility. The picture that Arndale Shopping Mall and its environs create is more precise; it is a tight-knit structure with Arndale at the centre and the rest surrounding it. On Deansgate, on the other hand, several smaller areas are interspersed and merged, and the boundaries are relatively less clear, which creates a degree of confusion. Many boundaries exist but are relatively vague and vary from person to person. It is, therefore, difficult to represent these areas graphically. The only two relatively clear boundaries are the junction on the south side of Sainsbury's (where Deansgate meets John Dalton Street) and the junction near St Mary's Gate. These boundaries are described as marking where the commercial area begins and ends. Within this area, however, the district remains confusing and ambiguous, as does Cross Street, with more explicit boundaries located near the junction of South King Street and Cross Street and on the south side of the Royal Exchange Theatre. The former is often defined as the transition from the financial to the business district, although this cannot be seen as a clear and sharp boundary. The latter is the start of the business district, and this area is much more precise, ending at Exchange Square at the end of the road.

This area gets a more neutral rating. People were less concerned about the attractiveness of the buildings and such in this area, although they thought one or more of them are beautiful. People were also not usually concerned about whether the shops were nicely decorated. What they talked about most in this area is demand. Some people saw the

appeal of this area as elastic and that the appeal was high here when they wanted to buy something. Some explained that branded shops like KFC, McDonald's, and Zara can be found in every city, so this district is the same as any other city. People described more streets in the area as featureless and very ordinary. They usually said these streets are 'ordinary' and 'common', 'similar to many other cities'. Due to the lack of uniqueness and continuity, this area is more prone to *placelessness*, which is a term that is often viewed negatively that related to globalisation, the emergence of popular culture, and the loss of social and cultural ties within a particular place/territory (Carmona, 2010). Nevertheless, this place is not considered a negative place either. I did not receive very negative comments about this place from the participants.

7.6. Manchester Cathedral and National Football Museum

The area where Manchester Cathedral and the National Football Museum are situated is also very recognisable. However, it is difficult to say that this area is considered a whole in official definitions, as they are often treated as separate locations. Some maps (visitmanchester.com, n.d.) classify it as a business district, including the 'Central Retail District' area, and describe it as 'The area fulfils all shopping needs, from high-end to high street fashion, and is a popular stage for buskers and street artists.'

However, it is clear that no one thinks this area should be considered a commercial or retail area. Nor is the neighbourhood perceived as a cohesive whole according to my findings. The clearest picture of the place lies in the two sites themselves, Manchester Cathedral and the National Football Museum. The two buildings are quite different in style, so people tend to think of the gardens situated between and near to the two as another very clear place, with these two buildings at the centre.

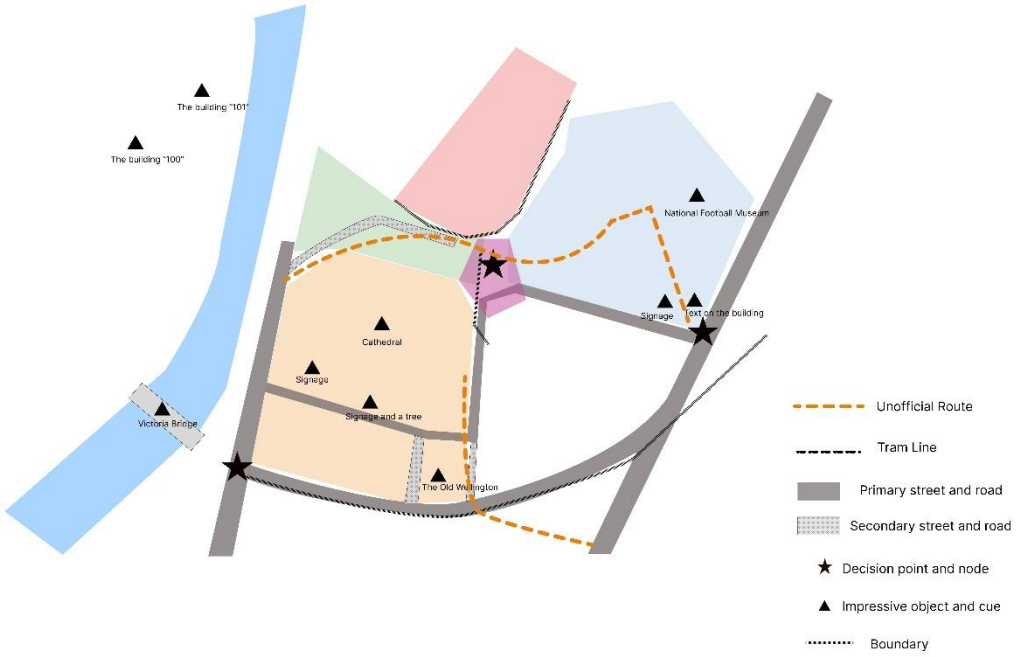

Figure 55 The image of Cathedral and National Football Museum, drawn by author. Following the reorganization of the data, the image has been updated, and therefore differs slightly from the previously published version.

Figure 55 shows an image of this area. As shown in the figure, there are also quite a number of informal routes in this area. People tend to walk casually in the square and meadow to the west of the National Football Museum, the garden to the south of the Cathedral, and the large open spaces nearby. The general locations and paths are indicated by the yellow curves in the figure.

The Old Wellington, a small pub next to the church, is always noticed, and most people think this is due to its very distinctive architectural style. Victoria Bridge on the River Irwell is also impressive. Across the river, there are a couple of distinctive buildings that are always noticeable because they are clearly visible from this side of the river, including two glass-fronted buildings with the giant letters ‘100’ and ‘101’ on them. These buildings are undoubtedly noticeable because of their appearance and size. The

river is also part of the composition of the impression, but it is at the edge, not at the centre. Moreover, the river itself acts as a boundary. Manchester Cathedral is very easy to find; the building is very distinctive and not to be missed, both in terms of massing and style. Almost everyone had a similar story to tell, saying, ‘As soon as I saw the building, I thought it must be the Cathedral,’ and the sign in front of the building with the text ‘Manchester Cathedral’ helped to confirm that the building was indeed the Cathedral. The National Football Museum is the most instantly recognisable building, and there is no mistaking it as it has a huge ‘National Football Museum’ written on the glass wall, identifying itself. The square in front of the National Football Museum has many prominent objects, such as a fountain in the centre, a pathway, and a garden-like open space, but in people’s minds, the square is also a whole. The sign at the eastern end of Fennel Street, which is the intersection, was noticed and annotated by many people. Despite both being green spaces, the gardens to the north of the Cathedral and the lawn in front of the National Football Museum are often seen as two distinct areas, but the boundary between the two is blurred and transitional in shape. In addition, there is a distinct boundary between Chetham’s School and the Football Museum, as they are clearly of completely different styles. As mentioned in the previous section, Cateaton Street is another distinct boundary.

This area is often considered a historical area, and people have labelled it as such. Different groups described this area as a ‘tourist area’, ‘cultural history area’, and ‘historical area’. Moreover, it received various annotations. Participants emphasised the area’s greenery, recreational features, and suitability for photographs and socialising; several paths through gardens and green spaces were described as ‘nice walks’, and one group of participants highlighted the ‘pretty bricks’ on the ground.

Regarding impressions and attractiveness, the area was rated very positively overall. People generally rated the area as suitable for taking photos, sunbathing, socialising, and relaxing. The green spaces felt pleasant and made people feel relaxed. People also described the area as quiet and less busy. The few negative comments concerned the National Football Museum, which some felt was slightly out of keeping with its surroundings as a modern building. However, the positive comments about this place far outweighed the negative ones.

7.7. Summary

As discussed in this chapter, the image of Manchester comprises several concepts that can be extracted. The city contains information that leaves an impression, mainly physical features, including but not limited to landmarks. There are some relatively clear boundaries, but they are not dominant in the city. Unlike the areas defined by Lynch, most areas are not very large, and a considerable part of the city is not divided by standard features but rather by one or more dominant elements (such as landmarks), which can blend in with the surroundings. These areas often do not have apparent boundaries, so in the images I have drawn, they are all indicated by dotted lines to show their approximate scope. In addition to the planned roads in the city, there are also potential invisible roads, which represent how people explore the city. These observations and analyses can be summarised and synthesised, ultimately becoming the research results of this thesis. Therefore, in the next chapter, I will discuss the four elements that emerge from these images and the design framework they form.

Chapter 8. Designing Wayfinding System for a City Centre: A Framework and A Deck of Cards

The previous chapter delved into how individuals utilise environmental cues to navigate and reach their destinations, resulting in the delineation of shared mental wayfinding images for diverse areas within Manchester city centre. These images encapsulate common perceptions formed during the journey towards specific locations. With these images identified, the question arises: how can they inform the development of a location-based urban wayfinding system?

This chapter aims to explore a method for converting external features in cities into cognitive maps. This chapter includes four parts. In section 8.1, I will discuss four elements that emerged from the images, including points, planes, lines, and timing. I will compare these four elements to Lynch's five elements of city image, highlighting how my framework focuses on wayfinding and navigation, while Lynch's framework is more concerned with the overall perception of a city's structure and image.

More importantly, this chapter aims to find a suitable methodology and logic to integrate these four elements with the design to form a framework and ultimately concretise them into a wayfinding system design. Section 8.2 discusses the design strategies that emerged from the research findings. Section 8.3 introduces a framework composed of the four elements and design strategies, which forms the foundation of the main outcome of this thesis. Section 8.4 provides a detailed description of the Wayfinding System Design Support Cards (WSDSC), a toolkit designed to help users extract external features from cities and display them on maps to form cognitive maps, which can then be converted into designs. Section 8.5 outlines two experiments to test

the WSDSC. Finally, Section 8.6 offers a summary of the chapter.

8.1. Four Elements from Wayfinding Image

Utilising Manchester's city centre as a case in point, there exists a collective public perception of wayfinding for diverse areas. This perception emerges from the overlapping wayfinding processes of many individuals, their utilisation of clues, and their interpretation of the urban environment. While the utilisation of environmental content may vary among individuals, a common underlying concept exists regarding the place-based wayfinding process and the impression of the city itself. This concept, shown as the images of diverse areas in Manchester city centre, is a crucial reference for successfully navigating the city, as it is formed by amalgamating various references within the urban landscape. Furthermore, understanding the form of wayfinding that accompanies these perceptual and mental images of the city is essential for designing effective wayfinding systems. The wayfinding system design based on those images has positive implications not only for navigation in complicated urban environments such as city centres but also for perceiving and understanding the city.

The forms of wayfinding impressions in this thesis, which constitute its contribution to knowledge, can be categorised into four: points, lines, planes, and timing. There is a marked difference between this and the results of Lynch's study. To be precise, my research advances a framework based on Lynch's theories and approach, and the results show an extension and difference to Lynch's theory.

As mentioned in the literature review, Lynch identifies five elements that compose a

city: paths, nodes, districts, landmarks, and edges.These five elements are the components that make up the impression of a city and are used to enhance the recognisability and legibility of the urban environment. While there are similarities, these five elements differ significantly from the four elements proposed in this thesis. Lynch views wayfinding as one of the essential ways in which people explore the city, through which they form a holistic impression of the city, and thus derives these five elements, which are intended to enhance and strengthen the clarity and legibility of the city. My study, on the other hand, takes a different perspective from Lynch's. In this thesis, I focus on how cities and the information in the urban environment influence the wayfinding process. In information-rich cities and the age of digitalisation, the legacy of Lynch's theories requires reframing, as the urban context has changed with thick signage descriptions, an abundance of visual media, digital navigation, and virtualised exploration.

Therefore, as aforementioned, the images developed in this thesis are images of wayfinding in cities, and the four elements emerging from these images constitute a wayfinding system design method based on place-based information in the urban environment. In other words, my research centres on designing a wayfinding system to enhance the city's image. I will explain in detail how each element differs from Lynch's theory in the following subsections.

These four elements contribute to the knowledge of cartography and constitute a methodological framework for designing wayfinding systems. A detailed explanation of these four elements is given below:

Points. Points refer to an individual piece of information or a specific location where a clue or reference is situated, acting as a distinctive element used as a reference in the wayfinding process, such as a landmark and its location. In other words, points refer to

the location of information units. Points are distributed throughout the city but must have visibility on the route. Otherwise, they are meaningless for wayfinding.

Lines. Lines are the routes people take through the city, and the references in the form of routes. Lines include both visible and invisible lines. Visible lines include physical structures in the city, such as streets and tram tracks. Some of these visible lines are references, useful for wayfinding. Invisible lines usually do not have a clear physical structure, such as non-street paths through squares, parks, or open spaces. These invisible lines usually consist of people's choice behaviour and the geometry of the planes that limit that choice. Lines and desire lines are different concepts. Lines is a concept specifically introduced in the context of wayfinding to refer to the paths or routes that people use for navigation, providing a reference for the wayfinding process. In contrast, desire lines refer to the actual routes that people choose to take, reflecting their preferences and behaviour. Regardless of whether they are visible or not, Lines connect to Timing.

Planes. Plane refers to an area of the city that can be large or small, usually consisting of a core point and related surrounding areas and is perceived in its entirety. Within the planes, there may or may not be multiple related points. Planes divide large areas into smaller ones, reducing people's cognitive load in complex environments, especially unfamiliar ones, and helping them define space and orient themselves. These planes may be represented as graphics or geometry on a physical wayfinding system, such as a map.

Timing. Timing refers to the location from which one can see information, a combination of time and place. It does not simply refer to time or location but rather to a moment when a person can see a piece of information or a location from a particular position. In other words, timing refers to the timing and sequence in which an individual

receives, processes, and applies information about the urban environment, including temporal and spatial interactions. Individuals perceive information in space at specific locations and moments and use it to orientate themselves, find directions and paths, and confirm whether they have arrived at their destination. Nevertheless, many factors often influence individual choice behaviour in the city and are challenging to predict completely. Therefore, the primary role of timing in wayfinding system design is to optimise the wayfinding experience by reasonably arranging information displays.

Lines connect timing, and they across or go through planes. Points change with timing, and sometimes overlapping timing, while sometimes overlapping the core points of planes, which exist on or beside lines. Overall, the four elements echo each other in a variety of relationships that ultimately form the form of wayfinding (Figure 56). Next, I will explain and elaborate on these four elements in detail.

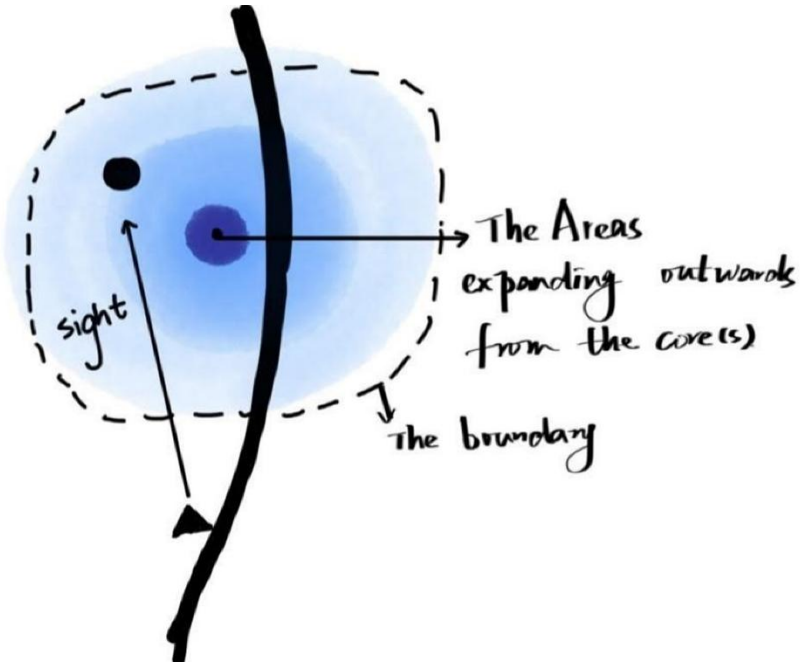

Figure 56 Brief diagram of the relationship between the four elements of points, planes, lines and timing, drawn by the author.

8.1.1. Points

Points refer to an individual piece of information, such as a clue or reference, and the specific location where it is situated. They are visual stimulus units during the wayfinding process, which are objects that are separate, characterised and can be used as references. It can be said that each point is a unit of information.

Points are not entirely represented as dots on a map. A building might be represented as an area on the map; for example, some vast buildings, including the Manchester Art Gallery, Manchester Town Hall, and Arndale Shopping Mall, are typical examples. These buildings occupy an area in the city and are not represented as dots on the map. However, such buildings are perceived as a whole, a single individual in concept. The building itself is a separate clue and reference, especially those that are iconic. This perception is usually shaped by the building's elevation facing the street and the elevation facing wayfinders. Elements on the building façade, such as unique architectural style, decorations, materials, designs, and artefacts, create a unique visual identity for the building and explain why people consider this building a reference point. Therefore, the building constitutes a point in people's perception. Points are not specific to buildings' shapes. Instead, they exist in people's perceptions as points. As far as wayfinding is concerned, points exist in various forms. The fewer points there are, the less clear the perceptions people develop of the city or region, and the less likely they are to have a perception of the city's unique identity.

Figure 57 Arndale Shopping Mall, Town Hall, and Art Gallery (from left to right) represented as shapes on a map. They do not appear as dots occupying a small area, but are perceived as individual entities rather than as areas. Base map downloaded from Digimap.

Points are not the same as landmarks among Lynch's five elements, although it is similar to, but not identical. Landmarks are prominent and easily recognisable objects and structures in the city (Lynch, 1960), a concept that remains one of the most essential definitions (Yesiltepe et al., 2021). Landmarks act as anchors and reference points (Richter & Winter, 2014), which is significant within its surrounding environment (Caduff & Timpf, 2008). However, the scope of points is broader than that of landmarks. As discussed in previous chapters, people use other cues besides landmarks for wayfinding. Some cues are not considered landmarks, but they are still meaningful to the wayfinding process, used as cues, and incorporated into people's cognitive maps.

Lynch defines landmarks as unique objects that stand out from their environment and encompass many forms. However, as I discussed in Sections 2.3.2 and 6.2.1, Lynch focuses more on prominent architectural landmarks, although he also states that landmarks can be anything of any size that stands out from their surroundings. Some references are small and may be as simple as a sign on a building, while others may be fluid, such as the posters on the Art Gallery building. Therefore, points and landmarks, as defined by Lynch, represent two overlapping but distinct concepts.

In addition, another core distinction was along the way. Points valid for wayfinding

must be on either side of the lines or visible on the lines; otherwise, they are meaningless for wayfinding. This means that points may be dynamic, and whether an object is a point is determined by the different positions of the wayfinder. Ultimately, Lynch's definition of landmarks focuses on their importance as part of a city's impression, whereas my proposed points are based on wayfinding purposes.

Points are mostly clustered along roads and near people's paths. They are sometimes situated directly on the road, serving as cues during the wayfinding process. Typical examples of such points include various cues located along both sides of Deansgate, such as the House of Fraser, Sainsbury's, and the Moon Under the Water (Figure 58).

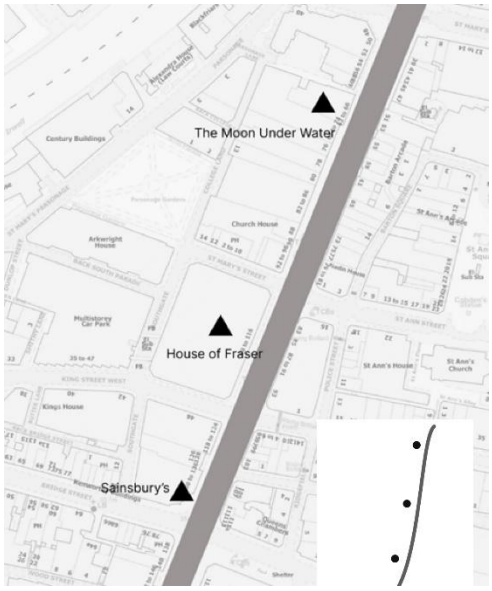

Figure 58 Information units, including Sainsbury's, House of Fraser, and The Moon Under Water, as points on/near Deansgate. Base map downloaded from Digimap (https://digimap.edina.ac.uk/); street and points drawn by the author in Figma.

Some points are scattered further away from the road, but because these references are visible from a distance, they still have meaning for those travelling along the road. For example, the two buildings across the river from Manchester Cathedral, with text such as '100' and '101' written on them, are visible from Deansgate due to their height, conspicuous lettering, and unobstructed views, thus becoming references for people in

this location (Figure 59 & 60). When points are used as landmarks and references to the location of information, they can correspond to any object—a building, a billboard on a building façade, or a big screen on a corner—depending on what objects or information are available in the city to be used as references.

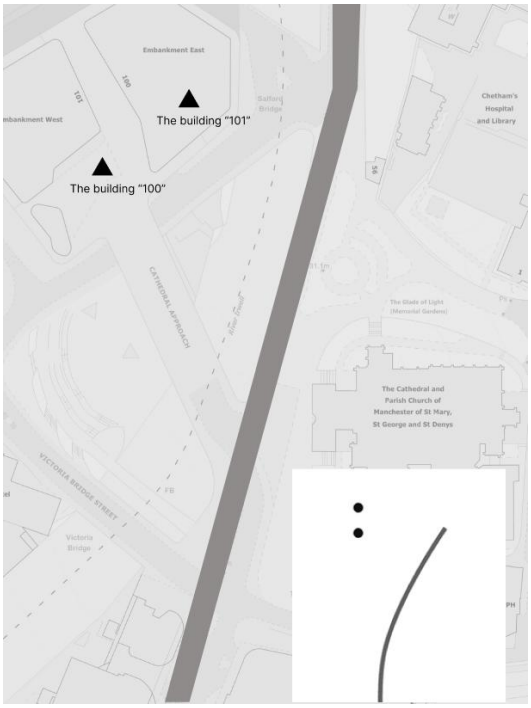

Figure 59 Points that are further away from the road but visible from it. Two buildings in Manchester are shown, located on the opposite side of the river but visible from Deansgate. Base map downloaded from Digimap (https://digimap.edina.ac.uk/); street and points drawn by the author in Figma.

Figure 60 Building with '100' highlighted in red lines and visible from the street. Photo by the author.

Part one of my research hypothesis is that areas with incoherent points are prone to disorientation during wayfinding. Points that are not coherent are classified into the following two cases.

1. Points are few and far from each other.

In this case, people need help perceiving the route coherently, even when the street structure is relatively straightforward, which may be because people are not able to connect the points and form routes in their minds. When points are too far apart, it is equivalent to some areas having no points. An example is John Dalton Street, which has no recognisable points. People have a very vague perception of the street and perceive it as lacking character. Moreover, this situation is not uncommon in other cities. When I was researching Liverpool, there were hardly any points on Hanover Street, which caused me to get lost in the area. It should be noted that the same situation exists in a significant proportion of Chinese cities because the size of Chinese cities is generally much larger, and the references are further apart. For example, data from the National Bureau of Statistics of China (2014) shows that the urban area of Beijing is 12,187 square kilometres. The current official data from the Ministry of Civil Affairs of the

People's Republic of China (2022) shows that the area of Beijing is 16,418 square kilometres. Manchester, on the other hand, covers an area of only about 116 square kilometres. In the broader Chinese cities, such areas and streets without any points may be common. Jingshi Road in Jinan City, Shandong Province, China, serves as an example. The road is long, with similarly designed skyscrapers on both sides (Figure 61). Although the road has a straightforward structure, the reference points are far apart, meaning there are fewer points along this road, which may make it difficult for individuals to form continuous references. In addition, when there are fewer points, even if there is no need to turn or change routes, this can lead to negative emotions, which were identified in walking interviews, mainly in the form of some participants feeling uneasy and doubting whether the route they have chosen is the right one.

Figure 61 Streetscape of Jingshi Road, Jinan City, Shandong Province, China. Source: Street view image from Baidu Maps.

2. Lots of points but distributed haphazardly.

When there are many points and they are distributed in a disorganised way with no clear priorities, this can also have a negative impact on wayfinding. A typical example is Chinatown. Since Chinatown is a distinctive cultural area, it is reasonable to assume

that many Chinese or Asian-related elements in the area serve as points. However, too many unorganised points lead to information overload, which in turn creates the impression that every path around the area could be the right one.

8.1.2. Lines

Lines are the routes that people take or follow during urban wayfinding process. As Tim Ingold (2008, pp. 79–80) argues, people leave tracks as they walk, which can form a meshwork, and the connections, forks, and crossings of these lines indicate which way individuals will go, depending on where a person wants to go. The lines in wayfinding are not just streets, roads, and lanes that have been planned in the city, but also the routes that people take when travelling through certain terrains and areas (Figure 62). However, lines are traces of past journeys; they do not reveal the immediacy or choice behaviour of wayfinding decisions until after the event, through analysis.

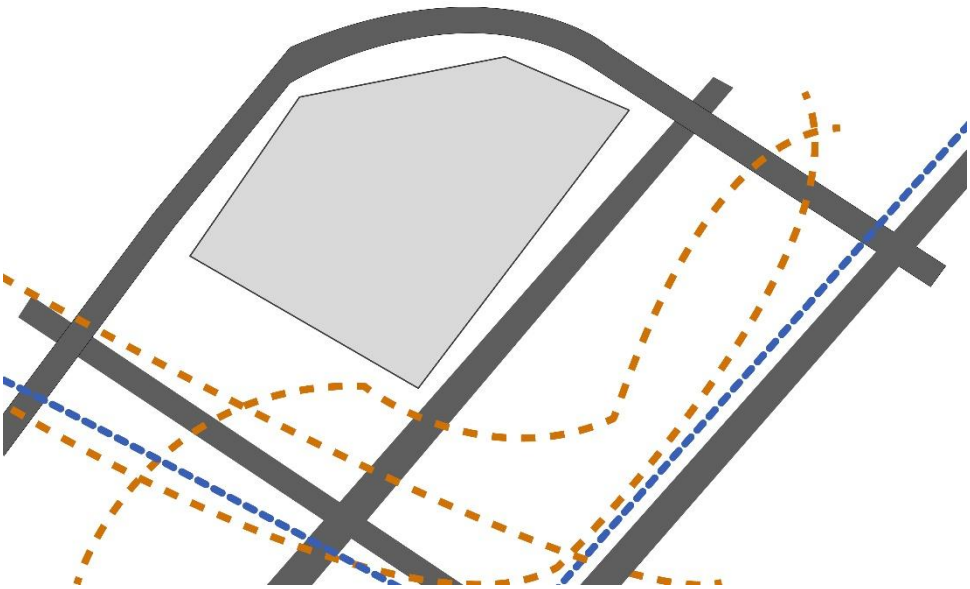

Figure 62 Diagram of lines. Dark grey strips represent planned lines, such as streets. Dotted yellow lines indicate invisible lines, which may be people's paths through space. Dotted blue lines indicate continuous references, such as tram tracks. Drawn by the author.

Lines have similarities to Paths in Lynch's five elements, but they are different: Lines are an extension of paths. Lines include not only the paths people use in the city but, more importantly, they emphasise the role of visible routes as a reference for wayfinding.

Part two of my research hypothesis is that clear lines enhance the clarity of navigation and make information meaningful because the information must be visible along the way. Constructing information continuity is extremely important for improving overall spatial perception and the wayfinding experience, and lines provide a reference for this continuity. In terms of wayfinding, the most essential lines are those that people can follow.

As aforementioned, lines are categorised into visible and invisible lines. Of these, visible lines are very often essential references and information in their own right, whereas invisible lines have more of an impact on wayfinding in terms of mobility. A person getting lost hardly ever happens if they can see a distinctive line that they can follow all the time and that matches the map easily. An example of some specific lines, such as the tram tracks in Manchester, are essential references for two reasons: the tram tracks are unique enough to be different from all other streets, and the tram tracks are coherent and consistent. As long as one can confirm that the tram track can go from point A to point B, one can follow it without worrying about getting lost due to loss of reference and without bothering to look for another reference point. The role of tram tracks in wayfinding highlights the importance of lines in the wayfinding process.

Compared to some memorable lines, other streets will likely be overlooked unless they highlight an impressive, unique shape that easily corresponds to the map. Two examples are the two roads discussed in Section 6.2.2: the curved section of Princess Street that

leads west into Cross Street, and Cateaton Street, located to the south of the Cathedral.

Lines are different from paths as defined by Lynch, the meaning of which has been discussed in Sections 2.3.2 and 6.2.2. In short, paths are defined mainly in terms of a city's clear, distinct roads and streets. Paths and desire lines also focus on people's movement in urban space. However, the most crucial significance of lines is that they can establish a reference and awareness of wayfinding for people among these streets and invisible lines. The role of lines in wayfinding may be more important in establishing a continuous and consistent reference for people. The key to a wayfinding system is that it should appear along the way. Lines provide visual clues for guidance and structural layout, helping people understand how the environment is organised and aiding them in using the environment.

8.1.3. Planes

Planes are the small areas in a city. Although there seem to be some similarities, it is an entirely different concept from districts in Lynch's theories. Compared to districts, planes are usually smaller areas and are composed of the points within them rather than common features. It may be expected that people think of specific points as more in keeping with their surroundings and, therefore, not just as points but as core points of a plane. In addition, people find densely distributed and relatively similar points in an area. Areas with similar clustered points are also considered planes. Planes in cities are usually smaller than Lynch's definition of districts and may be contained within districts. Individual larger planes may overlap with districts. As far as my research goes, I have not found any planes larger than districts, but this should depend on the city plan, so I cannot conclude that such planes do not exist.

Part three of my research hypothesis is that planes have core points. In this context, a

core point is an object that occupies a dominant position in a plane. For this thesis, most of these cores are buildings, especially landmarks, presumably because of their large size and prominence in their environment. However, there are also core points that are not buildings, such as the small plane next to Piccadilly Gardens, where the core point is the grove and the benches within it. It should be noted that the core points occupy a central position in the planes, but this central position is in terms of psychological impression, not geographical location. Planes usually have at least one core point. Some planes have other points within the area related to the core point. Other points are related to the core point in the sense that they are connected to people's perception and understanding of the area, not just in a geographical sense. Planes are areas centred on the core point and expand or radiate outwards along with the surrounding points (if there are some) until reaching the boundary, which may be vague or precise. It cannot be denied that there are very few planes without core points or where none of the points within such planes can dominate the range. The concept of several types of planes is shown in Figure 63 below. I will explain these types separately next.

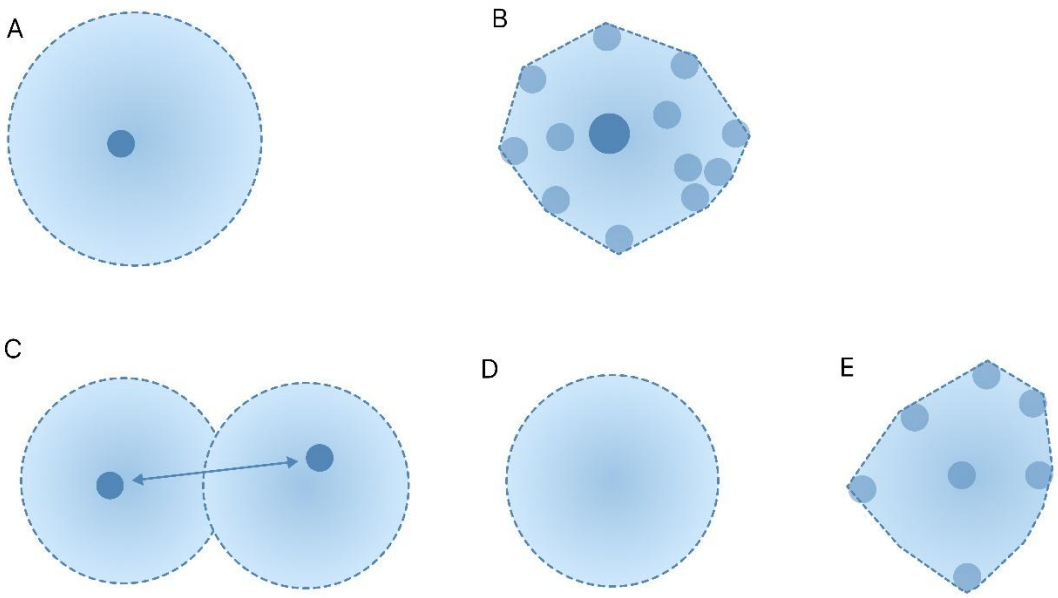

Figure 63 Different types of planes. In the diagram: A shows a plane with only one core point; B, a plane with one dominant core point and other weaker points; C, when two planes with clear core points are located together, they form a relative position, which is more conducive to wayfinding; D, some rare planes with no points, primarily found in leisure squares; E, a plane with multiple points, but none of them dominant. Drawn by the author.

Planes with an explicit and distinctive core point are relatively easier to locate and navigate (picture A in Figure 63). People usually have a clear perception of such planes. Notable examples include the National Football Museum, Cathedral Library, and Manchester Cathedral. For these planes, the core points are the eye-catching buildings as well as landmarks. People's understanding and impression of the area start from the core point and spread outwards to form numerous planes in the city. These core points are part of the points, so the planes echo the points. These core points are not separate but are symbolic of a nearby area.

A small area on the south side of the Cathedral is considered part of the Cathedral and includes several buildings that are more in keeping with the Cathedral's style. Although the Old Wellington is a notable site as well as an essential cue in the process of finding

the Cathedral, many people prefer to think of it as an entrance to the Cathedral and its surrounding area rather than as a separate area from the Cathedral. The gardens to the north of the Cathedral are also often considered to fall within this context, as are the paths in the gardens that allow people to walk around, and no one thinks of these sites as separate and distinct. The large expanse of lawn in front of the National Football Museum, with its fountains and footpaths, is undoubtedly considered part of the National Football Museum itself. The scope of the Central Library does not stop at the building but extends to encompass the surrounding open space, especially the square in front of it, which is a small area of its own with the street as a boundary. These are typical of areas with a clear central point and a strong identity and impression of the central point. Despite other impressive elements within the area, these cannot dominate and the area remains centred on the most dominant location within it. These planes with a single, strong core point are very easy to navigate, making it easier to create a strong impression and a better wayfinding experience.

Some planes have a core point and simultaneously have an extremely large number of points around them as cues in the urban environment for the wayfinding process (picture B in Figure 63). Such planes tend to be very irregular in shape, are usually larger in extent, and have relatively blurred boundaries. A typical example is Chinatown. Although the Arch, as the most unique and culturally significant landmark in the area, is seen as the centre of the area, there are many related points around it. These points include texts in the Chinese language, Asian shops, Asian style—especially Chinese-style buildings—all perceived as elements related to Chinatown and references in the wayfinding process. Therefore, the image of Chinatown consists of a core point with a strong identity and many other points scattered around it. Another typical example is the plane formed by the Arndale Shopping Mall and the shops around it. The Arndale Shopping Mall and the surrounding shops form a plane, which is a typical example of this type of area. The huge shopping mall is the core point, and the

shops around it are grouped to form a central business district, which is very irregular in shape, with very fuzzy edges, or perhaps no edges at all. Such areas usually have a consistent style, and people form consistent judgements about such planes, as everyone thinks Chinatown is a separate district. However, such planes do not mean that wayfinding is easy. On the contrary, in such planes, people may find wayfinding difficult, which may be because the very vague boundaries and irregular shapes prevent people from forming the perception that they have arrived at their destination, and the excessive number of points also makes it ambiguous.

If multiple planes have dominant core points and are nearby, they will form a district and become strong contrasts of identity (picture C in Figure 63). The best example of this is the district consisting of Town Hall and the Central Library, where the positive impact of the relative echo of these two buildings on wayfinding was mentioned by almost all the participants who passed through the area and was seen as very helpful in helping them to identify the exact location of the area.

Some places have multiple cores, and none of them can dominate (picture E in Figure 63). For example, on Princess Street, several restaurants are within a short distance of each other. Some participants considered this small area a district and labelled it as ‘food’ on the map. However, none of these restaurants stands out as particularly representative of the area. People’s perceptions and impressions of the place are even more vague in such areas.

Planes with no core point (picture D in Figure 63) are relatively rare, but Piccadilly Gardens may serve as an example. The garden itself is a separate area with no impressive centrepiece. Although the Statue of Queen Victoria is a frequently mentioned landmark, individuals do not think of the garden as ‘the statue and its surroundings’. As impressive as the statue is, it is only a ‘statue in a garden.’ Piccadilly Gardens cannot be

considered a point because, in people's perception, it is seen as an area rather than an object. This is the fundamental difference between this type of plane and a point formed by large buildings: planes are perceived as spaces, whereas points are seen as individual objects.

Many areas of the city do not form any plane at all, meaning they have no character, are very similar, do not have a unique status, and cannot be distinguished from the rest of the city. There are many examples of this in Manchester's city centre, such as John Dalton Street, which many describe as 'nothing special'. There are also many parts of Cross Street and Deansgate which were seen as needing to be more distinctive. One participant commented, 'I don't think it is any different from any other city; what's here is in any other city.'

The visibility of core points affects how easy it is to find the plane in which they are located. Manchester Cathedral is an example, as the cathedral itself, as a core point, can be seen from a long way away on Deansgate, so people can quickly tell that they have arrived or are about to arrive there. If people can see both the core points and the road that leads directly to the core points, then they will not get lost. The opposite example is Chinatown: the Arch, the core point of Chinatown, is in the centre of Chinatown and the neighbourhood. It is almost impossible to see when people are on the outer avenues, so some participants found Chinatown hard to navigate.

The core point affects how people feel about planes. For example, the small block of planes next to Piccadilly Gardens, because its core point is the woods and the benches, would be perceived by some as an area used for resting. The square and fountain next to the National Football Museum, because of its proximity to the museum, would be described by people as 'It feels like it is related to sports.' Areas with bus and tram track stations as focal points, such as the transport interchange next to Piccadilly Gardens,

make people feel busy.

Planes and the districts defined by Lynch are two different concepts. As I discussed in Sections 2.3.2 and 6.2.3, districts refer to more extensive areas within the city, which can be identified by common characteristics such as function and architecture (Lynch, 1960). Compared to districts, planes are significantly smaller. Although some planes are composed of several points similar in people's perception and form a common area, this is not the main feature of planes. The most significant difference between planes and districts is that planes have a central point. Apart from the square-type planes, most radiate outwards from a core or several core points.

The primary role of planes in a wayfinding system is to provide a clear perception of the city, especially a more specific, small-area perception. The planes are the framework for organising and structuring different wayfinding system designs, creating a clearer perception of the city and providing logic and a basis for the hierarchical presentation of information. Depending on the different planes, different information can be presented in the wayfinding system design.

8.1.4. Timing

People will see different information and cues at different times and locations, constituting timing. Timing refers to the specific locations combined with time when some points enter people's lines of sight. The fundamental explanation of timing is that when people are in a specific location, it is unlikely that they will see landmarks a mile away because people have a limited range of sight. Timing includes more complex concepts, as shown in Figure 64, which I will explain carefully in the following.

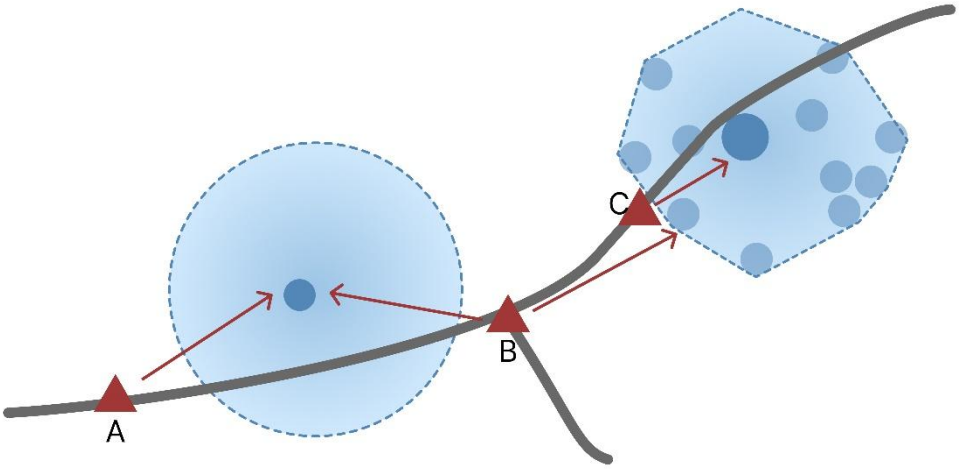

Figure 64 Schematic diagram of timing. The figure shows three examples labelled A, B, and C, indicated by red triangles, and the line of sight, indicated by the red arrow. A shows the location of points seen, which may include some confirming the destination. B shows the timing of the decision point type, where different points can be seen, and people may make decisions based on this information. C shows an entrance to a plane, where people see relevant points and therefore think they have arrived at the plane. Drawn by the author.

There is information that is not visible from some directions, even though it is right at a location. A typical example is the Bifa in Chinatown that I discussed in subsection 6.1.8. Points have either one or multiple timings, and the timing determines where the point can be seen as a cue and where it cannot.

Points take on different roles at different timings. The Arch in Chinatown, for example, is often considered not a helpful landmark for wayfinding. However, the timings of the Arch are limited to its vicinity because it is located inside Chinatown, which means that it cannot be seen from the main road outside. In most cases, the Arch appears alongside other elements, such as Chinese characters, making the Arch significantly more helpful for orientation than for finding a direction or the correct route. One participant told me, 'If I want to ask a friend to meet me in Chinatown, I would say meet me by The Arch.'

In addition, some buildings, generally because they are taller and stand out from the

complex, may be landmarks from a distance but not at close range. A typical example is the Arndale Shopping Mall, which I discussed earlier in section 6.2.1. Most workshop groups considered it a landmark and prominent in its area, but during the walking interviews, it was often parts of the building, such as the large screen, that were seen as reference points.

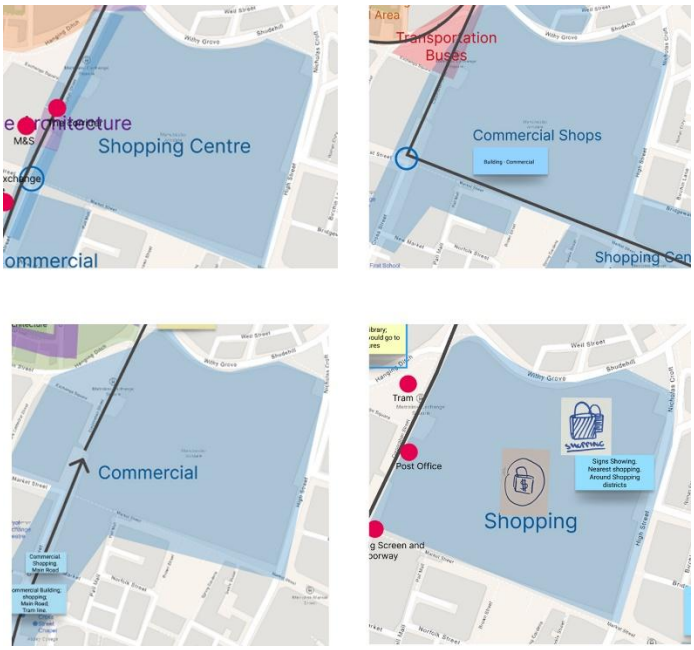

Figure 65 Visual transcription of the workshop results, some of which highlight the Arndale Shopping Mall marked during the workshop. Base map downloaded from Digimap.

Timing includes decision points and places where people locate themselves. Typically, most decision points are located at intersections, but not only at intersections. Individuals usually stop at an intersection to orientate themselves and decide to turn or go straight based on the points around them. In addition, when people are in a specific location and see a particular reference or cue, they make decisions as a result. This decision involves not only turning or going straight but also confirming that one is still on the right path, deciding whether to turn back or change routes. When there is a reference that corresponds to the map near the decision point—that is, when the point is visible—the time for people to decide becomes shorter, and hesitation decreases. The

likelihood of taking the wrong path also decreases. In other words, decision points are easily formed when timing is clustered, which is why some intersections are essential in the wayfinding process, while others are ignored or cause people to get lost.

When the boundary of a plane (although it may be indistinct) intersects with a line, timing may be formed, along with the perceived entrance to the plane. In other words, timing is formed when a person walks to a specific location, sees a specific point, and judges that they have entered a particular area. This timing can help confirm the time and location of changes in the content presented by the wayfinding system.

Another critical role of timing is determining whether a destination has been reached. If a destination is visible at a location, one can determine whether they are approaching or have arrived. Once individuals have identified the destination, wayfinding becomes easy and enjoyable without negative consequences.

The role of timing in wayfinding systems can be multifaceted, although it may ultimately be only partially represented on a map. It ensures that relevant wayfinding information is provided where people need it, and it is arguably also a factor in filtering information in wayfinding system design. Another vital role is that timing identifies where physical wayfinding systems (such as signage) should be placed. My fourth research hypothesis is that the fewer timings there are, the more critical a physical wayfinding system such as signage becomes, because these are usually areas with fewer references and more vague impressions.

Timing is a concept that Lynch does not seem to address, and it is also an extension of my Lynch-based theory. This element allows researchers and designers to incorporate the dynamics of the city and its people into the design framework rather than understanding the city statically.

8.1.5. Summary

Overall, these four elements, namely planes, points, lines, and timing, potentially form a framework that can be used to design wayfinding systems. According to my research, the most critical aspect of the wayfinding process is to correspond the information with the information on the map. The four elements can be incorporated into cartography, including both paper maps and electronic maps, creating a design framework that facilitates the matching of accurate information with maps and integrates this information into the design. To this end, a set of cards can serve as a toolkit to assist in this process, which will be discussed in subsection 8.3.4.

It should be said that points are essential references and information units in the wayfinding process, providing certainty of spatial location and anchors for cognitive maps; lines are the routes that wayfinding may involve, forming the basis of routes and providing a reference for continuity; planes are the areas of the city, as well as the framework for the layering of information design and clear understanding of the city; and timing is an element that combines the three, providing the location of information presentation and the dynamic effectiveness of the information. In what way and in what visual language should this information be incorporated into the wayfinding system design? I will explain this next.

8.2. Design Strategies

Although wayfinding is a process from start point to destination, wayfinding system design should consider the entire city as a region. Any location in a city can be a starting point or an endpoint. Therefore, my hypothesis is that wayfinding system design is not

specific to one or a few routes but should be applied to the network that all routes, which are lines, weave in a city.

Several design approaches and ideas surfaced primarily from the workshops, forming an essential part of the final design framework. The results of the walking interviews helped me reflect on and analyse the outcomes obtained from the workshops. During the workshops, participants worked together to design place-based wayfinding systems for Manchester city centre, which did not provide a complete design solution but rather served as an idea of a future wayfinding system design in an urban environment. This thesis focuses on the creation of a procedural wayfinding system for cities, which emphasizes the logical reasoning and design thinking demonstrated by participants. The design thinking and logic behind the design behaviours and methods provide a meaningful way to translate place-based information into wayfinding system design in visual language.

8.2.1. Visual Designs

The workshops aim not to develop new visual design methods but to explore how to incorporate urban information and images into wayfinding system design through dialogue and the construction process in generative workshops. This transformation process involves extracting the characteristics of the city, forming an image of the city, and observing, discussing, and analysing this information through interaction and dialogue. Ultimately, this information is marked on the map and incorporated into the design. While some visual design approaches, including colour schemes, graphics, wayfinding, and icon design, surprisingly emerged in the workshops, this thesis is more concerned with how urban information is translated into the visual language behind these designs.

For visual artists, drawing is a complex and expressive medium to convey selective information discreetly (Wood, 2006). It is crucial to analyse what messages the participants were trying to convey through their work, which helps to understand their understanding of the city and the extraction of key features. That is, it is essential to understand how these selective messages were chosen and how they were used.

As shown in subsection 5.2.5, participants in the workshops incorporated various pieces of information they considered meaningful for wayfinding and the urban experience into the wayfinding system, covering a wide range of buildings, landmarks, transport hubs, parks, squares, heritage sites, artefacts, famous attractions, streets, and shops. This information was used as the basis for selecting meaningful wayfinding content. Based on this meaningful information for wayfinding, many visual designs have emerged.

Graphic and icon design is a fundamental and common form of presentation. They are not only designed to give the wayfinding system aesthetic appeal but also to convey and summarise information. Symbols have an arbitrary relationship to the object being symbolised and represent the object by a rule or convention (Isherwood, 2009). In the research process, there are two main ways to represent specific locations graphically. The first approach is to use the characteristics of the object itself as the basis for a concrete graphic. For example, one group drew a simple graphic of a cathedral to represent the location, while another group drew a graphic of the arch in Chinatown on the signage they designed. This type of graphic is based on the real external contours and distinctive features of the object, with the pattern applied as a visual code for the object in the wayfinding system design. The second approach is to use symbols. For example, a football is used to represent the National Football Museum, a book represents the Central Library, and an artwork represents the Art Gallery. These symbols are not based on the external contours or distinguishing features of the objects or buildings but on people's subjective understanding and perceptions of these locations.

Figure 66 Design examples created in the workshop, including outline-based graphics and symbolic graphics. Designed by participants.

This design approach is also universal in representing districts and areas. For example, an icon of a tree is used to represent green spaces; an image of a shopping bag indicates a commercial area; a graphic of a camera represents tourist areas; and graphics of French fries and a Coke represent the 'food walk' area in front of them.

Figure 67 Symbolic graphic design of the area from the workshops, designed by participants.

Colour schemes also appeared. Colour can be used as a wayfinding design tool, and choosing the right colours for a wayfinding project can create a brand and identity, which comes from designers knowing how to balance art and science (Gibson, 2009). In wayfinding system design, the focus is on the function of colour schemes as differentiators rather than on the aesthetics of colour, such as harmony and combination. Different colours express different locations and areas in the city and convey different messages in the wayfinding system if a set of rules is applied consistently.

Visual design also encompasses directional design, commonly expressed as arrows. Visual forms of maps are also often noted for their importance, and people usually list what important information should be included on the map, such as regionally significant buildings, locations, and landmarks.

Another type of design is information stations, which combine cues and visual designs. The most common form is signage. The most apparent design logic conveyed during the wayfinding system design process is that the wayfinding system is not a single design but a combination of information designs. An information station, such as signage, is a carrier of various information, which may include distances, current locations, maps, lists of essential objects, buildings and landmarks, the names and functions of areas, texts, and any other information that might be helpful for the wayfinding process. Therefore, the most essential aspect of wayfinding system design is to establish a logic for combining this information and the visual design reasonably. Behind the visual design is how people summarise and distil the city's characteristics and how they encode the city.

8.2.2. Coding the City

The results of the workshops' visual designs show an attempt to build a wayfinding system that categorises information in the city to convey messages and tell stories. In other words, the information in the urban environment is coordinated and organised to build a code for the city, which is then applied to the wayfinding system design.

The information in the city was extracted and coded in a categorised manner. The codes were derived from the iterative process of the workshops and the commonalities of people's understanding of the urban streetscape during the walking interviews. Specifically, urban elements were given unique design meanings and incorporated into the design process. This coding process not only reflects individual perceptions and understandings of the cityscape but also establishes a unique set of rules and logic through continuous design evolution.

This coding is expressed through graphics and visualisation. Icons, symbols, and pictograms are designed to refer to specific places and areas (as discussed in the previous section 8.2.1), and these graphics can be incorporated into wayfinding system design as visual codes. Whether designing icons for regions, graphics for places, symbolic graphics, or cosmetic outlines, the essence of these designs is to find a visual language as a code for the place or region to be applied to the overall wayfinding system design.

Assigning different meanings to colours is a subjective development, but the design logic behind it is noteworthy. One group created a signposting system based on a colour scheme, and although they only designed one sign due to time constraints, they explained the design rules. The rule was that different colours were used to differentiate between the inside and outside of the area. In their finished design, the artefact is a road sign with different colours pointing in different directions and representing different areas. The colour red means 'Chinatown', indicating that this direction is within Chinatown, while the colour blue means 'Not Chinatown', indicating that the direction it points to is no longer within Chinatown. They stated that these signs should be placed all around Chinatown. They also produced another road sign displaying information such as the district name; they noted that all critical areas and buildings inside the district should be listed on this board. Those boards and signs should be placed in each district. Another group provided a similar design idea, although they did not produce an artefact, describing the design approach: 'Colour code the districts so the signs are in the corresponding colours, so it is easy to understand at first glance. The whole district can be in one colour.'

Figure 68 Signage in different colours representing the design of signs in various areas. Designed by participants.

These designs reflect a mindset of coding districts within the city according to a set of rules. Different colours are assigned to different areas of the city, and guidelines are placed at boundaries and entrances to ensure that information within the area (such as landmarks and signs) is designed to represent the area's colour, ensuring consistency in the design.

In addition, another way of coding is to categorise information in the city and create a visual language for each category. This coding approach was developed iteratively in the workshops, emerging from the results of the walking interviews, which were applied and further refined in subsequent workshops. The city's cues were categorised according to their different characteristics and roles, such as landmarks, architecture, squares, greeneries, libraries, stores, attractions, decision points, and other roles identified by participants. If each category of places, areas, and objects were given a code, such as a visual graphic, and that graphic was then labelled on a map, an unambiguous map could be created easily. This map would present clues in the city useful for wayfinding, cultural districts, or beautiful locations that enhance the urban

experience, giving the city stronger legibility and potentially helping users enhance their experience in the city. These codes should be composed, combined, and organised logically, following the design tiers that emerged from the workshop results. I will then explain the design tiers and how these urban codes integrate to form a comprehensive wayfinding system.

8.2.3. Information Hierarchy

All visual designs and information codes can be organised according to specific rules, and this rule, based on my findings, is a spatially related information hierarchy for conveying and communicating. Wayfinding is a linear process from start points to destinations. The line may take any shape, and at times it may fold or loop due to getting lost or taking a detour. Following this line, people pay attention to the surrounding areas and extract information and cues from the urban environment, which includes the existence of points and point clusters along the line. In other words, my research hypothesises that wayfinding in the city is also the process of the line passing through the urban area. The line and the urban area it passes through together form a concept supported by the wayfinding system as a tool for navigation.

Cities do not appear as chapters but are ordered organically (Gibson, 2009). Therefore, the organisation of wayfinding information should also be organic, meaning it should be layered and adapt to the natural flow of the city. The information hierarchy divisions consist of the connections between locations and decision points in space. These design thinking and methods emerged from the workshops, which divide the city into zones, areas, and districts—from larger zones to smaller zones and specific locations such as destinations. This approach was also reflected in real wayfinding during the walking interviews, where some participants assessed the neighbourhoods ahead and guessed whether their destinations were within them. For example, one person assumed that

Chinatown must have many shops, so they concluded that the place was in a different direction from where there were fewer shops.

The information hierarchy manifests itself mainly in relation to areas. As far as the wayfinding process is concerned, it proceeds from large to small scales. However, in terms of wayfinding system design, the process can go from large to small as well as from small to large. There are two perspectives in this process: the wayfinder-based perspective and the designer-based perspective. The tiers constitute a reasonable rule for organising visual designs and information codes. This set of rules operates based on considering an individual's wayfinding behaviour as a line traversing the area from the start to the end (Figure 69).

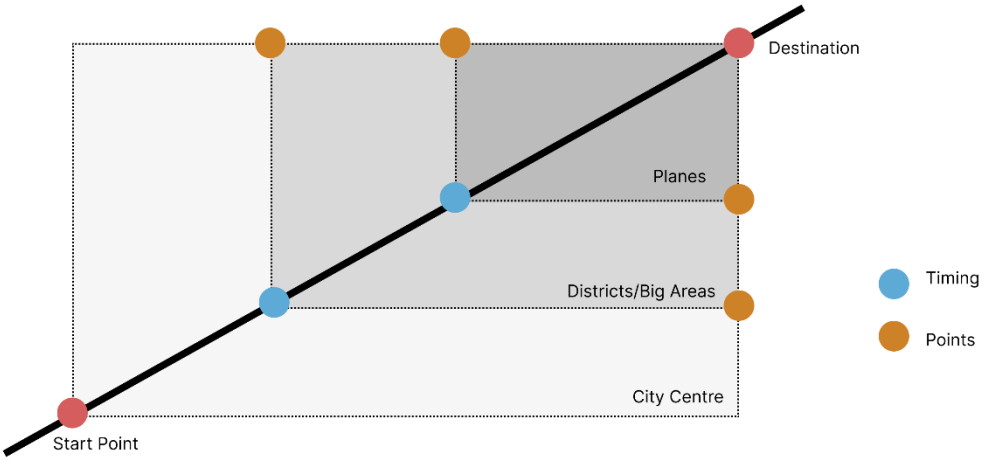

Figure 69 When an individual performs a single wayfinding behaviour, the process moves from a large area to a specific location. Drawn by the author.

When focusing on a single instance of wayfinding carried out by an individual, the environment cannot be ignored, especially when the wayfinding takes place in the middle of a city, even though the process can be seen as a route from beginning to end. Thus, a wayfinding session is not merely a linear movement but, more importantly, a

line through the area. During this movement, people make decisions based on points in their line of sight at locations where timing is gathered, eventually arriving at their destination. When wayfinding in a city, one searches for a specific place within a large area, and this process is like going from the whole to the specific. In urban wayfinding, people must first reach a neighbourhood before they can search for a street address (Correa de Jesus, 1994). Organising signage information systems to respond to people navigating from general to specific destinations is particularly important (Calori & Vanden-Eynden, 2015). Throughout this process, wayfinding cues and movement information are continuously communicated via various environmental features and interfaces (King & de Jong, 2016). Cognitive maps provide insights into the layering of information during this process and, due to the variety of their elements, offer a way to combine spatial and semantic information (Wessel et al., 2013). When people navigate cities, their cognition starts at a macro scale and shrinks as they approach their destination, shifting from a broad urban perception to a small specific location. This change in perception is reflected in the wayfinding process, indicating that maps of different scales are needed, and information must be organised and arranged hierarchically as the scale changes.

Specifically, as illustrated in the schematic (Figure 60), one enters the city or city centre, then moves to one of the larger zones, followed by smaller zones, and finally reaches the destination, which may even be the entrance to a building. In the actual wayfinding process, people may pass through several other areas before arriving at the destination zone. The division of these zones depends on various urban plans with differing shapes, sizes, and boundaries, and based on this, the tiers are formed according to the city's public image.

From a designer's perspective, any point in the city can serve as a starting point, and any point can be an endpoint. Therefore, there is not just one such line in the city, but

countless lines. Wayfinding in the city is a network (Figure 70) of countless lines generated by numerous individuals travelling from multiple starting points to numerous destinations. This tier of the wayfinding system is ultimately a method of combining information and spatial hierarchies for design, making it applicable to both individual lines and networks of lines. The information design hierarchy of the wayfinding system needs to integrate the perspectives of both the wayfinder and the designer.

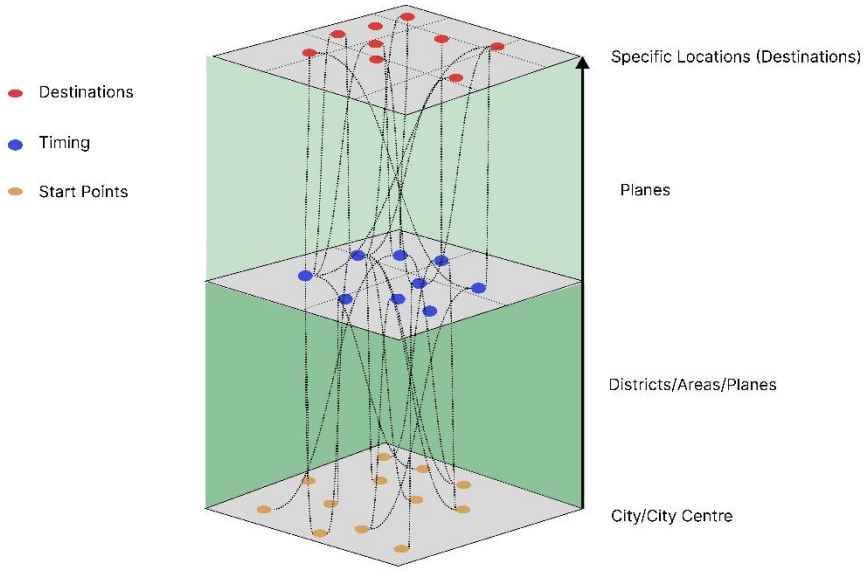

Figure 70 Diagram representing the design tiers for organising space and information—the wayfinding networks in cities. Yellow dots indicate start points, blue dots indicate decision points, and red dots indicate destinations. Starting from a start point, one traverses the space, passing through one or more decision points before arriving at the destination. Drawn by the author.

An additional point to emphasise is that although tiers are divided into three levels in both schematics in this subsection, I argue that, in terms of real-world wayfinding, the number and type of levels will likely vary depending on the urban plan and size of the city.

8.2.4. Summary

Overall, after extracting cues from the urban environment, the visual design provides ideas and concrete methods to graphically and visually represent this information and these cues, while the coding method offers ways and logic to organise the information. The tiers present design principles that can be followed to organise both the visual designs and the codes. The most important aspect is to apply this knowledge collectively to design a complete wayfinding system. Therefore, the four elements can be combined with this knowledge to form a framework for wayfinding system design. In the next section, I will explain how the four elements can be used together with these design principles in wayfinding system design and the role each element plays.

8.3. A Framework

My research hypothesis is that the four elements discussed in Section 8.1, together with the research methods outlined in Section 8.2, can form a framework that serves as the basis for the cards. These four elements can be extracted from the environment, each playing different roles in the wayfinding system. Together with the design method, they constitute a comprehensive framework. After extracting the four elements from the urban environment, visual design provides ideas and concrete ways to graphically and visually represent the information. Methods and coding of the city offer ways to organise this information. Moreover, tiers provide design principles that can be followed to organise both the visual designs and the codes.

The framework is divided into three main parts, as shown in Figure 71. It aims to integrate environmental information, cognitive maps, urban features (cultural, historical, and human), and visual coherence into the final wayfinding system when applied to a

city.

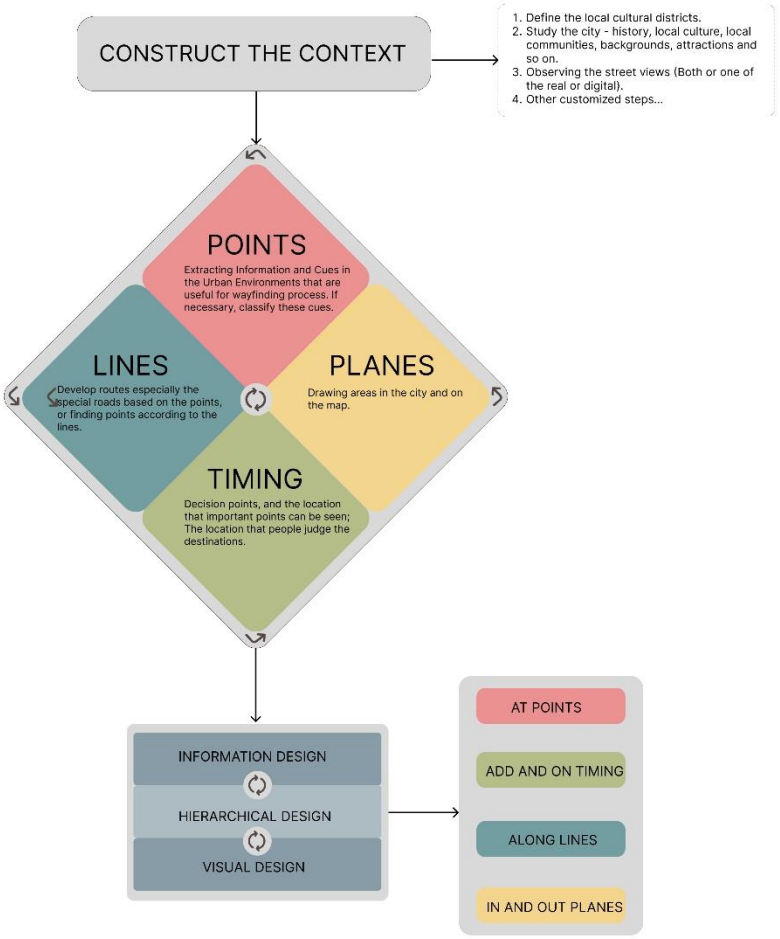

Figure 71 Framework diagram, drawn by the author.

The first part of the framework is to construct the context, which involves conducting a detailed survey and understanding the city or region where the design will be implemented. This may include defining cultural districts within the city or region, understanding various aspects such as history, population, context, architectural features, cultural facilities, and more, as well as observing the streetscape and carrying out field research. The researcher can be the designer or any individuals involved in the design process. Based on my research experience, conducting the research together with participants can be an effective approach.

The second and central part is the identification of the four elements of the city, which together form the cognitive map and image of the city. For example, landmarks can be points. Roads and travelled routes form lines, and some special roads or road segments may be highlighted as lines. It is crucial to record the locations where information is visible—namely timing—as this helps maintain the coherence of the wayfinding system. Equally important is noting locations where information is not visible (i.e., lacking timing), as these may indicate spots prone to confusion and where guidance is needed. It is also important to highlight prominent symbolic landmarks, which may serve not only as points but also as core points of planes. Typically, the intersection between the boundaries of planes (if present) and lines marks where the wayfinding system design shows a change in the level of information. Overall, these four elements should be applied flexibly, taking into account urban planning, city structure, and information use.

It should be emphasised that this process is cyclical and iterative rather than linear, as illustrated in the framework diagram. Points may be classified according to rules, which are subjective—some points may be landmarks, others artefacts. Designers, stakeholders, and others can develop these rules flexibly. The number of points and timing locations may influence route planning and selection. Timing may determine the placement of elements in the wayfinding system or mark key route locations, and lines may be adjusted accordingly. Timing can also indicate the entrance to an area or plane. When extracting these four elements from the urban environment, there is no fixed order, but rather multiple iterations. These elements should be clearly represented on maps.

The third step is design, which includes, but is not limited to, information communication and graphic design. Several design approaches emerged in workshops

and can serve as suggestions or references at this stage. Additionally, many design methods and guidelines have been developed from past and current wayfinding system design examples. These approaches currently include graphic design (icons, symbols, directional guides, colour coding, typography) and information design (information filtering and layering), focusing on coherence, consistency, and context. These design methods should be closely integrated with the four elements, leading to four proposed design strategies: At Points, Add and On Timing, Along Lines, and In and Out Planes. These strategies will be detailed in Section 8.4. However, while these suggestions provide options, the framework does not and should not limit design methods or strategies.

This framework combines the four elements and design methods to offer an underlying logic for wayfinding system design. The key challenge is how to apply this framework in practice. To assist this, a set of cards has been developed as a supplementary tool to facilitate the framework's application and visualisation. Next, I will introduce this card set in detail and explain how it corresponds to the framework.

8.4. A Deck of Cards: Wayfinding System Design Support Cards

As stated in the previous section, it is essential to apply this framework to design practice, especially in a simple and easy-to-understand manner. To facilitate this, a Wayfinding System Design Support Cards (WSDSC) toolkit has been designed to implement the framework in practice. Whilst the design discipline's results may differ (Cross, 2001), it is necessary to ensure that the framework can be used in other cities, or at least most other cities. The WSDSC was validated in the Mill Race area of Lancaster. Two experiments were conducted, each involving one participant, which included the interpretation and analysis of the area and the extraction of its characteristics. This area

is located north-east of Lancaster city centre and includes North Road, St. Leonard's Gate, Lower Church Street and surrounding streets. This area has a fine architectural heritage, which now helps Lancaster to be considered one of England's historic cities (2024). The aim of the test experiments was to further refine the set WSDSC and assess its feasibility in wayfinding system design, rather than to create aesthetically design works. It should be emphasised that visual design approaches and methods should not be limited to those listed in the thesis and on the cards, but may be developed, innovated, and modified. The detailed experimental process is described in section 5.3, and the results will be discussed and analysed in section 8.4.3.

WSDSC is a set of 48 cards, particularly suitable for utilization in a workshop format. For detailed information on the cards, the full set of WSDSC is included in Appendix B. The 48 cards are primarily divided into four main parts, namely:

- Instruction cards, six in total, for introducing the usage and procedure of WSDSC.

- Four Preparation cards to guide users in understanding the city from multiple perspectives, corresponding to the first primary step in the framework, which is construct the context.

- Eighteen Code City cards provide detailed step-by-step instructions on how to use the four elements to code the city and the information contained therein. These include two instruction cards, four Points cards, three Lines cards, four Planes cards, and five Timing cards.

- Nineteen Design cards to assist visualise the extracted four elements into design, providing the corresponded design methods and strategies.

These include two Introduce cards, four Setup cards, five Strategy cards, and eight Method cards.

In addition, there is a Customisation card, which can be duplicated in any quantity to allow users to add their own creativity and ideas. This card is included because WSDSC provides a basis for design rather than limiting design strategies and approaches.

WSDSC is designed to offer specific, step-by-step instructions for wayfinding system design, enabling both professional designers and non-professionals to use the framework. With these cards, users can apply the framework in different cities and regions, flexibly adjusting and tailoring it according to the city's planning, layout, and characteristics to design wayfinding systems. The correspondence between the framework and the cards is illustrated in the figure below (Figure 72). The Preparation section corresponds to the context part of the framework, primarily helping users to establish an understanding of the city or region. The Code City cards represent the process of extracting the four elements from the city or region, while the Design cards assist users in visualising these extracted elements as a wayfinding system. Next, I will provide a detailed explanation of each part of WSDSC and how to use these cards.

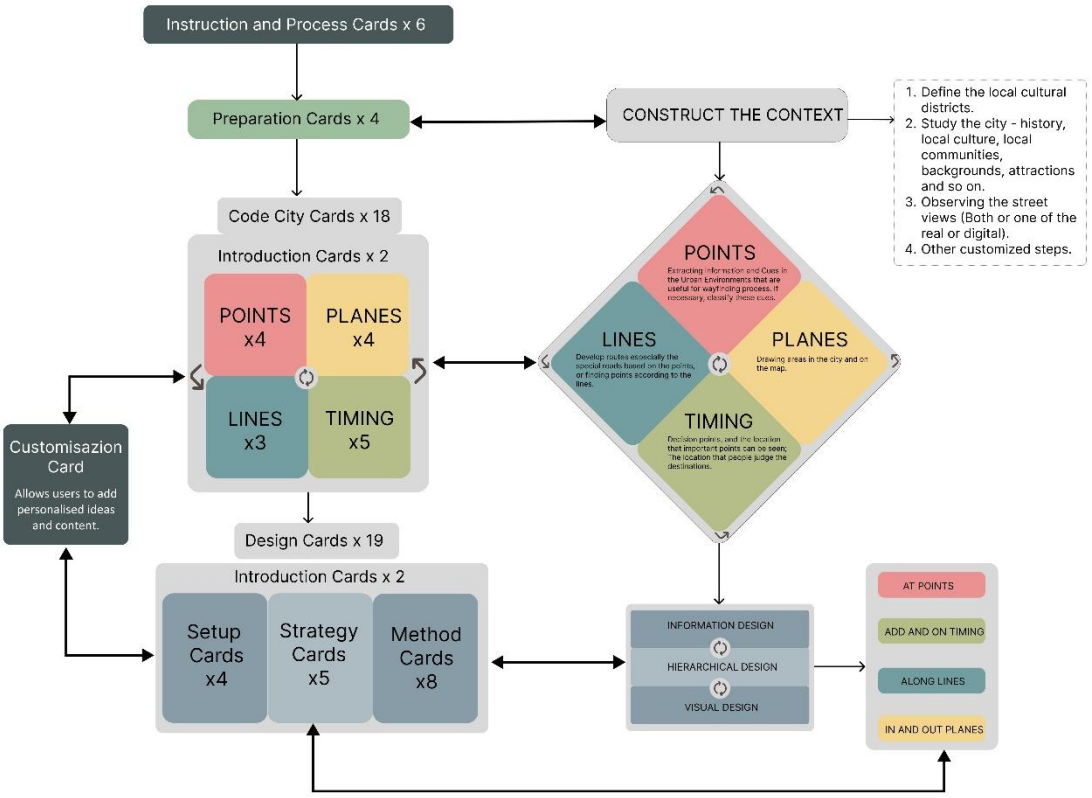

Figure 72 WSDSC as a toolkit corresponding to the design framework. Drawn by the author.

8.4.1. Instruction and Preparation Cards

Instruction Cards serve as the user manual for WSDSC. This section explains how to use the cards for design and defines some essential terms. It includes six cards: two introduction cards, two process cards, and two key terms cards.

The introduction cards provide a brief overview of WSDSC, explaining its purpose and how to apply it, helping users understand how to use the system. The process cards display the colour codes for each part of the deck, assisting users in quickly locating steps and finding the required cards. The key terms cards introduce two essential

terms—wayfinding and wayfinding system—to help users, especially non-professionals, grasp these fundamental concepts.

The preparation cards consist of four cards in total, corresponding to the ‘construct the context’ section of the framework. The first card introduces this stage and explains how to use the cards, while the remaining three focus on specific actions: defining attractions, understanding areas, and identifying cultural districts. These cards help users prepare for the design process by building an understanding of the city, identifying cultural districts, and recognizing attractive or unattractive areas, as well as areas that are easy or difficult to navigate. The goal is to establish a basic conceptual framework for the design. The steps outlined in these cards are iterative, guiding users to gradually develop an understanding of the city or area to be designed, thereby laying the foundation for the design.

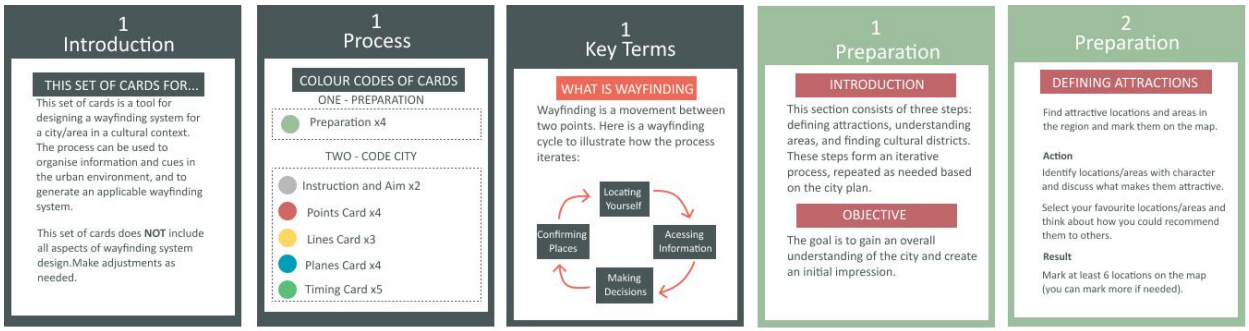

Figure 73 Part of the Instruction and Preparation cards, designed by the author.

In general, instruction cards form the first part of WSDSC, through which users can learn the methods and processes for using the system. Preparation cards constitute the second part, designed to help users establish a preliminary understanding of the city and design context through three iterative steps.

8.4.2. Code City Cards: The Roles of Four Elements

The four elements are mainly used to encode information in cities, and this encoding can be reflected in cartography, which means that this method can be used in physical wayfinding system design, such as signage, as well as in digital navigation, which is becoming increasingly popular today. What makes them work is a design approach based on information communication and graphic design. Points are information units that assist the wayfinding process at different locations and times, along lines, as timing takes shape. Planes provide a basis for information hierarchy, breaking down urban areas into smaller units and offering a clearer perception. The purpose of the Code City cards is to assist users in extracting external features encoded with the four elements from the urban environment, step by step, according to the instructions, so that they can be visualised in subsequent stages. As discussed in Chapter 6, these external features influence people's perceptions of cities and, as a result, shape the city's image. When information is filtered at this stage by using four elements, different city images can be presented, emphasising their unique characteristics and thereby enhancing the uniqueness of the city's image.

Code City cards should be used alongside a city-based or virtual wayfinding task, such as walk in the city or through an online street view map. This set includes two introduction cards, four Points cards, three Lines cards, four Planes cards, and five Timing cards. The introduction cards provide an overview of how to use this section. The remaining four cards help the user extract information from the city. Points and Lines cards include Action and Result sections, which guide the user on the actions to take and the expected results. Planes and Timing cards include Action and Example sections, which provide guidance on actions to take and offer examples. The figure (Figure 74) below shows some of these cards, which will be explained in more detail

below.

Figure 74 Part of Code City cards, designed by the author.

Points cards

There are four Points cards, which are tools used in the WSDSC to identify key information and references within the city. The first card provides specific steps to assist users in identifying references and information for wayfinding in the city. The second and third cards present some pre-existing categories used to classify points, which emerged from the results of the walking interviews and were subsequently used in the workshops. The final card is a customisable one that allows users to create their own categories, rather than being restricted to those provided by the card. Categorising points is not a necessary step, but it can be helpful in the design process. Whether or not to use these categorised cards largely depends on the type of design the user is aiming to create.

Lines cards

Lines cards are tools used in WSDSC to create routes and link places, helping users identify the paths people are likely to follow in a city. These cards guide users in finding efficient paths and direct attention to specific roads and notable road features, distinguishing between those that are easy to navigate and those that are more difficult. The cards can be used to mark both visible and invisible routes, providing a valuable foundation for wayfinding system design.

Planes cards

Planes cards are used to define and label areas within a city, helping users divide the space based on perception and create a stratified, partitioned view of the city. Unlike the other cards, Planes cards provide not only the steps for each action but also examples. Planes cards consist of four types: Planes with a dominant core point (which may or may not be surrounded by related points); Planes with multiple points, where no single point dominates the area; Planes without points but perceived as a unified region rather than an individual object; a card for identifying boundaries of planes.

Timing cards

Timing cards are used in the WSDSC to help users identify and mark the locations of timings in the wayfinding process. These cards provide specific steps and instructions on how to identify various types of timings during the journey. Each card includes actions and examples. The first card helps users locate decision points where they see points and make choices, marking these important decision points on the map. The second card focuses on marking the locations where users confirm their arrival at the destination. The third card encourages users to find as many timings as possible for important points, for example, a point that may be visible from two streets. The fourth card helps users identify locations in the city with no timings, where they may feel uncertain or worried about getting lost or going the wrong way. Although locations with less timing need wayfinding guidance, this card helps users identify areas particularly in need of a wayfinding system. The final card assists users in identifying timings at the boundaries of planes, such as the entrances to planes, indicating that the information presented by the wayfinding system should change at these locations.

Code City cards are a tool designed to help users extract the four elements from the urban environment and represent a key step in the design process. This section of the

cards corresponds to the second part of the framework, which focuses on the application of the four elements. These cards assist users in extracting information from the urban environment and labelling it on a map, thereby transforming it into a cognitive map primarily consisting of points, lines, planes, and timing. This step provides the foundation and structure for the design process, effectively bridging the gap between the information in the urban environment and the design.

8.4.3. Design Cards: Construct Wayfinding System

There are nineteen Design cards, two Introduction cards, four Setup cards, five Strategy cards, and eight Method cards. These cards offer design strategies and methods for constructing the wayfinding system, aiming to assist users in visualising the four elements extracted from the city and developing a comprehensive design solution. This solution includes, at a minimum, visual design, information communication design, and wayfinding system design in various formats and media. The Introduction card provides a detailed overview of these cards. It explains the cards, outlines the three stages of the design process, offers recommendations for their use, and specifies the objectives of the design. The other three card sets correspond to specific stages in the design process, which I will elaborate on in more detail below.

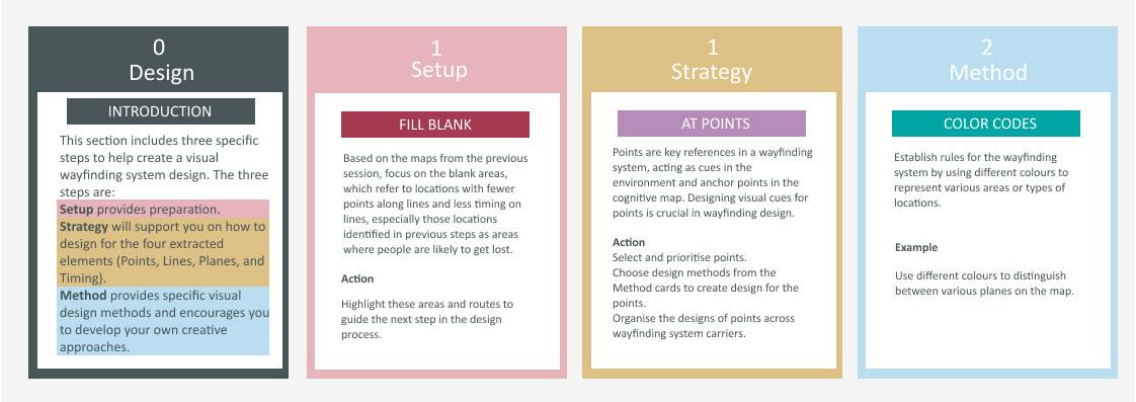

Figure 75 Part of Design cards, designed by the author.

Setup cards

Although the three steps of the design process are iterative, the design begins with the Setup cards. There are four Setup cards, which are intended to help users prepare, build a foundation, and organise their design in advance. All of the cards provide an action. The first card is Fill Blank, which helps users focus on blank areas on the map—often places and sections of road where information is scarce, and where it is easy to get lost. The second card is Identify Tiers, which assists users in establishing the hierarchy of the wayfinding system, thereby determining the information to be presented by the wayfinding system design. The third card is Select Carriers, which helps users select the appropriate carriers for the design. This card is the only special card in this section, as it provides examples in addition to actions. The final card is Custom Setup, which encourages users to develop their own approach and methodology for wayfinding system design.

Strategy cards

There are five cards that present four design strategies, namely: at points, add on timing, along lines, and in and out of planes. These four strategies are intended to provide methods for bridging the gap between the four elements and specific design approaches.

In addition, there is one card that encourages users to develop their own strategies. I will explain these four strategies in more detail below.

A. At Points

Points are units of information and visual stimulus points during wayfinding. They serve as reference for wayfinding, helping people confirm their location and orientation. As stated by Couclelis et al. (1987), anchors are cognitively salient cues in the environment that perform active cognitive tasks, such as helping to organise spatial knowledge, facilitating navigation, and aiding in estimating distance and direction. Although conceptually distinct, points also act as anchors, serving as focal points in cognitive maps and contributing to spatial awareness.

Points, however, have their limitations. In two experiments with test WSDSC, participants noted that shop-type points may close down and disappear in the future. In contrast, cultural districts, for example, are unlikely to disappear; they will likely be preserved and may become symbols of the city and unique attractions. Points not only affect wayfinding but also shape people's perception of the city. Therefore, the selection of points significantly impacts the formation of a city's unique image.

The choice of points has a significant impact on the formation of the city's unique image. Signage and map-based information factors are influenced by information designers (Jeffrey, 2019), and the subjective choices of users can significantly affect the image of city. This suggests that involving more people in the process is important, which is why I propose that WSDSC is particularly well-suited for application in workshops.

In terms of design strategy, at points aims to help users incorporate points from the urban environment into the design of the wayfinding system. These points serve as key reference markers and should be highlighted as visual cues. Thus, the card provides actions, including layering and selecting points, choosing the appropriate design method from the Method section to create a visual cue, and organising these designs on a carrier.

B. Along lines

The design strategy for lines consists of two main aspects. The first aspect is to highlight special parts, highlight special parts of visible lines, such as tram tracks, bridges, and rivers. These lines stand out from the environment and can be highlighted on a map or within a physical wayfinding system. Possible visual design solutions include colour coding, special graphic signs, and other methods.

The second aspect is to make non-special lines special and to make invisible lines visible. Making non-special lines special involves design interventions, such as highlighting and colour coding roads, which can be applied both on maps and in the city. Making invisible lines visible usually involves labelling lines that lack physical structures, thereby increasing the flexibility of wayfinding. This approach may result in resource savings, time efficiency, or enhanced scenic experiences along the way.

Most importantly, lines form the network of a wayfinding system in a city. In terms of wayfinding system design, all information must be on lines or at least visible along lines. Organising the wayfinding system along lines is essential to ensure that information is accessible to those walking along the route.

C. In and out planes

Planes help to improve spatial clarity and legibility. The primary role of planes is to identify areas, allowing people to recognise, remember, or identify specific regions of the city. Another important role of planes is organising space, as urban spaces become more structured and easier to understand when planes are defined. Another significance of planes lies in their ability to influence the formation of the city's image. When a city seeks to establish its unique urban image, emphasising the planes, especially those represented by cultural districts, is equivalent to highlighting the city's culture and characteristics. Colour coding and visual schemes are possible, both on maps and within the physical wayfinding system. Additionally, if the design process emphasises the unity of visual elements, it enhances the visual coherence of the city and its sense of wholeness.

Planes also provide a way to filter and hierarchically organise information. Different information may be presented inside and outside the planes to help people use and access the information effectively. This not only helps to avoid information clutter and overload, which could impede wayfinding, but also varies the scale of the wayfinding system to match the cognitive scale of the user.

D. Add and on timing

Timing can filter information and determine where it is presented. Setting up a wayfinding system, such as signage, at the right time ensures that people receive the information they need at the right place and moment. In digital maps and applications, dynamic adjustments of timing can offer more flexibility and effectiveness. Areas with insufficient timing usually lead to an increased likelihood of getting lost, and people's perception of such areas becomes vague. Symbols imply the stimulation of an absent

stimulus (Krampen, 1965), and areas with too little timing can be supplemented with appropriate visual stimuli, such as signage. This can help designers identify optimal locations for physical wayfinding systems, including determining the order of importance of decision points. Timing can also aid in identifying the entrances to planes and in determining when and where to adjust the layers and scales of information. In other words, timing can help decide where to place the artefact or visual design of the wayfinding system and what information should be displayed on it.

Method cards

There are eight Method cards, which are intended to provide users with specific design methods for visualising the four elements that will ultimately make up the wayfinding system. Each card has examples of the methods provided to help users understand them. These methods include icon and graphic design, colour coding, map design, object outlines, direction guides, text, and information stations. These methods are derived from my research results. However, it is not possible to cover all the design methods for the wayfinding system. Therefore, there is also a card on developing your own methods, which encourages users to create and refine their own design methods.

As discussed in the previous section, Code City cards bridge the gap between information and design in urban environments and provide the foundation. The Design cards, which correspond to the final part of the framework, offer users concrete design strategies and methods as references for their designs, while also allowing them to incorporate their own creativity and ideas to form an actual design solution.

8.5. Experiments for Testing WSDSC in the Lancaster Mill Race

Two test experiments, similar in format to the workshops, were conducted. The detailed procedure is explained in Section 5.3, with specific results presented in Section 5.3.3. WSDSC was refined through these two experiments, ultimately culminating in a complete version. The purpose of these experiments was to evaluate the effectiveness of WSDSC in practical applications, including the feasibility of extracting and labelling the four elements from the environment and transforming them into design solutions.

The four-element extraction phase of the two experiments was conducted in an urban environment and a laboratory environment, respectively, yielding slightly different results. It should be noted that in the urban environment, participants absorbed more specific information. For example, the participant in the urban environment identified two particular road sections, specifically two slopes, which the participant using the Street View map in the laboratory environment did not notice. Nevertheless, in both urban and laboratory settings, the WSDSC demonstrated its ability to assist users in creating design solutions.

After summarising the results from the two participants, I created a diagram to illustrate their design proposals. The proposals put forward by the participants revealed some commonalities. As shown in the diagram, the green triangles indicate the locations where signage should be installed, a suggestion shared by both participants. The orange triangles mark locations identified by the participants in the urban environment experiment as appropriate for signage or other wayfinding systems. This discrepancy may be due to the fact that, in the laboratory environment, participants took a virtual walk using Google Maps Street View, which includes only major roads and excludes alley interiors, causing participants to disregard these as viable routes. Both participants

proposed colour-coding solutions, primarily focusing on the design of lines. As shown in the diagram, the sections marked in red indicate the areas the participants believed should be assigned colour codes. One participant's design suggested assigning colours to the roads, matching the colours to the exterior walls of the Grand Theatre. The other participant proposed a scheme with different colours for the roads. Both considered colour coding for lines an effective design method. Additionally, other design methods such as icons, graphics, and object outlines were also utilised.

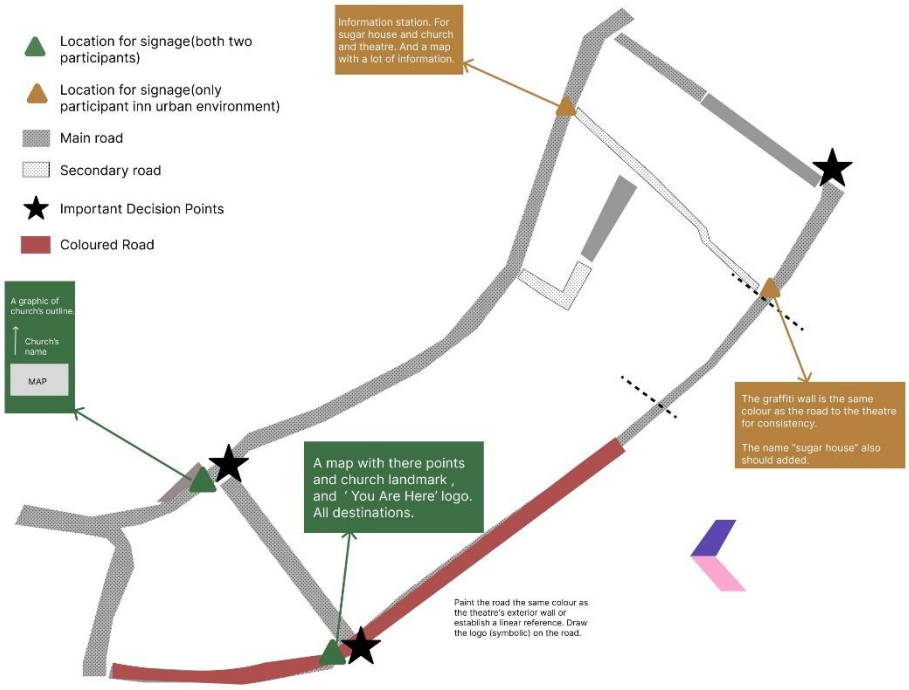

Figure 76 The visualization of the design proposals, draw by the author.

When asked for feedback on the WSDSC, the non-professional participant mentioned that although she had little to no design experience, she was still able to produce feasible design solutions using the set of cards. The design proposals generated in the two experiments were limited for several reasons. Firstly, time constraints played a role: the first experiment lasted approximately two and a half hours, and the second lasted around one and a half hours, which was clearly insufficient. Secondly, the purpose of

the experiments was not only to test the feasibility of the cards but also to refine their details, which slightly affected the final results. Nevertheless, it can be concluded that using WSDSC to develop a wayfinding system design is feasible.

By using WSDSC, the four key elements can be extracted from the city and used as a foundation for design, enabling the selection of feasible design solutions. These solutions can then be further integrated into a wayfinding system design. Code City cards assist in identifying the four key elements of the urban environment. Points marked on the map provide specific guidance as information units, while also contributing to the creation of a unique urban identity. These visual anchors help people identify directions and orient themselves. Planes offer clear urban zoning and can adjust the content and scale of information presentation. Lines establish a framework for constructing wayfinding system designs and help create coherence and flow in the system. In areas with less timing, such as those marked by triangles in the figure above, a wayfinding system, including physical signage, can be implemented to aid navigation. Design cards help generate design solutions. Most importantly, the results of these solutions can take the form of various wayfinding systems or maps. This demonstrates that WSDSC is not only adaptable to traditional physical wayfinding system design but can also be applied to modern electronic navigation systems, with potential applications for future wayfinding system designs. As a framework and a tool to implement the framework in design practice, WSDSC does not restrict specific design carriers but instead provides support for design solutions.

The results of the experiments also show that using WSDSC should be a multiple, iterative process, with steps repeated until the wayfinding system in the area is saturated. Based on the experience and results obtained from the experiments, I suggest that multiple iterations of workshops or focus groups may be the best platform for using WSDSC. Non-professionals can use WSDSC smoothly, but guidance from

professionals will make the design process smoother and more engaging, and will also enrich the design solutions.

8.6. Summary

Overall, this chapter presents the main findings of this study—namely, the WSDSC and its underlying framework—designed to address the primary research questions of this thesis.

First, in Section 8.1, four key elements are introduced: points, lines, planes, and timing. Points are independent units of information that provide people with a reference for wayfinding. Points are similar to Lynch's landmarks, but more importantly, they include non-architectural objects and must be visible along the path. Lines form a grid to design the wayfinding system and ensure its continuity. While Lynch's paths emphasise clear, planned routes, lines encompass both visible and invisible routes within the city, providing dynamic and continuous guidance for wayfinding. Planes provide a basis for a clear urban layout and information hierarchy. Planes cover smaller areas than districts and typically contain one or more core points. Timing organises the first three elements to form a dynamic presentation of information. Timing is a new extension of Lynch's theory, focusing on when and where information is perceived, ensuring that dynamic and effective information is provided throughout the wayfinding process. These elements provide a framework for identifying and encoding external features in urban environments, thereby addressing RQ1.

T These four elements form a methodological framework for encoding the city, accompanied by a corresponding collaborative design logic and method. Visual design

translates this coding into a visual language, making it graphical and perceptible. The information hierarchy provides the underlying logic for organising these visual languages and visualisations, as well as the scale of the wayfinding system. By combining the four elements with these design strategies, I have proposed a design framework.

Based on this framework, I designed the WSDSC, which represents the main outcome of this thesis. WSDSC is explained in detail in Section 8.4 to address RQ2. The toolkit consists of three main steps: the first helps users understand the city's context and background; the second guides users to encode information in the city using the four elements and present it on a map; the third introduces detailed design methods to assist users in creating design plans. Subsequently, WSDSC was tested and refined in the Lancaster Mill Race area, undergoing two trials, which are discussed in Section 8.5. The results show that WSDSC effectively supports users in the wayfinding system design process, particularly when applied in multiple iterations to gradually refine design solutions. Based on these test results, I recommend that WSDSC is especially suitable for multi-user workshop environments, where it can enhance both design effectiveness and user experience under professional guidance.

Overall, this chapter addresses the primary research questions of this thesis by presenting and discussing the main research outcomes. It provides a flexible and practical tool for wayfinding system design in urban environments, enabling users to design systems adaptable to various formats and media, meeting future development needs. In the next section, I will discuss the conclusions of this thesis, outline its contributions, reflect on its limitations, and explore directions for future research.

Chapter 9. Conclusion

The research interest and initial motivation presented in this thesis are based on the expectation to use wayfinding system design as a medium to further enhance people's experience of the city. I emphasised the unique cultural identity of the city of Manchester, while also considering how the framework could be adapted for other cities through the development of a framework and toolkit. These research interests and motivations have driven me to explore urban identity and cognitive maps as a foundation for wayfinding system design and to investigate a new set of design methodologies.

Chapter 1 introduces this thesis. In Chapter 2, the literature review highlights two key focuses in wayfinding: external features and internal representations. Based on a review of past and current design works and projects for wayfinding systems in Chapter 3, an analysis of trends offers a vision for the future of wayfinding systems, including which elements should be incorporated and how. Chapter 4 outlines the methodology of this thesis. First, backcasting was used to establish a comprehensive perspective from the past to the future, helping to identify solutions for future trends. Lynch's theory has provided a paradigm shift and served as a mapping tool to characterise how people perceive space, place, and urban coherence. By decoding Lynch's approach, I adopted walking interviews and workshops as data collection methods, conducting the research with Manchester as the case study. Chapter 5 presents a detailed description of the research processes and summarises the collected data, including information extracted from urban environments, people's understanding of cities, and design strategies and methods for wayfinding system design.

Chapter 6 explores which external features from the environment people use when wayfinding in cities and when designing wayfinding systems, as well as how this information is represented in cognitive maps. Based on the findings in Chapter 6, Chapter 7 maps Manchester's overall and district images to discuss these data-driven insights. Finally, Chapter 8 presents the main outcome of this thesis: the development of WSDSC, a toolkit of cards designed to apply the framework for wayfinding system design. This framework, consisting of four key elements, forms the foundation of the design process. The WSDSC toolkit was created to help implement this framework in design practice and was tested in the Lancaster Mill Race area to verify its feasibility for use in cities beyond Manchester.

This chapter is the conclusion chapter. It summarises the content of the previous eight chapters, responds to the research questions, discusses the research contributions and significance, states the limitations, and suggests directions for future research.

9.1. Responses to the Research Questions

The main research question of this thesis is: How can a design framework that combine external features and internal representations be proposed for a wayfinding system in the city that enhances the uniqueness of city's image and people's experience in the city?

WSDSC was developed to address the research questions of this thesis. Specifically, by collecting and analysing data, I explain in Chapter 6 which external features in urban environments support wayfinding and influence city image and analyse their respective roles in wayfinding based on Lynch's five-element theory. Subsequently, in Chapter 7,

these external features are transformed into visualised city images. Based on these analyses, in Section 8.1, I propose that four elements (points, lines, planes, and timing) be extracted from these city images, representing an extension and adaptation of Lynch's theory for wayfinding system design. In Section 8.2, I present specific design strategies. Subsequently, combining the four elements with the design strategies, I propose a framework. To enable the framework to be applied concretely, I design the WSDSC card set.

WSDSC aims to help users extract external features encoded with the four elements from urban environments and present them on maps to form city images. These images are then transformed into visualised design solutions through specific design setups, strategies, and methods, enhancing wayfinding experiences and the uniqueness of urban images. As an artefact that assists in the design of wayfinding systems, WSDSC provides a design framework, step-by-step procedures, and specific design approaches to create the wayfinding system design. By following the guidelines of WSDSC, wayfinding system designs that are adaptable to various forms and media and capable of addressing future needs and trends can be developed. Through the second major step of WSDSC, encoding information in the urban environment using the four elements, external features in the city can be selected to highlight the unique characteristics of the city image that users wish to convey, which are then reflected in the design solution.

9.1.1. RQ1: How can external features in the urban environment that support the wayfinding process and need be incorporated into wayfinding system design be extracted?

The four elements (points, lines, planes, and timing) in Section 8.1 can be used to extract external features in the urban environment that support wayfinding and should be incorporated into the wayfinding system, subsequently presenting them on a map. These elements provide a framework for identifying and encoding external features in the urban environment.

Points are individual information units in urban space, typically providing support for wayfinding systems due to their recognisability. Points allow people to identify landmarks and reference points in the city. By mapping these points onto a map, objects that stand out from the environment and aid wayfinding, along with their locations, can be extracted.

Lines represent paths that people use to navigate the city, including planned roads and informal routes such as shortcuts. Lines with distinct features serve as continuous references, creating a stronger psychological impression of the route. Lines allow both formal and informal routes to be mapped and highlight the importance of specific paths. They are particularly useful for filtering points in the city, as only those visible along or from the route are meaningful for wayfinding.

Planes are smaller areas within the city, typically consisting of one or more core points. Planes display the spatial characteristics and cognitive understanding of urban areas, helping to identify distinctive districts.

Timing focuses on the dynamic aspects of wayfinding, which involve the time and location at which points become visible. Timing allows people to identify points that influence wayfinding across different locations and times.

In summary, these four elements are interconnected and influence one another. By iteratively identifying these elements within the urban environment, the external features supporting wayfinding can be mapped and transformed into a cognitive map from a wayfinding perspective.

9.1.2. RQ2: How can the extracted external features be visualised and designed as a wayfinding system to enhance the uniqueness of the city's image?

WSDSC was developed to facilitate the extraction and organisation of external features in cities, integrating them into a cognitive map from a wayfinding perspective and visualising them as design solutions.

WSDSC comprises three main steps. In the first step, it enables users to conduct background research and analysis on the city and area to be designed. In the second step, with detailed guidance, users can extract, encode, and filter external features using

four elements. These features are organised and presented on a map, integrating them into a cognitive map from a wayfinding perspective, such as a collection of internal representations. In the third step, WSDSC offers design setups, strategies, and methods, providing specific approaches to extracting external features. There are three types of setups: Fill Blank, which focuses on areas lacking wayfinding guidance; Identity Tier, which helps establish the hierarchy of the wayfinding system, particularly the information hierarchy; and Select Carriers, which involves selecting the carriers for the design. There are four design strategies: at points, along lines, in and out of planes, and adding to and on timing. Finally, specific methods are provided, including icon and graphic design, colour coding, map design, object outlines, direction guides, text, and information stations.

At each step, WSDSC outlines specific actions and, depending on the section, defines the expected outcomes and provides examples to guide the user. It also emphasises the importance of allowing users to freely explore their ideas and creativity, ensuring that the design process is not constrained by the cards at each step. Therefore, it offers a Customisation card that can be replicated multiple times.

In summary, WSDSC is a practical toolkit for wayfinding system design, offering a systematic design framework. By defining setups, strategies, and methods, it provides concrete support throughout the entire design process—from preparatory work and information extraction and organisation to the visual presentation of the design. Through this process, WSDSC transforms external features in urban environments into visual design solutions.

9.2. Contribution of Research

The main objective of this research is to explore wayfinding system design to enhance the unique image of a city. Based on this objective, I initially sought to explore ways to visualise a city's culture and image and incorporate these into wayfinding system design. Ultimately, the main contribution of this thesis is the development of a set of cards for designing wayfinding systems, namely WSDSC. These cards assist users in extracting four key elements from the urban environment and visualising them as a wayfinding system design, using specific design methods and strategies. By selecting and organising these four elements, different types of information can be presented, thereby influencing the city's image. Consequently, through wayfinding system design, WSDSC enhances the uniqueness of a city's identity in the context of wayfinding. WSDSC adapts to both physical, traditional wayfinding systems and new applications centred on electronic navigation, as it provides a design approach and logic that embraces the infinite possibilities of the future

The primary audience for WSDSC includes graphic designers and wayfinding designers, particularly those who wish to involve non-professional stakeholders in the design process. Other non-professionals, such as ordinary city residents, can also use WSDSC for design purposes, although the need for professional guidance may vary depending on individual design skills. Based on my research, WSDSC does not currently specifically target urban planners, planning departments, or related policymakers, but this could be a potential direction for future development.

The urban context for Kevin Lynch's framework has changed, and his theory has ceased to expand to address this new shift. Lynch's theory emerged in the 1960s, and he later revisited it in the 1980s. This means that Lynch's research did not respond to the needs

of the digital age and did not consider digital navigation devices or the complexity of modern architecture. It should be noted that cities are constantly changing, expanding, and being rebuilt as times evolve. In this sense, Lynch's five-element coding system may no longer fully apply to today's cities. Additionally, Lynch focused primarily on American cities, so his research was somewhat limited to the forms, layouts, and planning of those urban environments. From an academic perspective, the contribution of this thesis lies in the development of WSDSC and its underlying framework. By introducing four novel elements, it further integrates Lynch's theory into wayfinding system design, making it adaptable to contemporary and complex urban environments, while also proposing extensions and variations. Among the four elements, 'points', 'lines', and 'planes' represent modifications derived from Lynch's theory, while the 'timing' element constitutes an extension of Lynch's theory, introducing a dynamic perspective into wayfinding system design. WSDSC provides feasible design methods and strategies, thereby enhancing the practical application of theoretical concepts in design solutions.

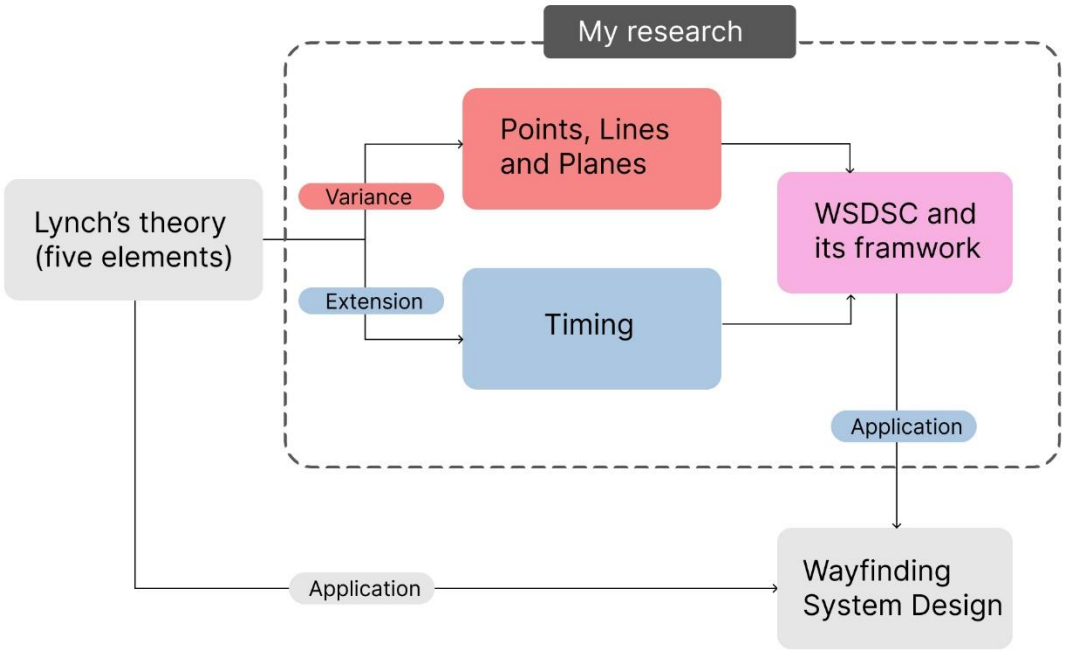

Figure 77 Extensions and variations of Lynch's theory in this research, with its application, showing the contribution of the thesis.

Another part of this thesis's contribution relates to the workshop process and the cognitive tools designed for it. This process provides a useful reference and toolkit for others interested in this type of research, as well as a structured framework for design practice.

9.3. Limitation

The limitations of this study must be acknowledged. Firstly, this research was conducted in Manchester, a unique city that is relatively typical in retaining its historical buildings, heritage, and various cultural districts. This suggests that the transferability of the research findings is particularly relevant to cities or areas within cities with historical sites, heritage buildings, monuments, and cultural districts. Consequently, the applicability of the results may need to be reconsidered for newly developed cities and areas. Nevertheless, if such cities or regions aim to build a cultural image, this framework may serve as a useful reference for subsequent wayfinding system design. Additionally, as Manchester is a Western city, it is important to consider whether the framework requires adjustment in other cultural contexts.

Another limitation is that most participants had never been to Manchester or had only visited a few times. They came from other cities in the UK and overseas, with only two participants being local to Manchester. These participants had limited knowledge of Manchester, and the data they provided reflected more of a visitor's perspective than a local one. It should be noted that if more participants from Manchester had been included, they might have provided more diverse data based on their local knowledge.

During the research process, I encountered several challenges, which also led to limitations in the study. First, to ensure participants could complete the study smoothly, the walking interviews were limited to a certain distance and duration, which may have restricted their comprehensive experience of the space. Another challenge was enabling participants to gather information from the urban environment during the workshops. As mentioned in section 5.2.1, it was impossible to bring Manchester into the room, so I used a large number of visual materials, such as street view and panoramic photos. This had some impact on the research results, as participants worked in a laboratory environment rather than an urban setting. Although the walking interview data supplemented wayfinding in the urban environment, the design results were still somewhat limited. Therefore, if conditions and funding permit, adding a step to the workshop where participants walk through the design area and gather information, similar to the first experiment conducted when testing WSDSC, would be beneficial.

In addition, this study primarily employed qualitative methods, such as walking interviews and workshops, to collect data. Although data collected through these methods can reflect people's subjective views and experiences, it may also be influenced by the participants' personal biases. Incorporating quantitative methods, such as conducting surveys to gauge people's perceptions of the city and identifying areas where they tend to get lost, as well as employing techniques like space syntax to analyse spatial accessibility, visibility of objects within spaces, and pedestrian flow, would be particularly beneficial. Moreover, regarding wayfinding in complex urban environments, although participants can intuitively and instantly process urban information and establish a connection with the city, they are inevitably affected by environmental factors such as noise and traffic. Additionally, the approach adopted in this study focuses primarily on walking and does not explore wayfinding experiences related to driving or public transport.

9.4. Suggestion for Further Research

I recommend further research based on my findings and the limitations discussed above. Future studies could include validation and exploration in a broader range of cities with diverse cultural backgrounds and varying urban forms. Given my research interests and background, I primarily focus on cities in China. For example, Beijing is a typical city with a regulated grid structure, where most roads run due south–north and east–west, and it is quite large. Similar cities include Chengdu and Jinan. Tianjin, by contrast, features a different urban form, with more inclined and winding roads. Chongqing is distinct due to its mountainous terrain, presenting an extremely complex environment for wayfinding. Its multi-layered structure complicates navigation on a flat map, making a wayfinding study in Chongqing potentially very insightful and meaningful. These cities also have diverse cultural backgrounds. Beijing is renowned as a historic capital, home to cultural heritage sites such as the world-famous Forbidden City and the Great Wall. Tianjin is known for its famous Crosstalk culture. Jinan is celebrated for its local springs, which the city promotes as a distinctive feature. Chongqing and Chengdu are famous for their cuisine, alongside rich cultural heritages. An in-depth study of these diverse cities can provide valuable insights for designing more inclusive wayfinding systems, thereby enhancing both accessibility and cultural identity.

Figure 78 Maps of Chinese cities showing, to a certain extent, their form, shape, and planning. A: Beijing; B: Chongqing; C: Chengdu; D: Tianjin; E: Jinan. Source: all maps downloaded from OpenStreetMap (https://www.openstreetmap.org/).

In future research, it would be valuable to combine qualitative and quantitative data. For example, using spatial and urban analysis tools such as GIS to analyse traffic flows,

pedestrian routes, and public transport within the city could provide movement data for walking, driving, or using public transport. This data could then be compared and integrated with my qualitative findings to inform wayfinding system design. Additionally, as mentioned previously, incorporating methods such as space syntax offers valuable insights into how spatial structures influence people's wayfinding behaviour.

Future research could also consider various urban activities—such as shopping, socialising, and cultural events—and examine how these activities affect wayfinding strategies and people's perceptions of the city. For instance, the 'ghost landmark' concept discussed in section 7.2 represents an intriguing avenue for further study. Such landmarks, which no longer physically exist but persist in residents' perceptions, may offer important perspectives on urban wayfinding and influence the creation of new landmarks and the shaping of the city's image.

Moreover, research should be situated within the context of urban planning and development. Methods like workshops and walking interviews can effectively capture residents' use and experience of urban space. Integrating research findings into planning processes will support improved urban accessibility and enhance people's experiences within the city environment.

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Appendix

This appendix contains the materials used in the workshops and walking interviews, including procedures, supporting tools, and question sheets, as well as the full set of WSDSC cards, which form the main outcome of this thesis.

Appendix A: Workshop and Walking Interview Materials

Workshop materials

This section includes the materials used in the workshops, comprising the workshop outlines and the visual support materials (i.e. the artefacts) employed.

Outline of workshops

This outline represents the initial plan for the workshops. Some activities were modified, removed, or adjusted during the actual sessions due to practical considerations. The following outline was generated using SessionLab (https://app.sessionlab.com/) and is presented on the next page.

Wayfinding Workshop

SessionLab

energizer/icebreaker | theory | discussion/debriefing | Mapping/Drawing | exercise | Evaluation

TIME			GOAL
00:00 10m	**Introduction**	A brief introduction to the workshop, including a basic outline of the research topic and a brief outline of the general flow of the workshop.	Allow participants to relax.
00:10 20m	**Icebreaker**	Participants were asked to think about the question: Have you ever gotten lost? The second step will be to answer the question: What is your favourite location in Manchester? Ask participants to share the specific place they have visited, tell what feelings they got in that place, and explain why they liked that location. Mark it on the map.	To jog participants' memories of Manchester and to initially form their knowledge of the wayfinding system.
00:30 3m	**Pair-wise comparision**	Participants will be asked to choose between two images that better match the description.	
00:33 5m	**City Tour video**	A short video was shown of a previous wayfinding process that I had done in Manchester city centre.	
00:38 10m	**Tutorial**	A brief description of definition and elements of the wayfinding system with examples.	
		Group Mapping	
00:48 20m	**Information Strategy**	Selecting information from the wayfinding system and developing a wayfinding strategy.	
01:08 20m	**Identify desicion points**	Identify on the map the locations where decisions need to be made during the wayfinding process, such as landmarks and unique buildings.	
01:28 20m	**Drawing area**	Create culturally relevant visual areas on the map.	
01:48 20m	**Developing routes**	Find the starting and finishing points and develop the routes in the cultural wayfinding system.	
02:08 10m	**Future Building**	Participants were asked to imagine how the wayfinding system might develop over the next 50 years.	
02:18 25m	**Wayfidning system building**	Using artifacts and a set of toolkits, each group organised information on a large blank map and designed icons and signage to form a cultural wayfinding system.	

TIME			GOAL
02:43 25m	**Result sharing**	Each group presents the results of their project and describes their design concept.	
03:08 5m	**Evaluation From**	Participants are invited to fill in the workshop questionnaire and return it to me.	
03:13			

TOTAL LENGTH: 3h 13m

Materials

- ☐ Drinks- coffee, tea, and water in Introduction
- ☐ Cakes and cookies. in Introduction
- ☐ A blank map of Manchester in Icebreaker
- ☐ Online collaboration Platform such as Miro and Figma in Group Mapping
- ☐ physical materials- printed blank maps, coloured pens, sticky notes, etc. in Group Mapping
- ☐ A set of toolkits, including cards, maps and classify boards. in Wayfidning system building

Wayfinding Workshop - block details

00:00
10m

Introduction

A brief introduction to the workshop, including a basic outline of the research topic and a brief outline of the general flow of the workshop.

ADDITIONAL INFO

Name, institute of me, contributions of my research and

GOAL

Allow participants to relax.

MATERIALS

- Drinks- coffee, tea, and water
- Cakes and cookies.

00:10
20m

Icebreaker

Participants were asked to think about the question: Have you ever gotten lost?

The second step will be to answer the question: What is your favourite location in Manchester?

Ask participants to share the specific place they have visited, tell what feelings they got in that place, and explain why they liked that location. Mark it on the map.

ADDITIONAL INFO

Take part in this session myself by telling a story about getting lost in Manchester China Town; try to take no more than a minute per participant.

GOAL

To jog participants' memories of Manchester and to initially form their knowledge of the wayfinding system.

MATERIALS

- A blank map of Manchester

00:30
3m

Pair-wise comparision

Participants will be asked to choose between two images that better match the description.

00:33
5m

City Tour video

A short video was shown of a previous wayfinding process that I had done in Manchester city centre.

00:38
10m

Tutorial

A brief description of definition and elements of the wayfinding system with examples.

ADDITIONAL INFO

The wayfinding system includes wayfinding signs, directional signs, maps, landmarks, environmental information design, etc.

Group Mapping

MATERIALS

- Online collaboration Platform such as Miro and Figma
- physical materials- printed blank maps, coloured pens, sticky notes, etc.

00:48
20m

Information Strategy

Selecting information from the wayfinding system and developing a wayfinding strategy.

ADDITIONAL INFO

Participants will be asked to choose messages that reflected Manchester's culture as much as possible.

01:08
20m

Identify desicion points

Identify on the map the locations where decisions need to be made during the wayfinding process, such as landmarks and unique buildings.

ADDITIONAL INFO

Data from the Cultural and Creative Cities Monitor (CCCM) on the cultural districts selected for the list of references

01:28
20m

Drawing area

Create culturally relevant visual areas on the map.

01:48
20m

Developing routes

Find the starting and finishing points and develop the routes in the cultural wayfinding system.

ADDITIONAL INFO

Data from the Cultural and Creative Cities Monitor (CCCM) on the cultural districts selected for the list of references

02:08
10m

Future Building

Participants were asked to imagine how the wayfinding system might develop over the next 50 years.

02:18
25m

Wayfidning system building

Using artifacts and a set of toolkits, each group organised information on a large blank map and designed icons and signage to form a cultural wayfinding system.

MATERIALS

ADDITIONAL INFO

Each group will have a set of toolkits, including cards, large size maps and classify boards.

- A set of toolkits, including cards, maps and classify boards.

02:43
25m

Result sharing

Each group presents the results of their project and describes their design concept.

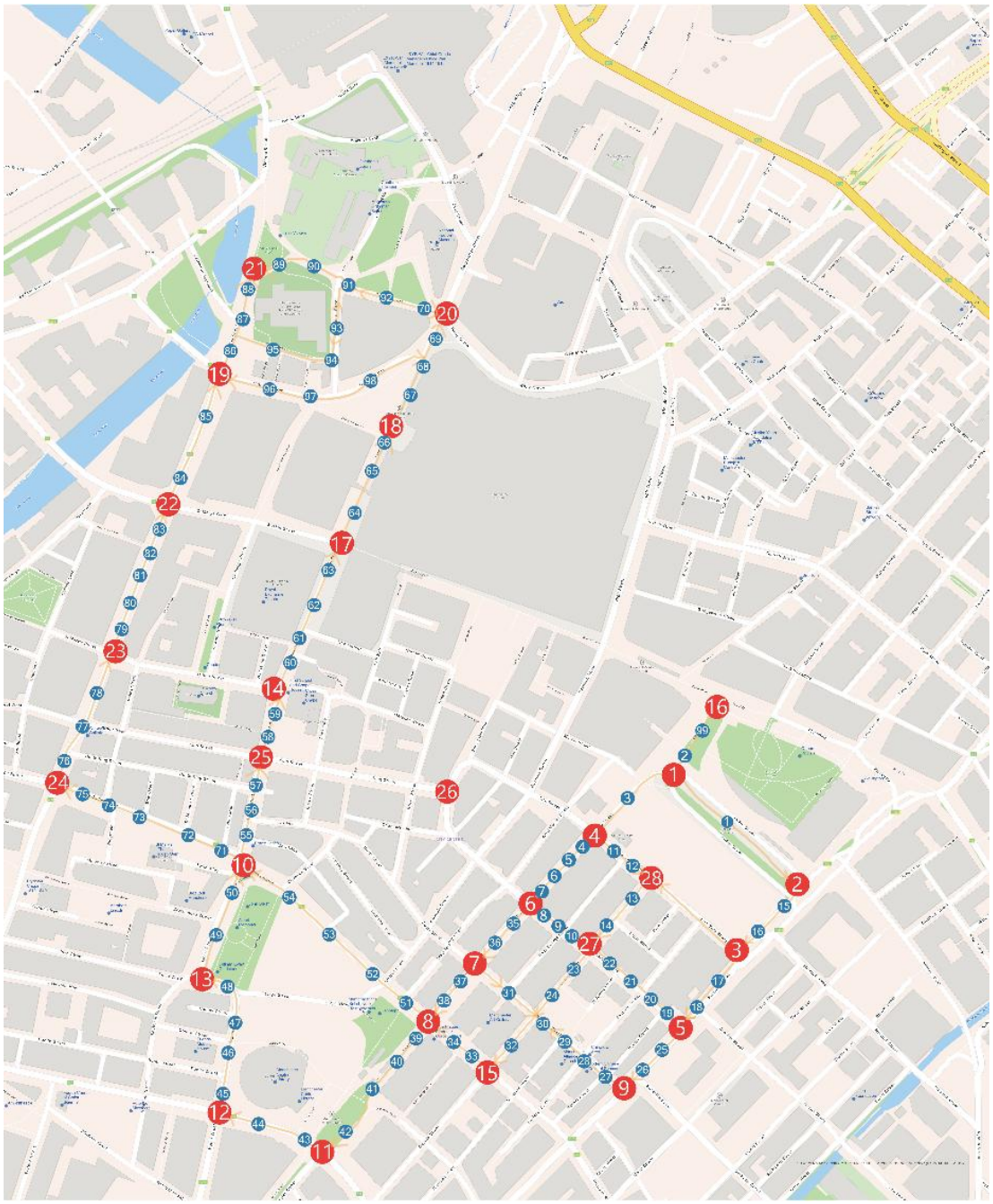
03:08
5m

Evaluation From

Participants are invited to fill in the workshop questionnaire and return it to me.

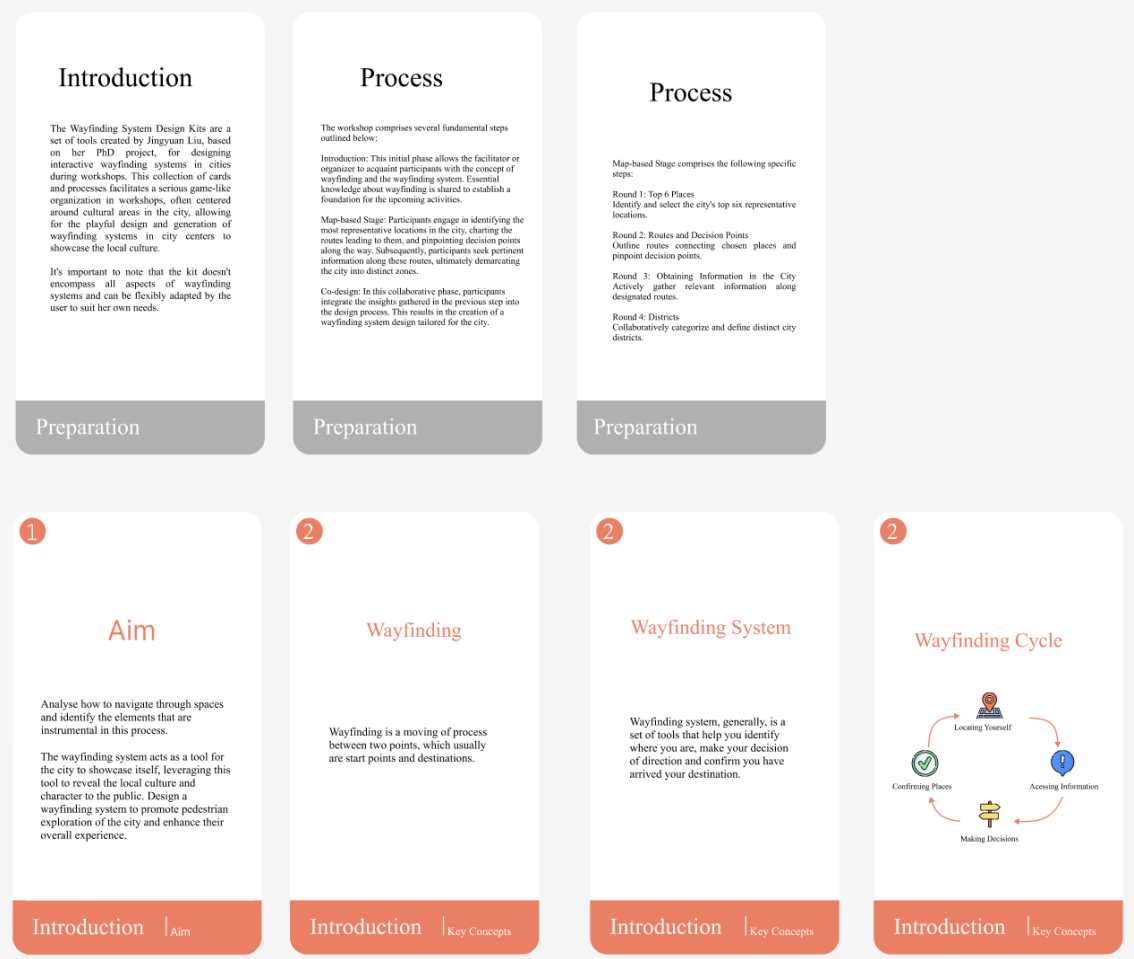
The A0 size map used in workshops

The large maps with numbering. The content of the large maps used in all the workshops was similar, covering the same area. All maps were downloaded from Digimap.

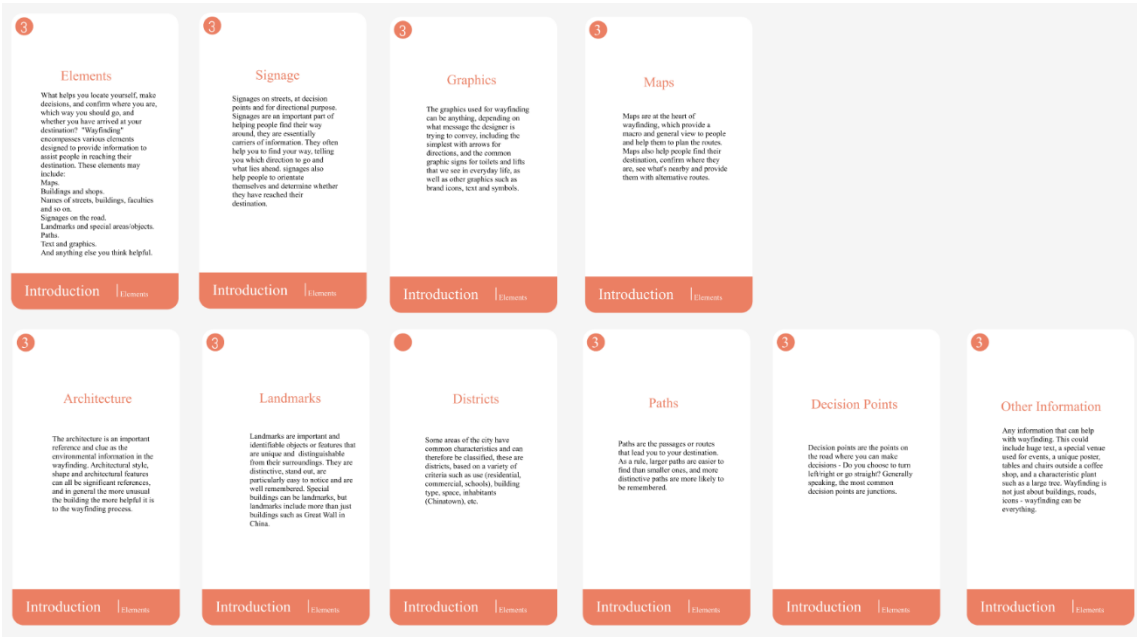


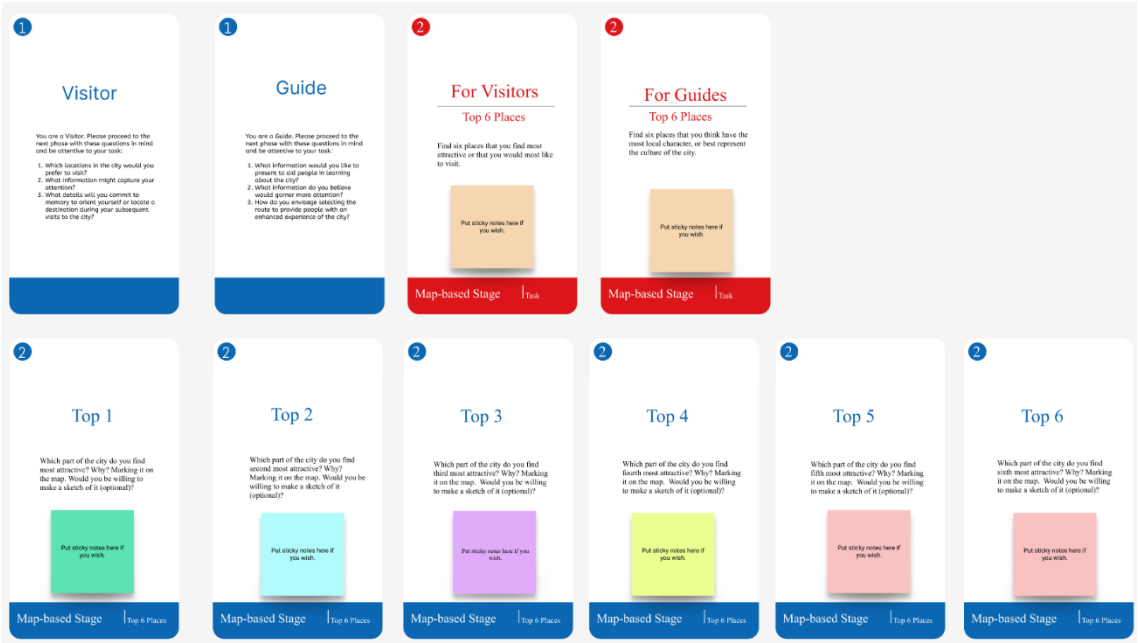
The Artefacts as tools

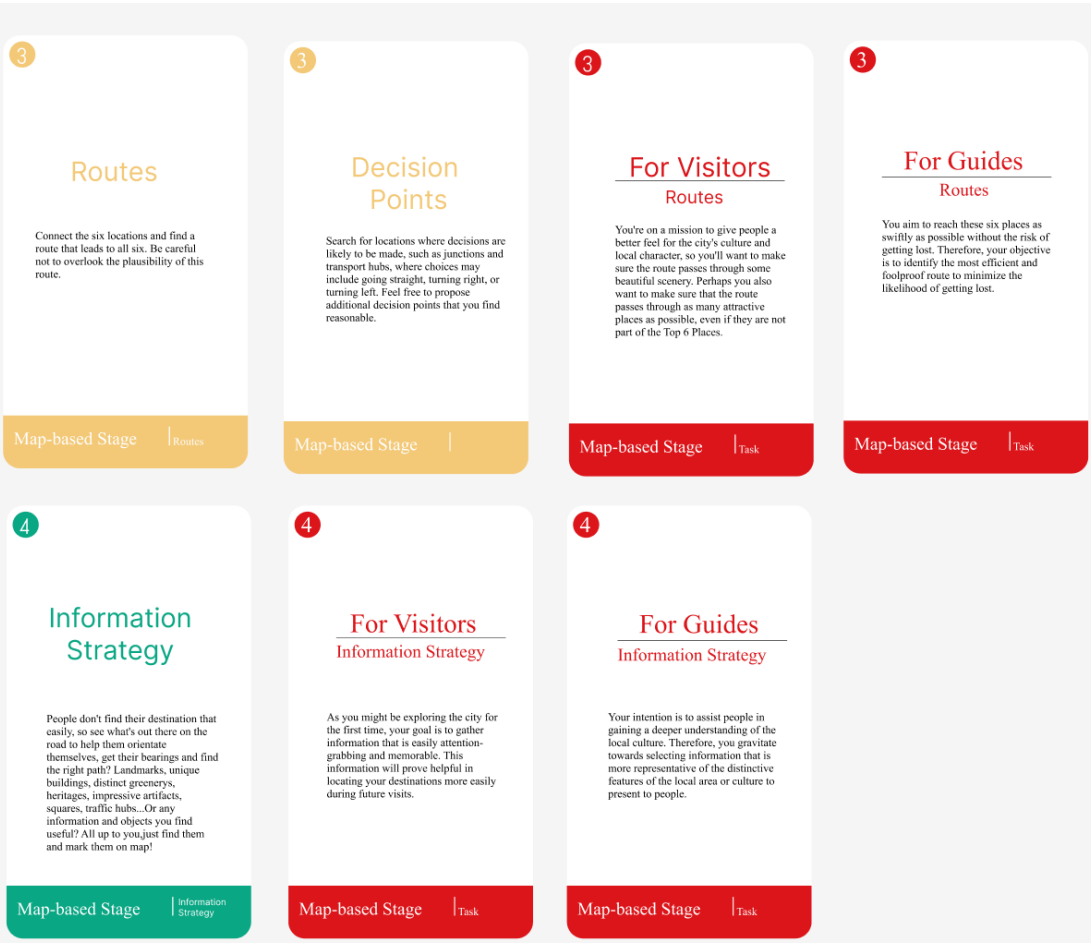
The artefacts created for the workshops primarily consist of a set of cards and accompanying tools.



The icons on the Wayfinding Cycle cards are sourced from Flaticon (https://www.flaticon.com/), all created by Freepik.


3
Elements
What helps you locate yourself, make decisions, and confirm where you are, which way you should go, and whether you have arrived at your destination? "Wayfinding" encompasses various elements designed to provide information to assist people in reaching their destination. These elements may include:
Maps.
Buildings and shops.
Names of streets, buildings, faculties and so on.
Signages on the road.
Landmarks and special areas/objects.
Paths.
Text and graphics.
And anything else you think helpful.
Introduction | Elements
3
Signage
Signages on streets, at decision points and for directional purpose. Signages are an important part of helping people find their way around, they are essentially carriers of information. They often help you to find your way, telling you which direction to go and what lies ahead. signages also help people to orientate themselves and determine whether they have reached their destination.
Introduction | Elements
3
Graphics
The graphics used for wayfinding can be anything, depending on what message the designer is trying to convey, including the simplest with arrows for directions, and the common graphic signs for toilets and lifts that we see in everyday life, as well as other graphics such as brand icons, text and symbols.
Introduction | Elements
3
Maps
Maps are at the heart of wayfinding, which provide a macro and general view to people and help them to plan the routes. Maps also help people find their destination, confirm where they are, see what's nearby and provide them with alternative routes.
Introduction | Elements
3
Architecture
The architecture is an important reference and clue as the environmental information in the wayfinding. Architectural style, shape and architectural features can all be significant references, and in general the more unusual the building the more helpful it is to the wayfinding process.
Introduction | Elements
3
Landmarks
Landmarks are important and identifiable objects or features that are unique and distinguishable from their surroundings. They are distinctive, stand out, are particularly easy to notice and are well remembered. Special buildings can be landmarks, but landmarks include more than just buildings such as Great Wall in China.
Introduction | Elements
Districts
Some areas of the city have common characteristics and can therefore be classified, these are districts, based on a variety of criteria such as use (residential, commercial, schools), building type, space, inhabitants (Chinatown), etc.
Introduction | Elements
3
Paths
Paths are the passages or routes that lead you to your destination. As a rule, larger paths are easier to find than smaller ones, and more distinctive paths are more likely to be remembered.
Introduction | Elements
3
Decision Points
Decision points are the points on the road where you can make decisions - Do you choose to turn left/right or go straight? Generally speaking, the most common decision points are junctions.
Introduction | Elements
3
Other Information
Any information that can help with wayfinding. This could include huge text, a special venue used for events, a unique poster, tables and chairs outside a coffee shop, and a characteristic plant such as a large tree. Wayfinding is not just about buildings, roads, icons - wayfinding can be everything.
Introduction | Elements


1
Visitor
You are a Visitor. Please proceed to the next phase with these questions in mind and be attentive to your task:
1. Which locations in the city would you prefer to visit?
2. What information might capture your attention?
3. What details will you commit to memory to orient yourself or locate a destination during your subsequent visits to the city?
1
Guide
You are a Guide. Please proceed to the next phase with these questions in mind and be attentive to your task:
1. What information would you like to present to aid people in learning about the city?
2. What information do you believe would garner more attention?
3. How do you envisage selecting the route to provide people with an enhanced experience of the city?
2
For Visitors
Top 6 Places
Find six places that you find most attractive or that you would most like to visit.
Put sticky notes here if you wish.
Map-based Stage | Task
2
For Guides
Top 6 Places
Find six places that you think have the most local character, or best represent the culture of the city.
Put sticky notes here if you wish.
Map-based Stage | Task
2
Top 1
Which part of the city do you find most attractive? Why? Marking it on the map. Would you be willing to make a sketch of it (optional)?
Put sticky notes here if you wish.
Map-based Stage | Top 6 Places
2
Top 2
Which part of the city do you find second most attractive? Why? Marking it on the map. Would you be willing to make a sketch of it (optional)?
Put sticky notes here if you wish.
Map-based Stage | Top 6 Places
2
Top 3
Which part of the city do you find third most attractive? Why? Marking it on the map. Would you be willing to make a sketch of it (optional)?
Put sticky notes here if you wish.
Map-based Stage | Top 6 Places
2
Top 4
Which part of the city do you find fourth most attractive? Why? Marking it on the map. Would you be willing to make a sketch of it (optional)?
Put sticky notes here if you wish.
Map-based Stage | Top 6 Places
2
Top 5
Which part of the city do you find fifth most attractive? Why? Marking it on the map. Would you be willing to make a sketch of it (optional)?
Put sticky notes here if you wish.
Map-based Stage | Top 6 Places
2
Top 6
Which part of the city do you find sixth most attractive? Why? Marking it on the map. Would you be willing to make a sketch of it (optional)?
Put sticky notes here if you wish.
Map-based Stage | Top 6 Places


3
Routes
Connect the six locations and find a route that leads to all six. Be careful not to overlook the plausibility of this route.
Map-based Stage
Routes
3
Decision Points
Search for locations where decisions are likely to be made, such as junctions and transport hubs, where choices may include going straight, turning right, or turning left. Feel free to propose additional decision points that you find reasonable.
Map-based Stage
3
For Visitors
Routes
You're on a mission to give people a better feel for the city's culture and local character, so you'll want to make sure the route passes through some beautiful scenery. Perhaps you also want to make sure that the route passes through as many attractive places as possible, even if they are not part of the Top 6 Places.
Map-based Stage
Task
3
For Guides
Routes
You aim to reach these six places as swiftly as possible without the risk of getting lost. Therefore, your objective is to identify the most efficient and foolproof route to minimize the likelihood of getting lost.
Map-based Stage
Task
4
Information Strategy
People don't find their destination that easily, so see what's out there on the road to help them orientate themselves, get their bearings and find the right path? Landmarks, unique buildings, distinct greenerys, heritages, impressive artifacts, squares, traffic hubs...Or any information and objects you find useful? All up to you,just find them and mark them on map!
Map-based Stage
Information Strategy
4
For Visitors
Information Strategy
As you might be exploring the city for the first time, your goal is to gather information that is easily attention-grabbing and memorable. This information will prove helpful in locating your destinations more easily during future visits.
Map-based Stage
Task
4
For Guides
Information Strategy
Your intention is to assist people in gaining a deeper understanding of the local culture. Therefore, you gravitate towards selecting information that is more representative of the distinctive features of the local area or culture to present to people.
Map-based Stage
Task

3

Establishing wayfinding system at decision points.

Utilize blank cards and signpost cards as tools to set up markers at decision points, providing people with information and directional guidance. You have the flexibility to include any information you find useful. These markers can take the form of signages or adopt a creative approach of your own design.

Design | Design Methods

3

Set up wayfinding systems in the vicinity of the destination.

Establishing suitable guidance, whether through signage or other means, to inform individuals that the destination or a specific building is ahead or near, facilitating accurate navigation.

Design | Design Methods

3

Creating wayfinding systems along the route

When people are on the road, they may need to orient themselves or ensure they are on the right path. Establishing a wayfinding system in any form assists them in obtaining this information.

Design | Design Methods

3

Creating Wayfinding Systems for District Guidance

Develop the wayfinding systems to indicate the upcoming area, helping individuals decide on their direction. Examples: for shopping, direct them to the business district; for dining options, suggest neighborhoods with numerous restaurants; and for a cultural experience, highlight areas with clusters of museums and art galleries.

Design | Design Methods

3

Develop any additional wayfinding systems that you find beneficial.

Creating other wayfinding systems and employ all tools freely. There are no restrictions—feel free to explore and create as you see fit.

Design | Design Methods

DIY Card

Other Information

What it is? Write it down ↓

Other Signs

Draw it or describe your design ↓

Districting Board

Districting Board

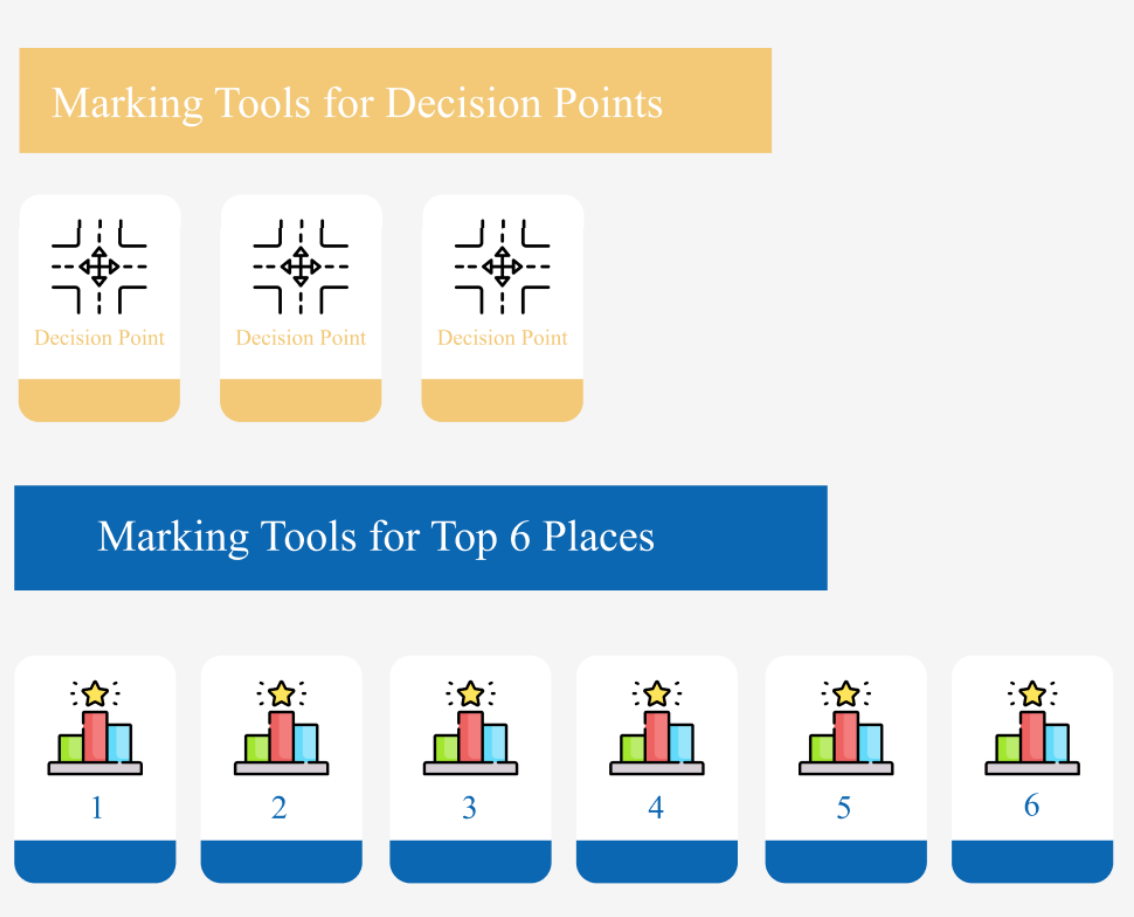
Districting Board

This district is delineated based on _____
Please place/stick the street view photos here or provide the wirte down the numbers for each photograph.

This district is delineated based on
Please place/stick the street view photos here or provide the wirte down the numbers for each photograph.

This district is delineated based on
Please place/stick the street view photos here or provide the wirte down the numbers for each photograph.

This district is delineated based on
Please place/stick the street view photos here or provide the wirte down the numbers for each photograph.



The icons on the cards are sourced from Flaticon (https://www.flaticon.com/), the Decision Points icon is created by Dreamstale, and the Top 6 Places icon is created by Freepik.

The icons on the cards are sourced from Flaticon (https://www.flaticon.com/),

The icons in the first row, from left to right, were created by: istar_design_bureau, Zlatko Najdenovski, Freepik, Gregor Cresnar, Freepik.

The icons in the second row, from left to right, were created by: Freepik, Freepik, Freepik, Freepik.

Walking Interview Question Sheet Provided to Participants

This form contains the question outline for the walking interviews and was provided to participants for reference during the sessions.

The start points and the destination of this trip: From **Piccadilly Garden** to **China Town.**

Please note:

- You could decide the route.
- Please **DO NOT** use the digital navigation such as Google Maps and GPS.
- You can fill this form with a pen, or with your electronic device. You can also record, video the street views, and speak during your trip to answer these questions. I will very appreciate if you could have a record of an audio or a video.

During The Trip			
Questions	At Start Point	On The Way	At Destination
What impressed you around surroundings?			
Are there any landmarks around you?			
What and where make you decide to turn/continue straight ahead? Please record every time when you decide.			
Do you think there is attractive? Why?			
How do you tell you arrived the destination?			

After The Trip	
Please describe the cultural experience during your trip.	
Please record the change in the street views throughout the trip.	
Finally, please try to draw a map with landmarks, and street views/objects that impress you. (You don't have to be very accurate, just a sketch)	

Appendix B: Wayfinding System Design Support Cards (WSDSC)

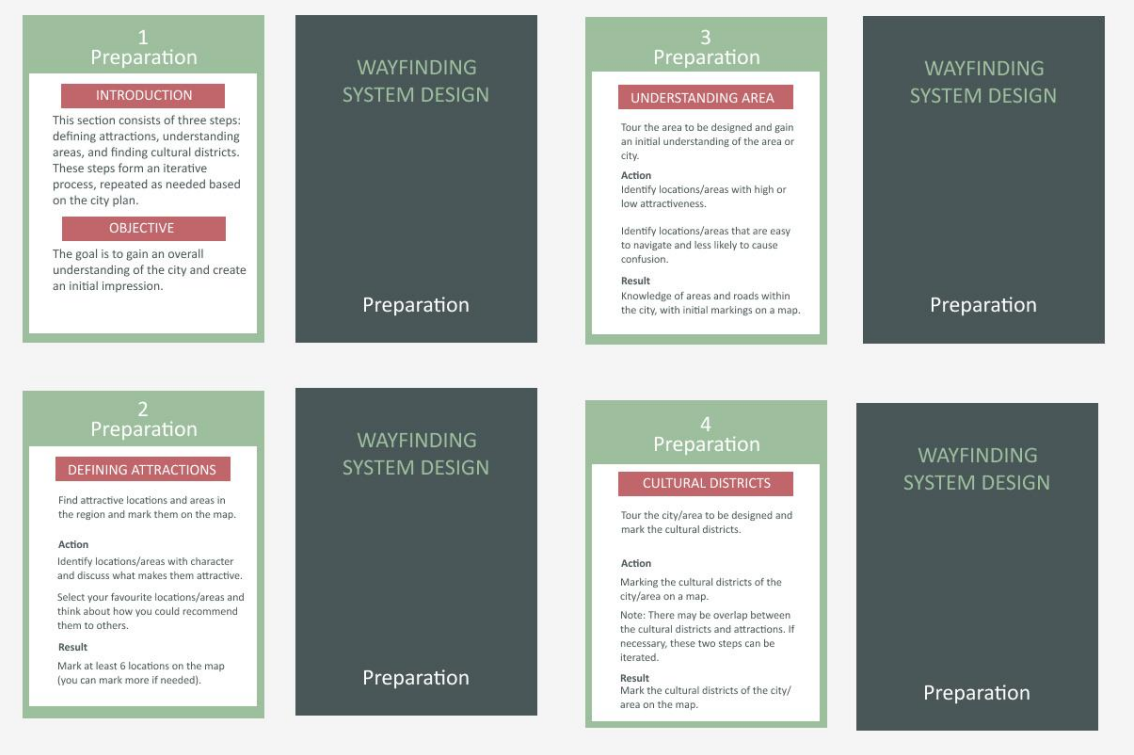
This appendix includes the full set of Wayfinding System Design Support Cards (WSDSC). For a clear version of the WSDSC, it is available at this link:

https://www.figma.com/design/ascNVLiUV4WdMbKY2PtLtO/WSDSC?node-id=0-1&t=DM4qHe6nPxcWbS7d-1

Instruction and Preparation (10 cards)

Instruction cards

Preparation cards

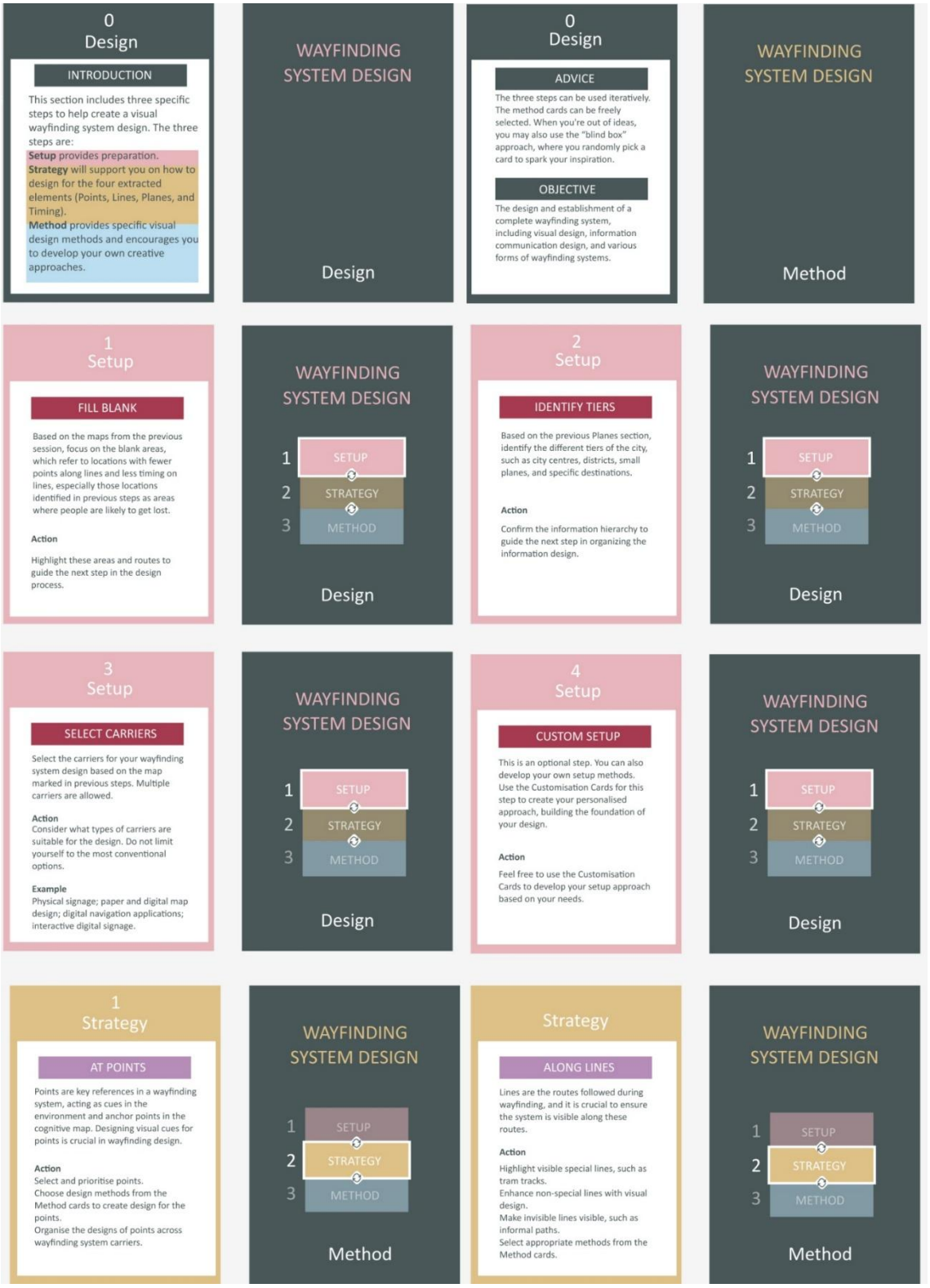


Code City cards (18 cards)


3
Code City
CLASSIFICATION
These information and cue categories can be used for labelling. Use an existing category from the card and label it on the map.
Artefact
Heritage
Unique Place
Greenery
WAYFINDING SYSTEM DESIGN
1 POINTS
2 LINES
3 PLANES
4 TIMING
Code City
2
Code City
PLANES
Some planes do not have a dominant core point but are formed by multiple points with common features, creating a cohesive area.
Action
Identify points with common characteristics and mark the area they form as a single entity on the map.
Example
Several restaurants forming a small plane, or buildings with similar architectural styles creating a cohesive area.
WAYFINDING SYSTEM DESIGN
1 POINTS
2 LINES
3 PLANES
4 TIMING
Code City
4
Code City
CLASSIFICATION
If you think this information doesn't fit into an existing category, you can create a new one. You can use Customisation cards.
Other Information
Name it by yourself
Stick notes here
Use custom cards
WAYFINDING SYSTEM DESIGN
1 POINTS
2 LINES
3 PLANES
4 TIMING
Code City
3
Code City
PLANES
Planes may have either clear or fuzzy boundaries. These boundaries are based on cognitive perception and help define the extent of the planes.
Action
Define the boundaries of the planes and mark them on the map.
Example
A commercial area with fuzzy boundaries as shops gradually disappear;
A street with contrasting architectural styles forms a clear boundary.
WAYFINDING SYSTEM DESIGN
1 POINTS
2 LINES
3 PLANES
4 TIMING
Code City
3
Code City
PLANES
Some planes are rare and may not have a core point or any other points. They are perceived as an area in the city rather than an object.
Action
Identify areas without points but perceived as a unified space. Mark these areas on the map.
Example
Large gardens and parking lots.
WAYFINDING SYSTEM DESIGN
1 POINTS
2 LINES
3 PLANES
4 TIMING
Code City
1
Code City
TIMING
Timing refers to when and where a point is visible during the journey. It is determined by the specific moment and location where a person can see a point, such as seeing a church at an intersection 10 minutes after starting the journey.
Action
Mark on the map locations where you see points and make decisions, especially at key junctions.
Example
At an intersection, seeing a garden and deciding whether to go straight or turn.
WAYFINDING SYSTEM DESIGN
1 POINTS
2 LINES
3 PLANES
4 TIMING
Code City
2
Code City
TIMING
Timing refers to when and where a point is visible during the journey. It is determined by the specific moment and location where a person can see a point.
Action
Mark the locations where you decide whether you have reached your destination.
Example
Seeing signage displaying the destination's name at a specific location, confirming that you have reached your destination.
WAYFINDING SYSTEM DESIGN
1 POINTS
2 LINES
3 PLANES
4 TIMING
Code City
3
Code City
TIMING
Timing refers to when and where a point is visible during the journey. It is determined by the specific moment and location where a person can see a point.
Action
Mark as many locations and times as possible where a point can be seen, based on the route and direction taken.
Example
A landmark can be seen on both A Street and B Street.
WAYFINDING SYSTEM DESIGN
1 POINTS
2 LINES
3 PLANES
4 TIMING
Code City


4
Code City
TIMING
Timing refers to when and where a point is visible during the wayfinding. Some areas may have no visible points, which can lead to feelings of being lost, disoriented, and frustrated.
Action
Mark locations where you cannot see any information and feel uncertain, worried about losing your way, or unable to orient yourself.
Example
A street without any visible points may be a difficult area for wayfinding.
WAYFINDING SYSTEM DESIGN
1 POINTS
2 LINES
3 PLANES
4 TIMING
Code City
6
Code City
TIMING
Timing refers to when and where a point is visible during the journey. Timing is formed at the intersection of the boundaries of planes and lines, where points become visible. This indicates the entrance to a plane.
Action
Mark on the map the intersection of lines and the boundaries of planes where points in the plane can be seen.
Example
Seeing Chinese characters at the boundary of Chinatown marks the entrance to the Chinatown area.
WAYFINDING SYSTEM DESIGN
1 POINTS
2 LINES
3 PLANES
4 TIMING
Code City

Design cards (19 cards) and Customisation card (1 card)




3
Strategy
IN AND OUT PLANES
Planes enhance spatial clarity and readability, while design strengthens the city's unique identity.
Action
Highlight planes.
Define the information displayed within the plane boundaries.
Ensure visual consistency across different design levels.
Select appropriate methods from the Method cards.
WAYFINDING SYSTEM DESIGN
1 SETUP
2 STRATEGY
3 METHOD
Method
4
Strategy
ADD AND ON TIMING
Timing is the filtering of information and its presentation at the right time and place to help users navigate efficiently. It also identifies areas where information is lacking, which often leads to confusion and getting lost.
Action
Provide guidance in areas with little or no timing.
Adjust the information hierarchy based on timing at the entry points to the plane.
Select appropriate methods from the Method cards for your design.
WAYFINDING SYSTEM DESIGN
1 SETUP
2 STRATEGY
3 METHOD
Method
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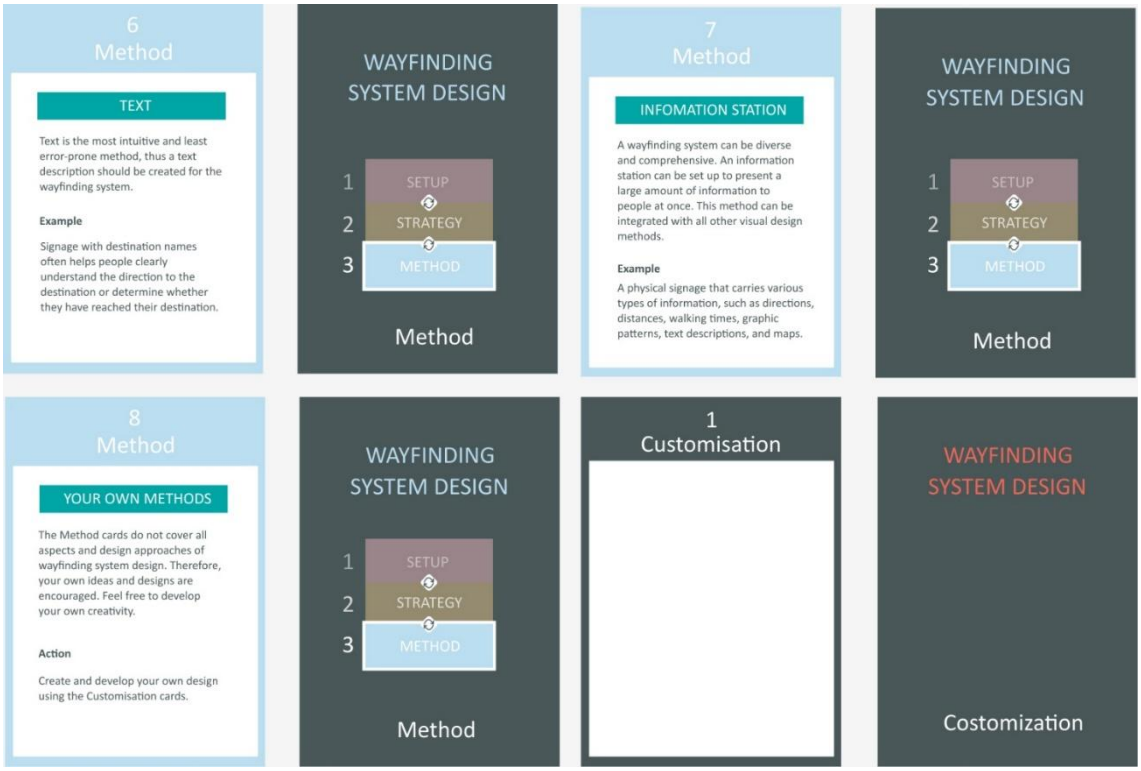
Strategy
YOUR OWN STRATEGIES
The strategies presented in the previous cards do not encompass the full scope of wayfinding system design. If you have your own ideas, feel free to incorporate them.
Action
Create and develop your own design strategies using the Customisation cards.
WAYFINDING SYSTEM DESIGN
1 SETUP
2 STRATEGY
3 METHOD
Method
1
Method
GRAPHIC & ICON
Graphic and icon design can serve as visual representations of points, timing, planes, and lines, creating symbols that represent these elements.
Example
A coffee cup icon can represent a coffee shop.
WAYFINDING SYSTEM DESIGN
1 SETUP
2 STRATEGY
3 METHOD
Method
2
Method
COLOR CODE
Establish rules for the wayfinding system by using different colours to represent various areas or types of locations.
Example
Use different colours to distinguish between various planes on the map.
WAYFINDING SYSTEM DESIGN
1 SETUP
2 STRATEGY
3 METHOD
Method
3
Method
MAP
Maps serve as the foundation of a wayfinding system, providing a macro perspective for people to understand the larger context of their surroundings. Create maps of different sizes, which can be combined with visual designs such as graphic design to enhance clarity and usability.
Example
Set up a "You Are Here" map to show people their current location and offer a general overview of the area.
WAYFINDING SYSTEM DESIGN
1 SETUP
2 STRATEGY
3 METHOD
Method
4
Method
OUTLINES OF OBJECT
Points, especially landmark-type points, may be unique within a city. Drawing shapes based on their appearance can help people locate them more easily.
Example
Draw shapes based on the outlines of unique points (such as famous buildings and monuments) as their visual design.
WAYFINDING SYSTEM DESIGN
1 SETUP
2 STRATEGY
3 METHOD
Method
5
Method
DIRECTION GUIDE
Directional guidance is crucial, as it tells people which direction to take. Arrow graphics or arrow-shaped signage are commonly used.
Example
Place direction signage with arrows at key locations, such as intersections or entrances.
WAYFINDING SYSTEM DESIGN
1 SETUP
2 STRATEGY
3 METHOD
Method


6
Method
TEXT
Text is the most intuitive and least error-prone method, thus a text description should be created for the wayfinding system.
Example
Signage with destination names often helps people clearly understand the direction to the destination or determine whether they have reached their destination.
WAYFINDING SYSTEM DESIGN
1 SETUP
2 STRATEGY
3 METHOD
Method
7
Method
INFOMATION STATION
A wayfinding system can be diverse and comprehensive. An information station can be set up to present a large amount of information to people at once. This method can be integrated with all other visual design methods.
Example
A physical signage that carries various types of information, such as directions, distances, walking times, graphic patterns, text descriptions, and maps.
WAYFINDING SYSTEM DESIGN
1 SETUP
2 STRATEGY
3 METHOD
Method
8
Method
YOUR OWN METHODS
The Method cards do not cover all aspects and design approaches of wayfinding system design. Therefore, your own ideas and designs are encouraged. Feel free to develop your own creativity.
Action
Create and develop your own design using the Customisation cards.
WAYFINDING SYSTEM DESIGN
1 SETUP
2 STRATEGY
3 METHOD
Method
1
Customisation
WAYFINDING SYSTEM DESIGN
Costomization